UNIVERSITY OF DERBY

A SYSTEMATIC APPROACH USING THE BEHAVIOUR CHANGE WHEEL, COM-B BEHAVIOUR MODEL AND THEORETICAL DOMAINS FRAMEWORK TO EVALUATE PHYSICAL ACTIVITY ENGAGEMENT IN A UNIVERSITY SETTING

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Table of Contents

List of Tables

List of Figures

Abbreviations

APEASE: Affordability, Practicability, Effectiveness/cost effectiveness, Acceptability, Side effects/safety profile and Equity

ANOVA: Analysis of variance

B: Coefficient for the constant also called the "intercept" in the null model.

BCTs: Behaviour change techniques

BCW: Behaviour change wheel

BHF: British Health Foundation

BIQ: Behavioural intentions questionnaire

COM-B: Capability, Opportunity, Motivation- Behaviour

CMOs: Chief medical officers

DALYs: Disability adjusted life years

df: Degrees of freedom

DPAQ: Determinants of physical activity questionnaire

DV: Dependent variable

EXP (B): Exponentiation of the B coefficient, which is an odds ratio

GOS/DHSC: Government Office for Science & Department of Health and Social Care

GPAQ: Global physical activity questionnaire

HBM: Health belief model

HESA: Higher Education Statistics Agency

HSE: Health Survey England

IRR: Inter-rater reliability

ISCA/CEBR: International Sports & Culture Association/Centre for Economics & Business Research

IV: Independent variable

KARPAS: Knowledge about the Recommended Physical Activity Scale

LKPAHQ: Levels of Knowledge of Physical Activity for Health Questionnaire

MET: Metabolic equivalent of tasks

NHS: National health services

NCDs: Non-communicable disease

ONS: Office for National Statistics

PA: Physical activity

PBQ: Past Behaviour Questionnaire

SBA: Settings-based approach

SCT: Social cognitive theory

S.E.: Standard error around the coefficient for the constant

SD: Standard Deviation

TDF: Theoretical domains framework

TPB: Theory of planned behaviour

TRA: Theory of reasoned action

TTM: Transtheoretical model

WHO: World Health Organisation

Preface

This piece of work, encompassing the conceptual design of the experimental studies, data gathering and the writing up of this entire thesis, has been exclusively written by the doctoral research student with direction from my ever-supportive supervisory team. Guidance for the qualitative inductive content analysis was provided by Dr Vicki Staples, while guidance on statistical analysis was provided by Dr Chris Bussell, Dr Mark Faghy and Dr Sigrid Lipka. The respective authors have been properly acknowledged for all the figures and tables employed in this research project that were not directly produced by the doctoral research student. Before commencement of each study in this research project, ethical approval was granted by the Health Sciences Research Ethics Committee (HS-REC) of the University of Derby. Some works in this thesis have been disseminated, as outlined below:

Conferences

- **Ndupu, B.L.N.,** Bussell, C., Faghy, M., Staples, V. & Lipka, S. (2018). *Physical Activity in the University Setting: A Qualitative Exploration of Capability, Opportunity and Motivation amongst Staff and Students*- poster presented at The Postgraduate Research Conference, Derby, 23 April 2018.

- **Ndupu, B.L.N.,** Bussell, C., Faghy, M., Staples, V. & Lipka, S. (2019). *An exploration of the Predictors of Physical Inactivity among Inactive University Administrative Staff and Postgraduate Research Students Using the Theoretical Domains Framework*- paper presented at The Postgraduate Research Conference, Derby, 14 June 2019.

- **Ndupu, B.L.N.,** Bussell, C., Faghy, M., Staples, V. & Lipka, S. (2019). *Qualitative Exploration of the Barriers and Enablers to Physical Activity among Staff and Students: A Group Interview Study*- paper presented at The East Midlands Doctoral Network Annual Conference, Derby, 11 September 2019.

Abstract

A systematic Approach Using the Behaviour Change Wheel, COM-B Behaviour Model and Theoretical Domains Framework to Evaluate Physical Activity Engagement in a University Setting

Introduction: Physical activity has been recognised to offer health benefits and reduce the risks of developing chronic diseases such as diabetes, cardiovascular diseases, hypertension, cancer, depression, and atherosclerosis. However, even with the known health benefits of physical activity, over a quarter of adults globally are physically inactive, which is a serious public health concern and thus calls for concerted efforts to increase physical activity levels in diverse settings. A university is a unique setting in which to promote health enhancing behaviours, such as physical activity, because it offers opportunity to be active (e.g., in-built sports facilities), provides flexible working conditions to enable staff and students a reasonable level of autonomy in managing their individual time and endowed with highly educated and well-informed staff base, which has been previously shown to influence individuals' engagement in physical activity. Therefore, the overall aim of the PhD research project was to understand the barriers and enablers to physical activity among university staff and students, design an intervention informed by this understanding and implement intervention to address these barriers, in order to create behaviours that lead to better engagement in physical activity.

Methods: A mixed-methods experimental design was utilised throughout the research, incorporating both qualitative (group interviews) and quantitative (surveys) data collection. The four experimental studies that make up this programme of work were designed using established behaviour change models, i.e., the Behaviour Change Wheel (BCW), the Capability, Opportunity, Motivation-Behaviour (COM-B) model and/or the Theoretical Domains Framework (TDF). The qualitative data were analysed in Nvivo12 using deductive content analysis, while the qualitative data were analysed using SPSS Statistical software 26.0, with significance level set at 0.05.

Results: Six prominent domains were identified as enablers and barriers to physical activity among university staff and students, i.e., knowledge; social influences; social/professional role and identity; environmental context and resources; beliefs about capabilities; and intentions (study 1). About 78.0% of the administrative staff and 67.0% of the PhD students were physically inactive, i.e., achieving less than 600 MET-minutes/week of moderate intensity physical activity. A multiple regression analysis showed that of the 14 domains of the TDF,

the ‘physical skills’ domain ($t_{106} = 2.198$, $p=0.030$) was the only significant predictor of physical inactivity among the administrative staff, while the ‘knowledge’ ($t_{99} = 2.018$, $p= 0.046$) and ‘intentions’ ($t_{99} = 4.240$, $p=0.001$) were the only predictors of physical inactivity amongst the PhD students (study 2). The administrative staff that were assigned to engage in supervised exercise sessions (experimental group) reported higher physical skills scores and overall physical activity levels compared to the control (study 3). The PhD students that were allocated to the education and intentions group, who received educational materials and asked to form implementation intentions of times, days and places they intend to carry out physical activity, reported higher overall physical activity levels compared to other treatment groups, i.e., intentions only, education only and control groups (study 4).

Conclusion: This thesis contributes to the knowledge on adult’s physical activity by detailing the development, implementation, and assessment of a bespoke brief 4-week behaviour change intervention that effectively increased university administrative staff and PhD students’ total physical activity levels, as well as time spent in physical activity weekly. The university was established as a unique setting to promote health-enhancing behaviour such as promotion of physical activity. Therefore, theory-based interventions underpinned by the BCW, COM-B model and TDF may provide an effective strategy to improve university staff and students’ engagement in physical activity, as well as their overall wellbeing.

Acknowledgments

I want to mostly thank the Almighty God for the gift of life, knowledge and wisdom. I came to the United Kingdom in 2013 to do a master's degree in Public health after leaving school for a very long time and therefore, did not know what to expect. However, the support I received from my tutors and the resources provided here at the University of Derby encouraged me to read for a PhD degree. I would therefore extend my utmost gratitude to my master's degree dissertation supervisor, Dr John Pritchard and tutors, Alan Whitfield and Gillian Carleton-Boylan for all their support and encouragement, which prompted me to study towards a PhD. I would like to thank my Director of Studies, Dr Chris Bussell and my other supervisors, Dr Mark Faghy, Dr Vicki Staples and Dr Sigrid Lipka, for always believing in me, and supporting me through the rough times. I would also like to thank my former supervisors, Professor Nick Draper, Dr Lindsay Smith, and Gillian Carleton-Boylan for the role they also played in making me believe in myself.

This thesis would have not been possible without the financial support, love, and encouragement from my darling elder sister, Ogbuefi Lawrencia Ndupu. I thank you my dear sister for single-handedly providing for me and making sure that I never lacked anything throughout my study here. I would not forget to thank my other sisters, Ogbuefi Catherine Omebu Ndupu and Mrs Ntianu Agnes Nwapa-Jourdan for their love, prayers and support. My darling mother, Ogbuefi Agnes Ndupu, I would want to show my sincere gratitude for your love, incessant prayers, and encouragement. You are a mother in a million and I appreciate you. I would like to thank my dear aunt, Mrs Florence Nwafor, for your kindness and always being there for me, especially when the stress of PhD sets in. You always had a way of encouraging me to keep moving on. I would also like to thank my very special friends, Ini Obot Nelson, and Shan Rambukwella, for always being there for me through both my happy and sad moments.

Finally, to my children, Adaeze and Bismarck. I know I have spent so many years away from you, but I want to thank you for understanding and encouraging me to pursue my dream. I will ever remain grateful to you.

I wish to dedicate this thesis in loving memory of my father, Ogbuagu Bismarck Lawrence Ndupu. Papa I know you would be very proud of me where you are now.

Chapter 1. General Introduction

1.1. Introduction

This thesis principally concerns the development, implementation and assessment of a bespoke intervention aimed at promoting physical activity (PA) among university staff and students. Therefore, this section will provide the rationale for this study by critically reviewing the prevalence of physical inactivity and its detrimental impacts. This section will also look at the health benefits of PA, and PA recommendations for adults. Furthermore, this section will look at the rationale for using behaviour change interventions, the influence of settings-based approaches and the uniqueness of the university as a setting to encourage PA engagement. Finally, this section will present the aims and objectives of this research and structure of the thesis.

1.2. Background and rationale for this research

Physical inactivity is a notable public health concern globally, and a prominent risk factor to morbidity and mortality worldwide, with 10% of deaths worldwide attributed to physical inactivity (World Health Organisation (WHO), 2017). Physical inactivity is also projected to be associated with approximately one million deaths and attributed to 8.3 million DALYs (disability-adjusted life-years) in the European Union region annually, if no action is taken to change this trend (WHO, 2018a). Likewise, in the UK, physical inactivity is recognised as the fourth prominent cause of morbidity and mortality (Townsend et al., 2015) and responsible for 1 in 6 (17%) of deaths (Lee et al., 2012). Physical inactivity has also been attributed to an increased risk of developing certain chronic illnesses such as coronary heart disease, type II diabetes, overweight/obesity, hypertension, stroke, cancer, depression and anxiety, rheumatoid arthritis, and all-cause mortality (Booth, Roberts, & Laye, 2012; Knight, 2012; WHO, 2018b).

Furthermore, physical inactivity burdens humanity via the unforeseen and increasing healthcare cost and loss of productivity. The economic implication of physical inactivity is likewise evident; physically inactive individuals spend 38% extra days in hospital compared to physically active individuals and see the doctor nearly 6% more often (UKActive, 2014). The economic impacts of physical inactivity is huge, with the global cost of physical inactivity to healthcare services estimated to be approximately £35 billion annually (British Heart Foundation (BHF), 2017). In the UK, according to the Physical Inactivity and Sedentary Behaviour Report 2017, the direct expenditures incurred annually by the NHS (National Health

Service) from managing the consequences of physical inactivity were approximately £1.2 billion (BHF, 2017). On the other hand, PA not only enhances physical health, but equally plays a role in psychological wellbeing of people of all ages (Edmunds, Biggs, & Goldie, 2013; Kumar, 2017). According to reports from the UKActive (2014), decreasing the levels of physical inactivity by 1% a year over a 5-year period, will save local authorities in the UK £1.2 billion on average through the reduction of money spent on physical inactivity associated illnesses. Encouraging people to become physically active will benefit the society as inactive people are responsible for the increasing mortality rates presently seen. Therefore, the integration of PA into individuals' lifestyles has been indicated to provide health benefits such as decreased risk of developing the chronic diseases, as well as decreased risk of premature deaths (Knight, 2012; WHO, 2018b).

In recent years, there has been considerable efforts to encourage PA along the continuum of individual-level and population-centred interventions (Heath et al., 2012). The most current 2019 UK's Chief Medical Officers (CMOs) PA recommendations, advocate that adults should engage in no less than 150 minutes of moderate amount of PA or 75 minutes of vigorous amount of PA every week, or an corresponding blend of both (Davies et al., 2019). Even with the established benefits inherent in PA and these PA recommendations, current research by Guthold et al. (2018) carried out among 1.9 million adults around the world indicated that over a quarter of the world's population, i.e. 27.5% (31.7% women and 23.4% men) were still physically inactive, i.e. achieving less than 150 minutes of moderate intensity PA per week. Furthermore, findings from the 2016 Health Survey for England (HSE), reported that 66% of males and 58% of females in England met the PA guidelines (NHS Digital, 2017), implying that 34% of men and 42% of women in the England were physically inactive. The failure to meet the recommended minimum PA guidelines has been linked to increasing risk of developing chronic illnesses such as diabetes, stroke, heart disease, and cancer by 20-30%, and shortening of lifespan by 3 to 5 years (Lee et al., 2012). Meanwhile, the Association of Public Health Directors reported that if everybody in England achieved the CMO's recommendations for PA, almost 37,000 deaths might be averted annually (Oxfordshire Sport and Physical Activity, 2016). Therefore, as a strategy to reduce the prevalence of physical inactivity, co-ordinated efforts should be put in place in different settings as advocated by the WHO in their settings-based approach (SBA) to health promotion (WHO,1981, 1986).

The SBA to promoting health, comprises an all-inclusive and multi-disciplinary approach that incorporates action across risk influences. The objective is to maximise the prevention of disease through a whole system process (WHO, 2018c). According to the WHO (1986, p. 3), "Health is created and lived by people within the settings of their everyday life; where they learn, work, play, and love". The SBA is grounded in the WHO Health for All policy and, more precisely, the Ottawa Charter for Health Promotion and its main ideologies consist of community involvement, collaboration, enfranchisement and impartiality (WHO, 2018c). The settings in the WHO European perspective were categorised as households, workplaces, cities, societies, schools, townships, marketplaces, islands, penitentiaries, clinics, and universities (WHO, 2018c).The SBA has the prospects of integrating health distinctively into the ethos of a working and living setting to foster health with the fundamental target of enhancing overall wellbeing (Scriven & Hodgins, 2012). Moreover, there is an increasing evidence base about the efficacy of the SBA to promoting various health behaviours, including PA in diverse settings. Therefore, the SBA approach informed the selection of the university as a setting to encourage PA engagement, as an approach to improving overall staff and students' wellbeing, with the reported high predominance of physical inactivity in universities across the world (Pengpid et al., 2015).

The predominance of physical inactivity amongst university staff and students have been established, with a significant proportion not meeting the PA recommended levels. Pengpid et al. (2015) surveyed 17,928 undergraduates across 24 universities, suggested that the predominance of physical inactivity was 41.4%, which varied from 21.9% (Kyrgyzstan) to 80.6% (Pakistan). Within the UK, Aceijas et al. (2016) determined that 60% of university students were physically inactive. Although there are limited published studies available reporting the PA levels of university staff, a study conducted by Cooper & Barton (2015) to assess PA and mental well-being of staff in a UK university suggested that 42% of university staff were physically inactive. These results indicated that the physical inactivity prevalence among university staff and students were significantly higher than the national adult average of 22% (NHS Digital, 2019) and therefore present opportunities for the promoting health enhancing interventions such as PA engagement.

The university setting is unique because it provides further opportunities through the breadth of staff members roles, such as executive and senior management, administrative and professional services, support, teaching and research staff, as well as a diverse student population enrolled at different modes and levels of study (Universities UK, 2017; University of Derby, 2017a, 2017b). According to the current Higher Education Statistics Agency (HESA), in the 2016-17 academic year, there were 2,317,880 students supported by more than

419,710 staff across various universities in the UK (HESA, 2018). It is projected that the students numbers registering in higher education worldwide will be up to 262 million by 2025 (David & Mackintosh, 2011). As a result of the substantial proportion of students and staff in universities worldwide, as a setting, universities possess the capacity to create a positive influence on the overall wellbeing of the entire university population. The uniqueness of the university setting is also evident in that the staff and students spend 50 to 60 % of their waking time in the university environment (Alwan, 2011), therefore offering PA interventions could be an efficacious approach to engage staff and students in PA. The university setting also presents group support, existing structures of formal and informal communication among staff and students, convenience and likely corporate behaviour norms, which are potential advantages of university-based programmes over other approaches (Conn et al., 2009). Given the evidence base indicating an increasing levels of physical inactivity both nationally (NHS Digital, 2017) and globally (Hallal et al., 2012), it is now imperative to develop behaviour change interventions that target PA increase as a major outcome in the university setting (Conn et al., 2009).

Although initial activities around PA promotion were mostly not supported by theories, the necessity for interventions to be underpinned by suitable theoretical foundations and permit consequent reproduction was necessary. This paradigm change saw researchers concentrating more on understanding the correlates and determinants of PA, mainly the psychological and social influence (Sutton, 2008). Thus, philosophies of behavioural change originally established within social psychology are more prominent in literature (Buchan et al., 2012). There is considerable evidence that interventions that are underpinned with overarching psychological models are more inclined to be effective at modifying behaviour compared to interventions that are not (Hobbs et al., 2013; Michie et al., 2014). This is because even when one or more theories are selected to support an intervention, they do not deal with the entire array of probable influences thereby excluding possibly vital variables. For instance, the frequently employed psychological models in the PA domain such as the Health Belief Model (Hochbaum, 1958); the Social Learning/Social Cognitive Theory (A. Bandura, 1986); the Theory of Reasoned Action /Theory of Planned Action (Ajzen, 1991); and the Transtheoretical Model (Prochaska, Redding, & Evers, 1996) do not deal with the significant functions of associative learning, habit, impulsivity, emotional processing and self-control (Michie et al., 2014), which could be responsible for the reported mixed effects of PA interventions conducted in the university setting.

Recent developments have also recognised the need to go beyond the employment of individual psychological models to support interventions, which lead to the development of the Behaviour Change Wheel (BCW). The BCW, was developed by combining 19 frameworks of behaviour change found through the systematic review of literature (Michie, van Stralen, & West, 2011). The BCW is an overarching psychological model comprised of a behaviour system known as the COM-B (i.e. Capability, Opportunity, and Motivation- Behaviour) model of behaviour at the hub (Michie et al., 2014). This model is the starting point employed by the BCW for understanding behaviour in the circumstance in which it takes place. The COM-B model posits that for a behaviour to take place, there has to be the capability to do it, there must be the opportunity for the behaviour to occur, and there must be sufficient strong motivation to perform the behaviour (Michie et al., 2014). The COM-B model is encircled by nine intervention functions (i.e., education, training, coercion, enablement, restriction, environmental restructuring, modelling, persuasion, and incentivisation) that can be used to change the target behaviour and then by 7 policy categories (i.e. service provision, environmental/social planning, legislation, fiscal measures, guidelines, regulation and communication/marketing) that can be used to support these interventions.

Furthermore, Cane, O'Connor, & Michie (2012) proposed the Theoretical Domains Framework (TDF), which comprises 14 domains of behaviour change that could be mapped to the components of the COM-B model to further expound it. They include cognitive and interpersonal skills, memory attention and decision processes, behaviour regulation, and knowledge (psychological capability); physical skills (physical capability); social influences (social opportunity); environmental context and resources (physical opportunity); emotions and re-enforcements (automatic motivation); and beliefs about capabilities, beliefs about consequences, goals, social/professional role and identity, intentions, and optimism (reflective motivation). The TDF is an integrative framework created from a fusion of psychological theories as an instrument to help employ theoretical approaches to interventions targeted at behavioural change. However, it does not indicate testable associations between elements but presents a theoretic lens through which to examine the emotional, cognitive, environmental and social impacts of behaviour (Atkins et al., 2017). Identifying the reasons people do not engage in enough PA is intricate and multidimensional, involving individual, relational, environmental, and policy determining factors. This is detailed in the ecological approach as reinforced by the SBA (Dooris, 2006). Therefore, research which advances understanding of any of these factors has strong potential to better inform PA promotion (Young, Ross, &

Barcelona, 2003). The COM-B and/or TDF have been employed effectively in various interventions such as NHS smoking cessation clinics (Fulton et al., 2016), increasing PA levels in children suffering from motor deficiencies (Kolehmainen et al., 2011), improvement of hearing-aid use in adult auditory rehabilitation (Barker et al., 2014), improvement in GP's management of lower back pain (Bussières et al., 2012), increasing hand hygiene behaviour amongst hospital staff (Dyson et al., 2011), identifying the enablers and barriers to exercise among older people with HIV, increasing engagement in PA amongst asylum seekers, and in the adult population in different settings (Michie et al., 2014). However, the COM-B and/or TDF have not yet been used in the PA context in the university setting, therefore this research aims to further validate the effectiveness of these psychological models in the PA domain in the university context.

In summary, encouraging active lifestyle may assist in addressing some of the key health problems the UK is currently facing. Therefore, increasing the levels of PA has the likelihood of enhancing the psychological and physical wellbeing of the country, decreasing deaths due to all-cause mortality, and increasing the overall life expectancy. Increasing the levels of PA could also be cost saving by considerably reducing problems associated with chronic illnesses and the burden on health facilities.

1.3. Research Aim and Objectives

The aim of this research is to assess the physical inactivity levels in a university setting in order to understand individuals' barriers and enablers to engagement in PA, with the specific aim of changing behaviours towards PA.

The objectives of this programme of research are:

- To explore issues, barriers, challenges, enablers, and opportunities to engage in physical activity using group interviews in a university setting;
- To identify the predictors of physical inactivity among university administrative staff and post-graduate research students using surveys; and
- To assess the impacts of a series of brief bespoke behaviour change interventions underpinned by the Behaviour Change Wheel, the COM-B behaviour model and the Theoretical Domains Framework, on physical activity engagement among university administrative staff and post-graduate research students.

1.4. Structure of Study

This thesis is structured into eight chapters. After this introduction chapter, **Chapter two** presents a critical literature review to examine the evidence regarding university-based interventions aimed at increasing PA. This chapter also details the rationale for the focus on a university setting, the detrimental impacts of physical inactivity, the potential benefits of PA, the approaches to understanding behaviour change and encouraging PA engagement among adults. **Chapter three** presents the methodological considerations that underpin this programme of research. It identifies the epistemological stance of the research and factors that influenced the mixed-methods approach used in this study. It further presents the various data collection and sampling methods, the ways that reliability, validity and bias and ethical issues were handled.

Chapter four describes the findings from the first experimental investigation aimed at exploring the enablers and barriers to PA among staff and students in a university setting, using group interviews. This chapter presents a background, context and rationale for the study, then details the methods used, findings, discussion and conclusion. The findings from the study described in chapter four, informed the design of the questionnaire used in the second experimental study (**Chapter Five**) which aimed to identify the predictors of physical inactivity amongst university administrative staff and post-graduate research (i.e., PhD) students, using the TDF.

The findings from the study presented in chapters five, informed the third experimental studies, which developed, implemented and assessed bespoke interventions aimed at increasing PA levels among university administrative staff (**Chapter six**) and PhD students (**Chapter seven**). The final chapter, **Chapter eight,** presents the general discussion of the thesis, examines the impact of the research and contribution to the body of work towards the creation of new knowledge in the PA field. Furthermore, this chapter describes the strengths and weaknesses of this research project, provides a general conclusion and recommendations for future research areas.

Chapter 2. Literature Review

2.1. Introduction

The previous chapter presented an introduction, background, and rationale for this programme of research, and also outlined the aim and objectives, and the structure of studies carried out in this research programme. The focus of this chapter is to critically review the evidence regarding university-based interventions designed to encourage staff and students (18 years and above) to take part in PA. To achieve this, this section will start by critically reviewing the global physical inactivity prevalence, as well as its prevalence in the United Kingdom, and in the university setting. This section will also discuss the rationale for the focus on a university setting, the detrimental impacts of physical inactivity, the potential benefits of PA, the approaches to understanding behaviour change and encouraging PA engagement among adults (i.e. the theoretical frameworks underpinning this research), and the contributing factors to PA engagement among staff and students in a university setting. The current interventions used in the university setting to promote PA and the various behaviour change strategies (i.e., behaviour change techniques (BCTs)) that have been effectively used to deliver PA interventions are presented at the end of this chapter.

2.2. Global prevalence of physical inactivity

Physical inactivity is a prominent global risk factor for illnesses and deaths, with one out of 10 deaths globally associated with physical inactivity (WHO, 2017). Physical inactivity levels are increasing in several nations, especially the low- and medium-income nations, with crucial consequences for rises in the incidence of non-infectious illnesses and the overall health of people around the world (WHO, 2010). Strong evidence suggests that physical inactivity is attributable to 10.0% of burden of ailment from colon and breast cancers, 7.0% of type II diabetes, and 6.0% of coronary heart disease, and also attributable to 9.0% of early deaths globally (Lee et al., 2012). However, even if physical inactivity was not eradicated but instead reduced by 10.0% or 25.0%, over 533,000 and over 1.3 million deaths, respectively, could be prevented annually. Furthermore, by reducing physical inactivity, peoples' life expectancy around globally is projected to rise by 0.68 years (Lee et al., 2012). Notwithstanding the eminent gains of routine PA, an integrated examination of population-centred surveys involving 1.9 million people worldwide suggested that over a quarter of adults (27.5%), i.e.

23.4% of males and 31.7% of females, were physically inactivity, i.e. not meeting the weekly 150 minutes of moderate amount of PA recommended (Guthold et al., 2018).

Globally, there is a wide disparity in the reported levels of physical inactivity between the developing and the developed nations, with the highest values reported in Latin America and Caribbean (39.1%) and high-income Western nations (36.8%), while the lowest values were reported in Oceania (16.3%) and low-income nations (16.2%) (Guthold et al., 2018). It is alarming to observe that the physical inactivity prevalence in the high-income western nations was significantly higher than the global average of 27.5% and more than double the figure reported in low-income nations for both women and men (Guthold et al., 2018; WHO, 2019). Furthermore, across all areas in the world, women were observed to be generally more physically inactive compared to men, with up to 10.0% and higher variances in prevalence between them. For example, in developed nations 48.0% of women and 41.0% of men were physically inactive in comparison with 21.0% of women and 18.0% of men developing nations, respectively (WHO, 2019b). These variations in physical inactivity levels between the developed and the developing nations may be due to the high proportion of manual occupations and poor transport infrastructure in developing nations, which results in more activity being carried out at work and for transportation (Guthold et al., 2018).

On the contrary, the improved automation of work, as well as in almost all areas of life in developed nations presents limited possibilities for people to engage in sufficient PA, however, in the developing nations there is more work and active transportation associated PA essential for both women and men (WHO, 2019b). Therefore, it may be argued that in developed nations, the shift to more inactive jobs and motorised transportation may be attributed to the greater physical inactivity levels, while in developing nations, more activity is carried out at work (e.g., manual labour) and for transportation (e.g. cycling and walking). Even though decreases in work-related and household PA are unavoidable as nations prosper, and use of technology rises, governments ought to make available and sustain infrastructure that encourages better active transport, sports and leisure (WHO, 2019b). Despite the fact that improvements in technology in developed nations has a major influence on physical inactivity levels, the huge disparity of physical inactivity levels between the developed and developing nations may also be due to poor reporting systems in the developing nations and the employment of self-report and diverse instruments to assess physical inactivity, which makes comparison between nations challenging (Guthold et al., 2018).

It is evident that there has been a progressive rise in physical inactivity across the world and if this trend carries on, the World Health Organisation goal of decreasing physical inactivity globally by 10.0% by 2025 (WHO, 2013b) may not be achieved. Therefore, strategies to improve peoples' PA levels require to be given precedence and immediately scaled up (Guthold et al., 2018).

2.3. Prevalence of physical inactivity in the UK

In the UK, physical inactivity has been recognised as the fourth prominent cause of illness and debility, with 19.0% of men and 26.0% of women reported to be inactive (Townsend et al., 2015). In England, one in three males (33.3%) and one in two females (50.0%) are not active enough to accrue the health gains of PA (HM Government, 2014). Physical inactivity is projected to lead to 600,000 deaths annually, in the European Union regions, if nothing is done to change this trend (Dugdill et al., 2008). However, findings from previous studies (Jakicic & Davis, 2011; Warburton, Nicol, & Bredin, 2006) indicated that increased PA was linked with a decrease in health risks, such as the development of chronic illnesses. Additionally, due to the health gains of PA, adults are advised to participate in not less than 2.5 hours (i.e. 150 minutes) of moderate amount of PA or 75 minutes of vigorous amount of PA or an equal blend of both weekly (Department of Health, 2011b; WHO, 2010a).

Even with the several benefits linked with PA and the widespread health improvement efforts by the UK government, estimates suggest that only 61.0% (63.0% of males and 59.0% of females) of UK adults achieve the recommended levels of PA (Office for National Statistics (ONS), 2017; Sport England, 2017), implying that that 37.0% of men and 41.0% of women do not achieve it. In support of this, a study by the International Sport & Culture Association / Centre for Economics & Business Research (ISCA/CEBR) (2015) reported that the percentage of British adults that fail to achieve the national recommended PA levels were projected to be above one-third (37.0%).

According to the report of the ONS (2017), in 2015/16, only 26.0% of adults in England were classified as physically inactive. However, a more current report by British Heart Foundation (BHF) (2017) indicate that 39.0% of adults in the UK are physically inactive (see Table 2.1).

Table 2. 1: Physical inactivity levels across the UK (BHF, 2017)

Country	Physically inactive adults (%)	Number of physically inactive adults (000s)	Physically inactive females (000s)	Physically inactive males (000s)
England	39	16,800	9,900	6,900
Scotland	37	1,620	930	690
Wales	42	1,030	600	430
Northern Ireland	46	650	370	280
United Kingdom	**39**	**20,100**	**11,800**	**8,300**

The levels of physical inactivity reported amongst adults in the UK ranges from 22.5% to 39.0% (British Heart Foundation, 2017; International Sport & Culture Association / Centre for Economics & Business Research (ISCA/CEBR), 2015; Office for National Statistics (ONS), 2017; Sport England, 2017; Townsend et al., 2015). These divergent physical inactivity levels reported may be due to the range of methods and instruments used to measure PA levels among adults in the UK, and thus may have an impact on the range of findings. For example, in the Physical Activity Statistics, 2015 by British Heart Foundation, a self-report measurement approach was utilised which involved asking individuals to report the amount of exercise they engage in or have engaged in (Townsend et al., 2015). While the Office for National Statistics (2017) drew information about physical inactivity among adults in the UK from the Sport England Active Live survey (Department for Culture Media and Sport, 2015). Unlike the self-report survey used by the British Heart Foundation to measure PA levels among UK adults, the Active Live Survey, though a self-report measure, involved asking participants if they had engaged in 30 minutes of moderate intensity PA at least twice in the previous 28 days.

Furthermore, in the report by the International Sport & Culture Association/Centre for Economics & Business Research (ISCA/CEBR) (2015), physical inactivity levels among UK adults were drawn from the World Health Organisation's Global Health Observatory. This involved the administration of the Global Physical Activity Questionnaire (GPAQ), a validated instrument that measures PA across different domains (i.e., work, recreation, transportation, and home life). It is important to note that the WHO made some adjustments in order to align survey findings to their characterisation of inadequate PA (i.e. engagement in a minimum of

150 minutes of moderate intensity PA, or 75 minutes of vigorous intensity PA, or an equivalent combination of both every week), to limit the bias associated with self-report measures, to account for urban/rural reporting, and the age composition of the population surveyed (ISCA/CEBR, 2015). Although self-report measures have been generally used to measure PA levels in the UK, the approaches employed by different researchers have been diverse, which may be responsible for the range in physical inactivity levels reported across the literature. Therefore, employing validated and standardised measures, such as the International Physical Activity Questionnaire (IPAQ) or the Global Physical Activity Questionnaire (GPAQ) (WHO, 2012), used extensively globally to measure PA, would improve the consistency of findings as well as comparability across different studies. It remains evident, irrespective of the tool used to measure PA, that the prevalence of physical inactivity is high in the UK. Therefore, further research into the efficacy of behaviour change interventions is needed to better understand and encourage pro-physical activity behaviours among adults in the UK.

As illustrated in table 2.1, across the nations in the UK, the most physically inactive nation was Northern Ireland (46.0%), followed by Wales (42.0%), England (39.0%) and Scotland (37.0%). Out of these four nations, only Scotland had inactivity levels lower than the UK average. Additionally, in all the four nations, females were generally more physically inactive compared to males. The percentage of physical inactivity among men and women were comparable across the four nations, i.e., 41.0% men and 59.0% women in England; 43.0% men and 57.0% women Scotland; 42.0% men and 58.0% women in Wales; and 43.0% men and 57.0% women in Northern Ireland (BHF, 2017).

Table 2. 2: Physical inactivity levels in the English regions (BHF, 2017)

Regions	**Physically inactive adults (%)**	**Number of physically inactive adults (000s)**	**Physically inactive females (000s)**	**Physically inactive males (000s)**
North East	42	900	570	330
North West	47	2,640	1,510	1,130
Yorkshire and the Humber	40	1,720	1,050	670
East Midlands	39	1, 460	840	620
West Midlands	40	1,810	1,040	770
East of England	37	1,750	980	770
London	40	2,670	1,610	1,060
South East	34	2,370	1,410	960
South West	35	1,550	950	600

As shown in table 2.2, apart from East of England (37.0%), South West (35.0%) and South East (34.0%), all other regions in England reported levels of physical inactivity above the national average of 39.0%. However, the physical inactivity level in the East Midlands region (39.0%), where this study was conducted, was comparable to the national average (39.0%). As observed in the four nations of the UK, across the various regions of England, women were more physically inactive compared to men (BHF, 2017).

Generally, physical inactivity levels increased with age (Townsend et al., 2015), as people aged 16 to 24 years were least likely to be physically inactive (15.0%), while those 75 years and above were most likely to be physically inactive (54.0%) (ONS, 2017). In England, females (27.0%) were more predisposed to be physically inactive than their male contemporaries (24.0%), and people from the Asian, Black and Chinese ethnicities were more predisposed to be physically inactive than people from White and Mixed ethnicity (ONS, 2017). The degree of physical inactivity was highest amongst the lowest socio-economic groups (HM Government, 2014). For example, individuals who had been unemployed for a long time or had never work were more predisposed to be physically inactive (37.0%), whereas people in administrative, management, and professional jobs were least predisposed to be physically inactive (17.0%) (ONS, 2017). Additionally, South Tyneside, Leicester, Barking and Dagenham and Rochdale (all 30.0%) were the Local Authorities with the highest physical inactivity levels, while Wokingham (13.0%) and Brighton and Hove (14.0%) Local Authorities had the lowest PA levels (ONS, 2017). Meanwhile, a report by the Association of Public Health Directors revealed that if everybody in England achieved the CMOs' PA recommendations, almost 37,000 deaths could be averted in the UK annually (Macmillian Cancer Support, 2014).

Furthermore, it is alarming to know that the UK is one of the most inactive nations compared to some other European Union nations. of the six nations investigated, the UK reported the greatest predominance of physical inactivity, with 37.0% of the adult population (32.0% males and 42.0% females) categorised as being insufficiently active, which was significantly higher than the European Union average (22.0% males and 30.0% females), while Poland reported the least, with 19.0% of the adult population (14.0% males and 24.0% females) categorised as being insufficiently active (ISCA/CEBR, 2015). The wide difference in physical inactivity between Poland and the UK could be due to increasing urbanisation, which is associated with decreasing PA. For example, the UK has the least proportion of people residing in the rural areas (19.0%) compared to Poland, where 39.0% of the population reside in the rural areas. Likewise, occupation structures and employment markets play a huge part, with above 35.0%

of Polish occupations concentrated in farming and manufacturing professions, which is above twice the corresponding percentage reported in the UK (15%) (ISCA/CEBR, 2015). Considering this high physical inactivity prevalence in the UK, in comparison with some other nations in the EU, understanding the detrimental impacts of physical inactivity and the advantages of PA will help in developing plans to enhance levels of PA. Therefore, employing easy, cost-effective and safe ways to increase physically activity such as using active transport (i.e. walking and cycling) might have both economic and health benefits (Bopp, Bopp, & Schuchert, 2015; Litman, 2019; Yang et al. 2012).

2.4. Detrimental effects of physical inactivity

Physical inactivity is currently acknowledged as a prominent risk influence of non-communicable diseases (NCDs) (Guthold et al., 2018; WHO, 2019b), and the fourth prominent risk factor for deaths globally (Kohl et al., 2012; WHO, 2008, 2010b), with the associated 5.3 million deaths yearly (Lee et al., 2012) attributable to inadequate PA (WHO, 2010c, 2015). These estimates suggest that, of all deaths from NCDs (e.g. diabetes, cardiovascular diseases and cancers) (WHO, 2018f), 6 to 10% could be linked to physical inactivity (Lee et al., 2012). In support of the association of physical inactivity and development of NCDs, results of a study by Lee et al. (2012) indicated that physical inactivity raises the probability of developing numerous NCDs. Globally, it is projected that physical inactivity raises the possibility of developing some protracted illnesses such as heart disease, diabetes, cancer and stroke by 20 to 30% and reduces lifespan by three to five years (WHO, 2019c). Strong evidence also indicates that physical inactivity has a detrimental impact on psychological wellbeing and overall quality of life (Guthold et al., 2018). Furthermore, physical inactivity burdens people through the loss of productive and the hidden and increasing health care costs (WHO, 2019c). Overall, physical inactivity is attributable to about 9 of untimely deaths worldwide (Lee et al., 2012).

Apart from these chronic diseases associated with physical inactivity, it also has financial impacts. For example, in 2013, the global economic burden as a result of physical inactivity was $67.5 billion, which was the same as the gross domestic product (GDP) of Costa Rica for the same year (Torjesen, 2016). This is in conformity with the findings of an investigation by Ding et al. (2017), which indicated that in 2013, the global health systems expenditures due to physical inactivity was $53.8 billion, of which the public sector spent $31.2 billion, the private sector spent $12.9 billion, and households spent $9.7 billion. In addition, deaths associated with physical inactivity were accountable for $13.7 billion loss in productivity and $13.4 million DALYs (disability adjusted life years). DALYs provide an indicator of general burden of an ailment (Torjesen, 2016). One DALY denotes the loss of the equivalent of a year of complete healthiness (WHO, 2019a). While the developed nations suffered the impacts of the financial burdens (i.e. 80.8% of healthcare expenditures and 60.4% of incidental expenditures), a higher percentage of the disease burden (i.e., 75.0% of DALYs) happened in developing nations. Likewise, as reported globally, physical inactivity also weighs profoundly on the UK healthcare, with estimated cost of about £1.2 billion annually attributed to illnesses associated with physical inactivity (BHF, 2017). In summary, because of inequality in the distribution of resources and thus the unaccomplished healthcare requirements in developing nations, they are paying for physical inactivity with regards to their life lost, while the developed nations are paying with their wallets (Ding et al., 2017; Torjesen, 2016). Therefore, providing simpler ways to participate in PA and making it more available for everyone is of utmost prominence in the attempt to decrease the problem of inactivity-associated diseases and enhance the future overall health of the population (BHF, 2017). This is also important because of the numerous health benefits of being physically active.

2.5. Potential benefits of physical activity

Physical inactivity has been linked with undesirable cardiovascular condition, greater risks of diabetes mellitus, obesity, cancer, and premature death (Held et al., 2012; Wijndaele et al., 2011). Dunstan, Thorp & Healy (2011) revealed that extended overall inactive time has a detrimental association with cardiovascular risk factors, illness, and mortality outcomes. Conversely, PA has been established to possess some potential benefits on overall health and wellbeing. The physiological benefits consist of a decreased possibility of developing type II diabetes (Orozco et al., 2008; Roumen, Blaak & Corpeleijn, 2009), coronary heart disease (Berlin & Colditz, 1990; Sattelmair et al., 2011), contracting several forms of cancers (Lee, 2003), and developing a stroke (Lee, Folsom, & Blair, 2003); psychosomatic benefits consist of decreased anxiety *(*Petruzzello et al., 1991; Taylor, 2003), decreased possibility of depression (Dunn et al., 2001; Teychenne et al., 2008), osteoporotic fractures (Moayyeri, 2008), and enhanced self-esteem (Ekeland, Heian & Hagen, 2005). Therefore, engaging in routine moderate PA could assist in avoiding or decreasing the possibility of developing cancer, obesity, diabetes, mental health conditions, musculoskeletal health (e.g. osteoporosis and osteoarthritis) and cardiovascular disease (Department of Health, 2011b), and improvement of the quality of life (Bize, Johnson & Plotnikoff, 2007), and reduction in death rates (Barengo et al., 2004; Bucksch & Helmert, 2004).

It is imperative to examine the mechanisms by which PA reduces the risks of developing these chronic diseases. Routine PA has a positive impact on several recognised risk factors for cardiovascular disease. For instance, PA increases weight loss; decreases blood pressure; decreases levels of the low-density lipoprotein (also known as bad cholesterol) in the blood, in addition to total cholesterol; and increases levels of the high-density lipoprotein level (also known as good cholesterol) in the blood (Myers, 2003). Even though the impact of a PA programmme on any specific risk factor might usually be little, the impact of sustained, moderate PA on total cardiovascular risk, when combined with other lifestyle changes such as appropriate diet, smoking cessation, and medication usage, can be remarkable (Myers, 2003).

Furthermore, various mechanisms have been reported on how PA can prevent some forms of cancers, with a key mechanism being how PA affects hormone levels. As reported by Cancer Research UK (2016), being physically active can alter some hormones levels, as well as oestrogen and insulin. It has been established that PA can reduce the level of oestrogen in women. Oestrogen is believed to stimulate the progression of several womb and breast cancers, therefore decreasing the levels of this hormone could aid in decreasing the possibility of developing these cancers (Cancer Research UK, 2016). Additionally, PA can decrease the insulin levels in the blood (Andersen et al., 2013). Insulin is extremely vital in regulating how the human body stores and consumes energy from food, therefore fluctuations in levels of insulin can have effects throughout the body. However, Lu et al. (2017) stated that insulin can trigger signals that instruct cells to proliferate, and since cancer begins when cells proliferation is uncontrolled, decreasing levels of insulin could aid in preventing some forms of cancer from progressing (Cancer Research UK, 2016). In spite of the increasing volume of literature investigating PA and cancer, there is limited evidence on the safety of PA amongst all cancer survivors, as most assessments have selectively signed up subjects. It is moreover uncertain the ideal amount of exercise required for fundamental cancer prevention or symptom regulation in the course of and following cancer therapy (Brown et al., 2012), even though there is sound evidence that being physically active can help individuals during and after cancer therapy (Cancer Research UK, 2016).

As with cancers, PA play a key role in reducing the risk to developing type 2 diabetes (Diabetes Prevention Program Research Group, 2002; Pan et al., 1997; Tuomilehto et al., 2001). Since type 2 diabetes arises as a result of the body not being able to produce sufficient insulin to properly function or the cells in body being insensitive to insulin (i.e. insulin sensitivity), improvements in insulin levels and increase in insulin sensitivity would help in the reduction of glucose in the blood. The major mechanisms through which PA helps in the reduction of glucose in the blood is through the increase in insulin sensitivity and decrease in the levels of glycated haemoglobin (HbA1c) in the blood. The increase in insulin sensitivity enables the cells in the muscle to utilise any insulin available for the uptake of glucose in the course of and following activity. The cells in the body take up glucose and utilise it for energy when a person's muscles contract during activity, regardless of the availability of insulin (American Diabetes Association, 2019).

Additionally, a meta-analysis by Boulé et al. *(*2001) indicated that PA increases glycaemic regulation as evaluated by reduction in HbA1c. Glycated haemoglobin (HbA1c) is the mean glucose level in a person's blood for the previous 2-3 months, with high level signifying excessive glucose in the blood. The normal value of HbA1c for non- diabetic patients is below 6% and value ranging from 6 to 6.4% signifies higher risk of developing diabetes (i.e. prediabetes), while values above 6.5% or more signifies the presence of diabetes (Diabetes UK, 2019). Such reduction in the level of HbA1c is expected to decrease microvascular complications and reduce risk of cardiovascular disease, which is the general cause of death in diabetic patients (Gu, Cowie & Harris, 1999). Amongst people who have type 2 diabetes, routine moderate-intensity PA performed three times weekly can yield little but substantial enhancements in blood glucose regulation. Both aerobic and resistance exercise programmes yield comparable benefits, however, higher degrees of intensity of PA yield more benefits. Moderate to high intensities physical fitness seem to decrease the risk of all-cause mortality in type 2 diabetes patients (Coulson, 2011). Therefore, in diabetic patients, regular PA favourably affects the body's ability to use insulin to control glucose levels in the blood (Myers, 2003).

Strong evidence suggests that routine PA is effective in managing depression (Perraton, Kumar & Machotka, 2010; Rimer et al., 2012). The possible mechanism through which PA may reduce depression involve psychological influences such as enhanced self-efficacy (i.e. a person's belief in his/her capability to enact behaviours required to produce explicit performance accomplishments), distraction, a perception of mastery, and transformations in self-concept (i.e. the ways a person reflects on, appraises or sees themselves), in addition to physiological influences such as improved synthesis and metabolism of serotonin (Dishman et al., 1997), and endorphins. Participation in routine PA increases the levels of serotonin, a neurotransmitter for emotional processing, in the brain (Harmer, 2008; Patrick & Ames, 2015). Serotonin plays a major role in temperament, nervousness, fear, and overall sense of well-being, therefore, low levels of serotonin can lead to anxiety and depression (Integrative Psychiatry, 2020). As with serotonin, PA increases the serum levels of endogenous opioids such as endorphins, which leads to decrease in pain, changes in mood state and exercise stimulated excitement (Harber & Sutton, 1984). However, endorphins work together with two other neurotransmitters (i.e. norphenylephrine and serotonin) that are released during exercise to help relieve stress and make the individual feel good (Laurence, 2018).

A study by the International Sport & Culture Association / Centre for Economics & Business Research (2015) also illustrated the benefits of physical activity in enhancing psychological health and wellbeing. The results of this study indicated that increasing the participants' physical activity levels produced significant enhancements to sleep quality, efficiency, energy, self-esteem, and general wellbeing; while decreasing both domestic and work stress prevalence.

Increasing PA necessitates the involvement of the general public and ethnically appropriate method and thus requires a combined effort amongst diverse sectors and fields (WHO, 2019c). The health and economic gains of routine PA reiterates the importance of PA promotion across all age categories and in different settings. Consequently, given the high predominance, as well as the health and financial obligations, tackling physical inactivity represents one of the four major priority in the WHO's worldwide action plan to manage non-communicable diseases (NCDs) (WHO, 2013). In this context, the settings-based approach (SBA) developed by the WHO in the 1980s identified that to promote health, interventions are required to be carried out in different settings (World Health Organisation, 1981, 1986). Therefore, incorporating evidence-based PA in various settings such as universities, where a large proportion of staff and students have been shown to be physically inactive, might be a strategy to increase PA levels.

2.6. Rationale for the focus on a university setting

2.6.1. Physical inactivity prevalence in the university settings

Physical inactivity prevalence among university staff and students have been established, with a substantial percentage of them not meeting the PA levels recommended. In recent years, technological and industrial advancements have decreased the manual labour involvement needed to do all types of duties, both in the office and home. This has effectively decreased the physical exertions encountered by most individuals at their place of work, reducing work-associated injuries and debilities as a result of repetitive physical task (Hallal et al., 2012). In the last 20 years, the amount of European occupations involving more active jobs has reduced by about 7 million; whereas the amount of less active jobs has increased by 43 million (WHO, 2010a). This transformation has resulted in about 18% (i.e., from 55% to 67%) overall rise in the proportion of less active jobs in Europe across the same period. Although this signifies only one sphere of life where the European population are getting insufficiently active at work, evidence indicates that the levels of activity are decreasing in various domains, as well as leisure, housework and transportation (WHO, 2010a). Liberated from the exigencies of everyday exercise, people lead progressively inactive lifestyles. Conversely, dealing with the challenges of physical inactivity does not necessitate going back to working conditions requiring energetic or tough physical tasks. Furthermore, it does not even require significant involvement in planned sporting activities, or other similar organised engagements. The main problem is how to encourage people to change their behaviour toward PA. For instance, merely attempting to engage in walking more frequently and quickly may offer significant gains for people's general health (ISCA/CEBR, 2015).

The health benefits of engaging in routine PA are fully recognised for adults (Reiner, Niermann, Jekauc, & Woll, 2013). Therefore, approaches to encourage PA engagement have become a vital public health strategy to help prevent chronic diseases (Bonevski, Guillaumier, Paul, & Walsh, 2013). The frequency of accomplishing the recommended physical levels decreases swiftly from the ages of 18 to 24 years (Grim, Hortz, & Petosa, 2011) when numerous young individuals are embarking on tertiary education (Haase et al., 2004; Huang et al., 2003; Irwin, 2004). For example, in the US, approximately 50% of the university students' population are not attaining the PA levels recommended (Weinstock, 2010). In 2011/12, the Australian data for people 18 years and above revealed that 66.9% of adults were insufficiently active (Australian Bureau of Statistics, 2012). Irwin (2004) stated that students residing in campus premises were more prone to be physically inactive, and therefore may be at more risk of developing various diseases. Furthermore, several studies worldwide have established the predominance of physical inactivity in university staff and students, with a significant proportion of them not achieving the PA recommended levels. A survey study conducted by Pengpid et al. (2015) among 17,928 undergraduates from 24 universities in 23 low, medium and high-income nations, indicated that physical inactivity prevalence was 41.4%, with the lowest prevalence reported in Kyrgyzstan (21.9%) and the highest prevalence reported in

Pakistan (80.6%). Approximately 79% of female and 73% of male students, in universities in the UK, do not attain the PA recommended levels of 150 minutes of moderate-intensity PA per week (Haase et al., 2004). An investigation by Haase et al. (2004) showed that the predominance rate of physical inactivity amongst university students was 23% in North-Western Europe and USA; 30.0% in central and Eastern Europe; 39% in the Mediterranean region; 42% in Pacific Asia; and 44% in developing nations. This was further supported by individual studies in different countries, which suggest that rate of physical inactivity among university students was 42.3%, ranging from 17% in the USA to 73.6% in Lebanon (Abdullah et al., 2005; Al-Isa, Campbell, Desapriya, & Wijesinghe, 2011; Awadalla et al., 2014; El-Gilany, Badawi, El-Khawaga, & Awadalla, 2011; Fontes & Vianna, 2009; Musharrafieh et al., 2008; Suminski, Petosa, Utter, & Zhang, 2002). In general, being a student in the university was established to be linked with a high risk of physical inactivity (El-Gilany et al., 2011).

Even though there are limited studies with regards to prevalence rate of physical inactivity amongst university staff, a study by Mwangi et al. (2017) among staff in a Kenyan university indicated that 59.9% of the participants were physically inactive. Rissel, Mulley, & Ding (2013) reported that 69% of staff and students in an Australian university were physically inactive. In conformity of the high prevalence of physical inactivity among university staff, another study by Leininger & Adams (2015) revealed that 47.7% of staff in a university in the U.S. were physically inactive, while a study conducted by Cooper & Barton (2015) among staff in a UK university suggested that 42% of staff where physically inactive, i.e. not meeting the recommended 150 minutes of moderate-intensity physical activity a week. These physical inactivity levels reported amongst university staff were significantly lower than those reported amongst university students in the UK (Haase et al., 2004). Additionally, most university staff are engaged in diverse office-based responsibilities for administrators or teaching and research for academics. Conversely, administrators have been reported to sit for prolonged durations in comparison with academics, which may lead to higher physical inactivity (Agha & Al-Dabbagh, 2010) and higher risks of developing cardiovascular disease (Gilson et al., 2007). Additionally, it is also of interest to note that universities, by default, house highly educated individuals. It is noted that those with higher education qualifications tend to be more physically active, and knowledgeable of the desired PA levels (Joshua et al., 2012; Romaguera et al., 2011). Therefore, for university staff and students to be reporting high levels on physical inactivity is surprising and worth considering in more depth.

2.6.2. Benefits of physical activity among university staff and students

The prevalence of physical inactivity among university staff and students remains high, with a substantial percentage not achieving the recommended PA levels of at least 150 minutes of moderate intensity PA weekly (Cooper & Barton, 2015; Pengpid et al., 2015; Weinstock, 2010), even with the established health benefits of PA (Reiner et al., 2013). Strong evidence suggests that engaging in routine moderate intensity PA reduces the risks of developing musculoskeletal problems, cardiovascular disease, poor weight management and obesity and improves mental health and wellbeing, as well as cognitive functions and productivity (i.e. work and academic) of university staff and students.

2.6.2.1. Mental health and wellbeing

University staff and students are at a high risk of developing numerous health problems, including mental health problems. For university staff, substantial increase in workloads and family pressure may leave them often anxious and overwhelmed, thereby having a serious effect on their mental health (Spalek, 2021). On the other hand, for numerous students, attending university could be a very stressful period. As well as dealing with academic demands, several students have to cope with the stressful independent responsibilities of separating from their families whilst some may have to deal with several work and family obligations, which can have a negative impact on their mental health and wellbeing (Pedrelli et al., 2015). Mental health problems have been associated with physical inactivity, implying that increasing the PA levels among university staff and students may have some health benefits such as enhancing their overall mental health and wellbeing. Consistent with previous studies carried out in the university setting (UKactive Research Institute, 2018; Usher & Curran, 2019), engaging in PA may result in the enhancement of students' mental health and wellbeing. For example, the British Active Survey 2018/2019 carried out among 3,661 participants in different universities in the UK, suggested that students who were physically active, i.e. participating in at least 150 minutes of moderate-intensity PA weekly (Department of Health, 2011b), were more inclined to have greater mental health and wellbeing than those that are physically inactive (UKactive Research Institute, 2018). Another study aimed at determining the predictors of mental health status amongst university students revealed that PA levels and participation in sporting club resulted in the improvement of students' general mental health and wellbeing (Usher & Curran, 2019).

As with the university students, participation in routine PA have been shown to improve the mental health and wellbeing of university staff, even though they are more commonly overlooked. In support of this, a study by Cooper & Barton (2015) aimed at assessing PA levels and mental health and wellbeing among university staff indicated an association between PA and overall mental health and wellbeing comparable to that of the general population. This finding is reinforced by Emerson et al. (2017), suggesting that the increase in PA levels through a 3-month exercise programme was associated with an improvement in mental health and wellbeing, as well as reduction in stress and increase in self-efficacy, social satisfaction, energy levels and overall quality of life. Furthermore, earlier investigations suggested that health promotion programmes carried out in workplaces, including universities, were largely linked to decreased healthcare expenditures and increased health of employees. Notwithstanding the importance of mental health and wellbeing in attendance and productivity in the workplace, limited health promotion investigations have aimed at improving mental health and wellbeing of employees (Emerson et al., 2017). However, as a result of the increasing healthcare expenditures linked to mental health, focusing on mental health through health promotion programmes in the universities may be an efficient approach to decreasing unforeseen healthcare expenditures linked to presenteeism and absenteeism (Emerson et al., 2017).

Even with the benefit of PA in enhancing overall mental health and wellbeing, previous studies indicate that numerous university staff (Cooper & Barton, 2015; Leininger & Adams, 2015; Mwangi et al., 2017) and students (Awadalla et al., 2014; Pengpid et al., 2015; Weinstock, 2010) are still not meeting the recommended PA level, i.e., a minimum of 150 minutes of moderate intensity PA weekly, and thus experiencing high levels of poor mental health and wellbeing. Universities may have a vital role to play in supporting both physical and mental health of staff and students, therefore, designing, developing, and implementing theory-driven interventions to increase PA levels may help university staff and students become more active and enhance their mental health and wellbeing. Furthermore, universities ought to employ a more thorough and co-ordinated approach to fostering the mental health and well-being of their staff and students, demonstrating that thoroughly developed approaches focused on increasing PA levels which would invariably enhance mental health and wellbeing are needed. In order to design and implement effective PA activity interventions that would ultimately improve the mental health and wellbeing of university staff and students, specific barriers to university-based PA interventions, including cultural differences, should be considered (Cooper & Barton, 2015).

2.6.2.2. Cognitive function and productivity (work and academic)

The engagement in routine moderate intensity PA has also been associated with the improvement of cognitive function and productivity among university staff and students. Poor physical health may have detrimental impacts on productivity in the workplace, such as the university setting, through absenteeism (i.e. loss of productivity because of workdays missed) and presenteeism (i.e. decreased productivity during work periods), which may have serious cost implications to the employers (Brown et al., 2011; Sharifzadeh, 2013). Presently, most employers use health promotion programmes to improve staff lifestyles, in order to reduce absenteeism and presenteeism and improve productivity (Mattke et al., 2014; Proper & Van Mechelen, 2007), however, less emphasis has been placed on the role that increased PA levels may have on increasing productivity. Health promotion programmes, such as interventions aimed at increasing PA levels, have been explored by several workplaces, including universities, as a cost-effective strategy to reduce financial deficits linked with sicknesses or injury (Baicker, Cutler, & Song, 2010). Strong evidence suggests that health promotion programmes, such as PA interventions, are cost-saving in terms of reduced healthcare expenses as well as absenteeism from work (Baicker et al., 2010; Cancelliere et al., 2011), which could directly have a huge effect on productivity. Even though there are limited studies that specifically investigate the effects of PA on productivity among university employees, the findings of a current study by Jindo et al. (2020) revealed that, regardless of the frequency of exercise (i.e. once, twice, three or more times weekly), there was an association between participating in PA and the vigour of work engagements. This implies that interventions aimed at improving PA levels amongst university staff could be used as a university-wide approach to reduce staff absenteeism and presenteeism at work, thus improving their overall productivity.

In general, PA has been characteristically linked to enhancements in metabolic functions, e.g., hormonal, respiratory, and cardiovascular. Nevertheless, in the past years, it has expanded the number of investigations that associate PA to both cognitive and academic performance (Maureira & Diaz, 2017). Recently, several investigations have established the association between PA and marks attained by students in primary and secondary schools, as well as universities, which may likely be because of the enhancement of attention, memory and executive functions following the increase of blood vessels and neurogenesis (i.e. process through which new neurons are produced in the brain) prompted by the engagement in PA (Maureira & Diaz, 2017). For instance, a study by Kayani et al. (2018) investigating the association between PA and academic performance among university students, revealed a significant effect of PA on academic performance, probably due to improvement of self-esteem. In line with the findings of these studies, the British Active Survey 2018/2019 carried out among 3,661 students across different universities in the UK, indicated that the more physically active students, i.e. partaking in at least 150 minutes of moderate-intensity PA weekly, were found to have greater academic performance and employability in comparison to students that are physically inactive (UKactive Research Institute, 2018). For example, the most physically active students (55.7%) reported having greater academic attainment (i.e. achieved an average of 48 to 56 UCAS), followed by the moderately active students (43.9%), with the least being the physically inactive students (39.3%). Nevertheless, the moderately active (45.8%) and physically inactive (45.6%) students most commonly reported academic attainment of 32 to 47 UCAS points (UKactive Research Institute, 2018). Similarly, the most physically active students (52.7%) stated being more confident of securing employment within six months compared with the moderately active (40.6%) and physically inactive (38.2%) students (UKactive Research Institute, 2018).

Furthermore, a report by Castelli et al. (2015) demonstrated that routine involvement in PA and improved physical fitness levels are associated with improvements in cognitive functions (e.g. memory and attention) and academic performance. These brain functions play a vital role in learning. Long-term investigations have revealed that increases in PA, brought about by spending more time in physical education, were associated with better academic attainment. Even single bouts of PA have been linked to improved grades in academic examinations, better attentiveness, and more effective information transfers from temporary to permanent memory (Castelli et al., 2015). Therefore, future studies should further investigate the effectiveness of PA interventions as a university-wide strategy to reduce absenteeism and presenteeism and improve productivity among university staff, as well as to improve cognitive and academic performance among university students.

2.6.2.3. Musculoskeletal disorders (MSDs)

As with the improvement in mental health and wellbeing, as well as cognitive performance and productivity, engaging in routine PA has also been shown to help in the improvement of musculoskeletal disorders (MSDs), such as neck and back pains, osteoarthritis, fragility fractures, osteoporosis, and rheumatoid arthritis, among university staff and students. Osteoarthritis, neck and back pains, and other MSDs have been reported as the top 10 major causes of age-specific years lived with disability (YLD) among adults globally (Vos et al., 2017). However, the most common MSDs that affect millions of individuals globally include back pain and osteoarthritis (i.e. arises when the protective cartilage that protects the ends of people's bones wears out with time) (Akazawa et al., 2020). In the UK, MSDs represent the third highest NHS programme expenditure. Apart from its huge impact on the health service, MSDs have also been associated with the loss of 30 million productive working days annually, in the UK, causing a significant effect on the country's economy (Public Health England, 2018). However, engagement in routine PA has been advocated as a major public health intervention to aid healthy ageing and maintenance of mobility, which has been shown to improve musculoskeletal health as well as health outcomes (Vos et al., 2017).

The most prevalent MSD and one of the major prominent cause of disability globally is neck pain (Hoy et al., 2014). For instance, it is estimated that 45.5% of office employees will develop a MSD such as neck pain (Cagnie et al., 2007), which can lead to decrease in hours worked, decrease in engagement in leisure activity and decrease in sleep quality (Long, Johnston, & Bogossian, 2012). Previous studies (Fochsen et al., 2006; Geiger-brown et al., 1999) have shown that neck and back pain were major reasons for staff absenteesim from work. This is reinforced by Hanna et al. (2019), demonstrating that the university employees that were insufficiently active experienced lower or upper back pains more in comparison with those that were physically active. In support of these findings, a systematic review and meta-analysis carried out by Moreira-Silva et al. (2016) revealed that interventions conducted in the workplace to increase participation in PA significantly decreased overall MSDs such as musculoskeletal, neck and shoulder pains among employees. Furthermore, another systematic review by Moreira-Silva et al. (2017) also demonstrated that PA interventions carried out in workplaces, including university settings, significantly decreased overall MSDs among employees. These findings showed that the university employees that were physically inactive or sedentary were more exposed to an increased risk of developing MSDs such as back pain (Hanna et al., 2019). Therefore, strategies that focus on decreasing sedentary periods using organised and practical PA interventions should be integrated into the universities health promotion programmes to support the prevention of all possible forms of MSDs and their complications. However, further research is required to ascertain the efficacy of work-associated PA interventions, especially in university settings, on MSDs such as pains on the fingers, hands, wrists, elbows, and arms, as well as lower and upper back pains.

Similarly, as with university staff, PA has also been shown to reduce the risk of developing

MSDs among university students. A study by Hendi et al. (2019) aimed at examining the pervasiveness of MSDs and its relationship to PA among university medical students indicated that there was a considerable correlation between the musculoskeletal disorders and PA levels, with students engaging in more PA having less likelihood of developing MSDs than those not engaging in sufficient PA. Consistent with this finding, a current study by Pugh et al. (2019) aimed at assessing the relationship between fitness, exercise and musculoskeletal health among undergraduate nursing students suggested that those students that exercised more were less likely to develop MSDs than those that exercised less. Furthermore, to reinforce these findings, another study by Can & Karaca (2019) demonstrated a significant relationship between PA and musculoskeletal system pain complaints (i.e., pain on the neck, shoulder, lower and upper back), suggesting that the university students that participate in more PA were less likely to have MSDs than those that do not. Their findings also revealed that the university students that spent more time on computers and smartphones were more predisposed to developing MSDs than those that did not, possibly because while using these devices, students usually sit for prolonged periods of time (Can & Karaca, 2019), and thereby not engaging in sufficient PA to gain the health benefits

However, even though it has been established that the pervasiveness of MSDs, especially neck pain, among university students vary across different levels of study and programmes, probably due to distinctive programme associated exposures (e.g., use of computers for prolonged periods), limited studies have thoroughly examined the pervasiveness of MSDs and associated risk influences amongst university students (Chan et al., 2020). This lack of pertinent information may prevent university administrators from successfully earmarking resources to manage or prevent MSDs among students (Chan et al., 2020). Therefore, future studies should consider employing PA as a strategy to reduce the prevalence of MSDs, and its associated detrimental effects, amongst university students.

2.6.3. Settings-based approach to health promotion interventions

The settings-based approach (SBA) developed by the WHO in the 1980s identified that to promote health, interventions are required to be carried out in different settings. The SBA is progressively being acknowledged as an efficient approach of engaging people and particular populations in targeted interventions aimed at promoting health (Dooris, 2009). According to the WHO (1986, p. 3), "Health is created and lived by people within the settings of their everyday life; where they learn, work, play, and love”. The SBA originated from the WHO’s

Health for All strategy, and its main ideologies include community involvement, collaboration, enfranchisement and impartiality (WHO, 2018c). The settings within the WHO European perspective were categorised as islands, municipalities, communities, villages, cities, schools, homes, hospitals, workplaces, markets, prisons, and universities (WHO, 2018c).

The SBA has been gaining prominence over the years, however, one of the major drawbacks of this approach is the difficulty encountered in getting robust data and thus it is often undemanding to evaluate selected programmes rather than the whole setting (Scriven & Hodgins, 2012). In response, Dooris (2006) argued that in order to successfully assess a setting in its totality, assessment methods need to deal with the interactions, affiliations and multidisciplinary potentials of the setting utilising an ecological approach. One could argue that this limitation could probably be handled by the continuous development of the conceptual and theoretical foundation that drive these settings-based intervention programmes (Whitelaw et al., 2001). Even with these limitations, strong evidence suggests that the SBA has the potentials to incorporate healthy habits specifically into the culture of a working and dwelling settings to enhance wellbeing (Scriven & Hodgins, 2012). There is a growing evidence base about concept and practice that is reinforcing the SBA and presenting understanding to people and establishments of the prospects that the SBA could offer in the efforts to decrease NCDs and eventually enhance people's health. Dooris (2006) argued that to successfully assess the setting in its totality, assessment methods should address the interactions, affiliations and collaborative prospects of the setting using an all-inclusive and ecological approach. Therefore, grounded on the benefits of the SBA in promoting health, the university was chosen as a setting to carry out this research.

Higher education institutions have been established as a unique setting to encourage healthy lifestyles (Plotnikoff et al., 2015). Importantly, the university setting offers perfect surroundings for programmes aimed at increase PA, because of the existing social support, captive audience, and the number of peoples' waking periods spent in the university environment. According to Vaughan-Jones & Barham (2009), various categories of staff and students usually spend over 30.0% of their waking hours and most employees spend over four decades of their lives working in universities, and thus it is a perfect setting to access a huge number of different categories of students at different levels and modes of study and staff members with different job roles, to help modify PA behaviour (Vaughan-Jones & Barham, 2009). University settings provide further opportunities through the breadth of staff members roles, such as executive and senior management, administrative and professional services, support, teaching and research staff, as well as a diverse student population enrolled at different modes and levels of study, for example, full-time (75%) or part-time (25%) modes: undergraduates (77%), postgraduate taught (18%) or postgraduate research (5%) (Universities UK, 2017; University of Derby, 2017a, 2017b), enabling this research to have broad application. According to the current Higher Education Statistics Agency (HESA), in the UK, in the 2016-17 academic year, there were 2,317,880 undergraduate and postgraduate students in various universities, supported by more than 419,710 staff (i.e. 49% employed on academic contract and 51% on non-academic contract) (Higher Education Statistics Agency, 2018a, 2018b). It is projected that by 2025 the amount of students registering in tertiary institutions globally would be up to 262 million, a striking growth 32% of from the 2010 figure of 178 million (David & Mackintosh, 2011). As a result of the substantial proportion of staff and students in universities worldwide, the university as a setting possess the capacity to positively affect the health of the entire university population.

Through universities, a high proportion of students leaving home for the first time could be accessed, and thus has the potential to offer encouragement to adopt healthy behavioural practices that may persist all through their lifetime (Fredman, 2012). This is very important because this is the period when students develop their lifestyle skills and behaviours, and thus the right time to promote healthy behaviours. Universities are considered as institutions that support high ethical behaviours, which could determine research-centred standards for neighbouring societies to emulate. This allows for the prospect and obligation to create and carry out the best obtainable research evidence, and to establish a standard for other groups to emulate (Fredman, 2012). Universities possess an array of resources, amenities and trained staff; generally comprising health specialists, which makes this setting perfect for carrying out programmes aimed at lifestyle-associated health problems (Fredman, 2012). Furthermore, students are provided access to first-class amenities, machinery, and well-trained staff, as well as a range of health courses, which may facilitate the promotion of very efficacious health behaviour programmes. In support of this, the findings of an investigation by Plotnikoff et al. (2015) suggested that several studies carried out in the university settings, which employed university amenities, such as sport facilities, selected walking paths revealed substantial enhancements in the outcomes of PA.

Moreover, easiness in accessing staff and students, employment of prevailing amenities and resources is also economical, which is frequently a key drawback of programmes aimed at promoting health (Plotnikoff et al., 2015). Consequently, there are substantial opportunities to carry out behaviour change interventions to enhance the overall health of staff and students that represents a substantial percentage of the entire population. The university setting also presents group support, existing structures of formal and informal communication among staff and students, convenience and likely corporate behaviour norms, which are potential advantages of university-based programmes over other approaches (Conn et al., 2009). This will further provide the ecological framework for the justification of the employment of SBA in this current study. Given the evidence base indicating an increasing level of physical inactivity both nationally (NHS Digital, 2017) and globally (Hallal et al., 2012), Therefore, it is imperative to design behaviour change interventions that target the increase in PA level as a major outcome in the university setting (Conn et al., 2009).

2.7. Approaches to understanding behaviour change and promoting physical activity in adults

2.7.1. Advances in understanding and promoting physical activity in adults

Significant efforts have been put into understanding PA behaviours because of the growing predominance of physical inactivity in adults (i.e. >18 years old) (Kohl et al., 2012; Sallis et al., 2016). In fact, in the past two decades, investigations relating to the determining factors and correlates of PA have fast-tracked. Focusing mainly on demographic or personal features such as age, gender, health condition, perceptions, mind-set, and drive (Bauman et al., 2012), these investigations have frequently examined the ability for theories that largely target individuals, such as the self-determination theory and the theory of planned behaviour (Ajzen, 1991; Deci & Ryan, 1985), to predict and give reasons for behaviour change (Armitage, 2005; Hagger, Chatzisarantis & Biddle, 2002; Teixeira et al., 2012). Likewise, interventions designed to encourage PA engagement have commonly used individual-level psychosomatic and mental behavioural approaches (e.g. education, self-monitoring, goal setting, and mental reformation) (Greaves et al., 2011; Speake et al., 2016; Tully, 2015). Such efforts frequently entails trying to advance people through stipulated phases of behaviour change, as detailed in the Transtheoretical Model (TTM) (Prochaska & DiClemente, 1983). Even though there are some evidence for both the effectiveness of these procedures (Shilts, Horowitz, & Townsend, 2004) and the prognostic usefulness of these models (Marshall & Biddle, 2001), support for the TTM is fairly insubstantial (National Institute for Health and Care Excellence, 2014), with mixed outcomes arising from investigations assessing its usefulness as a behaviour change predictor, as well as an intervention foundation (Adams & White, 2005; Bridle et al., 2005).

Strong evidence indicates that PA levels across the world have remained static (or worsened). For example, the findings from a current research by Guthold et al. (2018) indicated that from 2001 to 2016, the levels of physical inactivity has remained static at 28.5%, with the highest levels found among the Caribbean and Latin American women (43.7%), while the lowest levels were found among Oceanian men. Additionally, meta-analyses of PA interventions have regularly reported insignificant general effect sizes (Conn, Valentine, & Cooper, 2002; Harris et al, 2009) and significant heterogeneity in effect size strength (Conn et al., 2009) despite the use of theories of behaviour change. Therefore, new approaches are needed to design effective interventions to change behaviour towards PA.

2.7.2. Recent advances in understanding behaviour change

To take full advantage of the prospective usefulness of interventions, it is essential to be aware of the target behaviour and how to transform it. Therefore, it is vital to gain a theoretical insight about behaviour change. In this perspective, theory signifies the accrued information of the mediators of change, in addition to the a-priori postulations concerning the meaning of human behaviour, and those factors that influence it (Davis et al., 2015). The employment of theory is encouraged as a fundamental stage in the intervention planning and assessment, and in synthesising evidence (e.g. the UK Medical Research Council's guidance for creating and assessing multifaceted interventions) *(*Glanz & Bishop, 2010). This is important for numerous reasons. Firstly, the past history of behaviour and the underlying determining factors of change could be properly recognised and focused on by the intended intervention programme (Hardeman et al., 2005; Michie, 2008; Michie & Abraham, 2004), and pertinent behaviour change techniques (BCTs) chosen and/or modified and personalised (Michie, 2008; Michie & Prestwich, 2010; Rothman, 2004). Secondly, theoretically discovered mediators (i.e. mechanisms of action) may be explored to obtain more insight about the ways that the intervention produces its impacts (Michie & Abraham, 2004; Rothman, 2004, 2009). This permits investigators to ascertain if ineffective interventions have been unsuccessful because the intervention has produced no effect on the postulated facilitator or because the postulated facilitator has produced no influence on behaviour (Michie & Abraham, 2004; Rothman, 2009), therefore enabling more effective modification of the intervention. Thirdly, theory recaps the growing information about the ways to change behaviour across diverse peoples, habits, and settings. Lastly, interventions supported by theories present potentials to test and verify the theories. This therefore supports the advancement of more effective theories that ultimately reinforces the optimisation of interventions (Michie, 2008; Rothman, 2004).

Furthermore, investigators have in recent times looked at new possibilities in trying to progress the knowledge about behaviour change, as well as the establishment of taxonomies of the several approaches that have been used to stop smoking (Michie, Hyder, Walia & West, 2011), improve intake of healthy diets and increase PA levels (Abraham & Michie, 2008; Michie et al., 2011), and reduce alcohol intake (Michie et al., 2012). Investigators have as well studied the best ways to construct behaviour change communications (Gerend & Maner, 2011; Gerend & Shepherd, 2016); the usefulness of innovative mobile and sensing technologies (King et al., 2008, 2013); and the correlation between affective reactions to exercise and adherence to exercise (Ekkekakis, Parfitt, & Petruzzello, 2011). Besides these new lines of research, investigators have started recognising the significance of going beyond a limited emphasis on personal-level methods of behaviour change to the ecological approaches that take into account the several personal, environmental, policy, and societal contributing factors of health behaviours (Bauman et al., 2012; Cruwys et al., 2015; Sallis, Owen & Fisher, 2008). Exemplifying a significant change from conventional theoretical methods, the postulation in the core of these theories is that being aware of behaviour change at diverse levels is crucial for the advancement of effective interventions (Sallis, Owen, & Fisher, 2008). For example, previous studies (Broyles et al., 2011; Resnick, Orwig, Magaziner, & Wynne, 2002) recognise the benefits of PA linked with focusing on, and identifying with, an individual's social support and resources, and the norms that evolve in group settings. Some studies have also revealed that when individuals have more positive insights as regards protective social influences in their societies (e.g. with regards to the value of social systems, the level of social interconnection, and the degree of dependence in neighbours) they are more predisposed to participate in PA (Brennan et al., 2003; Kaczynski & Glover, 2012). In order to properly understand behaviour change, overarching theoretical models or theories need to be employed to support interventions.

2.8. Theoretical framework underpinning this research project

Strong evidence indicates that interventions which are supported with all-encompassing psychological theories are more inclined to be effective at transforming behaviour than interventions not supported with theories (Albarracín et al., 2005; Hobbs et al., 2013; Michie et al., 2014). This has provoked debates around the usefulness of the older psychological models, theories and framework in health behaviour interventions. Michie et al. (2014) argued that the most frequently employed psychological models, theories and frameworks in the PA domains such as the Health Belief Model (Hochbaum, 1958); the Social Learning/Cognitive Theory (Bandura, 1986); the Theory of Reasoned Action/Planned Behaviour (Ajzen, 1991); and the Transtheoretical Model (Prochaska, Redding & Evers, 1996) do not cover the complete array of potential influences, thereby possibly excluding most likely vital variables. Michie et al. (2014) further argued that these older psychological models that are still being used to inform interventions that promote PA among inactive people do not tackle the vital roles of impulsivity, disposition, emotional processing, will power and associative learning. However, recent developments of integrating these older models have led to developments of newer models with wider influences such as cognitive, automatic, reflective and contextual factors (Michie et al., 2014). Therefore, the alternative may be to use newer integrative overarching models and frameworks that do not have these limitations of the older ones. On this premise, the Behaviour Change Wheel (BCW), the COM-B model and the Theoretical Domains Framework (TDF) were thus chosen to underpin this research.

2.8.1. The Behaviour Change Wheel (BCW)

The behaviour change wheel (BCW) developed by Michie, van Stralen, & West (2011) (as shown in Figure 2.1) was recommended as one of the frameworks to underpin this current study because it guides intervention developers, investigators and practitioners to reflect on the complete array of options and select those that are most favourable through standardised assessment of concepts and facts.

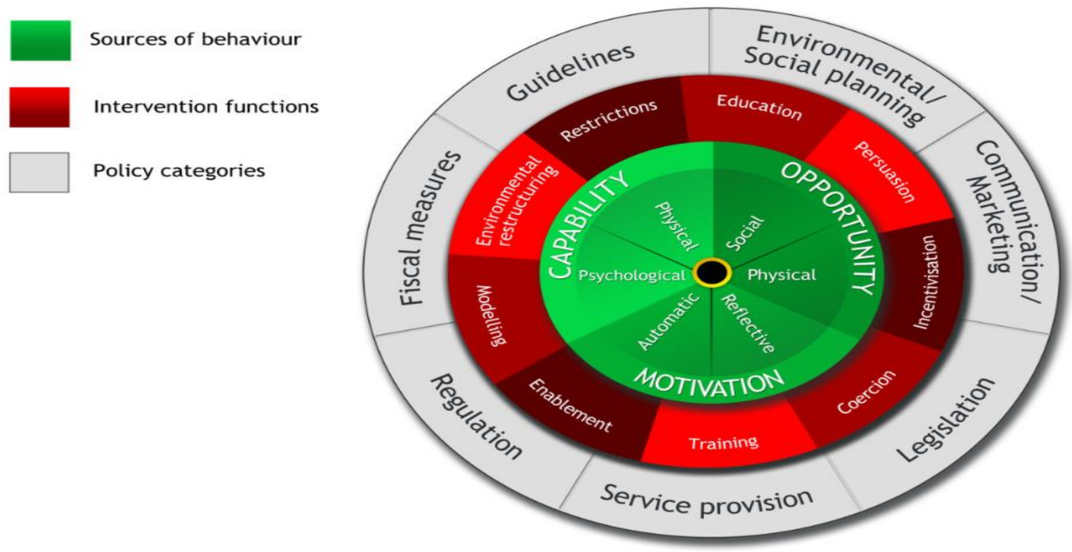

Figure 2.1: The Behaviour Change Wheel (Michie, van Stralen, & West, 2011)

However, it is not a universal remedy, nor an outline for behaviour modification, but a structure for rendering the paramount employment of the knowledge and resources accessible to develop a strategy (Michie et al., 2014). It is an overarching model created from 19 frameworks of behaviour change discovered in standardised review of literature. This framework possesses the benefits of being developed from previously existing taxonomy and thus encompassing models which have hitherto been deemed to be vital and employing an all-embracing behaviour model to map interventions to likely behaviours targeted. It is the most current behaviour change model constructed by incorporating existing model explicitly to overcome the limitations of the older models or theories (Michie, van Stralen, & West, 2011). Consequently, employing constructs from diverse pertinent theories could demonstrate to be more useful instead of employing a single theory. Therefore, integrating numerous theories might reduce the drawbacks of individual theories and enhance the results of intervention (Hobbis & Sutton, 2005). More importantly, the accuracy and practicability as established with the Behaviour Change Wheel are also important when planning effective behaviour change interventions (Rothman, 2004).

As illustrated in Figure 2.1, the BCW consists of three layers. The innermost hub is the COM-B model, which is also referred to as the ‘sources of behaviour’. This is surrounded by a second layer known as ‘intervention functions’. This layer consists of nine intervention functions, i.e. education, training, incentivisation, environmental restructuring, restriction, coercion, enablement, modelling, and persuasion, which could be selected from based on the specific analysis arrived at employing the COM-B model. Then the third and outer layer is known as the ‘policy categories’. This layer consists of seven policy categories, i.e. fiscal measures, service provision, environmental/social planning, regulation, communication/marketing, legislation and guidelines, which could enable or support the delivery of these interventions (Michie et al., 2014). The BCW can be applied to support interventions (Michie, van Stralen, & West, 2011).

Growing awareness of the failure to transform research findings into practice has led to better understanding of the significance of using dynamic execution and dissemination approaches. Although there is a growing body of research evidence about the successes of various approaches used to change different behaviour, these are not readily available to professionals and policy makers (Grimshaw, 2001). Therefore, key benefits of the BCW is that it has a comprehensive coverage, it is coherent, it has a strong association with a behaviour model, and it is usable by and useful to policy makers, intervention designers, service planners and researchers (Michie, van Stralen, & West, 2011).

The BCW offers a step-by-step approach for developing interventions aimed at changing behaviour, as illustrated in Figure 2.2. Although the process is referred to in linear terms, it is evident that it may necessitate cycling back and forth between stages as various issues and obstacles are revealed. Therefore, flexibility is very imperative when employing this approach (Michie et al., 2014). The BCW provides three key stages to designing behaviour change interventions, which is further divided into eight steps (see Figure 2.2) (Michie et al., 2014).

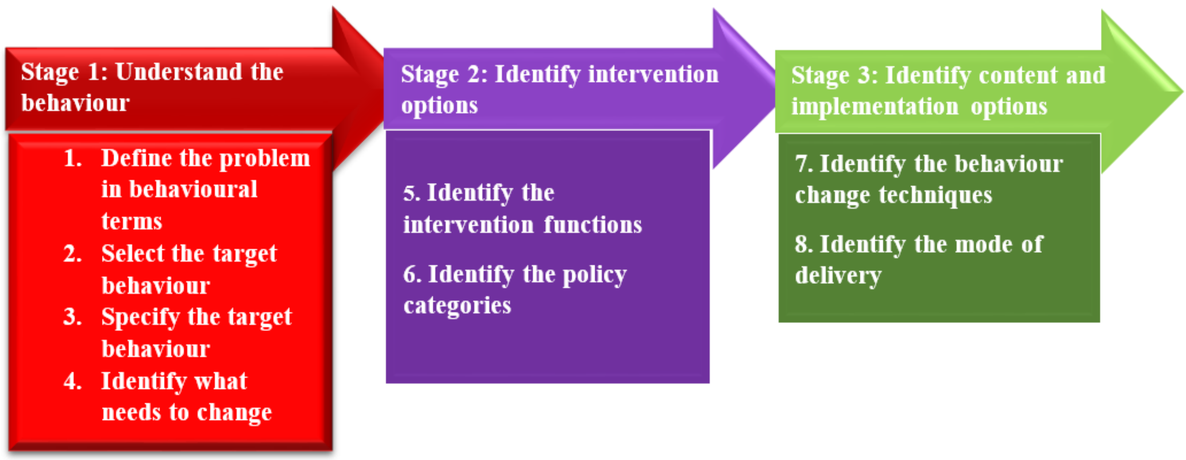

Figure 2.2: The steps of the Behaviour Change Wheel in designing interventions (Michie et al., 2014)

2.8.2. The COM-B model of behaviour

The COM-B model, as shown in Figure 2.3, is the inner hub of the BCW that is used to identify the things that require to be changed in an individual and/or environment to accomplish the expected behaviour (Michie et al., 2014).

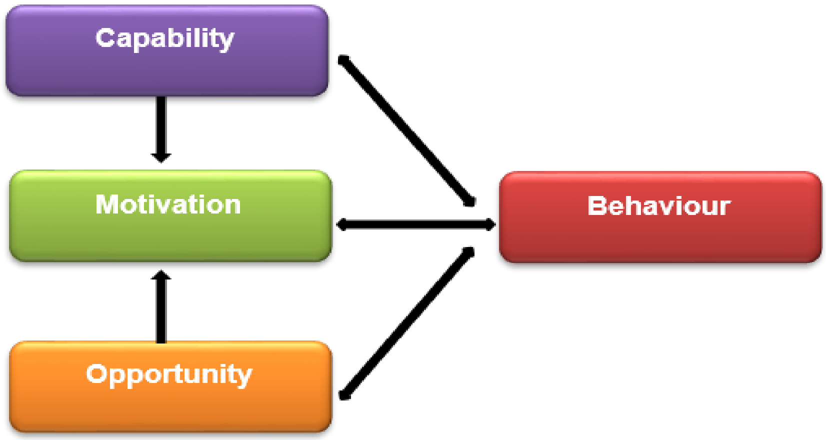

Figure 2.3: The COM-B behaviour model (Michie et al., 2014)

Dedicating time and effort to totally understanding the target behaviour is a crucial and frequently disregarded stage in intervention design. The more precise the exploration of the targeted behaviour is, the more the likelihood that the intervention will transform the behaviour in the anticipated way (Michie et al., 2014). This step is very important because behaviour change interventions may be ineffective because wrong postulations have been done concerning the things that require to change (Michie et al., 2014). Each of the three constituents of the COM-B could be further categories heuristically into two forms. Capability can be categorised as either physical (possessing physical strength, skills, or energy) to engage in the behaviour or psychological (possessing awareness, mental strength, skills or energy) to engage in the behaviour. Opportunity could be social (involving social cues, cultural norms, and interpersonal influences) or physical (the things the environment permits or enables, with regards to triggers, resources, time, physical barriers, locations). Motivation may be automatic (processes involving desires, impulses, reflex responses, and wants and needs) or reflective (comprising self-conscious planning and assessments (views concerning what is good or bad) (Michie et al., 2014).

These components of automatic and reflective motivation produce the different levels of human motivational system detailed in the PRIME Theory of Motivation: Plans, Responses, Impulses, Motives (wants and needs) and Evaluations (West & Brown, 2013). As illustrated in Figure 2.4, these components interact by interlinking arrows so that, for instance, fostering capability or opportunity could strengthen motivation. Increased motivation may instigate people to participate in activities which would enhance their capability or opportunity by transforming behaviour. For instance, possessing a bicycle (opportunity) or having the ability to ride a bicycle (capability) may increase motivation to ride a bicycle. However, motivation alone will not enhance riding skills or afford access to a bicycle unless the person acts (behaviour) on this motivation to purchase a bicycle or to practice riding a bicycle (Michie et al., 2014).

When gathering information to understand the target behaviour, data should be gathered from as numerous appropriate sources as conceivable, because most of the accurate scenario will be informed by multiple perspectives (Michie et. al., 2014). It is well acknowledged that frequently investigators have poor insight into the reasons people behave as they do (Nisbett & Wilson, 1977), therefore triangulating data using several sources will reinforce the general understanding of the target behaviour. If feasible, it is recommended that investigators should also gather data employing an array of approaches, involving direct observations, focus groups and interviews, questionnaires, review of appropriate local articles such as expert opinion and service protocols (Michie et al., 2014). If a consistent picture of a behaviour and the factors influencing it is obtained from more than one source and employing more than one approach, it increases confidence in the analysis. Conversely, the nature of behaviour may constrain the data gathering approach; for instance, observation technique is obviously unlikely to be feasible if the behaviour takes place infrequently or privately (Michie et al., 2014). Therefore, in order to ascertain what requires changing for the University of Derby staff and students to participate in PA, group interviews and online questionnaire surveys were employed to understand their views and opinions about the determinants (i.e., barriers and facilitators) of PA.

2.8.3. The Theoretical Domains Framework (TDF)

As illustrated in Figure 2.4, the COM-B behaviour model could be further expanded into 14 domains, employing a more comprehensive instrument referred to as the Theoretical Domains Framework (TDF), to understand behaviour (Michie et al., 2014).

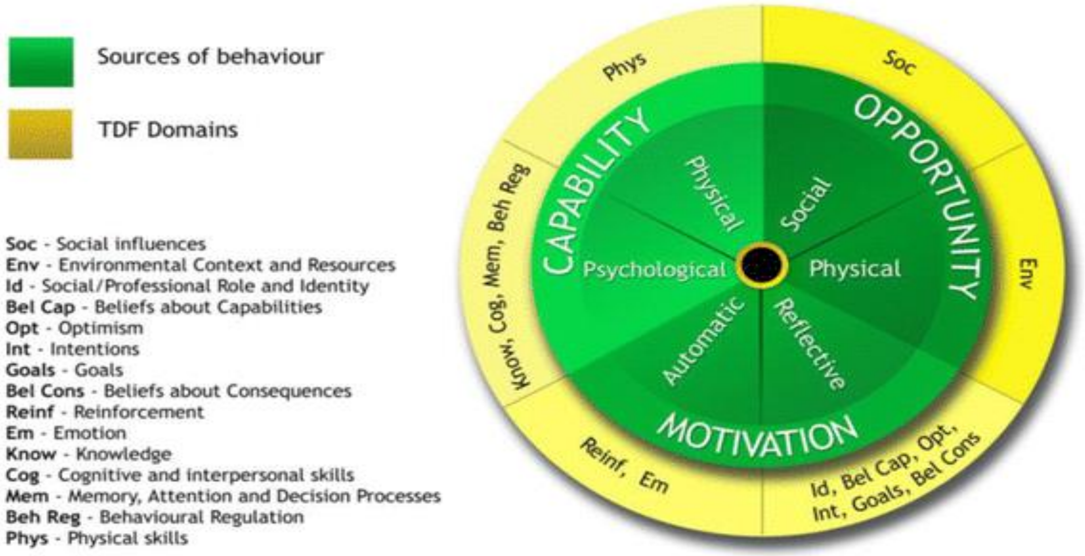

Figure 2.4: The Theoretical Domains Framework (Atkins et al., 2017)

The TDF (Cane et al., 2012; Steinmo et al., 2015) was created in response to request from implementation investigators who recognised that application of evidence-based practice depends on changing behaviour and theories of behaviour change are thus very relevant and potentially helpful in informing implementation interventions (Michie et al., 2014). Conversely, they were aware of the large number of such theories and their overlapping constructs and lacked method for selecting and employing such theories. There are some indications that interventions underpinned by theories are more efficacious at changing behaviour compared to those that are not supported by theories (Borrelli, 2011; Glanz & Bishop, 2010; Noar, Benac, & Harris, 2007; Noar & Zimmerman, 2005; Trifiletti, Gielen, Sleet, & Hopkins, 2005; Webb, Sniehotta, & Michie, 2010) even though the evidence is neither consistent no strong (Prestwich et al., 2014). The TDF is an integrative framework combining major theoretical concepts employed in pertinent theories, and was developed in a collaboration between psychologists and implementation investigators (Michie et al., 2014) as an instrument to support the utilisation of theoretical methods in designing interventions focused on behavioural change (Cane et al., 2012; Duncan et al., 2012).

Table 2. 3: The descriptions of the Theoretical Domains Framework (TDF) (Cane et al., 2012)

S/N	TDF Domains	Description
1	Knowledge	A consciousness of the subsistence of something
2	Physical skills	A capability or competence developed through rehearsal
3	Social/professional role and identity	An articulate set of habits and exhibited individual traits of a person in a communal or work environment
4	Beliefs about capabilities	Acknowledgement of the actuality, certainty, or cogency concerning a skill, ability, or capability that an individual could put to beneficial use
5	Beliefs about consequences	Acknowledgement of the actuality, certainty, or cogency concerning consequences of a behaviour in a specified condition
6	Optimism	The self-assurance that things would ensue for the best, or that anticipated objective will be accomplished
7	Reinforcement	Raising the likelihood of a reaction by arranging a contingent association, or exigency, between the reaction and a specified inducement
8	Intentions	A deliberate resolution to carry out a behaviour or a tendency to act in a particular manner
9	Goals	Mental depiction of consequences or end states that a person desires to attain
10	Memory, attention, and decision processes	The capability to remember information, focus selectively on facets of the environments, and select between two or more options
11	Environment context and resources	Any circumstances of an individual’s condition or surroundings that prevents or inspires the enhancement of proficiencies and skills, autonomy, social proficiency, and adaptive behaviour
12	Social influences	Those relational processes that may cause a person to transform their opinions, moods, or habits
13	Emotions	An intricate response patter, encompassing heuristic, psychological, and behavioural components, through which the person tries to handle an individually important issue or occurrence
14	Behavioural regulation	Anything targeted at handling or transforming objectively examined or evaluated activities

The TDF comprises 14 domains as detailed in Table 2.3. The TDF is a theoretical framework that does not postulate testable associations between components but presents a hypothetical lens to examine the mental, emotional, social and ecological influences on behaviour (Atkins et al., 2017). This Framework has been employed to prospectively expedite the implementation of interventions in healthcare settings (Dyson, Lawton, Jackson, & Cheater, 2013; French et al., 2013; Tavender et al., 2014) and retrospectively in theory-based process evaluation (Cane et al., 2012; Curran et al., 2013; French et al., 2013). Even though validated questionnaires that can be used to assess the TDF domains are currently available, majority of investigations have depended on qualitative evaluations of focus group or interview data, which is time consuming (Huijg et al., 2014; Taylor, Lawton, Slater, & Foy, 2013; Taylor et al., 2013). In recent times, the TDF has been applied in the physical activity context in different settings such as among asylum seekers in a local support groups (Haith-Cooper et al., 2018); among obese pregnant women in a hospital (Flannery et al., 2018); and among the elderly living with HIV in communities and health establishments (Quigley et al., 2019). However, the assessment of the effectiveness of the TDF in the PA context in a university setting is lacking, therefore, this current research project aims to explore the determinants (i.e. enablers and barriers) of PA and the predictors of physical inactivity amongst staff and students in a university setting, using the TDF.

Although these newer frameworks and models, especially the BCW and COM-B model have been employed widely to guide the design of diverse interventions aimed at changing behaviour, they have faced several criticisms of late, the major ones being from Ogden (2016). Ogden (2016) argued that time was not yet right for the synthesis of evidence of behaviour change, and proposed that the recent effort may be untimely, because BCW and BCTT (behaviour change techniques taxonomy) may have been founded on insubstantial information, as well as incorrect focus on employing coding protocols to envisage people's behaviour. This was in line with an investigation by Teixeira (2016) which suggested that the quality of information so far may not be ready to integrate, since behaviour change studies are still in their infancy and therefore possesses large amounts of contradictions and several sources are incorrect. On the contrary, findings of a study by Johnston (2016) suggested that the systematisation of theories such as the COM-B model (Michie et al., 2011) and the TDF (Michie et al., 2005) have been particularly vital in making sure that rudimentary, fully tested theoretical innovations support health and healthcare improvements. Furthermore, Albarracin & Glasman (2016) alleged that novel enhancement in approaches to transform behaviour is crucial for a dynamic discipline and advances in public health. They also believed that possessing a classification of things that have worked is instrumental to inventive exploration on the subsequent generation of behaviour change techniques (BCTs).

Finally, Ogden (2016) also alleged that the BCW and BCTT have opened the avenue for transformations in policy and practice and similarly presented a structure and terminology for professionals intending to create and carry out interventions. However, Ogden (2016) was unsure about the best alternate logical way to tackle all the concerns raised about the BCW, COM-B and the BCTT. Even with these criticisms, the BCW, COM-B model and/or TDF have been used and are still being used extensively in a range of populations and settings globally, such as healthcare professionals in primary care setting (Yamada et al., 2018); clinical staff in orthopaedic ward (Thomas & Mackintosh, 2014); adults at risk of diabetes in leisure and community setting (Penn et al., 2013); pregnant women in health clinic (Thompson et al., 2018); smokers attending NHS stop smoking services (Fulton et al., 2016); and parents in childhood weight management (Curtis, Lahiri, & Brown, 2015). Furthermore, these models/framework have also been used in the PA context among asylum seekers (Haith-Cooper et al., 2018); older people living with AIDS (Quigley et al., 2019); overweight and pregnant women (Flannery et al., 2018); and elementary school teachers (Weatherson 2017), but has not yet been used in the university setting, which is the novelty of this research project. The major benefit of the BCW, COM-B model and TDF is that they can guide researchers and intervention designers at various levels of competences to be able to design interventions targeted at changing behaviour (Michie et al., 2014). Therefore, these frameworks were chosen to support this research because, apart from its successful broad applications, as a non-psychology researcher, it provides a translational approach to developing and implementing interventions aimed at changing behaviour. However, it is imperative to identify the barriers and enablers to PA in a target population, in this case the university staff and students, to be able to design effective interventions to increase the PA levels among those that are inactive.

2.9. Determinants of physical activity among university staff and students

Even though it is key to understand the determinants of PA among the study population during intervention development, there are limited studies focused on evaluating PA determinants among university staff in comparison with those involving university students, therefore some studies conducted in workplaces will also be used to support discussions involving university staff. The academic routine and work pattern of the university staff are unique in comparison with those of workers in other work settings. Various university staff indicated engaging in more than 40 hours of work weekly, as well as early hours in the mornings, late at night, and even on weekends, due to the type of their job, involving teaching various modules, carrying out research, and expediting research investigations (Das, Rinaldi-Miles, & Evans, 2013). This work is frequently carried out without any extra hours or monetary inducements (Das et al., 2013). University staff as well have more diverse work periods in comparison with staff working in other establishments. Furthermore, because of the characteristics of their work, numerous university staff extend their work to their homes, and therefore finding it difficult to draw the lines between home and work lives (Das et al., 2013). All these factors discussed could possibly influence the university staff from engaging in PA.

The review of PA determinants is very important, because the barriers to PA engagement are important excuses people give for not participating in routine PA. Centers for Disease Control and Prevention (2010) reported that the commonest reasons specified for failing to participate in PA involve: time constraints; lack of social support; inconveniencies in engaging in PA; demotivation; perceiving PA as unenjoyable and uninteresting; lacking self-assurance in their capability to engage in PA; possessing the phobia of getting hurt; lack of skills in self-management; and lack of a conducive physical environment that promote PA. An investigation by Fletcher et al. (2008) stated different barriers to PA programmes in the workplace, when workers were classified as blue-collar or white-collar employees. Although time constraint was the major mutual barrier for these groups of employees, the white-collar employees reported timetabling and work inconsistencies as the most shared barriers for time. On the other hand, the blue-collar employees reported working shifts (as anticipated by the kind of their work) as their most frequent time barrier (Fletcher et al., 2008). Additionally, results from other studies involving mass transit employees indicated that their barriers to participation in PA varied and included work timetables, unfavourable climate, lack of organised and appropriate breaks, and lack of opportunities to encourage PA engagement (Escoto et al., 2010; French et al., 2007; Tse, Flin & Mearns, 2006). Another study carried out by Taylor et al. (2013) posited that the benefits for engaging in PA involved decrease in anxiety, better enjoyment, enhanced health consciousness, and enhanced workplace social interface while barriers involved management backing.

Various investigations have evaluated PA determinants among staff and students in universities using quantitative, or qualitative approaches, or mixed methods approach (i.e. a combination of both approaches). An investigation by Deliens et al., (2015) that assessed the barriers and enablers to PA and inactive habits among students in a Belgian university, revealed that PA was influenced by convenience, time, perceived enjoyment and self-discipline, their social network (i.e. lack of social support, parental influence, and modelling), physical environment (i.e. accessibility and ease of use, time and distance required to travel, and costs), and macro environment (e.g. mass media and promotion). An investigation by Gómez-López, Gallegos, & Extremera (2010) which aimed at assessing the reasons Spanish university students adopt inactive lifestyle revealed that the main barriers reported for not engaging in PA include: time constraints, not liking the PA, feeling lazy, lack of social support, incompetence, and not seeing its practicality or usefulness. Another investigation by Martínez-Lemos, Puig-Ribera, & García-García (2014) focused on identifying the impact of the willingness to change on PA engagement among Spanish university students indicated that barriers inhibiting students from participating in PA include: work obligations, time constraints and laziness. Furthermore, a current mixed methods research by Aceijas et al. (2016) which aimed at examining the enablers and barriers to PA amongst students in a UK university suggested that lack of time, price, embarrassment, study pressure and university systems were the major barriers for PA.

Although there are limited research involving university staff, the following studies showed different determinants of PA in comparison with those reported for university students. For example, a study by Leininger & Adams (2015) that examined the barriers to PA engagement and an assessment of those achieving the recommended PA every week, revealed that lack of time, adhering to their individual exercise programme and timetable inconsistencies were major barriers preventing them from engaging in PA. A qualitative study by Das, Rinaldi-Miles, & Evans (2013) employed focus group discussions to examine university staff's perceptions of barriers and advantages of PA. Their results, as consistent with the findings of previous research, suggested that time constraints and knowledge were the main barriers preventing university staff from participating in PA.

The association between increased PA levels and reduced risks of developing chronic diseases, and between physical inactivity and raised risks of developing chronic diseases have been constantly acknowledged in various scientific literature (Aceijas et al., 2016). Therefore, identifying why university staff and students engage in PA or not is imperative to developing effective intervention programmes (Biddle et al., 2004; Kaewthummanukul & Brown, 2006). As a result, intervention designs should be instituted on understanding of factors that prompt university staff and students to engage in PA (Kaewthummanukul & Brown, 2006). Therefore, first two studies in this research project employed mixed methods design. The qualitative approach employed group interviews to examine the barriers and enablers to PA amongst university staff and students, while the quantitative approach employed surveys to examine the physical inactivity levels and the predictors of physical inactivity amongst administrative staff and PhD students, who were found to be the most physically inactive groups compared to other staff and student groups, respectively.

2.10. Intervention strategies used to promote physical activity in the university setting

Efficient approaches to improve population PA levels, especially among those that are inactive, are greatly required, in view of the fact that the increased problems associated with NCDs are due to physical inactivity (Lee et al., 2012). Current transformations in the perceptions of PA at present recommend that the totality of PA is essential, and that approaches to enhance active lifestyle, via integrating PA as a routine, are vital for attaining population-level transformation (Kohl et al., 2012). University campuses have been recognised as dynamic workplaces and learning settings through which a broad range of people can be accessed. Frequently, universities are huge establishments in most areas with workforces varying from maintenance employees to accountants to administrators and very skilled teaching and research staff. Furthermore, universities attend to huge student populations, largely young adults, with a number of them residing in the university premises (Bopp et al., 2018). Most students registered in universities have the tendency to reduce their engagement in PA right from their first year all through to the last semesters (Keating et al., 2005; Small & Morgan, 2014), suggesting a necessity for programmes to inculcate healthy everyday life habits during this life phase that can transfer into later life. This decrease in PA engagement may possibly be associated with relocating from the university premises, which may open up the prospect for other types of PA such as cycling and walking (i.e., active transport). That, in addition to the prospects for workplace health promotion programmes targeting university staff, indicates that university campuses may possibly be a unique location for health enhancing promotion ventures, such as promotion of PA. Therefore, the importance of PA amongst university staff and students cannot be over-emphasised.

Several interventions such as active transport, i.e. walking and cycling (Bang et al., 2017; Bopp et al., 2016, 2018; Kaplan, 2015; Thorgersen-Ntoumani et al., 2014; Wilson et al., 2016), stair climbing (Meyer et al., 2010; Olagbegi et al., 2017), standing (Jerome et al., 2017; Mansoubi et al., 2016; Swartz et al., 2014; Zhu et al., 2018), education (Ghaffari et al., 2013; Parrott et al., 2008), implementation intentions (Conner, Sandberg & Norman, 2010; Milne, Orbell, & Sheeran, 2002; Murray, Rodgers & Fraser, 2009; Prestwich, Lawton& Conner, 2003), and multi-component interventions (Healy et al., 2013; Hurdiel et al., 2017; Watanabe & Kawakami, 2017) have been implemented in university settings to increase PA levels among inactive staff and students. Maselli et al. (2018), aimed to assess the efficacy of interventions used in PA promotion among university students finding that multi-component interventions were more effective, because they deal with diverse attributes of human behaviour and action, such as reasons of an action, the awareness of the association between the anticipated result and the activities required to accomplish it, the recognised or actual capability/competences to carry out planned activities and to accomplish anticipated outcomes via them, and the approaches individuals employ to self-control their individual behaviour.

In recent times, there has been a growing demand for the employment of multicomponent interventions as a way to improve PA amongst the adult populace (Pronk, 2009). The use of multicomponent interventions to improve physical inactivity, especially among working adults and university students have shown prominent results too. For instance, a meta-analysis of workplace health promotion programmes for encouraging healthy behaviour, indicated that PA among adult workers was enhanced by multifaceted interventions (Schröer, Haupt, & Pieper, 2014). In addition, several other systematic reviews (Matson-Koffman et al., 2005; Mozaffarian et al., 2012; World Health Organisation, 2009) also advocated a similar approach. Multicomponent interventions usually involve both personal and environmental adaptations, such as cognitive-behavioural and motivational strategies (Hutchinson & Wilson, 2012); group walking (easy, cost-effective, accepted by the physically inactive) (Anastasia et al., 2017; Bang et al., 2017; Gilson et al., 2009;Gilson, McKenna, Cooke, & Brown, 2007; Rote et al., 2015); counselling (Kwak et al., 2014; Matson-Koffman et al., 2005); education (e.g. use of educational posters, flyers, e-mail and text messages) (Hutchinson & Wilson, 2012; Matson-Koffman et al., 2005); provision of informational messages (Anderson et al., 2009); family participation in interventions (WHO, 2009); employment of signs (e.g. posters and stickers) to encourage stair use (Bellicha et al., 2015; Boutelle et al., 2004; Meyer et al., 2010; Mozaffarian et al., 2012; Soler et al., 2010; WHO, 2009); active transport (i.e. walking and cycling) (Bopp et al., 2018; Brockman & Fox, 2011; Kaplan, 2015; Schröer et al., 2014; Wilson et al., 2016); employer inducements (i.e. using incentives) (Anderson et al., 2009); provision of services and equipment for PA (Anderson et al., 2009; Matson-Koffman et al., 2005; Mozaffarian et al., 2012; WHO, 2009); and implementation of innovative strategies to advocate PA engagement (Lin et al., 2014; Matson-Koffman et al., 2005).

An ecological approach (Sallis et al., 2008) is also suggested, to illustrate that several multidimensional influences such as interpersonal, intrapersonal, organisational, community and societal policy-level influences, may interactively impact on particular health behaviours, across diverse levels and fields. The model likewise proposes that multidimensional interventions may possibly be efficient in changing behaviour (Sallis et al., 2008). Conversely, there are limited quality evidence concerning the effectiveness of multicomponent interventions in workplaces focused on PA promotion. Majority of studies that assessed the impacts of interventions involving stair use employed time-series (Bellicha et al., 2015; Soler et al., 2010); observational (Boutelle et al., 2004); pre and post (Meyer et al., 2010) or case series (Choi et al., 2016) study designs. Very limited studies (Engbers, Van Poppel et al., 2005; Freak-Poli et al., 2013; Lin et al., 2014; Matson-Koffman et al., 2005; Sallis et al., 2008; To et al., 2013) involving randomised controlled trials have been employed to evaluate the influences of other constituents with environmental restructuring. It was construed that there was inadequate and poor-quality data for the evidence, therefore, investigations with more thorough research strategies are required. However, carrying out randomised controlled trials in a workplace is challenging because of workers' opposition to randomisation and possible bias (Conn et al., 2009).

The interventions focused on increasing the PA levels among the university staff and students have generally shown mixed results, but even with that, they have been mostly found very effective at increasing PA, especially amongst those that are physically inactive (Maselli et al., 2018). The heterogeneity in results, which could reduce the ability to draw compelling inferences concerning the evidence of efficacy, may be due to the diverse countries where these interventions were carried out; the use of diverse study design and theoretical frameworks or none at all to support the studies; attrition rates; different intervention duration; diverse range of participants, in addition to the diverse tools employed to measure PA and overall reporting of the investigations (Maselli et al., 2018). Therefore, it may be argued that the PA assessment tools used in several investigations in the university setting may have been inaccurately or inappropriately utilised. A survey inquiring for the number of days per week an individual has engaged in a minimum15 minutes of PA, even if authenticated, may be incapable of differentiating between PA done in bouts of 15 minutes and those done in bouts of 30 minutes or more, ascribing a matching PA score to participants taking part in diverse amounts of PA (Maselli et al., 2018). For instance, the uncertainty of the findings in a study by Magoc, Tomaka, & Bridges-Arzaga, (2011) may reveal unsuitable incessant scoring of the questionnaire (i.e. the International PA Questionnaire) employed to assess PA, which was developed to be recorded as MET minutes/week of PA and not as days/week.

The instruments used to measure PA in most university-based interventions are diverse and include activity monitor to measure sitting, standing and stepping (Alkhajah et al., 2012; Evans et al., 2012; Zhu et al., 2018); inclinometer plus accelerometer to measure posture and PA

(Mansoubi et al., 2016); pedometer alone to measure daily step count (Gilson et al., 2007); pedometer plus dairy (Gilson et al., 2009) or activity logbook to measure step counts completed every day and PA measured using self-report questionnaires (Thorgersen-Ntoumani et al., 2014); accelerometer alone to assess PA and sitting behaviour (Swartz et al., 2014); accelerometer plus activity dairy (Meyer et al., 2010); cross-sectional online survey (Bopp et al., 2015, 2018; Wilson et al., 2016); questionnaire plus dairy (Gathersleben & Appleton, 2007); behaviour risk factor surveillance system to measure demography and moderate to vigorous PA (Bopp, Kaczynski, & Wittman, 2011); online travel survey plus weekly PA computed by multiplying time and frequency and dividing by 150 (Brockman & Fox, 2011); and students directly observing elevator and stair use by university employees (Boutelle et al., 2004). Therefore, it is not surprising that it has been challenging comparing PA levels across different studies carried out in universities in different countries.

Furthermore, it has been argued that interventions which are supported by theory and evidence-base have a higher likelihood to be effective than those that are not (Michie, Atkins & West, 2014). Several interventions conducted in the university setting to increase PA among inactive staff and students have largely been underpinned with the older psychological theories, models or frameworks such as the social ecological model (Bopp et al., 2011; Gilson et al., 2009, 2007), social cognitive theory (Bopp et al., 2018; Boyle, Mattern et al., 2011; Bray et al., 2011; Brown et al., 2014), transtheoretical model (Greene et al., 2012; Kattelmann et al., 2014; Quintiliani et al., 2010), theory of planned behaviour (Epton et al., 2014; Parrott et al., 2008; Skår et al., 2011), health belief model (Okazaki et al., 2014), self-affirmation theory (Epton et al., 2014), and the role of social support (Cavallo et al., 2012; Swartz et al., 2014). Whereas some other studies (Epton et al., 2014; Greene et al., 2012; Kattelmann et al., 2014; Okazaki et al., 2014; Quintiliani et al., 2010) reported using more than one theory. On the other hand, several studies (Alkhajah et al., 2012; Chau et al., 2014; Claxton & Wells, 2009; LeCheminant et al., 2011; Mansoubi et al., 2016; Meyer et al., 2010; Thorgersen-Ntoumani et al., 2014; Zhu et al., 2018) did not indicate using any theoretical framework or model to underpin their interventions, which may have also contributed to the heterogeneity of reported results. In the investigations where one or more theories/models were reported to inform the interventions, the association between the theory and the intervention constituents were evident. Conversely, the findings of most studies that assessed concepts associated with the theory frequently indicated no relationship between variations in PA facilitators and PA levels, implying that the theoretical concepts were incapable of explaining the variations in PA, and, in some other circumstances, the interventions failed to have an impact on the PA facilitators being targeted (Maselli et al., 2018).

This may signify the reality that most interventions were systematised, employing a top-down method, and did not consider the participants' needs prior to carrying out the intervention plan. For instance, focusing largely on self-efficacy in individuals who lack PA associated self-efficacy, which was not the cause of physical inactivity in the first place, will probably result to an insignificant change in PA levels. Therefore, potential studies must examine specific participants' needs so as to determine the facilitators of PA that require to be focused on most by the intervention to promote PA (Maselli et al., 2018). When using a theory, model or framework to support a study, it is very important to report the strategies and the Behaviour Change Techniques (BCTs) used to enhance replicability of the study and to understand why a study was effective or ineffective, which might assist in the improvement of the quality of the study should it be carried out again in the future. The findings of a current systematic review carried out by Maselli et al. (2018) suggested that even though some studies reported the strategies and BCTs they used to design and implement their interventions, others did not, thus making it challenging to replicate these studies. Even though Maselli et al. (2018) found some approaches customary to efficacious interventions, it was uncertain which of the exact intervention constituents, or their integrations, were the most efficacious in encouraging PA. Therefore, it may be argued that the findings in this systematic review by Maselli et al. (2018) were at times inconsistent, given that very comparable interventions resulted in substantial increases or to no variations in PA levels. It is thus evident from this review that more investigations with higher quality are required to decrease the possibility of bias; and better recording of approaches employed, with more information concerning the contents and the method, is essential for a better insight about the interventions. Additionally, the combination of quantitative results with a qualitative assessment of the procedures will improve knowledge about the main influences that should be contemplated during execution. Evaluating specific participants' needs and features, employing a bottom-up method, may possibly permit an improved application of theory, leading to enhanced effectiveness of the intervention (Maselli et al., 2018).

The duration of the intervention studies conducted in the university setting to increase PA among university staff and/or students have generally ranged from 5 days (Evans et al., 2012) to 72 weeks (Zhu et al., 2018) and the number of participants varied from 30 (Evans et al.,

2012) to 2,829 (Brockman & Fox, 2011). However, some previous research (Ghaffari et al., 2013; Healy et al., 2013; Martens et al., 2012; Quintiliani et al., 2010) aimed at changing behaviours towards PA have suggested that 4-week interventions were effective enough to increase PA and even some anthropometric and health parameters among university staff and students. Therefore, this current research project employed a pre and post 4-week bespoke multicomponent behaviour change interventions underpinned by the BCW, the COM-B model (Michie, Atkins & West, 2014) and the TDF (Cane et al., 2012) to increase PA levels amongst the inactive administrative staff and post-graduate research (i.e. PhD) students, who were established by an early survey study in this present research project to be the most physically inactive compared to other staff and student groups, respectively.

2.11. Behaviour change strategies

Changing behaviour is complex and involves personal, interpersonal, social, cognitive, and environmental influences (Michie, Atkins & West, 2014). Behaviour plays a major part in maintaining health, as well as in preventing, managing and treating disease and debility (Carey et al., 2019). Inactive behaviours have been attributed to world wide disease burden, which can often result in untimely death (WHO, 2017), while active behaviours have been established to help reduce the risks of developing chronic diseases and untimely death, improve mental health and overall quality of life (Bize, Johnson & Plotnikoff, 2007; Knight, 2012; Rimer et al., 2012; WHO, 2018b). Therefore, the need for inexpensive and efficacious behaviour change interventions to increase PA engagement is paramount. However, notwithstanding the rapid increase in behaviour change intervention studies, the impacts of these interventions continue to be generally small, inconsistent and unsustained for long periods (Kwasnicka et al., 2016; Marteau, Hollands & Kelly, 2015). Therefore, a collective advancement in the development of more efficacious interventions may be enhanced by creating a more broadly mutual understanding of the processes by which interventions cause change (Moore & Evans, 2017). A more in-depth knowledge of the ways and reasons that interventions accomplish their impacts, through detection of the associations between behaviour change strategies and the mechanism of actions they aim at, would allow researchers to develop interventions that incorporate elements more liable to be efficacious (Onken et al., 2014) and elucidate intervention impacts better (Carey et al., 2019). Therefore, behaviour change interventions are frequently implemented as component of multifaceted systems that incorporate several behaviour change strategies (Carey et al., 2019).

Behaviour change strategies, or behaviour change techniques (BCTs), as they are normally referred to, are replicable elements of an intervention developed to redirect or change the underlying processes that control behaviour (Michie, Atkins & West, 2014). Behaviour change strategies are developed to facilitate changes in behaviours, which are accomplished through the augmentation of factors that accelerate change in behaviour, or through the mitigating factors that inhibit change in behaviour (Carey et al., 2019). Therefore, interventions that aim to change behaviours require effective strategies. The BCT taxonomy v1 (Michie et al., 2013) comprises 93 items that enable the active components of interventions to be methodically depicted, evaluated, and reproduced. Several BCTs have been extensively used in the PA context and informed some of the decision taken in this research, including the intervention designs. The major BCTs that have been commonly used in the PA context include: action planning, identifying barriers/problem resolution, relapse prevention, goal setting (behaviour), use of follow-up prompts, prompts/cues, and self-monitoring of behaviour (i.e., self-regulation approaches), credible sources; information about the health consequences; review behaviour goal(s); demonstration of the behaviour; instruction on how to perform a behaviour; behavioural practice/rehearsal; and monitoring of behaviour by others without evidence of feedback.

2.11.1. Self-regulation approaches

Self-regulation approaches such as goal setting, action planning, identifying barriers/problem resolution, relapse prevention, use of follow-up prompts, prompts/cues, and self-monitoring of behaviour have been used extensively as behaviour change strategies to increase PA engagement in different populations in diverse settings (Michie et al., 2009; Williams & French, 2011; Dombrowski et al., 2012). This is in line with a systematic review and meta-analysis by Murray et al. (2017), suggesting that these self-regulation approaches were effective at increasing both participation in PA and maintenance of PA. Furthermore, another systematic review carried out to assess the impacts of PA promotion using controlled trials among university students, suggested that self-regulatory approaches were effective at increasing participation in PA (Maselli et al., 2018).

2.11.1.1. Goal setting (behaviour)

Goal setting (behaviour) is a BCT that involves setting or agreeing on a specific goal based on the behaviour to be accomplished (Michie, Atkins & West, 2014). It could also be an encouragement to initiate or sustain a behaviour change. However, it does not require specific planning for the sequence of the behaviour or execution. For instance, the goal may just be to participate in more exercise the following week (Michie et al., 2011). Goal setting is generally utilised and recognised as a strategy for encouraging PA engagement (Swann et al., 2020). Existing practice depends on setting detailed goals, such as engaging in 10,000 steps daily or achieving the national PA recommendations weekly, as a strategy to increase PA (Swann et al., 2020). Goal setting theory posits that individuals that are unsatisfied with their present PA level would be more inclined to set targets to increase PA and would be more fulfilled when they are accomplished (Locke & Latham, 2002). Goal setting is so effective in changing behaviour towards PA that it has been widely utilised as a strategy to increase PA participation in diverse populations and settings, including the university settings. This is reinforced by a web delivered intervention by Magoc, Tomaka & Bridges-Arzaga (2011) among university students using self-regulation approaches such as goal setting for PA, which indicated that this strategy was effective at increasing PA levels among students. Goal setting has also been used extensively in workplaces to increase employee's PA levels (Dishman et al., 2009; Iwasaki et al., 2017). Goal setting increases PA levels through the enhancement of the direction, self-regulation (e.g. utilisation of strategies) and tenacity of task-focused effort (Locke & Latham, 2002; Bandura, 2004).Therefore, behaviour change interventions aimed at increasing PA levels among university staff and students should consider incorporating an element of goal setting strategy.

2.11.1.2. Action planning

As with goal setting, action planning is another self-monitoring approach that has been used widely to increase PA levels. Action planning is a BCT that involves the use of carefully thought-out plans regarding where, when, and how to carry out a behaviour. This also incorporates plans about the circumstance, intensity, regularity and timespan the behaviour would be carried out (Michie, Atkins & West, 2014). Such plans are usually done using 'implementation intentions' and 'If-Then' template. For example, if condition B is encountered, then I will start behaviour C to accomplish goal A (Gollwitzer & Sheeran, 1999). Creating action plans on where, when and how to carry out PA using the implementation intentions and if-then plans have been found effective at increasing PA engagement among university staff and students (Brown et al., 2014; Milne, Orbell and Sheeran, 2002; Prestwich, Lawton & Conner, 2003; Kwak et al., 2009; Conner, Sandberg & Norman, 2010) by mentally linking the expected critical situation (i.e. environmental prompts) to effective goal-focused responses, thus increasing the memory to engage in PA (Gollwitzer & Sheeran, 1999).

Additionally, a systematic review and meta-analyses by Williams & French (2011) suggested that action planning was one of the behaviour change strategies associated with significant increase in both PA self-efficacy and PA levels. Even with appropriate action planning, strong evidence suggests that strong intentions does not ensure goal achievement (Webb & Sheeran, 2006). The reason for this is that putting an action in place by forming an intention to engage in a specific goal, as posited by the model of action phases (Heckhausen & Gollwitzer, 1987), is just the initial step to goal achievement; to achieve the goal the individual has to also efficiently control genuine striving for the goal, i.e. successfully carry out their goal intention. However, achieving one's goal intentions may be challenging because individuals frequently encounter obstacles in trying to achieve their goal (Gollwitzer & Sheeran, 2006). The two major self-regulatory issues associated with health enhancing behaviour such as engagement in PA, which seem to present the biggest obstacles to efficacious goal striving are not starting in the first place and getting impeded after starting (Gollwitzer & Sheeran, 2006). Therefore, identifying barriers/problem resolution is another behaviour change strategy used in combination with action planning, to ensure that any possible barriers to goal achievement is prevented and any problems appropriately resolved.

2.11.1.3. Identifying barriers/problem resolution

Identifying barriers/problem resolution is a BCT that involves people being tasked with identifying potential barriers to enactment of a behaviour as well as analysing things that may affect the behaviour and considering ways to transform behaviour with several plans that surmount obstacles or enhance enablers (Michie, Atkins & West, 2014). Barriers may be physical, social, emotional and/or mental. For example, a person may feel too fatigued to do exercises on Fridays, and thus decide to sleep earlier on Thursday nights (Michie et al., 2011). Several action planning behaviour change strategies used to encourage engagement in PA with implementation intentions and if-then plans also plan on how to overcome possible barriers and solve any imminent problems that might prevent engagement in PA. This is consistent with Bélanger-Gravel et al. (2013) who employed the if-then plans, and the identification of potential barriers to PA engagement and ways to overcome them, as strategies which effectively increased PA engagement and maintenance among inactive adults. A systematic review by Maselli et al. (2018) also highlighted the importance of identifying barriers to PA and problem resolution (i.e. coping strategies) as effective behaviour change strategies used to encourage participation in PA in university settings. According to U.S. Department of Health and Human Services (2020), identifying the common barriers to PA such as lack of time, motivation, energy and skills; social support; fear of injury, weather conditions, and high costs and lack of exercise facilities and developing strategies to resolve these problems may help to make PA a part of peoples' daily routine. Therefore, further studies should continue to examine and improve university-based PA intervention by integrating ways of identifying possible barriers to PA and resolving any problems that may arise as strategies to support staff and students in changing their behaviours towards PA and preventing any relapse.

2.11.1.4. Relapse prevention

Relapse prevention is a self-regulatory approach in which people are motivated to formulate plans to maintain behaviour that has been changed. The person is persuaded to concentrate on conditions or incidences in which the changed behaviour may relapse, and then formulate ways to increase the possibility of success. For example, people involved in routine jogging may lay emphasises on bad weather conditions as a possible obstacle to maintaining their exercise, so they may be urged to utilise a treadmill in the fitness centre on cold wet periods (Michie et al., 2011). Sustaining routine PA is a continual process. Even people that have been routinely engaging in exercise or PA for years encounter obstacles that they must strive to surmount. However, when people are given appropriate coping skills, it is possible to surmount these obstacles and prevent any likely relapse, i.e., reverting to inactive behaviours. Relapse starts with a person having one incidence of inactivity (e.g., one skipped exercise routine). As these lapses progress, it could lead to irritation and weaken enthusiasm, which may cause people to entirely stop their exercise routines (Physical Activity Intervention Research Laboratory (PAIRL), 2015). Consequently, once people start participating in PA and maintaining it as a routine daily, it becomes imperative to prevent them from reverting to inactive behaviours. This is in line with findings from a systematic review by Maselli et al., (2018), demonstrating that relapse prevention was an effective strategy to keep people continuously engaging in routine daily PA. This BCT exerts its effects through the improvement of peoples' self-confidence to continue engaging in PA after effectively coping with some high-risk circumstances (i.e. once people are faced with circumstances that have been overcome previously, they feel proficient of triumphing once more) (PAIRL, 2015). Even though relapse prevention has been effectively used in university settings to prevent staff and students already engaging in routine PA from reverting to being inactive, they are usually not reported. Therefore, more PA intervention studies in the university context should employ and report the plans formulated by staff and students to prevent them from reverting to inactive behaviours. This will help university staff and students to maintain routine PA.

2.11.1.5. Self-monitoring of behaviour

After preventing any potential relapse, it is vital to self-monitor the behaviour. Self-monitoring of behaviour is a BCT that involves the establishment of ways for people to observe and document their behaviour (Michie, Atkins & West, 2014). Studies that employ this BCT commonly require participants to keep a detailed record of their PA levels as an approach to changing their behaviours towards PA (Compernolle et al., 2019). For example, people could be given pedometers/accelerometers and a form to record their day-to-day total number of steps or PA logs to record the time, duration, and conditions in which the PA was carried out. Objective measures have been widely used as instruments to measure PA levels and have been associated with increases in PA levels, as well as improvements in psychosocial outcomes among university staff and students (Baghianimoghaddam et al., 2016; Sharp & Caperchione, 2016; Brett & Pires-Yfantouda, 2017; Papalia et al., 2018; Riddell, Baskerville & Castell, 2019). These objective measures increase participation in PA by making it easier for people to adhere to goals set through the quantification of PA engaged in and tracking the number of steps taken, which motivates them to engage in more PA (Papalia et al., 2018). Even though bespoke PA interventions utilising these objective measures have been established to be practical and efficacious, numerous popular objective measures still fail to considerably use theoretically supported behaviour change strategies (Coolbaugh, Raymond Jr & Hawkins, 2015; Yang, Maher & Conroy, 2015). Furthermore, a current study by Mathew et al. (2019) aimed at assessing the effectiveness of workplace pedometer-based walking intervention at improving PA of employees, suggested that this intervention was practical and efficacious at increasing PA over a short-term. Therefore, pedometer/accelerometer-based interventions, underpinned by established theoretical framework/model such as the COM-B model and TDF, could be effective at increasing PA participation over a long-term among university staff and students, especially those that are physically inactive.

As with objective measures, the benefits of PA logs in self-monitoring and strengthening PA engagement among diverse populations and settings have been well established (Tucker & Irwin, 2007). Physical activity logs have also been used extensively in university-based behaviour change interventions to self-monitor PA and promote participation in PA. This is congruent with a study by Magoc, Tomaka and Bridges-Arzaga (2011), suggesting that PA logs were effective at measuring duration and intensity of PA, days when PA were carried out, and time spent in both moderate and vigorous PA. In support of this, another study carried out by Sriramatr, Berry & Spence (2014) among university students indicated that PA logs were effective at recording PA engaged in weekly. This BCT reinforces the engagement in PA through the enhancement of behavioural regulation (i.e. behavioural, emotional, and/or mental capabilities for controlling or transforming behaviour) (Carey et al., 2019). However, in addition to self-monitoring of PA with objective measures and/or activity logs, engagement in PA may be increased by integrating other behaviour change strategies, such as goal setting (Brett & Pires-Yfantouda, 2017). Therefore, a combination of self-monitoring strategies (e.g. objective measures or PA logs) and goal setting, with theoretically supported behaviour change interventions denotes a promising approach for increasing PA among university staff and students.

2.11.1.5. Follow-up prompts/cues

Even when other self-monitoring strategies are being used to promote PA participation, it is important to also use follow-up prompts as reminders. Follow-up prompts is a BCT that involves the utilisation of triggers, which are given once people have started a behaviour change routine, to help prompt them to continue. Eventually, as people get better at carrying out the behaviour, cues and prompts are decreased. For example, sending people individual alarms, e-mails, text messages, or other prompts to assist them remember to exercise or engage in planned or routine PA (Michie et al., 2011). Emails have been widely used as follow-up prompts to support interventions aimed at promoting routine PA in university settings (Sriramatr, Berry & Spence, 2014). In reinforcement of this finding, a systematic review of PA interventions in university settings by Maselli et al. (2018) demonstrated that follow-up prompts were effective at prompting university students to engage in PA. The follow-up prompt acts by reminding people to engage in the prescribed or planned PA. Hence, encouraging people to utilise commonly occurring routine events such as a particular period in a day, emails, SMS messages or mobile phone alarms to prompt them to start their PA routine, will motivate them to maintain this behaviour (Michie et al., 2011). Therefore, integrating some of these self-regulation behaviour change strategies into interventions conducted in the university settings may be an effective strategy to change staff and students' behaviours towards PA.

2.11.2. Credible source

Credible source is another BCT that involves the utilisation of visual or verbal communication from a reliable source in support of or against the behaviour under investigation (Michie et al., 2011). Information or messages from reliable sources have been established to influence the persuasiveness of information or messages and have thus been used to promote PA engagement in different settings (Lee & Walker, 2019). Strong evidence suggests that health enhancing messages from very reliable sources constantly produce more positive mind-set, resulting to greater behavioural intentions and more engagement in PA than messages from low reliable sources (Latimer, Brawley & Bassett, 2010). For example, a quasi-experimental investigation by Lee & Walker (2019) indicated that the use of point-of-decision prompts from credible sources relatively increased the use of stairs among university students. This may be because people would be more likely to use the stairs when they have confidence that the communicator is competent to give valid and correct information (i.e. expertise) and gives the information in a truthful, unbiased and honest way (i.e. trustworthiness) (Lee & Walker, 2019). Consistent with these findings, another study by Quintiliani et al. (2010) indicated that tailoring PA messages to an expert established topic was effective at increasing PA engagement immediately and at one-month follow-up among university students. The effectiveness of credible sources at increasing PA engagement is further reinforced by the theories of persuasion which posits that the persuasiveness of messages might possibly be considerably influenced by the features and sources of the messages (Chaiken, 1980; Petty & Cacioppo, 1986). However, the influence of source trustworthiness of the information or messages provided on PA depends on the environment where the study is being carried out. Therefore, interventions aimed at increasing PA in a university setting should employ tailored health information or messages from credible sources to improve its trustworthiness and acceptance.

2.11.3. Information about health consequences

In using information about the health consequences as a behaviour change strategy, participants are provided written, visual and/or verbal information concerning the health consequences of engaging in a specific behaviour (Michie et al., 2011). For example, as a way to increase their engagement in PA, participants in a study may be informed that prolonged physical inactivity could increase their risks to protracted diseases such as cardiovascular diseases, diabetes, obesity, and other protracted diseases. This is consistent with a systematic review by (Maselli et al., 2018), demonstrating that the most frequently utilised approach to promoting PA among university students was the provision of information concerning the benefits of PA and the health consequences of physical inactivity. In reinforcement of this finding, another study carried out by Fredriksson et al. (2018) indicated that the university staff and students who appropriately detected more illnesses linked to physical inactivity as well as overrated the risks linked to physical inactivity were considerably more physically active than those that did not. In addition, another study by Norton et al. (2011) that integrated an educational session involving the provision of information about the health benefits of routine PA and the national PA guidelines, indicated significant increase in PA levels among participants. This demonstrates that informing people about the health consequences of inactivity, health benefits of routine PA and the recommended PA levels improves engagement in PA by raising their awareness and expectancies concerning PA, thus increasing their motivation to participate in PA (Carey et al., 2019; Maselli et al., 2018). Therefore, more health enhancing programmes in university settings should consider using information about the health consequences of physical inactivity as a strategy to increase or promote PA among staff and students.

2.11.4. Instruction on how to perform the behaviour

Instruction on how to perform a behaviour is a behaviour change strategy that entails advising or agreeing on how to carry out a behaviour, including skills training. Specifically instructing people about the ways to effectively execute a behaviour, will increase their likelihood to engage in the behaviour. For instance, instructions on techniques to use in the gym, on how to perform exercises/sports in the sports centre, or on the accurate frequency and extent of cycling to work, would increase participation in PA (Michie et al., 2011). Previous studies have shown that supervised interventions where participants are provided instructions on how to perform an exercise or PA were more effective at increasing PA levels compared to unsupervised interventions (Cox et al., 2003; Mazzetti et al., 2000; Norton et al., 2011; Storer et al., 2014). This is consistent with the findings of a systematic review by Maselli et al. (2018), suggesting that providing instruction on how to perform an exercise or PA significantly increased PA engagement amongst university students. A current systematic review by Howlett et al. (2019) also revealed that providing instruction on how to perform the PA was effective at increasing PA engagement among healthy inactive adults. Furthermore, another study carried out by Fennell, Peroutky & Glickman (2016) amongst inactive university staff indicated that those who were supervised and provided instructions on how to perform the PA were more likely to engage in PA than those that were unsupervised. Even though the university staff involved in the supervised exercise intervention were more active than the unsupervised during the intervention period, the participants were not able to accomplish and sustain the minimum recommended exercise on their own after the intervention ended and support removed (Fennell, Peroutky & Glickman, 2016). However, most of the participants re-enrolled in the subsequent session of this programme, indicating that they still had the behaviour to go on engaging in exercise, but needed some form of supervision with instructions on how to perform the exercise

(Fennell, Peroutky & Glickman, 2016). This signifies an encouraging step in a direction that might bring about a sustained improvement in exercise self-efficacy, because this organised and supervised exercise intervention was useful at enhancing behaviours towards PA. Therefore, long-term supervised interventions, involving provision of instructions on how to perform exercise or PA should be employed as a strategy to encourage university staff and students, especially the inactive ones, to engage in routine PA.

2.11.5. Demonstration of the behaviour

As with instructing people on how to perform a behaviour, demonstrating how to perform the behaviour is another behaviour change strategy that has been used effectively to promote PA engagement in diverse populations in diverse settings. Demonstration of the behaviour involves showing people how to carry out an activity, through physical or visual methods (Michie et al., 2011). For example, a qualified coach might give people a demonstration of a specific exercise or show them how to play a specific sport. Demonstrating how to engage in a behaviour by a trained personnel, especially amongst those that have not performed that behaviour before would increase their confidence and the beliefs in their capabilities to engage in the behaviour and with time their self-efficacy, thereby motivating them to routinely engage in the behaviour (Carey et al., 2019). This is aligned with the findings of a systematic review by Maselli et al. (2018), showing that the demonstration of how to perform PA by a professional, a lecturer, or a PA counsellor through individual PA counselling, group sessions, seminars or practical activities resulted in an increase in PA engagement among university students. These findings are consistent with the mechanism of actions (i.e. beliefs of capabilities and skills) through which this BCT changes behaviour (Carey et al., 2019). Therefore, interventions aimed at improving participation in exercise or PA amongst university staff and students should consider integrating this behaviour change strategy (i.e., demonstration of the behaviour) into these interventions for more effective outcome.

2.11.6. Behavioural practice/rehearsal

Although not usually reported in intervention studies designed to promote PA, behavioural practice/rehearsal is a behaviour change strategy that have been used to increase routine participation in PA in numerous populations and settings. Behavioural practice/rehearsal involves encouraging people to rehearse and repeat the behaviour or circumstances that resulted in the behaviour. In the PA context, behavioural practice/rehearsal can help people to maintain routine PA by strengthening the activity and making it more consistent or automated so that it becomes an aspect of people's daily routine. For example, presenting people with opportunities to practise whilst they are going to carry out their PA or exercise routines (Michie et al., 2011). A recent systematic review by Howlett et al. (2019) suggested that the effectiveness of PA interventions carried out among healthy inactive adults were associated with behaviour change strategies such as behavioural practice/rehearsal. This may probably be because rehearsing or repeating any form of PA increases peoples' beliefs about their capabilities (i.e. beliefs concerning a person's capability to effectively perform a behaviour) to engage in that PA, and subsequently their skills (i.e. an expertise or competence developed through rehearsal), which motivates them to routinely engage in PA (Carey et al., 2019). This BCT could be very useful when incorporated in interventions aimed at improving skills of inactive university staff and students to engage in exercise or PA.

2.11.7. Monitoring of behaviour by others without evidence of feedback

This BCT involves observing or documenting outcomes of behaviours without peoples' awareness as a component of behaviour change strategies. For example, recording peoples' physical fitness, the frequency which they use the stairs or how they improve their skills to engage in an exercise or PA during a supervised session (Michie et al., 2011). Several studies have used this BCT in combination with other strategies to increase the participation in PA among different populations in diverse settings, even though this BCT is not clearly mentioned as a strategy. A meta-analysis by Bauman et al. (2017) to assess whether stair climbing interventions, involving the use of signages increased PA levels, indicated that these interventions supported by monitoring of stair use without providing any feedback increased stair use among the participants by 52%. On the other hand, a study by Blake et al. (2008) aimed at encouraging stair use in the workplace employing point-of-decision prompts with different communications as well as monitoring the way that employees use the stairs without evidence of feedback did not indicate any significant differences in both stair climbing and descent (Blake et al., 2008). The findings of this study may have been insignificant because only a small percentage of participants reported seeing the posters and only a small percentage of them were inspired to utilise the stairs because of the prompts (Blake et al., 2008). As a result of the inadequate reporting and assessment of this BCT in behaviour change interventions aimed at increasing PA, it is challenging to establish the mechanism of action through which it influences PA engagement. However, Carey et al., (2019) suggest that this BCT exerts its influence on PA participation through the increase in needs (i.e., deficit of something needed for existence, well-being, or individual accomplishment) and social influences (i.e., those relational processes that can lead be people to change their thinking, mental state or conduct). Therefore, there is an urgent demand for more thorough behaviour change studies employing the monitoring of behaviour by others without evidence of feedback to be appropriately reported

2.11.8. Review behaviour goals

In using this BCT, the goals of people under investigation are reviewed, and where needed these goals are modified based on current achievements (Michie, Atkins & West, 2014). This gives people an opportunity to appraise the effective accomplishment of previously established goals, with contingencies and further plans put in place for instances where goals are not achieved. For example, being incapable of exercising five times weekly due to other commitments, and thus adjusting periods earmarked to exercise at more appropriate periods or adapting it into a work schedule, such as walking to work (Michie et al., 2011). This BCT was one of the strategies used in a pedometer-based community walking programme by Baker et al. (2008), which showed a significant increase in step counts and time spent in recreational walking, and significant decrease in time spent inactive both during the week and weekends. Furthermore, a systematic review and meta-analyses of effective BCTs for PA and healthy eating by Samdal et al. (2017) revealed that this BCT, i.e., review of behaviour goals, was marginally associated with positive findings. These marginal findings may be because most studies, even though they report the intervention procedures employed, fail to appropriately specify the content of the behaviour change interventions as regards the BCTs utilised (Samdal et al., 2017). In addition, other reasons for these marginal findings include the extremely minimal impact of just one BCT; numerous BCTs jointly occurring in a specific intervention; different BCTs interacting to either increase or decrease efficacy; approaches used in delivering the BCTs; certain features not being portrayed by the BCT taxonomy employed; and variation of BCT across different populations and settings (Michie et al., 2018). This might thus make the identification of probably efficacious components in multifaceted interventions problematic (Michie et al., 2018). Therefore, combining this BCT (i.e., review behaviour goals) with other appropriate BCTs may be an effective strategy to promoting PA engagement amongst university staff and students.

2.12. Conclusion

This chapter suggested that even with the detrimental impacts of physical inactivity, the potential benefits of PA, and the PA recommended guidelines, the prevalence of physical inactivity was generally high globally and, in the UK, as well as the university settings; therefore, making the university an important setting to carry out interventions to change behaviours towards PA. Universities make for an interesting setting in which to base behaviour change research because much of the occupational work can be classified as sedentary activity; typically there are opportunities to be active on site, and there is a reasonable level of autonomy in daily working practices. Furthermore, by their nature universities are learning institutions and those attending tend to have higher levels of education and better awareness of the health benefits associated to PA. However as demonstrated through research outlined above, many staff and students within university settings do not adhere to the recommended guidelines on daily PA levels. This is important in understanding the determining factors and correlates of PA in order to design more effective interventions that will increase PA levels. The critical review of literature in this chapter suggested that interventions which are supported with comprehensive psychological theories were more likely to be effective at changing behaviours than interventions not supported with theories. However, most interventions carried out in the university setting to increase PA among inactive staff and students have generally been supported with older psychological theories such as the health belief model, social ecological model, social cognitive theory, transtheoretical model, and theory of planned behaviour, or with no theories. Recently, there has been an increased demand for the use of newer overarching psychological theories devoid of the limitations inherent in these older ones. Therefore, in recent years, the popularity of using the newer psychological theories such as the BCW, COM-B model and the TDF have increased among PA researchers and have been used in different contexts. However, these theories have not yet been employed in a university context. In order to advance the knowledge in the PA field, this research project has selected the BCW, COM-B model and TDF to support intervention development in a university context. This chapter then moved to review determinants of PA among university staff and students in order to understand the prominent barriers and enablers of PA among these populations, which could help inform intervention targets. Furthermore, various intervention strategies used to promote PA in the university setting were examined, which indicated that numerous types of interventions (e.g., walking and cycling, stair-climbing, standing, education, implementation intentions), as well as multi-component interventions, involving mixed-methods research design, were effective at increasing PA among inactive university staff and students. The instruments used to assess PA in university-based interventions are diverse and include various objective measures (e.g., accelerometer, pedometer, and inclinometer) and subjective self-report measures (e.g. IPAQ, GPAQ, activity logbook and diary). The duration of most PA interventions conducted in the university setting ranged from 5 days to 72 weeks, with interventions conducted for 4 weeks demonstrating to be effective at changing behaviour towards PA. Finally, several behaviour change strategies (i.e., behaviour change theories (BCTs)) that have been broadly used in the PA context were reviewed. The findings demonstrated that behaviour change interventions supported with BCTs, such as action planning, identifying barriers/problem resolution, relapse prevention, goal setting (behaviour), use of follow-up prompts, prompts/cues, and self-monitoring of behaviour (i.e. self-regulation approaches), credible sources; information about the health consequences; review behaviour goal(s); demonstration of the behaviour; instruction on how to perform a behaviour; behavioural practice/rehearsal; and monitoring of behaviour by others without evidence of feedback, have the potential to increase PA engagement among inactive university staff and students. Therefore, this chapter successfully argued that developing a 4-week intervention by using BCW, COM-B model and TDF was effective at increasing PA levels among diverse adults in diverse settings. The next step is to identify the research methodology in the process of designing and implementing this intervention and also to identify appropriate data collection and analysis methods, which is the aim of the next chapter.

Chapter 3. General Methodology

3.1. Introduction

The findings from a review of literature in the previous chapter indicated that even with the established detrimental impacts of physical inactivity and the benefits of PA, as well as the recommended guidelines put in place, the prevalence of physical inactivity was still high amongst university staff and students. Evidence suggests that interventions supported by theories were more effective than those not (Michie, Atkins & West, 2014). Therefore, overarching psychological models, i.e., the BCW, COM-B behaviour model and TDF were chosen to underpin this current research. This is because unlike the older psychological models such as the HBM, SCT, TPB, and TTM, these newer models have wider impacts on contextual, cognitive, automatic, and reflective factors that influence behaviour change (Michie, Atkins & West, 2014). Furthermore, the findings from the literature review demonstrate that a 4-week multicomponent intervention supported with appropriate behaviour change strategies are effective at increasing PA levels among different populations in different settings, including the university setting (Martens et al., 2012). Therefore, the findings from a review of pertinent literature informed the methodological approaches employed in this programme of research. This chapter reports on the methodologies involved in the development of this research project. The epistemological stance that underpins this body of research will be outlined and the utilisation of mixed methods (i.e., qualitative, and quantitative analysis) involved in the study design of this research project will be examined. The various data collection and sampling methods will be illustrated. The ways that reliability, validity, and bias were handled, as well as ethical considerations will be clearly described. Specific methodological approaches used for individual studies will be reported separately in each study chapter (i.e., Chapters 4, 5, 6 and 7).

3.2. Philosophical assumption

A research philosophy is described as a 'system of opinions and postulations concerning the creation of knowledge' (Saunders, Lewis & Thornhill, 2019). However, Blaxter, Hughes & Tight (2006) defined research philosophy as the beliefs concerning the ways that data will be gathered, analysed and utilised. Even though these two definitions seem different, they both indicate that the objective of research philosophy is to create knowledge. Research philosophy is a very vital part of research strategy, because it is involved with the creation of new knowledge (Saunders, Lewis & Thornhill, 2009). The research philosophy shows key postulations of the researcher and is guided by the pragmatic deliberations. Saunders, Lewis & Thornhill (2009) argued that researchers should not just be well-versed philosophically but should as well be capable of defending their selection against the alternatives. Although researchers might be purposely perceptive of them or not, at each phase in research several types of assumptions will be made (Burrell and Morgan, 2016). These consist of ontological assumptions (i.e., assumptions regarding the realities researchers come across in their investigation), epistemological assumptions (i.e., the postulations made by individuals concerning what is practicable to comprehend and the way to go about getting this knowledge), and axiological assumptions (i.e. concerning the degree and manners that the researcher's values impact on the research process) (King & Horrocks, 2010; Saunders, Lewis & Thornhill, 2019).

Developing credible research emanates from a coherent group of assumptions, therefore, in developing a research philosophy, deliberating on individual viewpoints and assumptions in relation to the main philosophies and research design allows for a constructive research process (Saunders et al., 2016). According to Crotty (1998), these assumptions evidently influence the way researchers understand their research questions, the approaches they employ and in what way they translate their results. A carefully planned and coherent series of assumptions will represent a reliable research philosophy, which will strengthen the methodological approach selected, research design and data gathering methods and analysis techniques. This will enable the development of a sound research study, where all components of research fit perfectly together. Consequently, it could be argued that the extent to which and individual's epistemology is correct is the degree to which the truth may be recognised, and the level to which that understanding might be utilised to advance individual's existences and desires. Nevertheless, mistakes in epistemology will make it challenging to accomplish anything in research (Landauer & Rowlands, 2001). Therefore, it is imperative to have some understanding concerning the ontological and epistemological assumptions employed in this research.

Table 3.1: Classifications of scientific paradigms and their components (Healy & Perry, 2000, p. 119)

	Paradigm			
Component	**Positivism**	**Critical Theory**	**Constructivism**	**Realism**
Ontology	Reality is factual and capable of being understood	Virtual truth created through social, monetary, traditional, political, gender and cultural values, developed over time	Manifold local and explicit created truth	Reality is factual, although, it is only improperly and probabilistically capable of being understood
Epistemology	Objectivists: results accurate	Subjectivists: value facilitated findings	Subjectivist: generated results	Adapted objectivist results possibly accurate
Conventional Methods	Experimental/survey confirmation of theories, mainly quantitative approach	Dialogical/dialectical: investigator is a transformative thinker that transforms the social world in which participants reside	Hermeneutical/dialectical: investigator is an ardent participant within the world under investigation	Convergent interviewing/case studies: triangulation, explanation of research questions through qualitative as well as quantitative approaches.

As illustrated in Table 3.1, critical theory and constructivism approaches are types of subjectivist paradigms in which reality is developed via interpretation, with the investigator being directly involved. On the other hand, realism is a metamorphosed form of objectivist paradigms, which presumes the existence of reality independent of the investigator and is strongly associated with the positivism paradigm. However, the employment of positivism in social science explorations has been opposed owing to its objectivist viewpoint, and there have been debates around its lack of understanding of the multifaceted human disposition (Healy & Perry, 2000). In addition, Healy & Perry (2000) claimed that the remaining three paradigms (i.e. critical theory, constructivism and realism) are better employed when investigating people and their real-life experiences.

In contrast, critical realism, a philosophical perception of knowledge that sits between the positivist and the constructivist/interpretivist paradigms has been increasingly accepted in social science research (Bhaskar, 1979; Dobson, 2001; Braun & Clarke, 2006; Fletcher, 2017). Fletcher (2017) argued that critical realism does not merely permit the investigators to detect casual catalysts (i.e., processes) that propel social occurrences or undertakings but likewise permits them to be involved with interpretation and casual evaluation. Critical realism recognises that the participant's senses are rather obstructed by researchers and researched reality, with regards to multilevel studies (Saunders, Lewis & Thornhill, 2016). Furthermore, critical realists argue that the selection of approaches must be determined by the type of the research question or objectives, and very frequently the most efficient method is to use a combination of quantitative and qualitative approaches to reduce the biases that are linked with either technique individually (Mcevoy & Richards, 2006). This research programme therefore assumes a critical realist perspective, which was considered to be appropriate, because it aims to assess physical inactivity levels and determine the predictors of physical inactivity in a university setting. Additionally, this research aims to understand individuals' enablers and barriers to PA engagement, with a specific aim of increasing PA behaviours among the most inactive staff and students employing a mixed methods approach.

3.3. Methodological Approach

Having understood the ontological and epistemological assumptions for this study, which informed the selection of the methodological approach (i.e., qualitative content analysis), it is imperative to critically review qualitative content analysis as a method and the rationale for selecting the deductive approach for this research project. Krippendorff (2013) categorised the methodological approaches to qualitative content analysis as inductive, deductive, and abductive. The deductive qualitative content analysis was chosen as the analytical approach in this present research, nevertheless, before progressing to justify reasons for choosing this approach, it is imperative to critically review the different types of qualitative content analysis.

3.3.1. Inductive approach

An inductive approach to content analysis, normally referred to as a bottom-up approach (Trochim, 2006), is driven by data or text (Krippendorff, 2013; Schreier, 2012) and depicted by an examination of relationships (i.e., patterns). Throughout the analysis, the investigator examines the data for similarities and dissimilarities that are designated in groups and/or themes on numerous stages of deduction and translation. The investigator progresses from the data to a theoretical perception, i.e., from the actual and explicit to the conceptual and general (see Figure 3.1). Therefore, the study commences with observation, the codes are described during the data analysis, and developed from the data (Hsieh & Shannon, 2005).

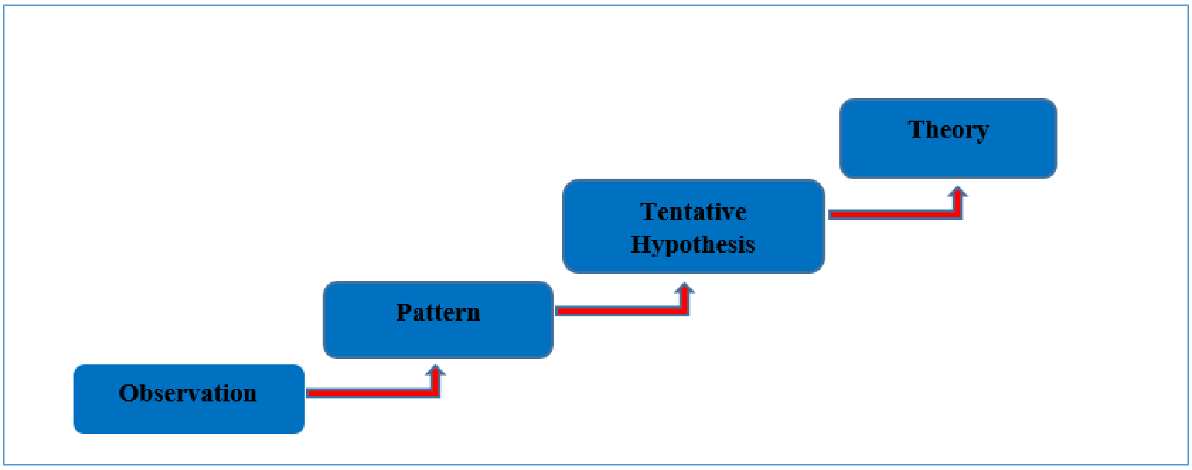

Figure 3.1: Inductive approach structure (Trochim, 2006)

A major strength of this approach is that information can be directly obtained by the investigator without imposing the use of predetermined themes, codes, or categories. Even with this strength, this approach fails to obtain a full understanding of the context, therefore fails to detect significant themes, codes, or categories. This may lead to findings that do not correctly represent the data (Hsieh & Shannon, 2005).

3.3.2. Deductive approach

The deductive approach unlike the inductive approach is driven by concepts or existing theories (Schreier, 2012) and usually known as top-down approach (Trochim, 2006). Employing this method, the investigator tests the meanings of prevailing theories or gathered data. As illustrated in Figure 3.2, they progress from prevailing theories to data or from a more theoretical and broader phase to a more distinct and explicit phase. The study starts with predefined theory, with codes defined prior to and during the analysis of data, i.e. the codes are usually developed from existing theory or pertinent research outcomes (Hsieh & Shannon, 2005).

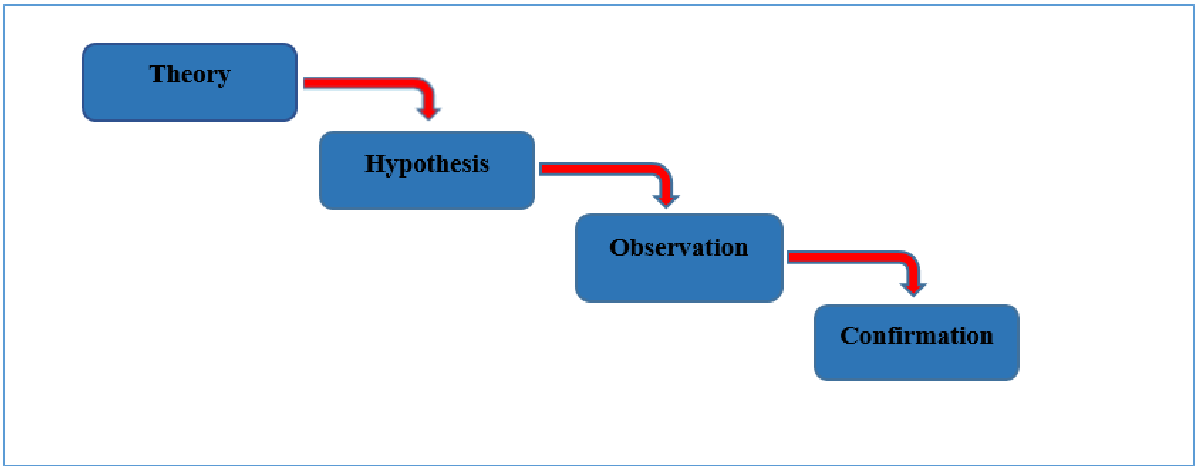

Figure 3.2: Deductive approach structure (Trochim, 2006)

A major strength of the deductive approach is that prevailing theory may be reinforced and expanded. Furthermore, as investigations in a field increase, a deductive approach makes clear the truth that investigators are not likely to be operating from the naive standpoint that is regularly seen as the trademark of naturalistic strategies. However, because a-priori themes or codes are used based on existing theory or research findings, the investigator may handle the data with a knowledgeable but, nevertheless, ardent preconception (Hsieh & Shannon, 2005). Therefore, the investigators may be more likely to discover evidence that supports, rather than those that do not support the theory. In responding to questions, some participants may get reminders to answer back in a specific way or assent with the questions to gratify the investigators. Furthermore, overstressing the theory may blind investigators to appropriate rudiments of the phenomenon (Hsieh & Shannon, 2005).

3.3.3. Abductive approach

The abductive or combined method (Elo & Kyngäs, 2008) to qualitative content analysis may be used for a more thorough comprehension and interpretation, and entails moving to and fro between inductive and deductive methods. Combining inductive and deductive methods to data analysis improves the strengths of this approach while decreasing its weaknesses. Even though a blend of inductive and deductive content analysis has been employed effectively by some investigations, the advantages and disadvantages of this method are hardly reported. Employing a combination of inductive and deductive approaches presents with several strengths, a classic one being that information can be directly obtained by the investigator using both predetermined, as well as themes, codes and categories evolving from the data, which improves the probability of detecting significant themes, codes or categories and findings that correctly represents the data (Hsieh & Shannon, 2005). Therefore, since a-priori themes or codes are employed based on existing theory or research findings (deductive), as well as codes emerging from the data (inductive), the investigator may handle the data with a knowledgeable but, nonetheless, more flexible disposition (Hsieh & Shannon, 2005). Another strength of using this approach is that a prevailing theory may be supported, extended or new theories even generated.

Even with these strengths, a major weakness of an abductive approach to content analysis is the likely misconception of affirming consequent that, in theory, makes it challenging to determine if certain theoretical hypothesis have more descriptive importance than others (Lukka & Modell, 2010). Conversely, in carrying out real research, this challenge is frequently addressed by acknowledging the features of the abduction as a continuing process requiring investigators to continually stay amenable to alternate justifications while excluding justifications considered less likely as they shuffle to and fro between theory and experiential data (Ackroyd, 2004).

3.3.4. Methodological approach used in this research

The most important line of reasoning when reflecting on the qualitative content analysis approach (i.e., inductive, deductive or a combination of both approaches) to employ is primarily the aim of the study; the approaches that are most appropriate to either test a theory, examine a new or an evolving field, or to resolve particular research enquiries. Furthermore, as can be evidenced by the critical review of these different methods of qualitative content analysis, they all have their individual strengths and weaknesses. However, the deductive approach to qualitative content analysis was selected as the technique to analyse the qualitative data, because this study seeks to test the efficacy of existing theories (i.e., the TDF and the COM-B behaviour model) in determining the barriers and enablers to PA among university staff and student, while not generating any new theories, therefore, it was deemed the most suitable approach to employ. Several current studies (Cassidy et al., 2018; Quigley et al., 2019; Yamada et al., 2018) have also employed this qualitative data analysis approach to test the effectiveness of the TDF in different contexts.

3.4. Research design

3.4.1. Research design employed in this research

The methodological choice determines the methods that will be employed to gather data to address the aim of this research project (Saunders, Lewis & Thornhill, 2016). Research projects can alter between each methodological choice in relation to their chosen aim. Research can take on either qualitative or quantitative approaches or a mixed-methods design (i.e., combination of both approaches) (Saunders, Lewis & Thornhill, 2019). However, the mixed methods approach was chosen instead of singular qualitative or quantitative approach, because this research purposes to examine the opinions and views of university staff and students concerning their perceived barriers and enablers to PA (qualitative approach) and assess levels of physical inactivity and determine the predictors of physical inactivity among inactive university administrative staff and PhD students (quantitative approach). It is imperative to understand the strengths and limitations of the various research methods to rationalise the choice of a particular research design.

There are several benefits in employing qualitative research methods. A major strength of qualitative research approach is that it generates in-depth narrative of participants' experiences, emotions and views, and explains the significances of their actions (Denzin & Lincoln, 1998). Denzin & Lincoln (2002) argued that qualitative research approach can help to completely understand the human experience in particular settings. Even with these strengths, a major drawback of the qualitative research method is the difficulty in generalising findings to a broader population due to the small sample size usually employed (Harry & Lipsky, 2014; Thomson, 2011). Findings from quantitative research, unlike the qualitative approach, can be generalised to the broader population because of the large sample size and random sampling usually employed (Carr, 1994). Another strength of the quantitative approach is that both sampling and data analysis are less time consuming because of the application of statistical software such as SPSS, thus the findings are reliable (Connolly, 2007). Given the strengths mentioned, quantitative research also has some drawbacks. A major weakness is that it fails to determine inherent fundamental connotation and descriptions of social phenomenon (Denzin & Lincoln, 1998).

The mixed methods research design was chosen for this research project, because it allows the integration of quantitative and qualitative data during the design, data gathering, analyses, interpretation and research presentation. This provides a richer and more thorough analysis compared to that of using either qualitative or quantitative approach alone (Saunders Lewis & Thornhill, 2016). This research design also expands the scope and extensiveness of research to counterbalance the drawbacks of either method alone (Blake, 1989; Greene, Caracelli, & Graham, 1989). Another strength of mixed methods design is that an investigator can go back to the qualitative data during the research project to review quotes in the perspective of the larger documents. When using quantitative data, numerous statistical tests may be carried out until validating evidence is identified (Malina, Nørreklit, & Selto, 2011). Furthermore, the mixed methods research design aligns with the critical realist epistemology, which was the chosen research philosophy for this research project (Saunders Lewis & Thornhill, 2016).

Even with these strengths, it is challenging to publish mixed method research because of the tendencies for investigations involving qualitative approaches to be lengthy (Malina et al., 2011). Another major weakness of mixed methods research design is in what way and at what time to combine the quantitative and qualitative data. There are two major transformative mixed methods research strategies, i.e., concurrent and sequential designs, which relatively lie at different ends of mixed methods design continuum based on when the data are gathered (Driscoll et al., 2007). The concurrent design enables the collection of quantitative and qualitative data simultaneously. A major strength of the concurrent mixed methods design is that they could be relatively intuitive for participants. Conversely, this design prevent follow-up on fascinating or unclear responses (Driscoll et al., 2007). In contrast, the sequential design is relatively complex and involves an iterative procedure, where the data gathered in one stage contribute to those gathered in the subsequent stage (Driscoll et al., 2007). This two-staged method provides an investigator with the opportunity to re-examine and analyse findings derived from one methodological approach and tailor to the subsequent approach. For example, an investigator could initially review and evaluate findings from a survey (quantitative approach) and modify the subsequent in-depth interview tool to follow-up on unclear or important responses (qualitative approach) (Driscoll et al., 2007). However, a fundamental weakness of the sequential design is the time needed to develop and carry out individual tailored instruments for each of the research approaches (Driscoll et al., 2007).

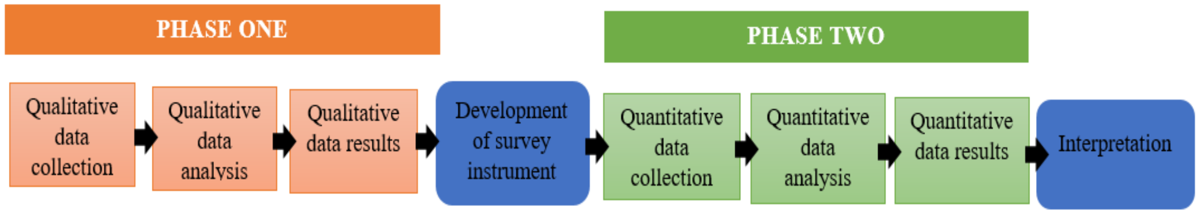

Figure 3.3: Exploratory sequential mixed methods research design (Berman, 2017)

As illustrated in Figure 3.3, the exploratory sequential mixed methods design (Palinkas et al., 2011) was chosen for this research project, as it enables the results from qualitative data collection and analysis to help form instruments which can be employed for quantitative data gathering and examination in order to interpret how the quantitative results provide new and better instruments and inform better intervention designs (Creswell & Plano Clark, 2018). Therefore, for this current research, the initial collection of in-depth data about the opinions and views of university staff and students concerning their perceived enablers and barriers to PA were done using group interviews (qualitative approach). Subsequently, the analysis of the results from the group interview study informed the development of additional questions, which were incorporated in the survey to examine the physical inactivity levels and predictors of physical inactivity among university administrative staff and post-graduate research students.

3.5. Research Strategies

Research strategy could be described as a well-defined plan to accomplish the aim of a research project (Denzin & Lincoln, 2011). The strategy is also the subsequent effect of the assumption, philosophy and approach undertaken by an investigator (Saunders et al., 2016). The strategies that were chosen to accomplish the aim of this research include survey and group interviews. Eight group interviews were conducted to collect qualitative data pertaining to the perceived views and opinions of university staff and students about the enablers and barriers to PA (this will be further discussed in the methods section of chapter 4- group interview study). Thereafter, surveys were used to collect quantitative data about physical inactivity levels of university staff and students and the predictors of physical inactivity among inactive university administrative staff and post-graduate research students (i.e., PhD students).

3.5.1. Survey

Survey studies, as with all other approaches to gathering data, have strengths and weaknesses. Attaining high response rates is of utmost importance in increasing the validity of survey results and generalising these results to the general population (Erwin & Wheelright, 2002). However, it has been recognised that securing high rates of responses using surveys can be challenging to control, even when administered face-to-face (Kelley et al., 2003). Therefore, scholars have been striving to employ approaches that would facilitate improvements in survey response rates. One common approach that has attracted attention is the utilisation of incentives (Van Horn, Green & Martinussen, 2009), because previous studies suggest that the use of incentives increase survey response rates (Deutskens et al., 2004; Singer & Ye, 2013). In this research project, an incentive was thus used to increase the response rates (see section 5.3.6 in Chapter 5). Respondents may overestimate or underestimate their true situation when responding to a survey compared with objective measures (Lagersted-Olsen et al., 2014; Prince et al., 2008), and the weather condition may also influence their responses (Tucker & Gilliland, 2007; Wagner et al., 2019). For example, during the winter period, people may report more physical inactivity compared to the summer period (Tucker & Gilliland, 2007). Therefore, seasonal influences should be considered when administering surveys.

Even with this weakness, surveys were employed in this research project, because they are economical, quick, simple to administer and a secure approach to gather data (Cook, Heath, & Thompson, 2000; Eysenbach & Wyatt, 2002). In this particular study the survey produced valuable data that augmented the rest of the research project. Within scientific studies, previously validated survey tools are utilised which means that the protocols for administering need to be followed as prescribed in the validated tool. This could be seen as a limitation and likewise a strength insomuch as it enables comparisons of the tool to be made across several studies as a means by which the survey was administered would be standardised and therefore allow comparative evaluations to take place. In addition, the versatility of survey studies is beneficial too, i.e., they can be employed by all sorts of individuals in diverse occupations. Therefore, the versatility presented by survey studies suggest that understanding ways to design and disseminate surveys are beneficial skills to acquire for all types of professions (De Carlo, 2018). Furthermore, collecting quantitative data using surveys allow for inferential statistics to be gathered, including participant’s views and opinions, thereby allowing for descriptive statistics (Saunders et al., 2016). In employing a survey, the data gathering process can identify associations between divergent variables and can be visually presented during analysis. Therefore, a survey can be an excellent instrument for getting feedback when employed appropriately. The survey employed in this study is a composite of questionnaires including demographic information, PA behaviour (using the Global PA Questionnaire (GPAQ)) (WHO, 2012a) and determinants of PA (using the Determinants of PA Questionnaire (DPAQ)) (Taylor, Lawton, & Conner, 2013) (cf. section 5.3.5: outcome measures, in chapter 5).

3.5.2. Group interviews

Currently, group interviews have frequently been erroneously referred to as focus group interviews (Denzin & Lincoln, 2000; Kwan, Chun, & Chesla, 2011), even though there are significant differences in the characteristics and forms between these two approaches (Denzin & Lincoln, 2000). This may have been the reason why it was very challenging finding qualitative studies that used group interviews for data collection. Even with this challenge, group interview was utilised in this research project to engage university staff and students in an organised discussion to gain an insight into their perceived barriers and enablers to PA participation. Although focus groups and individual interviews have been used widely in research (De Cocker, De Bourdeaudhuij, & Cardon, 2009; Frey & Fontana, 1991; Simons et al., 2014), group interviews were chosen to gather qualitative data for this research because the aim was to test the relevance of a theory (i.e. the TDF) in the PA context, and not to develop any new theories. Therefore, the group interviews were structured with prearranged questions underpinned by the TDF.

In group interviews, the mediator guides the investigation and the interface amongst participants using either a structured approach or an unstructured approach, depending on the aim of the interview (Denzin & Lincoln, 2000). The aim may be exploratory; for instance, the investigator may recruit numerous people to pre-test the wording of a questionnaire, measurement scales, or other components of survey design (Denzin & Lincoln, 2000). For this research project, an exploratory semi-structured approach was used to test the applicability of the 14 domains of the TDF in the PA context in a university setting utilising a validated measurement scale (i.e., DPAQ). Social researchers have generally overlooked group interviews and preferred to use individual interviews (Frey & Fontana, 1991). Conversely, in comparison with individual interviews, group interviews are somewhat economical to carry out and frequently generate rich cumulative and elaborative data; they can be thought-provoking for participants, thus assisting their ability to remember; and the flexibility of group interviews means that it can be easily adapted to any situation. As with all research strategies, group interviews also have some limitations worth acknowledging. A major limitation is that the findings from group interviews cannot be generalised to a much broader population (Denzin & Lincoln, 2000), which was not a problem in this research since the purpose was not to gain a representative sample but to explore of factors across the groups. The possibility of an outspoken person in the group overshadowing others is another limitation of a group interview (Denzin & Lincoln, 2000), however, since the researcher facilitated the discussion in a question and answer style (Mansell et al., 2004), the more outspoken participants were properly managed, while less outspoken participants were encouraged to express themselves more. The necessities for interviewer's proficiencies in group interviews are greater compared to individual interviews due to the existent group dynamics. Lessons from group dynamics indicate that the group characteristics (e.g., size) and members' backgrounds (e.g., style of leadership) can influence the interface and patterns of responses in a group. Nonetheless, group interviews have immense potentials in social research (Frey & Fontana, 1991). Moreover, it is challenging to investigate sensitive issues utilising this method (Denzin & Lincoln, 2000). However, this was not a problem in this present research, as no sensitive topics were discussed throughout the group interviews.

Notwithstanding the limitations of a group interview, it is still a viable choice for both qualitative and quantitative investigation (Denzin & Lincoln, 2000), because they present a prominent approach to gathering data in public investigations involving different ethnicities, especially in qualitative investigation (Okazaki, Lee & Sue, 2007; Uba, 2002). When moderated efficiently, group interviews offer a safe place for respondents to articulate and exchange their distinctive thoughts and accounts (Kwan et al., 2011). Furthermore, group interviews were chosen since they allow for questions to be limited to the interview schedule and prevent exploration outside the responses obtained from the participants, signifying that several interviews can be conducted in a short period (McLeod, 2014). This is important bearing in mind that the purpose of the investigation was to test the TDF via the examination of university staff and students' views and opinions about their perceived barriers and enablers to PA as they map to the domains of the TDF, it was imperative to use a restricted lens, which required a restricted method. Therefore, using a top-down approach involving groups interviews were found more appropriate in this context.

3.6. Sampling

The samples used in this programme of research were taken from the university's staff and students' populations. Sample size must be informed largely by the objective of the investigation and afterwards, the research strategy. Sampling is a vital stage in an investigation process because it assists in informing the quality of conclusions arrived at by the investigator that ensue from the underlying outcomes. Investigators must determine the sample size and by what means to choose them (i.e., sampling scheme), in both quantitative and qualitative investigations (Onwuegbuzie & Collins, 2007). Even though these choices could be challenging for investigators that employ either quantitative or qualitative approaches, sampling strategies could be even more difficult for investigations that combine both approaches either sequentially or concurrently (i.e., mixed methods research). The reason for this is that the sampling strategies must be individually planned for the qualitative and quantitative research constituents of these investigations, which is very challenging (Onwuegbuzie & Collins, 2007). This section will therefore discuss the major sampling strategies used for the qualitative and quantitative studies in this programme of research.

3.6.1. Group Interview Sampling

It was very challenging finding studies that used group interviews, this may be because group interviews have often been referred to as focus group interviews. Even though the only study identified using group interviews reported that 40 participants took part in their qualitative interview investigation, it was unclear the number of group interviews that were conducted and the number of participants in each group interview (Kwan et al., 2011). Generally, in qualitative investigations, sample sizes must not be too little to make it challenging to attain data and theoretic saturation; nor should the sample be too large as to make it challenging to carry out a profound, case orientated examination (Sandelowski, 1995) Even though no study has specifically identified the ideal sample size required to carry out a group interview study, it has been proposed that sample sizes ranging from 3 to 6 are enough for the most common qualitative research designs(Krueger, 1994; Martinez et al., 2016; Morgan, 1997; Onwuegbuzie et al., 2007). However, Patton (2002) posited that in qualitative studies, there are no guidelines for determining sample size. This implies that sample size is ascertained by the purpose of the research, things possible to achieve, and available time and resources (Patton, 2002). In this research project, the group interviews were exploratory, and the group membership in itself was not entirely important. The group interviews were convened to make the participants feel more comfortable being interviewed with others who are like them. It was the exploration of factors across the groups that were of interest and not to gain a representative sample. Therefore, based on this evidence, this study aimed to employ at least 6 participants for each group interview. Apart from the sample size consideration, sampling techniques used in recruiting participants are also very important in qualitative research.

The various sampling methods used to recruit participants in qualitative research include convenience (accidental or haphazard sampling), purposive (judgement sampling), snowball (word-of-mouth), quota, and case study sampling. However, the most common sampling methods are convenience and purposeful sampling because they align the best across virtually all qualitative research strategies (Luborsky & Rubinstein, 1995). Convenience sampling is a non-random sampling method where participants from the targeted population who satisfy specific practical benchmarks, such as the ease of accessibility, geographic closeness, availability at a specified period, or the readiness to take part are incorporated in the research (Dörnyei, 2007). Thus, it depends on the participants that can be easily accessed by the investigator and selection is based on those that are found first (Luborsky & Rubinstein, 1995). A major strength of convenience sampling is that it is affordable, simple and the participants are easily accessible. On the other hand, purposive sampling method includes finding and choosing people or clusters of people that are particularly well-informed concerning or proficient with the phenomenon of concern (Cresswell & Plano Clark, 2011). In simple words, the investigator determines what requires to be understood and starts to look for individuals who could and are prepared to give the information by virtue of understanding or proficiency (Bernard, 2002). Investigators that employ this method cautiously choose participants grounded on the aim of the investigation, with the anticipation that every participant will give distinctive and valuable information of significance to the investigation. Therefore, participants from the easily reached population are not exchangeable and sample size is not decided by statistical power analysis but by data saturation (Seun, Huang & Lee, 2014).

Convenience and purposive sampling share some common weaknesses which involves the selection of participants non-randomly, i.e., the investigator is biased and subjective in selecting the participants for the investigation. This hinders the investigator's capability to obtain conclusions concerning a population (Etikan, Musa, & Alkassim, 2016). Etikan, Musa, & Alkassim (2016) suggested that even though convenience sampling could be employed in qualitative as well as quantitative research, it is commonly employed in quantitative research, whereas purposive sampling is usually employed in qualitative research. This method of sampling cannot be employed when the variables in the investigation are purely quantitative and similarly in convenience sampling, the type of the investigation has to be typically quantitative. The selection of method to be employed is determined by the kind and nature of the study (Etikan et al., 2016), therefore, since the qualitative component of this research project (study 1) aimed at determining the opinions and views of specified groups of university staff and students about their perceived barriers and enablers to PA, the purposive sampling technique was viewed as more appropriate in this context.

3.6.2. Survey Sampling

The sample sizes used in the two survey studies (study 2), as well as the intervention studies (study 3 and 4) carried out in this research project were individually calculated a-priori. There has been an increasing understanding about the significance of statistical power analysis across research communities (Tomczak et al., 2014). Most statisticians and methodologists have a common agreement that employing bigger sample sizes in quantitative studies is better compared to smaller sample size communities (Tomczak et al., 2014). Sample size is not an end itself but is a factor that may reinforce assurance in research findings. Failure to consider the power of an investigation may result in significant misrepresentation and miscalculations such as reporting no statistically significant variances between the groups or no significant relationships between specified variables whereas such significant variances or relationships is present in the population. Such misrepresentation may stem from employing a sample size that is very little to dependably identify a significant effect. Therefore, an investigation report may communicate a depiction of representativeness that does not match up with the actualities (Tomczak et al., 2014). Nevertheless, such unwanted mistakes may frequently be avoided by carrying out a power analysis prior to the commencement of a study. A power analysis assists in dealing with the vital issue around the sample size being adequate, or more specifically, the extent of the size of a sample required to identify the outcome of interest (or to discover a significant result in the data) that exists in the population (Burmeister & Aitken, 2012; Eng, 2003; Martínez-Mesa et al., 2014). In summary, power analysis assists investigators in deciding the suitable (i.e. optimum) sample size before the study, which guarantees high trustworthiness of the inferences (Tomczak et al., 2014). After calculating the a priori sample size using statistical power analysis to ascertain the minimum number of participants needed to obtain reliable results, it is also important to determine how these participants will be randomised into several intervention groups based on the research aim.

Randomisation is a method of controlling experimental studies to prevent the likelihood of selection or accidental biases (Suresh, 2011). There is a myriad of randomisation techniques that have been generally used in quantitative studies, the key ones being simple, block, stratified, and covariate adaptive randomisation(Suresh, 2011). The Latin square design was used to carry out the randomisation of participants into various groups in the intervention studies (i.e., study 3 and 4). Latin square design is a technique that can be used to assign treatments in such a way that they emerge in a balanced manner in a square block, in which treatments emerge one time in every row and column. This allows treatment to be allocated randomly in rows and columns, with every treatment appearing only one time in each row and column (Kuehl, 2000). This is the most common alternative technique of randomisation when two or more blocking factors require to be controlled for. All methods of randomisation have their individual strengths and weaknesses. For Latin square design, the major weakness is that the number of levels of every blocking variable needs to be equivalent the amount of levels of the treatment factor. Typically, a blocking factor is a source of variability that may have an effect on the intervention outcomes but is itself not of primary interest to the investigator and may therefore be a confounder. Blocking factors vary wildly depending on the experiment. For example, in studies involving human such as this study, gender and age are generally employed as blocking factors (Gao, 2005).

Even with this weakness, the Latin square design can be used in studies with a fairly small amount of runs (Kuehl, 2000). Given that the participants are divided into subgroups known as blocks, unevenness in the blocks is not more than the unevenness between the blocks. Since this strategy decreases unevenness and likely confounding, it gives a better estimation of the impacts of the treatment. In using the Latin square design, there are no associations amongst the blocking variables or between the treatment and the blocking variables. This indicates that this design denotes the most common alternate approach when two or more blocking variables have to be controlled for (Gao, 2005).

3.7. Validity and Reliability

The degree to which an investigator strive to improve the quality of investigations (i.e. rigour) is accomplished through the measurement of validity and reliability (Lobiondo-Wood & Haber, 2013). Validity may be described as the degree to which a theory is correctly assessed in a quantitative investigation, i.e. suitability of an instrument to assess what it purports to assess (Golafshani, 2003). For instance, a survey developed to examine depression but then essentially assesses nervousness may not be deemed to be authentic (Heale & Twycross, 2015). On the other hand, reliability or the precision of a tool, is the second assessment of quality employed in a quantitative investigation (Heale & Twycross, 2015). In simple terms, reliability may be defined as the extent to which a research tool constantly has identical findings if it is employed in very similar condition on repeated instances (Heale & Twycross, 2015; Leung, 2015).

Therefore, this section will discuss the approaches used in establishing validity and reliability for both the quantitative and qualitative studies conducted in this research project.

3.7.1. Validity and reliability of the quantitative studies in this research project

When carrying out a quantitative study, it is imperative to reflect on the reliability and validity of the tools used in gathering data (Heale & Twycross, 2015). The three main types of validity are content, construct and criterion validity (Drost, 2011). Content validity involves the extent to which a research tool correctly assesses all facets of a concept, i.e., the tool must cover the whole domain associated with the variable or concept it was developed to assess (Zamanzadeh et al., 2015). Face validity is a subgroup of content validity, where specialists are requested their view concerning whether a tool assesses the intended constructs (Heale & Twycross, 2015; Nwana, 2007). Construct validity involves the degree to which a research tool assesses the proposed concept, i.e., whether inferences can be drawn regarding the test scores associated with the concept being studied. Finally, criterion validity is the level to which a research tool is correlated to other tools that assess very similar variables, i.e. correlations may be carried out to ascertain the degree to which the different tools assess the same variable (Heale & Twycross, 2015; Pallant, 2011).

Reliability refers to the dependability of a tool (Chakrabartty, 2013). For instance, a participant completing an instrument intended to assess motivation must have almost very similar answers every time the test is carried out (Blumberg, Cooper & Schindler, 2005). Even though it is impossible to produce a precise computation of reliability, an approximation of reliability could be accomplished through diverse instruments (Heale & Twycross, 2015). The features of reliability consist of internal consistency or homogeneity (measured using Kuder-Richardson coefficient, split-half reliability, item-to-total correlation, and Cronbach's alpha coefficient), stability (measured using test-retest reliability) and equivalence (measured using inter-rater reliability) (Heale & Twycross, 2015). For this research project, the Cronbach's alpha coefficient, the most broadly employed approach to measure internal consistency of an instrument, was employed to evaluate the reliability of the tools utilised in the quantitative studies. Although the values of Cronbach's alpha vary from 0 to 1, there have been debates concerning the suitable alpha values, with most authors reporting values ranging from 0.70 to 0.95 as acceptable (Lobiondo-Wood, & Haber, 2013; Bland & Altman, 1997; DeVellis, 2003; Nunnally 1994; Shuttleworth, 2015). The guidelines for interpreting Cronbach's alpha values are illustrated in Table 3.2.

Table 3.2: Guidelines for interpreting Cronbach's alpha values (George & Mallery, 2003)

S/N	**Internal consistency**	**Cronbach's alpha (α)**
1	Unacceptable	$0.5 > \alpha$
2	Poor	$0.6 > \alpha \geq 0.5$
3	Questionable	$0.7 > \alpha \geq 0.6$
4	Acceptable	$0.8 > \alpha \geq 0.7$
5	Good	$0.9 > \alpha \geq 0.8$
6	Excellent	$\alpha \geq 0.9$

A low alpha value (i.e., 0.5 or below) may be as a result of a low number of questions, weak interrelationships between items or divergent concepts. Therefore, if a low alpha is because of weak relationship between items then some items ought to be reviewed or removed. However, if alpha is very high (i.e., 0.9 or higher) it could indicate that some items are unnecessary because they are assessing the same question but in another form. According to Streiner (2003) the recommended maximum value for alpha should be 0.90.

In this research project, most of the instruments employed in collecting data such as the Global Physical Activity Questionnaire (GPAQ) (Keating et al., 2019; Wanner et al., 2017), and the Determinants of Physical Activity Questionnaire (DPAQ) (Taylor, Lawton, & Conner, 2013) were already validated psychometric instruments that have been extensively used in research, so there was no need to test their validity and reliability. The motivation subscale of the Motivation for Physical Activity Questionnaire (MPAQ) (Deci & Ryan, 2004), used to measure the reinforcement domain of the TDF, is readily available, but no validity studies could be found, therefore a reliability was carried out. Furthermore, the six additional items that were developed through the findings of study 1(group interview study) to measure two domains of the TDF (i.e., the Social/Professional Role and Identity and the Memory, Attention and Decision Processes domains) that were not assessed by the DPAQ, a validated instrument that measures the Domains of the TDF in the PA context. Therefore, internal consistency (i.e. reliability) of these six additional items were assessed using the Cronbach's alpha coefficient (see section 5.3.5 of chapter 5).

3.7.2. Validity and reliability of the qualitative study in this research project

Unlike the quantitative method in which investigators employ statistical approaches for determining reliability and validity of research results, in qualitative approach, investigators target to create and integrate methodological approaches to guarantee the credibility of the results (Noble & Smith, 2015). Such approaches involve accounting for individual preconceived notion that could have affected the results (Morse et al., 2002); recognising sampling biases and continuous critical consideration of approaches to guarantee adequate depth and relevance of data gathering and exploration (Sandelowski, 1993); keeping detailed records, indicating an evident decision trail and making sure that data interpretations are transparent and trustworthy (Long & Johnson, 2000; Sandelowski, 1993); incorporating substantial and rich word for word illustrations of participants' narratives to reinforce results (Slevin & Sines, 2000); establishing clearness with regards to the thought processes all through data exploration and consequent descriptions (Sandelowski, 1993) and involving other investigators to decrease bias in the research (Sandelowski, 1993).

Other approaches employed by qualitative investigators to establish validity and reliability in their research include respondent authentication, i.e., sending the interview transcripts to study participants to comment on, to establish if the final themes and theories generated sufficiently manifest the phenomena under investigation (Long & Johnson, 2000; Sandelowski, 1993); and data triangulation (Long & Johnson, 2000; Sandelowski, 1993), in which different approaches and viewpoints help yield a more broad set of results (Fraser & Greenhalgh, 2001; Kuper, Lingard, & Levinson, 2008). Furthermore, the use of inter-rater reliability (IRR) test (i.e., a statistical measurement used in establishing conformity between two or more investigators in quantitative research) in qualitative research has been argued, nevertheless, its relevance in qualitative research is uncertain. Several qualitative investigators claimed that measuring IRR was a vital approach for guaranteeing thoroughness of research findings, while others argued that it was irrelevant (Armstrong et al., 1997). Even with these uncertainties about the use of IRR in qualitative research, its use in qualitative research has increased (Costello et al., 2013).

Therefore, the qualitative study (i.e. study 1) of this research project employed some of these strategies mentioned above to ascertain the validity and reliability of the results. For example, to establish the inter-rater reliability, another researcher was given a coding structure to code an interview transcript then Cohen's Kappa (k) inter-rater reliability test was carried out to determine the level of agreement between two researchers. The guidelines for interpreting Cohen's kappa values for agreement strength are presented in Table 3.3.

Table 3.3: Guidelines for interpreting Cohen's kappa values (Landis & Koch, 1977)

S/N	Agreement strength	Cohen's Kappa (k) statistic
1	Poor	< 0.00
2	Slight	0.00 to 0.20
3	Fair	0.21 to 0.40
4	Moderate	0.41 to 0.60
5	Substantial	0.61 to 0.80
6	Almost perfect	0.81 to 1.00

Whereas to establish the intra-rater reliability, all the transcripts coded before were coded again after several months to confirm the consistency of the emerging themes (see section 4.3.5 of chapter 4). Then to authenticate the validity of the findings in the qualitative study, the interview schedule was designed through an iterative process between the researcher and the research project supervisors until the final version was agreed, and also pilot tested amongst a sub-group of the population under study to assess its feasibility (see section 4.3.3 of chapter 4).

3.8. Assessment of tools used to measure physical activity in this research project

The most widely used self-report questionnaire to measure PA- the International Physical Activity Questionnaire (IPAQ)- was initially considered as a tool to measure PA in the survey study (chapter 5), while an objective measure (i.e., pedometer) was considered as an instruments to measure PA in the intervention studies (chapters 6 and 7). However, in both the survey and intervention studies in this research project, Global Physical Activity Questionnaire (GPAQ) was used to measure total PA levels, while PA log was used to measure time spent in PA weekly. This is because the GPAQ has been validated against the IPAQ (Ruiz-Casado et al., 2016), assesses the three domains of PA (i.e., work, transport and leisure) required in this research project (WHO, 2012), which is not measured by the IPAQ, and used in several settings and different populations (Wanner et al., 2017) and therefore a robust tool to measure PA. The GPAQ is a 16-item questionnaire (WHO, 2012) advocated to be used as a global surveillance instrument for PA (WHO, 2004). Objective measures (e.g., pedometers and accelerometers) and subjective measures (e.g., self-report questionnaires) are extensively utilised in evaluating

PA (Chu et al., 2015). Of the approaches used to measure PA, self-report questionnaires are the most extensively employed, especially in large investigations because they are comparatively economical, less inconveniencing to participants and easier to administer (Blair et al., 2014).

The GPAQ (WHO, 2012) is one of the most employed questionnaires to measure PA. As with subjective instruments, objective measures have gained growing extensive utilisation for measuring PA. Nevertheless, a limitation of objective measures is the lack of differentiation between specific activities in diverse PA domains such as work, transport and leisure activities (Chu et al., 2015). Even though objective measures, such as pedometers and accelerometers, may minimise self-report biases and improve precision in PA measurements, they are relatively more expensive, particularly in a large scale population based research, and are likely to inconvenience some participants compared to self-report questionnaires such as GPAQ (Freedson et al., 2012). On the other hand, the GPAQ, as with all other self-report measures, may be prone to likely recall bias, social desirability, underestimation of physical inactivity, and overestimation of PA (Celis-Morales et al., 2012; Grimm et al., 2012; Lagersted-Olsen et al., 2014; Lee, et al., 2011).

The GPAQ was chosen as a tool to measure PA in the survey and intervention studies in this research project for several reasons. First, the GPAQ has been extensively validated in different populations in diverse settings, demonstrating good psychometric properties (see Chapter 5, section 5.3.5.1). Second, the GPAQ provides a standardised measure of PA, which will ensure consistent PA levels across the studies in this research project and improve comparability with other studies. Third, the GPAQ has been validated against the most widely used self-report measure of PA, i.e. IPAQ (Bull, Maslin, & Armstrong, 2009) and objective measures such as pedometers and accelerometer (Chu et al., 2015; Cleland et al., 2014; Wanner et al., 2017), suggesting a fair to moderate correlations (Chu et al., 2015). However, results from a current systematic review by Keating et al. (2019), suggested that the concurrent validity of the GPAQ against pedometers, accelerometer and PA logs was poor to fair. These results may be because various validation studies did not employ same evaluations to compare the GPAQ data with the pedometer, accelerometer, and PA log data (Keating et al., 2019). Therefore, further investigations with more thorough study designs are required prior to any inferences regarding the concurrent validity of GPAQ can be established. The GPAQ has been validated in over 100 countries worldwide (Guthold et al., 2011) including European countries (Laeremans et al., 2017; Wanner et al., 2017), and in different settings, including university staff and students (i.e. the population under investigation) (Riviere et al., 2016; Shah et al., 2016; Wattanapisit et al., 2016), thereby establishing the usefulness of this tool in measuring PA across diverse populations. Finally, according to van Poppel et al. (2010), the utilisation of diverse tools in several surveys and investigations makes comparing levels of PA across nations or investigations challenging. Therefore, a standardised questionnaire (GPAQ) was employed in the survey and intervention studies in this research project to improve comparisons of measured PA levels to those reported in other investigations or nations.

The GPAQ was chosen to measure PA levels in the survey study (study two) because of the large number of participants involved. The intervention for the PhD students (chapter 7) was delivered online, based on the study design employed, which involved no physical contacts with the participants, thus it would have been challenging to use objective measures. The intervention for the administrative staff (chapter 6) was delivered face-to-face, however, an objective measure was not used in order to ensure a consistent standardised measure of PA across the intervention studies. Future studies employing a mixed methods approach may consider using different instruments, i.e., subjective measures (e.g., self-report questionnaires) to measure PA in the survey studies and objective measures (e.g., pedometers and accelerometers) to measure PA in the intervention studies.

3.9. Ethical considerations

This research project was carried out according to the Data Protection Act 2018 (Department for Digital, Culture, Media and Sport, 2018), the current General Data Protection Regulation (GDPR) (Information Commissioner's Office, 2018) and the University of Derby's Good Scientific Practice (University of Derby, 2019). The study protocols for the three experimental studies carried out in this research project received full approval prior to their commencement by the Human Sciences Research Ethics Committee (HS-REC) of the University of Derby in the United Kingdom. For each of these three studies, all participants were communicated to through email to inform them about the aim of the investigation, their rights to withdraw from the investigation, the likely risks that may arise from taking part in the investigation and the way the data generated will be safely stored and used. Informed consent was also obtained from all participants before being allowed to participate in any of the studies in this research project. Furthermore, all data gathered, and any documents generated were anonymised and protected from unauthorised use by individuals not involved in the research. The ethical considerations are reported in individual experimental chapters, i.e. chapter 4 (study 1-

reference number: 09-1717-LNs); chapter 5 (study 2-reference number: 19-1718-LNs); chapter 6 (study 3- reference number: ETH1819-0099); and 7(study 4- reference number: ETH1819-0099).

3.10. Studies conducted in this research project and epistemological considerations

Table 3.4 presents a summary of the studies carried out in this research project demonstrating their sequential alignment and the progressive development of the research in order to address the core research question and hypothesis.

This research project assumed a critical realist paradigm that lies between positivist and interpretivist paradigms enabling the use of a mixed methods design. Critical realism is a modern philosophical viewpoint that presents a revolutionary option to the conventional positivist and interpretivist paradigms (Houston, 2001; Mcevoy & Richards, 2006). The fundamental aim of research from a critical realist perspective is not just to ensure the generalisability of research findings (positivism) or to ascertain peoples' beliefs or lived experiences (interpretivism), but to foster deeper levels of interpretation and explanation using both approaches (Mcevoy & Richards, 2006). The critical realists argue that the selection of research methodologies ought to be determined by the type of the research aim and in several instances it is advocated that the most efficacious method would be to employ a blend of qualitative and quantitative approaches (Olsen, 2002). What is most vital from a critical realist viewpoint is the way in which the qualitative and quantitative approaches are incorporated (Pratschke, 2003). The current research project utilised an exploratory sequential mixed methods design, which was found appropriate, with the results from a qualitative study (positivist paradigm) informing the development of the survey used in the quantitative study (interpretivist paradigm) to collect data.

Table 3.4: Summary of studies conducted in this research project

Study	Aim(s)	Study design	Participants/duration	Outcome measures	Procedures/intervention components	Findings
Study 1 (Chapter 4)	i) To gain knowledge about the enablers and barriers to PA amongst staff and students in a university setting employing the TDF, and ii) to develop additional items to measure the TDF domains not measured by the DPAQ.	Qualitative study utilising semi-structured group interviews.	Participants were selected using purposive sampling. University staff (i.e., academic, administrative, catering and cleaning service staff) and students (i.e. UG first year, PGR taught (masters), PGR research (PhD), and international students) took part in this study. The sample (n=40) included 18 males and 22 females. Data collected from Dec 2017-Feb 2018 (3 months).	Enablers and barriers to PA- using interview schedule developed with the 14 domains of the TDF.	Pilot study carried out among catering staff (n=5) & PhD students (n=5). Group interviews conducted in meeting rooms in the university. Audio recordings transcribed verbatim and imported into Nvivo12 and analysed using deductive qualitative content analysis.	Six prominent domains were identified as both barriers and enablers to PA among university staff and students: (1) environmental context and resources; (2) Intentions; (3) Social Influences; (4) Knowledge; (5) Beliefs about Capabilities; and (6) Social/Professional Role and Identity. Six additional items were developed from the participants' quotes to measure the two domains of the TDF (i.e., three items each to measure the 'Memory, Attention and Decision Processes' and 'Social/Professional Role and Identity') not measured by the DPAQ.
Study 2 (Chapter 5) Involved two separate studies.	Preliminary survey- to determine the PA levels of university staff and students to identify those that are most physically inactive.	Quantitative study employing online surveys.	Participants were selected using convenience sampling. 155 university staff and 219 students (n=374) took part in this study. Data collected from Oct-Dec 2018 (3 months).	PA levels- using the GPAQ, administered online via Qualtrics.	All university staff and students were invited to take part in this study via invitation emails, posters, and flyers as well as via the university's internal communication platforms, which contained a hyperlink to the online survey. Face-to-face administration of the survey was also used.	University administrative staff and PhD students were the most physically inactive compared to other staff and student groups, respectively and would thus benefit most from the intended interventions aimed at increasing their PA levels. The main survey study thus focused on these groups.
	Main survey- to identify the predictors of physical inactivity among the inactive administrative staff and PhD students.	Quantitative study employing online surveys	Participants were selected using convenience sampling. 121 administrative staff and 114 PhD students (n= 235) participated in this study. Data collected from Feb-Apr 2019 (3 months).	Physical inactivity levels- using GPAQ. Predictors of physical inactivity-using a composite questionnaire, i.e., DPAQ, the subscale of MPAQ, and the additional six items developed from study 1.	All university administrative staff and PhD students invited to participate in the study through all the recruitment strategies used in the preliminary study. Only the participants that were inactive (i.e., scored below 600 MET-minutes/week of moderate-intensity PA) participated in the study.	64% of university administrative staff and 62% of PhD students were physically inactive. 'Physical skills' was the only significant predictor of physical inactivity among university administrative staff, while 'knowledge' and 'intentions' were the only significant predictors of physical inactivity among university PhD students.

Study 3 (Chapter 6)	To examine whether the improvement of physical skills to engage in PA/exercise will increase PA levels among inactive university administrative staff.	Pre-post quantitative study design	21 administrative staff participated in this study. Data collected from Sept-Nov 2019 (3 months).	PA levels- using GPAQ; time spent in PA weekly- using activity logs; Physical skills- using physical skills subscale of the DPAQ.	The intervention was developed using the 8 phases of the BCW. Participants were allocated to EXP group (n=9) and CONT group (n=12) using Latin square techniques. After collection of baseline measures the participants in the EXP group were invited via email to engage in a badminton session supervised by a level 2 badminton coach at the university's sports centre at least once a week for the 4 weeks of the intervention. The participants in the CONT group were just asked to continue with their normal routine. Email reminders were sent to both groups weekly. Study measures were taken at baseline (week 0) and immediately after the intervention (week 4).	The participants in the EXP group recorded higher physical skills scores and higher PA levels and spent more time in PA weekly compared to the CONT group, suggesting that improvements in physical skills is associated with increases in both PA levels as well as time spent in PA weekly. There was no significant difference between the male and female participants with regards to PA levels as well as time spent in PA weekly across the intervention period.
Study 4 (Chapter 7)	To examine whether the improvement of knowledge about PA and/or intentions to participate in PA will increase PA levels among inactive university PhD students.	Pre-post quantitative study design	67 PhD students participated in this study. Data collected from Sept-Nov 2019 (3 months).	PA levels-using GPAQ; time spent in PA weekly- using activity logs; knowledge about PA- using a 2-item questionnaire; levels of awareness about PA for health was measured- using LKPAHQ; and intentions to engage in PA and past behaviours- using BIQ and PBQ, respectively.	The intervention was developed using the 8 phases of the BCW. Participants were allocated to EDU & INT group (n=17), EDU only group (n=18), INT only group (n=16), and CONT group (n=16)) using Latin square techniques. After collection of baseline measures, participants in the EDU & INT group were emailed educational materials about PA as well as implementation intentions and If-Then templates to plan days, times, and places they intend to engage in PA and how to overcome	The greatest increases in total PA levels and time spent in PA weekly were reported among the participants in the EDU & INT group, followed by the INT only group, the EDU only group, and the CONT group. There were no significant differences in the total PA between male or female participants. However, both male and female participants performed similarly in the time they spent in PA weekly up until week 3 and 4 where the male participants performed better than their female counterparts.

					possible barriers; the EDU group were only sent educational materials once; and the INT group were only sent the implementation intentions and the If-Then templates. The participants in the CONT group were not given any intervention but requested to carry on with their usual routine. Email reminders sent to both groups weekly. Study measures were taken at baseline (week 0 and immediately after the intervention (week 4).	

Abbreviations: BCW: Behaviour change wheel; BIQ: Behavioural intentions questionnaire; CONT: Control; DPAQ: Determinants of Physical Activity Questionnaire; EDU: Education; EXP: Experimental; GPAQ: General Physical Activity Questionnaire; INT: Intentions; LLPAHQ: Levels of Knowledge of Physical Activity for Health Questionnaire; MPAQ: Motivation for Physical Activity Questionnaire; PA: Physical activity; PBQ: Past behaviour questionnaire; PGR: Postgraduate; TDF: Theoretical domains framework; UG: Undergraduate

In this research project, study one involved an exploratory qualitative study design using semi-structured group interviews to 1) understand the barriers and enablers to PA among university staff and students; and 2) develop additional items to measure the TDF domains not measured by the DPAQ. Study one (chapter four) adopted an interpretivist paradigm which lays emphasis on how the world is socially structured and perceived (Blaikie, 2000). The research approaches that are usually linked to interpretivism are modest but intense, with the interface between the participants and researcher being perceived as a fundamental component of the investigation process (Philip, 1998). In study one, participants were chosen utilising purposive sampling technique based on how proficient or knowledgeable they are concerning the phenomenon under investigation, without essentially having to be representative of the general population (Goering & Streiner, 1996; Strauss & Corbin, 1998). Approaches that have been linked with interpretivist paradigm consist of textual analysis, interviews and focus groups (Mcevoy & Richards, 2006), therefore, group interviews were used to collect data in study one. The findings of study one indicated that six domains of the TDF, i.e., environmental context and resources; intentions; social influences; knowledge; beliefs about capabilities; and social/professional role and identity, were both prominent barriers and enablers to PA among university staff and students. Furthermore, an additional six items were developed from the participants' quotes to measure the two domains of the TDF i.e. (i) Memory, Attention and Decision Processes, and (ii) Social/Professional Role and Identity, not measured by the DPAQ. According to critical realists, qualitative approaches can assist in illuminating intricate constructs and associations that are implausible to be attained using standardised quantitative measures (Mcevoy & Richards, 2006).

Study two involved a quantitative study design using online survey which utilised a composite questionnaire including the six additional items developed in study one. In addition, a 4-item subscale of the MPAQ was utilised to measure the 'reinforcement' domain not measured by the DPAQ along with a validated 34-item DPAQ to measure the remaining 11 domains of the TDF. This study, alongside studies three and four adopted the positivist paradigm, based on the philosophy that peoples' presumptions ought to be set aside so as to ascertain objective realities established on experimental observations. The aim of positivistic investigation is to reduce likely causes of bias in order to improve the generalisability of research findings to a wider population through the identification of statistical associations between variables (Ackroyd, 2004). Methods generally linked to the positivist paradigm consist of systematic reviews, randomised controlled trials, statistical examination of official data, questionnaires, and structured interviews (Mcevoy & Richards, 2006). For example, a composite questionnaire was used to collect data in study two through two sub-studies, i.e., the preliminary survey study and the main survey study. The preliminary study aimed at determining the groups of university staff and students that were most physically inactive. The findings of this study identified that administrative staff and the PhD students were the most physically inactive compared to other staff and student groups within a university setting and would, therefore benefit from prospective interventions. The main study therefore focused on the administrative staff and PhD students to identify the predictors of physical inactivity amongst these populations using a composite questionnaire. The findings of the main study indicated that 64.0% of administrative staff and 62.0% of PhD students were physically inactive. The findings of this established that 'physical skills' was the only significant predictor of physical inactivity among administrative staff, while 'knowledge' and 'intentions' were the significant predictors of physical activity among PhD students. Both studies one and two identified 'knowledge' and 'intentions' as significant barriers and enablers to PA (i.e., predictors of physical inactivity) among PhD students and thus selected as intervention targets in latter studies. However, only 'physical skills' was identified as the predictor of physical inactivity among administrative staff.

Even though the bespoke interventions for the administrative staff (study three) and PhD students (study four) were run concurrently, they were reported in separate chapters of the thesis to provide more clarity to these individual studies. Studies three and four were developed using the eight phases of the BCW (Michie, Atkins & West, 2014) and involved a 4-week pre-post intervention, with measures taken at baseline (week 0) and after intervention (week 4). The participants in all the treatment groups in studies three and four were requested to complete weekly activity logs and weekly e-mails were sent to them as reminders. In study three, the participants (i.e. administrative staff) were allocated to two treatment groups (experimental and control groups) using the Latin Square design. The participants in the experimental group were asked to attend a badminton session supervised by a level 2 badminton instructor at the university's sports centre during the intervention period. Participants in the control group were not given any intervention and were asked to continue with their normal routine. The findings of this study indicated that the physical skills scores, PA levels and time spent in PA weekly were higher among participants in the experimental group compared to control group, demonstrating that improvement in physical skills resulted in increase in both PA levels as well as time spent in PA weekly. The result also showed that there was no significant gender difference with regards to PA levels as well as time spent in PA weekly across the intervention period. In study four, the participants were allocated to four treatment groups (education and intentions, education only, intention only and control groups) using the Latin Square design. The participants in the 'education and intentions' group were emailed educational materials about PA once for them to read, as well as implementation intentions and If-Then templates weekly in order that participants plan days, times and places they intend to engage in PA and how they would overcome possible barriers. The 'education only' group were only sent educational materials once for them to read. The 'intentions only' group were sent the implementation intentions and the If-Then templates weekly to plan days, times, and places they intend to engage in PA and how they would overcome possible barriers. The participants in the 'control' group were not given any intervention but requested to carry on with their usual routine. The findings of this study showed that the greatest increases in total PA levels and time spent in PA weekly were reported among the participants in the 'education and intentions' group followed by the 'intentions only' group, then the 'education only' group, with the least reported in the 'control' group. The finding also revealed that there was no gender difference in the total PA levels. Conversely, both male and female participants performed similarly in the time they spent in PA weekly up until weeks three and four, at which point males performed better than females. According to the critical realist paradigm, the strength of quantitative approaches lies in the fact that these approaches can be utilised to create consistent descriptions and present precise comparisons (Mingers, 2004).

Employing a mixed method approach in this present research project, as informed by the critical realists' paradigm, ensured a greater sense of balance and perspective. The outcomes increased the reproductive reasoning resulting in the development of the theoretically driven brief bespoke interventions that significantly improved physical skills among administrative staff. Furthermore, the knowledge about PA and intentions to engage in PA among PhD students were significantly improved leading to an increase total PA levels as well as time spent in PA weekly.

Chapter 4. Qualitative Exploration of the Enablers and Barriers to Physical Activity among University Staff and Students: A Group Interview Study

4.1. Introduction

Chapters two (literature review) and three (methodology) informed the design of the study in this present chapter. The philosophical assumption (i.e., the critical realist stance) employed in this research project posits that to get a holistic view of a phenomenon under investigation, mixed methods research design involving the interpretivist (i.e., qualitative) and positivists (quantitative) approaches should be used. Employing a qualitative approach, underpinned by overarching psychological theories/models, to understand the beliefs, views, and opinions of the populations under investigation is an important starting point in designing effective behaviour change interventions (Michie et al., 2014). This is supported by findings from the literature review which showed that studies supported with the newer psychological theories/models such as the TDF and COM-B model were more likely to be effective than those supported with the older psychological theories/models such as HBM, SCT, TPB and TTM. This is because these newer theories/models have broader influences on the cognitive, contextual, automatic, and reflective factors that influence behaviour change, which are lacking in the older ones (Michie et al., 2014). The TDF and/or the COM-B model have been used extensively to examine the barriers and enablers to PA in different populations in diverse settings (Flannery et al., 2018; Haith-Cooper et al., 2018; Quigley et al., 2019) but have not been used in the PA context in the university setting, which creates a gap in literature that this current study intends to fill. This chapter therefore illustrates the processes involved in a qualitative study employing group interviews, underpinned by the TDF and COM-B model, to examine the enablers and predictors of PA among university staff and students. The chapter starts by presenting a brief background, context and rationale for the study followed by the methods utilised in conducting the study. Finally, findings, discussion and conclusion are discussed in detail.

4.2. Background

Previous studies worldwide have established the predominance of physical inactivity amongst staff and students in the university setting, with a large proportion of them not achieving the recommended PA levels. Haase et al. (2004) revealed that the predominance of physical inactivity amongst university students varied from 23.0% in North-Western Europe to 44.0% in developing nations. This was further supported by individual studies in different countries, which suggests that more than 50.0% of the university students in Saudi Arabia (Awadalla et al., 2014); 34.0% of male and 55.0% of female students in Kuwait (Al-Isa et al., 2011); 33.3% of students in Egypt (El-Gilany et al., 2011); 73.6% of students in Lebanon (Musharrafieh et al., 2008); 33.3% of students in China and Brazil (Abdullah et al., 2005; Fontes & Vianna, 2009); and 17.0% of students in the USA (Suminski et al., 2002) were physically inactive. Likewise, Haase et al. (2004) reported that in the UK, 79.0% of female and 73.0% of male university students are not achieving the PA recommendations. In general, being a student in the university was found to be linked with a higher probability of being physically inactive (El-Gilany et al., 2011).

Inactive behaviour has significant effects on university staff and students' general health (Crombie et al., 2009; Keating et al., 2005), and to improve their health, interventions must target to increase PA level (Must & Tybor, 2005). Furthermore, perception of the reasons that university staff and students engage in PA or not is essential for intervention attempts to promote more active lifestyle (Biddle et al., 2004), because transforming behaviour involves a perception of the barriers and enablers (i.e. the determinants) of the behaviour in the context in which they take place (Atkins et al., 2017). Therefore, the university was chosen as a unique setting to conduct this programme of research because it provides enormous opportunities through the hosts of staff members with various roles (e.g., executive, senior management, administrative support, teaching and research, etc.), as well as the diversity of students enrolled at different modes and levels of study (e.g. full-time, part-time, undergraduates, postgraduate taught and research, etc.), which means that the research can have broad application.

Moreover, these staff and students spend 50.0 to 60.0 % of their waking time in the university environment (Alwan, 2011), therefore offering PA interventions here may be an efficient strategy to engage them in PA. The university setting also presents group support, established structures of formal and informal interaction amongst staff and students, convenience and likely corporate behaviour norms, which are potential advantages of university-based programmes over other approaches (Conn et al., 2009). Furthermore, the university staff and student populations are important because the staff members, especially those with administrative role that require them to sit for long hours can become inactive, while the students consist of a significant percentage of the younger populace that go on to exert a huge amount of impact on the general public via the major positions they occupy later in life as specialists, high-ranking administrators and policymakers (Stewart-Brown et al., 2000). Even with this inherent prospect, the universities have remained progressively sedentary over the years. Given the epidemiological case for increasing inactivity behaviour, it is now important to develop behaviour change interventions supported by psychological theories that target PA increase as a primary outcome in the university setting and other domains (Conn et al., 2009).

Furthermore, identifying the reasons people fail to engage in adequate PA is intricate and multidimensional, involving individual, relational, ecological, and policy elements. Studies that enhance knowledge about these influences have more potentials to inform PA promotion better. Therefore, understanding the enablers and barriers to PA engagement among staff and students in a university setting is the preliminary step in identifying potential intervention opportunities and to inform the planning and development of theoretically supported interventions appropriate to the University setting (Young et al., 2003). The aim of this present study was to gain knowledge about the enablers and barriers to PA amongst staff and students in a university setting employing the TDF to guide the exploration.

4.3. Methods

4.3.1. Study Design

A qualitative study was undertaken employing semi-structured group interviews to examine the enablers and barriers that influence the University of Derby staff and students to engage in PA, with data collection taking place from December 2017 to February 2018. This was in order to compare the reasons why university staff and students participate in PA or not, to be in a better position to develop interventions to increase PA levels among those identified to be physically inactive. The approval to conduct this study was received from the University of Derby's Health Sciences Research Ethics Committee (HS-REC) (Ref no: 09-1717-LNs) (Appendix 1).

4.3.2. Study participants and selection

The study participants included the University of Derby staff and students, and selection was based on their job roles, i.e., academic, administrative, catering and cleaning service staff; whereas the selection of students was based on their level of study and nationality, i.e., undergraduate first year, postgraduate taught (masters), postgraduate research (PhD), and international students (from Sri Lanka, Cyprus, Nigeria, Cashmere, Pakistan and Togo). The international students' group also comprised of second year, third year, postgraduate taught (master) and postgraduate research (PhD) students. The objective was to recruit six participants for each group interview in order to adequately manage the group and to also promote more open discussions among the participants (Jose & Hansen, 2013; Nagle & Williams, 2011). Only current university staff and students who were aged 18 years and over were allowed to take part in this study. Anybody who was below the age of 18 years and neither a current student nor staff of the University of Derby was excluded from this study. Even though the overall aim of this study was to assess the barriers and enablers to PA among inactive university staff and students, it was also important to know why those who were physically active were active. It is believed that this information would help during the intervention design.

4.3.3. Development of group interview question guide

The 14 domains of the TDF were employed in the development of the group interview question guide for this current study (Appendix 2). Semi-structured questions were developed to assess all the TDF domain, through an iterative process until the final group interview schedule was developed. For example, the question for the "Behaviour Regulation" domain was "How do you know how much PA you've done?" When development was completed, the group interview schedule was then pilot tested among some catering staff (n=5) and PhD students (n=5). The purpose of the pilot study was to assess the suitability of the questions and to provide initial indications on the feasibility of the study. Moreover, the pilot study also provided an opportunity to gain some experience in interviewing, especially in managing the flow of discussion (Majid et al., 2017). The pilot study was carried out in December 2017, within a week, with the group interview for the catering staff taking place first. The participants were chosen based on purposive sampling and the readiness to take part in the study. Invitation e-mails, including a participant's slip detailing the prospective days and time for the group interviews, were sent to all catering staff and PhD students. Once the participant's slips were returned another e-mail was sent to the participants with the confirmed day, time and venue of the group interviews. The group interviews were conducted in quiet rooms at the university campus during office working hours, with the researcher as the moderator and a PhD student conversant with qualitative interviewing methods as the assistant moderator. At each group interview, the participants were asked to sign a written informed consent and the discussions audio recorded with their permission. Each group interview lasted up to 90 minutes, with light refreshments provided (Jacob & Furgerson, 2012).

After these pilot group interviews, it was observed that the participants understood all questions asked, because the questions were appropriately answered, and no participant misunderstood any question nor required further explanations. Additionally, all questions in the interview schedule were extensively discussed among the participants within the allocated timeframe, no potential practical challenges were encountered following the steps as detailed in the interview schedule, and no alterations were made to the interview schedule, therefore the data obtained were used as part of the main investigation. This is consistent with a report by Majid et al. (2017) which suggested that if a pilot study does not lead to the amendment of constituents or techniques then the information may be appropriate for integration into the core study. Furthermore, the procedures undertaken in this pilot study were supported by a study by Dikko (2016), which indicated that the primary purpose of a pilot study was to ascertain how accurately an investigation tool would perform in the real study, by recognising possible challenges and areas that might need modifications; highlighting obscurities and difficult or unwanted questions and removing or changing them; verifying the time taken to carry out the interviews to ascertaining if it is realistic in real world application; and establishing if every question prompts ample response.

4.3.4. Procedure

4.3.4.1. Participant recruitment

After piloting the interview schedule, several methods were employed in recruiting participants for this study. Firstly, invitation posters and flyers (Appendix 3) were distributed in strategic locations at various University of Derby campuses, i.e., Kedleston Road, Markeaton Street and Britannia Mills sites. Secondly, the invitation was advertised in the university's internal communication platforms known as Derby Daily and Inform. Thirdly, invitation e-mails were sent to all university staff and students (Appendix 4) with participants slip (Appendix 5) showing the various groups of staff and students needed and proposed dates and times for them to tick as appropriate. Once the participants slip were received and up to six people in the same staff or student groups choose the same date and time, another e-mail was sent to them confirming the group interview venue and time. Then they were sent the participants information sheets (Appendix 6) that provided details of the study aims and objectives and what the study involves, in order to give enough time for them to read the participants information sheet before consenting to take part in the focus group discussions. This process continued until all the group interviews were conducted. Finally, the participants were sent reminder e-mails three days prior to each group interview to reiterate the time, date, and location of their group interviews. They were provided an opportunity to contact the research team if they cannot make the scheduled group discussion or have queries or concerns about the study.

4.3.4.2. Interview process

Eight group interviews were conducted in meeting rooms at different locations of the University of Derby during working hours. At the commencement of every group interview, the participants were requested to sign a written informed consent (Appendix 7) and assured of anonymity. All group interviews were facilitated by a moderator (i.e., the PhD research student) and an assistant moderator (other PhD students). The role of the assistant moderators was to take field notes during the discussions. Each group interview commenced with an introductory round in which the moderator and the participants introduced themselves, after which the aim of the study was communicated, and the ground rules (Appendix 8) read out to them. Each group interview discussion lasted up to 90 minutes and was audio recorded, using Dictaphone, with the participants' authorisation. After each group interview, debrief sheets (Appendix 9), which detailed relevant contact information and useful sources of information, counselling support (in case any part of the study causes a participant to be distressed), and some PA websites were given to all the participants. Light refreshments were provided during all the group interviews.

4.3.5. Data analysis

The qualitative content analysis was chosen as an approach to analyse the data generated from this present study, because it can be used to confirm existing theory, without generating new theories. Since this study purposes to assess the significance and applicability of an existing theoretical framework (i.e. the TDF) at assessing the barriers and enablers to PA in a university setting, without developing new theories, deductive qualitative content analysis was found to be the most appropriate method to use, as outlined by Datt (2016) and Elo & Kyngas (2008). Chapter 3, section 3.3. on pages 64-67 outlines the rationale for the selection of the deductive qualitative content analysis in this present study.

Other methods, such as the template analysis, could have been used to analyse the data in this present study but was not appropriate. Template analysis is an approach of thematic analysis, which helps in the organisation and analysis of qualitative data (King, 2012). It has been found useful in the analysis of various forms of textual data such as diary entries, interview transcripts, or focus group data (Brooks & King, 2014). Template analysis is a flexible approach that promotes the utilisation of hierarchical coding with a higher degree of structure.

It involves an iterative process, which allows the use of *a priori* themes (King, 2004). This method is flexible as regards the structure and style of the template that is created. Unlike several other qualitative analytic methods such as interpretative phenomenological analysis (IPA), discourse analysis, framework analysis, grounded theory, and conversation analysis (Gale et al., 2013; Howitt & Cramer, 2017), it does not indicate beforehand a fixed order of the levels of coding. Instead, it aids the researcher to develop themes more broadly where the richest data, with regards to the research aim, are located (Brooks et al., 2015). Even with these strengths, the template analysis was not used in this research project because this approach does not align with any particular paradigm; it involves the use of both deductive and inductive approaches; and *a priori* themes are usually tentative and can be changed, modified or even removed as the analysis progresses (King, 2004). However, since this present research aimed to test the efficacy and relevance of an existing framework, i.e., the TDF, in the PA context in a university setting without generating any new theories or modifying the *a priori* themes, the template analysis was not found appropriate.

The transcripts were then read and re-read several times before the coding process started. The coding scheme was pretested on a sample, i.e., by coding one of the transcripts using the TDF domains as a-priori themes to determine if the emerging themes map to the TDF domains. After pretesting the coding scheme, it was then applied to the data, with emerging themes being mapped to the appropriate TDF domains. However, in order to guarantee consistency and extensiveness, two separate researchers coded the transcripts. Another researcher, i.e., PhD student who is competent in using qualitative content analysis, was given one of the group interviews' transcript and the initial coding structure with their well-articulated operational definitions and constructs to code independently. After coding, a meeting was held between the two coders to compare the themes emerging and all disagreements (i.e., mainly from themes emerging under the Social/Professional Role and Identity and the Emotions domains of the TDF) were settled amicably (i.e., all differences in how these two domains were coded by the two coders were resolved after series of deliberations, until a consensus was reached). This was done in order to create a coding structure that was employed to the rest of the data. The Cohen's kappa inter-rater reliability test indicated that there was a considerable agreement between the two coders, $\kappa = 0.737$ (95% CI, 0.390 to 1.084), $p < 0.0001$, demonstrating that this agreement was significant (see Appendix 10). This was to establish the inter-rater reliability through an external audit employing peer review.

The audio-recordings from the group interviews were transcribed verbatim in Microsoft Word employing Windows Media Player and transcripts anonymised using pseudonyms to ensure no data could be linked back to any of the participants (Humble, 2016). These transcripts were proof-read and then imported into Nvivo12 software (QSR International) ready for coding. The 14 TDF domains were then employed as a-priori themes and coded as 'parent nodes' in Nvivo12, which formed the initial coding structure.

Then to establish the intra-rater reliability, all the data were initially coded and after some months, all the data were re-coded again and no differences were observed among the various themes at both time points. Subsequently, inferences were drawn based on the codes or themes. At this stage, the relationships and differences between different categories were identified and emerging patterns uncovered in order to present the analysis. Finally, the results for this study were then presented under each theme as enablers and/or barriers to PA among the participants and supported by sample quotes from the developed codes. The findings are displayed in Tables 1 and 2 in Appendix 11.

4.4. Results

4.4.1. Participants' characteristics

The study participants included current University of Derby staff and students who were 18 years and above. As illustrated in Table 4.1, the sample (n=40) included 22 female and 18 male university staff and students with an average age of 34.5 ± 7.37 years.

Table 4. 1: Demographic characteristics of participants in the group interviews

S/N	Focus group	Number of participants (M/F)	Mean age (SD)
1	PhD students	5 (5/0)	31.2 ± 5.89
2	International students	6 (4/2)	32.5 ± 5.86
3	Postgraduate Masters students	5 (1/4)	28.8 ± 5.40
4	Frist Year Undergraduate students	3 (2/1)	21.7 ± 1.53
5	Academic staff	5 (2/3)	41.4 ± 5.18
6	Administrative staff	5 (2/3)	36.0 ± 8.31
7	Cleaning staff	6 (1/5)	42.2 ± 12.66
8	Catering staff	5 (1/4)	42.2 ± 16.17
	Total	**40 (18/22)**	**34.5 ± 7.37**

4.4.2. Enablers and barriers to physical activity

Nine of the 14 TDF domains were reported as both barriers and enablers (i.e., environmental context and resources; knowledge; emotions; beliefs about capabilities; skills; social influences; intentions; optimism; and social/professional role and identity); four domains were reported as only enablers (i.e., behavioural regulation; reinforcement; goals and beliefs about consequences); while only one domain (i.e. memory, attention and decision processes) was reported as a barrier. However, this study will focus mainly on the six prominent domains that were identified as both barriers and enablers to PA, i.e., (1) environmental context and resources (17.0%); (2) Intentions (13.7%) (3) Social Influences (12.9%); (4) Knowledge (10.9%); (5) Beliefs about Capabilities (9.8%); and (6) Social/Professional Role and Identity

(6.8%), amongst university staff and students, in order to focus on the domains that are more likely to bring about the desired change.

Table 4. 2: The coding frequencies of the domains of the Theoretical Domains Framework

S/N	**Domains of the TDF**	**Coding frequency**	**Percentage of total**
1	Environmental Context and Resources	321	17.0%
2	Intentions	259	13.7%
3	Social Influences	245	12.9%
4	Knowledge	207	10.9%
5	Beliefs about Capabilities	186	9.8%
6	Social/Professional Role and Identity	128	6.8%
7	Beliefs about Consequences	103	5.4%
8	Skills	95	5.0%
9	Memory, Attention and Decision Processes	78	4.1%
10	Reinforcement	72	3.8%
11	Emotions	64	3.4%
12	Optimism	58	3.1%
13	Goals	40	2.1%
14	Behavioural Regulation	36	1.9%
	Total	**1892**	

The emerging themes from the group interviews fit into the 14 TDF domains and in line with the results of a recent investigation carried out by Quigley et al. (2019), and 71.1% of themes fit into the six most prominent domains (see Table 4.2). According to Michie et al. (2014), in changing behaviour, it is more beneficial to target a few prominent domains and progressively introduce change than attempting to target too many domains too quickly. See tables in Appendix 9 for the themes, subthemes and sample quotes based on the reported barriers and enablers to PA engagement in university staff and students.

4.4.2.1. Knowledge

Only one academic staff and master's student knew the recommended PA guidelines:

> *"Um… so, current recommendations are 30 minutes 5 times a week moderate intensity exercise"* (Mark- Academic staff- KNW1).

However, most of the participants (i.e., university staff and students) did not know the PA recommendations and varied widely in their knowledge about it, which may be an obstacle to PA participation:

> *"I think its 3 hours a week of intensive activity. There is also for moderate activity, which should be longer, probably 1 hour a day"* (Richard- international student- KNW2).

Although most of the participants lacked knowledge about the prevailing recommended PA guidelines for adults, some stated that the awareness of the benefits that can be gained through PA engagement influences them the most:

> *"The main influences I suppose are just my knowledge that it is good for me. That's my…that's what influences me the most, just my knowledge to do something that I ought to do"* (Jane- Administrative staff- KNW3).

Furthermore, some participants acknowledged that the knowledge about easily accessible sports and provision of information about sports events will influence them to participate in PA.

> *"Erm, I think knowledge would be an incentive in regard to the…if something was…if more information was provided on, say, the easily accessible nature of something, you know, more information, if there was a lot of information provided about a particular sport event or something like that, that's an incentive for me, because, I think, it's… it's that knowledge of it's easy to do, I can do this, it's okay"* (Michelle- master's student KNW4).

4.4.2.2. Social Influences

Most participants asserted that they would participate more in PA when their family, friends or colleagues are with them:

"Yeah, so friends, family um… that's what I found with myself, so there's a lot of encouragement between each other, and you can enjoy it more if you're with people that you enjoy being around" (Andrew- PhD student- SI1).

However, a few reported not engaging in the recommended PA because of family commitments:

"…then add on going home, picking up my child, um… cooking dinner, getting her to bed, that leaves me, if I'm lucky, half an hour" (Monica- Academic staff- SI2).

4.4.2.3. Environmental Context and Resources

Some of the participants acknowledged that the sports centre, high-rise buildings, nearness of the university to a park and shops, and availability of changing facilities and safe bicycle sheds were aspects of the university environment that would inspire their engagement in PA:

"Well yeah, I think having the sport centre in terms of our estate I think is great. A great facility in terms of location of the environment" (Anita- Administrative staff- ECR1).

"Erm, I think the location, because the …it's very much, obviously I know it's literally everything's high, it's not flat, all these buildings are high, so it's a fact of, you know, I'll always use the stairs instead of using the lift" (Michelle- Master's student- ECR2).

"…sometimes I deliberately set it up so that…because I see students over at other sites, so that I can have a walk in between from here to Britannia Mill, and that's…I really enjoy doing that but it's just fitting it in" (Jane- Administrative staff- ECR3).

"…I know a lot of people go to park farm for lunch, kind of walk to the shops and back" (Anita- Administrative staff- ECR4).

"It's pretty good that the park is quite near if you did want to go for a wonder walk, again, only if you can fit it in around you" (James- Administrative staff- ECR5).

"Um… I think it's quite good that it's got, you know, places to lock your bikes and there's the changing facilities in the gym" (Wendy-Administrative staff- ECR6).

Motivational signs by the lifts and advertisement about PA opportunities in university buses were mentioned by some of the participants as aspects of the university environment that would inspire their engagement in PA:

> *"I don't know if this makes sense, you know the lifts where they have those labels on, that says, "Don't use the lifts, use the stairs,"? That could be a bit of an encouragement, couldn't it?"* (Hillary- First year undergraduate student- ECR7).

> *"That's a good… and the advertisements in the bus as well, because sometimes when you look at the distance, especially during new session and they advertise that if you're a student, if you register at so, so time, so when you look at it you will start to think what if I do this in the uni, you know, it will pay off because I will be in uni after school, after my lecture or after everything you go back and do the exercise and go back home. I think that advert is good as well"* (Titilayo- International student- ECR8).

Furthermore, some other participants believed that the university provides several opportunities for staff and students to participate in PA through the provision of several PA initiatives such as the Move More and stair climbing challenge:

> *"I think this kind of um… even yesterday we were sitting in our office, there is… two girls come to our office just to give us some brochures that… to encourage us to go to gym with some details inside, I think. Um… this kind of thing arranged by the university, yeah, these kinds of things that maybe motivate us or are good things to go to, to do more and more now, like more training or more physical activities"* (Elvis- PhD student- ECR9).

> *"No, a few…sometimes they do um… running up the towers don't they? They have all the people who want to do it, you can run up every single tower in the university, and the first one who completes it gets a gym pass. They do it and they get a gym pass free for a month. So that gets not a lot, I don't know how many people actually do it, but… but quite a lot of people do it and whoever wins does get something for it and the gym"* (Aby- Cleaning staff- ECR 10).

On the other hand, even with these opportunities created by the university environment, some participants mentioned several barriers, such as time constraints and timing, financial constraints, work, family, and study commitments that influence the uptake of these opportunities:

"…it was 7.30 so of course people are being free, but most of the students are away so they're not enjoying that, you could just watch or just try, so they are doing something but not at a good timing, so because of the timing" (Frank- PhD student- ECR11)

"…but I've been down and it's too expensive. I think they ought to give like a, I don't know six weeks free or something or a month free just to encourage you. And then after that then you can decide whether it is worth the money what they're asking. Because they do have a lot of classes down there, I think, don't they? Because it is a big facility ain't it?" (Amy- Catering staff- ECR 12).

"I wouldn't be able to join a gym because I can't afford gym membership and transport to a gym, I'd have to walk, like, an hour to get to the gym and then I've walked an hour, I'm not doing exercise on top of that" (Martha- Master's student- ECR13).

"…my research and time for family, so there is no time left" (Christopher- PhD student- ECR14).

The weather, inaccessibility to certain sports facilities such as swimming pools and lack of advertisements of available PA opportunities were also considered as barriers to PA engagement by other participants:

"And I think, I don't know it is just, I think it is harder in winter to be healthier than in summer. I think you feel more like doing you know activities outside in summer. So, winter is a bad time but um… yeah, I think, I think everybody should do it" (Amy- Catering staff- ECR15).

"Um… If they had a swimming pool that would make a difference, perhaps um… that was a real missed opportunity in my opinion." (Catherine- Academic staff- ECR16).

"…And, I suppose they could have more posters about what's available there, but I'm only at University two days a week and then the rest of it is me at home, so I don't think it really impacts that much" (Martha- Master's student- ECR17).

The high-rise buildings and location of the university campuses, social timetabling at the sports centre especially for staff and the free bus scheme were also other barriers mentioned by some participants as preventing them from taking up the PA opportunities provided by the university:

> *"…I don't even take my lectures here, I take it at Friars Gate, which is just one long building, so it's a matter of getting to the building, jump in the lift, get to where you're going, come down, so there's really no room for that at all in Friars Gate"* (Bill- Master's student- ECR18).

> *"…but obviously the University of Derby is scattered all over the place, so you have to jump on the bus, you have to, so I don't think the whole University of Derby take the way it is really, I'm not sure that's, er… yeah"* (Bill- Master's student- ECR19).

> *"…as well and I think some of the sports…social timetables and things don't quite fit well for staff, they are a better fit for the students. And yeah, it's kind of geared a bit more for students than staff"* (James- Administrative staff- ECR20).

> *"…I noticed that Derby also does a free bus for students, it doesn't encourage them to walk, so they're just lazy"* (Frank- PhD student- ECR21).

While others stated that they would like to engage in more of different types of activities:

> *"Yes, some different activities, why not, experience something new"* (Joseph- Academic staff- ECR22).

However, some participants said that though they desire to take part in more PA, they were happy with the level they were already engaging in due to their health conditions. Whereas some others said that they intend to do more of the same types of activities:

> *"Well, I'm happy doing what I am doing now. I would like to do more, but with my health and everything I might not be able to"* (Jessica- Cleaning staff- ECR23).

> *"I want to do more of the same things"* (Barak- First year undergraduate student- ECR24).

In addition, other participants felt that their intentions to participate in PA were internally driven and not influenced by gifts of financial incentives:

"They're all internal motivators, I wouldn't be motivated by a gift or financial, it's what I want to do when I want to do it" (Mark- Academic staff- ECR25).

On the other hand, some participants that used to be active before do not intend to engage in PA, while some others who acknowledged that they ought to participate in routine PA were not doing any:

"I don't really, I don't really do anything. I used to go out on my pushbike a lot but I'm going to in summer because I haven't got a dog now. My life has changed quite a bit since I lost the dog really because I used to go out a lot more when I got the dog" (Amy- Catering staff- ECR26).

"I'm supposed to be going out every day to do like 30 minutes of… but I don't" (Oluchi- International student- ECR27).

While others acknowledged that they know they should be engaging in more PA and trying out new things, but they do not engage in any form of activities:

Erm, well I know that I should do more, and I do think about doing more. Erm, in terms of trying different things, well I don't do anything, so everything's different (Martha- Master's student- ECR28).

4.4.2.4. Beliefs about capabilities

Some participants reported having the belief in themselves to participate very well in PA, because they are fit enough and have the resources:

"I think, yeah, I think if I put my mind to it I could do it. I could do because I've not got anything wrong with me you know what I mean like, I'm fit enough, she says, um… no I'm fit enough I think for my age, so it is like yeah I could do anything I set my mind to it or wanted to" (Anne- Academic staff- BAC1).

Lack of confidence to participate in PA due to health issues, difficulty to take part in PA, as well as the distance to sport facilities were commonly stated as barriers to engage in PA:

"I can't do everything I want to do anymore because my lower joints won't let me" (Catherine- Academic staff- BAC2).

> *"Um… to me I think number one, it's difficult. Why? Initially there used to be gym very close to my house at Moorways and they closed that place. Now which means I have to come to town, you know, and from my house to town will be about 30 minutes or 40 minutes to town. So when I think about the time I have to walk or take the bus, and if I decide to stay back at uni, I don't normally come to uni every day, so as much as I would have loved to go to gym maybe two times in the week or three times, the distance to my house that's number one"* (Titilayo- International student- BAC3).

4.4.2.5. Social/Professional Role and Identity:

The participants believed that PA was essential in their course as students and in their job role as staff:

> *"I was encouraged to start doing physical activity when I joined the university. They had this fair in the atrium with different clubs and societies for students to join. So, I strongly believe that the university sees being physically active as important for students and this has influenced me to active"* (Donald- First year undergraduate student- SPRI1).

> *"As a cleaning staff, our daily work involves lots of physical activity and I think it is essentially necessary to be physically active to perform well as a cleaner. I mean cleaners are expected to be physically active, aren't we?"* (Joe- Cleaning staff- SPRI2).

Additionally, some participants felt that taking up opportunities to be physically active was an essential aspect of their identity, which could be an enabler to engaging in PA:

> *"As I said earlier, our job involves lots of physical activity and therefore demands us to be physically active. Although, I cannot say that all my colleagues meet the recommended physical activity guidelines, taking up physical activity opportunities with my colleagues to be active is an important part of my identity as a cleaning staff"* (Joe- Cleaning staff- SPRI3).

On the other hand, some participants mentioned several barriers that will stop them from participating in PA, such as the difficulty in taking up opportunities to engage in PA, low motivation to participate in PA and the fact that PA is not seen as an important attribute for them:

"There are so many opportunities in the university for us as administrative staff to be physically activity, but I guess the university authorities do not belief that it is important for us to be active. I feel they should have a timetable of activities at the sport centre that fit with our work routines. They focus more of students, which may be a major reason why most administrative staff are inactive" (Peter- Administrative staff- SPRI4).

"Um… as I said before, I am very lazy when it comes to physical activity. I cannot say for other students, but I believe that students are generally lazy when it comes to engaging in physical activity" (Oluchi- International student- SPRI5).

"The university authority is not interested in encouraging the academic staff to be physically active. They just increase our workload almost on daily basis and do not really care if we engage in any form of physical activity. Since physical activity has been associated with many health benefits, as well as reduction in absenteeism from work, we should be given time to engage in some form of physical activity. However, this is not the case, as the university authority do not believe physical activity is important for us." (Lynda- Academic staff- SPRI6).

Another barrier to engagement in PA mentioned by some participants was the university's focus on undergraduates. They believed that the university does not care if students in other levels of study are active or not:

"The university only cares about the undergraduate students. I remember them having sports fairs in the atrium for the undergraduates to encourage them to be physically active. For us, the university does not care if we are active or not. I guess that is why most of us are inactive. There is no encouragement from the university to make PhD students physically active" (Christopher- PhD students- SPRI7).

4.4.2.6. Intentions

Most of the participants stated that they plan to engage in more PA and also intend to engage in more of the same or different types of PA:

"Of course, I would like to do more physical activities (Mohammed- International student- INT1).

"Yes, some different activities, why not, experience something new" (Joseph- Academic staff- INT2)

"Well, I'm happy doing what I am doing now. I would like to do more, but with my health and everything I might not able to" (Jessica- Cleaning staff- INT3).

"I want to do more of the same thing, referring to the gym aspect getting back to my workout routine five days a week, I want to get back to that. As far as anything else, um, I don't see myself doing anything else right now" (Barak- First year undergraduate student- INT4).

However, some of the other participants stated that they had no plans to engage in PA and do not intend to do more PA:

"I don't really, I don't really do anything. I used to go out on my pushbike a lot but I'm going to in summer because I haven't got a dog now. My life has changed quite a bit since I lost the dog really because I used to go out a lot more when I got the dog" (Amy- Catering staff- INT5).

"I don't know, because I just, I don't like the feeling of it, I don't like the, the moving and the breathlessness, because I think I panic, because I assume it's the asthma" (Martha- Master's student-INT6).

4.4.3. Additional items to measure social/professional role and identity and the memory attention and decision processes

In order to test the relevance of the 14 domains of TDF in the PA context in the university setting, six additional items were developed to measure the 'social/professional role and identity', and the 'Memory, attention and decision processes' domains not assessed by the Determinants of Physical Activity Questionnaire (DPAQ) (Taylor, Lawton, & Conner, 2013), a validated scale that assess the TDF domains in the PA context. The quotes from participants were used to develop these six items.

For 'memory, attention, and decision processes' domain, for both university staff and students, the following shows the additional three items and quotes used in developing them:

(1) With all my competing priorities, it is difficult to justify time for physical activity:

"I have so much going on at work and at home which makes it hard for me to engage in any form of Physical activity. The truth is that there is no time to actually do all the activities I would love to do, if that makes sense" (Anne- Academic staff- MADP1)

(2) Sometimes I just forget I had planned to do physical activity, because am busy doing something else:

"On several occasions, I have planned to engage in physical activity, but due to my lab work and other study related commitments, I just forget to engage in it. I always feel bad afterwards, but this is a major barrier that prevents me from being active" (Elvis-PhD student- MADP2).

(3) The university offers so many options of physical activity that I can't decide which one(s):

"They have so many sports and exercise classes going on in the sports centre that makes it difficult for me to choose the ones to do" (Joe- Cleaning staff- MADP3)

Furthermore, for the 'professional/social role and identity' domain, for both university staff and students, the following shows the additional three items and quotes used in developing them.

(1) Being physically active is seen to be an important attribute for someone in my job role:

"As a cleaning staff, our daily work involves lots of physical activity and I think it is essentially necessary to be physically active to perform well as a cleaner. I mean cleaners are expected to be physically active, aint we? (Joe- Cleaning staff- SPRI).

Being physically active is seen to be important for people in my course:

"I was encouraged to start doing physical activity when I joined the university. They had this fair in the atrium with different clubs and societies for students to join. So I strongly believe that the university sees being physically active as important for students and this has influenced me to active" (Donald- First year undergraduate student- SPRI2).

(2) Like most staff, I am pretty lazy when it comes to physical activity:

"I think like most administrative staff, I am very lazy with regards to engaging in physical activity. We are sat in front of our computers all day, so yes am pretty lazy when it comes to physical activity" (Anita- Administrative staff- SPRI3)

Like most students, I am pretty lazy when it comes to physical activity:

"Um… as I said before, I am very lazy when it comes to physical activity. I cannot say for other students, but I believe that students are generally lazy when it comes to engaging in physical activity" (Oluchi- International student- SPRI4).

(3) Taking up opportunities to be physically active with colleagues is an important part of my staff identity:

As I said earlier, our job involves lots of physical activity and therefore demands us to be physically active. Although, I cannot say that all my colleagues meet the recommended physical activity guidelines, taking up physical activity opportunities with my colleagues to be active is an important part of my identity as a cleaning staff (Joe- Cleaning staff- SPRI5).

Being part of societies and clubs that offer opportunities to be physically active is an important part of my student identity:

I was encouraged to start doing physical activity when I joined the university. They had this fair in the atrium with different clubs and societies for students to join. So, I strongly believe that the university sees being physically active as important for students and this has influenced me to active (Donald- First year undergraduate student- SPRI6).

4.5. Discussion

This qualitative study applied the 14 domains of the TDF to provide valuable understanding about the barriers and enablers to PA amongst staff and students in a university setting. However, of these 14 domains of the TDF, the outcomes of the group interviews identified that there were six domains (i.e., referenced 71.1% times) that were key themes arising from the participant groups. The results from this exploratory study suggest novel and fascinating perceptions about the determinants (i.e., enablers and barriers) of PA amongst university staff and students in relation to their perceived capability, opportunity and motivation. Results of this study are corroborated by previous studies carried out among university staff and students' specific barriers and enablers to PA. Therefore, the findings of this present study will be discussed under two major sections, namely: factors reported as both enablers and barriers and development of additional items to assess the 'social/professional role and identity' and the 'memory, attention and decision processes', domains of the TDF.

4.5.1. Factors reported as both barriers and enablers to physical activity

Most of the participants identified social/professional role and identity; environmental context and resources; knowledge; social influences; skills; beliefs about capabilities; and intentions as both enablers and barriers to PA.

4.5.1.1. Knowledge

Most participants defined PA in different ways but were unaware of the PA recommendations for adults, with only two of the 40 participants (i.e., 5.0%) being able to correctly report the adult's recommendations for PA. This is in line with previous studies that similarly reported low awareness of the recommended PA level among adults in various countries. For example, only 34.8% to 36.1% of adults in the US (BeBastiani et al., 2014; Kay et al., 2014); 27.0% in Ethiopia (Abdeta, Seyoum, & Teklemariam, 2019); 8.4% to 18.0% in the UK (Hunter et al., 2014; Knox et al., 2013); 9.3% in India (Anand et al., 2011); and 4.4% in China (Abula et al., 2016) could correctly report the recommended PA guideline. However, the knowledge of PA reported in this study (5%) was much lower than those reported in other countries (8.4% to 36.1%), except in China (4.4%). It is also notable that this is a well-educated population, given the fact that it is a university setting and therefore such knowledge ought to be concerning and evidence that more needs to be done within the setting to raise peoples' knowledge of PA recommendations. This divergent knowledge about the recommended PA guideline reported across these countries may be due to unequal disseminations about PA (Abdeta et al., 2019).

It is unsurprising that educational interventions have been used effectively to increase knowledge about PA (Ghaffari et al., 2013; Parrott et al., 2008). According to Fredriksson et al. (2018), individuals with more awareness concerning the benefits of PA and the detrimental impacts of physical inactivity tend to participate more in PA. Consequently, the poor knowledge of the PA recommendations suggested by the results of this current study (Quotes: KNW1 and 2), emphasises some of the challenges involved in the long-term process of behavioural change (Andersen & Jakicic, 2009; Bennett et al., 2009), and should thus be encouraged more, because this awareness offers direction on the regularity, forms and magnitude of PA essential to obtain the health benefits (Fredriksson et al., 2018). Therefore, it is recommended that the knowledge base and educational information is elevated across the university setting since only 5% of the population sample were aware of the guidelines.

4.5.1.2. Social influences

The impact of social support on PA engagement has been extensively researched among adults in diverse contexts and settings. A major finding of this study suggests that a majority university staff and students would engage in more PA with encouragement from friends, family or colleagues (Quote SI1), while some others believed that not having this social support could act as a barrier to PA engagement (Quote SI2). This is aligned with the results reported in previous investigations carried out among university students (Dayi et al., 2017; Deliens et al., 2015), university staff (Brett & Pires-Yfantouda, 2017; Kamal & Radzani, 2016), adult population (Oliveira et al., 2011), which also revealed that family, friends and colleagues could offer a significant supportive role and encourage participation in PA. Strong evidence suggests that social support from friends, family and colleagues can influence people to engage in PA through the increase in their levels of self-efficacy and motivation. Conversely, insufficient social support has been acknowledged as a key barrier stopping people from participating in PA (CDC, 2010). This finding was partly comparable to those identified by Daskapan et al. (2006), Ramírez-Vélez et al. (2014) and Sultoni & Suherman (2017), which indicated that insufficient social influences were a barrier to engagement in PA. Even though strong evidence suggests that support from friends, family and colleagues will encourage people to engage in PA, most studies (Greaney *et al.*, 2009; Lacaille, Dauner, Krambeer, & Pedersen, 2011) only mentioned social support from friends, however, this present study demonstrated that social support from family and colleagues also influence engagement in PA (Quote SI1).

Social influences have been established to increase PA participation through its impact on self-efficacy and motivation (Ishii, Oka, & Shibata, 2011; Laird et al., 2018; McNeill et al., 2006; Motl et al., 2007). In support of this, Laird et al. (2018) posited that social support improves a person’s self-efficacy to surmount the obstacles to PA participation, and this improved self-efficacy is linked with increased PA participation. Furthermore, Laird et al. (2018) stated that social influences improve PA participation through the enhancement of individuals enjoyment of PA, which leads to increased participation in PA. However, since there are limited research investigating the mechanisms through which social influences affect PA, it is possible that other mechanisms exist. Therefore, examination of how social influences associate with PA can help in understanding more about the forms of future interventions that may be required to encourage continuous behaviour change towards PA amongst university staff and students.

4.5.1.3. Environmental context and resources

Most participants (i.e., 95%) mentioned aspects of the university environment (e.g. sports centre, location of campuses, high-rise buildings, proximity of university to shops and a park, changing facilities and secure bike sheds, motivational posters by the lifts and advertisements in university buses) and opportunities to do PA in the university (i.e., physical initiatives) that will encourage them to participate in sports or exercise (Quotes ECR1 to ECR10). One of the results of this present study was reinforced by previous studies which also revealed that the provision of convenient and accessible sports facilities would provide enough opportunities for university staff and students to engage in some form of sports or exercise (Bethancourt et al., 2014; Deliens et al., 2015; Donaldson-Feilder et al., 2017; Hashim, 2012; Lacaille, Dauner, Krambeer, & Pedersen, 2011). The opportunities offered by the provision of an intramural sports centre in the University of Derby should be fully maximised in future interventions aimed at engaging staff and students in PA, bearing in mind that the membership fees have been highly subsidised for both groups and would therefore enable staff and students to participate in PA. Furthermore, the location of a university campus near a park was reported as an aspect of its environment that would encourage staff and students to participate more in PA (Quote ECR5). This is in line with a study by Van Cauwenberg et al. (2015), which indicated that residential location and proximity to parks significantly increased participation in PA among middle-aged adults. In support of this, a systematic review study carried out by Bauman et al. (2012) to evaluate the correlates of PA amongst adults and children revealed that environmental influences such as access to PA spaces (i.e., green spaces, footpaths and parks) increase PA participation. This may be because parks present individual with the opportunity to spend quality moments with friends, family and colleagues away from the noise and hassles in the city, connect with nature and participate in PA (Burrows, O'Mahony, & Geraghty, 2018). Therefore, the location of the University of Derby near a park should be explored in developing interventions to motivate staff and students to utilise the open green space whenever it is convenient for them.

The significance of building heights and therefore stair use as an approach to progressively increase daily engagement in PA cannot be overemphasised. Several studies have reported the importance of signage by the lifts in encouraging stair use across diverse settings and populations (Bellicha et al., 2015; Engelen et al., 2017; Ruff et al., 2014; Soler et al., 2010; van Nieuw-Amerongen et al., 2011), but no study reported the influence of high buildings on encouraging or discouraging stair use. However, as consistent with the findings of this current study, some investigations have identified insignificant effects while others have not identified any effects on stair climbing in workplaces (Jean Adams & White, 2002; Coleman & Gonzalez, 2001). A quasi-experimental study by Grimstvedt et al. (2010) assessed the efficiency of a promotion strategy to improve stair climbing in detectable and undetectable staircases during and post-intervention follow-up among university staff and students in a United States university. Their results indicated that during the intervention period, stair use rose considerably and continued over baseline levels throughout post intervention evaluation. This implies that motivational and directional signage could considerably enhance use of stairs in a university setting. Additionally, staircase conspicuousness is an essential part of stair climbing campaign. Walking and stair climbing are economical PA strategies that is promising and does not entail any distinct equipment to partake.

On the other hand, some other participants reported time and timing; financial constraints; work, study and family commitments; and weather as the major barriers to taking up the PA opportunities provided by the university (Quotes ECR11 to ECR15). Even though limited studies have assessed the enablers and barriers to PA amongst university staff and students, this is principally aligned with the results from previous research (Aceijas et al., 2016; Cooper & Barton, 2015; Deliens et al., 2015; Gómez-López, Gallegos, & Extremera, 2010; Hoare et al., 2017), which also revealed that time, money, family commitments, physical environment, convenience and availability of sports amenities, and study commitments were major barriers inhibiting university staff and students from engaging in PA. These results are also partially comparable to those identified by Iván Martínez-Lemos, Puig-Ribera, & García-García (2014) among Spanish university students. Therefore, from a university perspective, examining the motives for participating in PA or not may ultimately help to better organise and encourage PA among staff and students.

4.5.1.4. Beliefs about capabilities

Another finding of this present study was that having the confidence in an individual's capability to carry out a behaviour (i.e., self-efficacy) such as PA engagement among university staff and students may encourage them to participate in it (Quote BAC1), while the lack of confidence in an individual's capability to participate in PA may act as an impediment (Quotes BAC2 and BAC3). The perceived lack of self-confidence in the capability of some university staff and students to engage in PA (i.e., lack of self-efficacy), which was stated as a barrier to PA engagement in this study is worrisome, but in consonance with the results from similar studies carried out by Edmunds, Hurst & Harvey, (2013) and Saadan et al. (2015). This indicates that the level of self-efficacy that people have may significantly influence their behaviour, i.e. if people think that they can successfully carry out a behaviour, they would be more inclined to carry out the behaviour (Pekmezi, Jennings & Marcus, 2009). As a result of its vital implications in changing health behaviour, self-efficacy has been extensively employed in several health fields, such as smoking, alcohol consumption, weight management, diet, sun protection, as well as PA (Pekmezi, Jennings & Marcus, 2009).

Self-efficacy has been posited to affect the activities that people select to engage in, the amount of energy they spend to pursue their objectives, and the levels of perseverance they exhibit regardless of obstacles, disappointments, and challenges (Mcauley et al., 2011). Therefore, it is hard to dispute that choice, determination, and perseverance are not associated with the effective participation and continuation of a PA routine. Consequently, self-efficacy has been associated with intricate health behaviour, and undeniably, it has been prominently reported as a major correlate of PA performance (McAuley & Blissmer, 2000). Self-efficacy is the most commonly known psychosocial determining factor for PA, thus, it is imperative to assess and, if required, improve people's self-efficacy for PA. Some strategies that have been used to enhance the self-efficacy for PA include goal setting and prescribing activity, rehearsing activity behaviours, and using pedometers/activity logs to self-monitor PA (i.e., past performance); modelling using videotapes of peer role models, and using peer role models to carry out sessions of group PA (i.e., vicarious experience); highlighting the physiological gains of PA, encouraging friends and family to encourage and strengthen activity performance, commending individuals for any improvement, and accrediting all accomplishments to individuals' personal determinations (verbal persuasion); and helping individuals to forestall and constructively elucidate physical uneasiness associated with PA (e.g., exhaustion and muscle pains), and using relaxation exercise to reduce nervousness (i.e., physiological cues). However, since the self-efficacy of a person to participate in PA has been identified as a principal prognosticator of compliance to PA, incorporating some of these effective strategies to increase people's self-efficacy to participate in PA might be a valuable approach to encourage engagement in PA (Ashford, Edmunds, & French, 2010) among university staff and students.

4.5.1.5. Social/professional role and identity

The Determinants of Physical Activity Questionnaire (DPAQ), a validated scale developed by Taylor, Lawton, & Conner (2013) to measure the domains of the TDF in a PA context, did not measure the 'social/professional role and identity' domain of the TDF. However, contrary to the claim by Taylor, Lawton, & Conner (2013), one of the findings of this current study indicated that the 'social/professional role and identity' domain of the TDF was relevant in the PA context and thus important to explore further. The 'social/professional role and identity' domain was another domain of the TDF reported as both barrier and enabler to PA amongst university staff and students. In this present study, the importance of PA in course/job role (Quotes SPRI 1 and SPRI2) and opportunities created for staff and students to be physically active (Quote SPRI3) were cited as enablers to PA. Conversely, the difficultly in taking up opportunities to do PA (Quote SPRI4), laziness of staff/students (Quote SPRI5), university administrators not seeing PA as important attributes to university staff (Quote SPRI6), and more focus of PA initiatives on the undergraduate students (Quote7) were all stated as possible barriers to PA engagement.

Even though the effect of 'social/professional role and identity' as a barrier and/or an enabler to PA engagement among staff and students has not been examined in a university setting, it has been generally studied in the PA context across different populations in diverse settings. For instance, a research carried out by Flannery et al. (2018) to determine the barriers and enablers to PA engagement amongst pregnant overweight women, in a hospital setting, reported ‘social/professional role and identity’ as an impediment to PA engagement. Furthermore, the findings of another qualitative study by Quigley et al. (2019) similarly indicated that professional/social role and identity was both a barrier and an enabler to engagement in PA amongst the elderly with HIV. It is important to ascertain the ways in which a person's social and professional identity can be influenced, in order to encourage the motivating factors while attempting to reduce the barriers. Therefore, when designing interventions to change behaviours towards PA in a university setting, it is worth considering issues concerning the professional, social role and identity of the staff and students.

4.5.1.6. Intentions

A unique feature of this current study is that the intention to participate in PA was revealed as a barrier as well as an enabler to PA engagement. Whilst most participants mentioned having made conscious decision and/plans to engage in more as well as the same and different types of activities (Quotes INT1 to INT4), some others reported having no plans to do more PA (Quotes INT5 and INT6). Intention is a premeditated resolution to carry out a behaviour or a determination to perform in a specific manner (Atkins et al., 2017), and has been established as an important construct in generally utilised health behaviour theories such as the transtheoretical model (Prochaska & DiClemente, 1983), protection motivation theory (Rogers, 1983), theory of planned behaviour (Ajzen, 1991), social cognitive theory (Bandura, 2001), health action process approach (Schwarzer, Lippke & Luszczynska, 2011), and more recently the theoretical domains framework (TDF) (Cane et al., 2012). Previous studies (Cooke et al., 2016; McEachan et al., 2011; McEachan et al., 2016; Sheeran, 2002) suggest that intentions portend a significant amount of variability in the regularity and duration of imminent PA. For example, McEachan et al. (2011) projected that 33% of inconsistency in imminent PA performance is explained by intentions. Empirical evidence also reinforced the significance of intentions in predicting change in PA performance, even though to a lesser extent than observed in correlational investigations (Rhodes & Dickau, 2012; Webb & Sheeran, 2006). In support of this, Rhodes & Dickau (2012) observed that the experiential manipulations of the intentions to engage in PA only resulted in slight changes in PA. However, the relationship between intentions and behaviour consistently reported in PA research indicated that there were benefits in fostering intentions, but likewise demonstrated that much inconsistency in PA was not accounted for by intentions (Rebar, Rhodes, & Gardner, 2019). Therefore, understanding behaviour necessitates not just the understanding intentions, but equally the factors that influence the probability of taking action on intentions (Rebar et al., 2019).

Even though intentions can undeniably have an effect on a range of health behaviours, the greatest intentions are frequently unsuccessful in translating into anticipated behaviours (Conroy et al., 2011). For example, individuals often set PA objectives, but later find themselves discouraged or frustrated by their inability to participate or continue carrying out the PA (Conroy et al., 2011). The importance of intentions in enacting a behaviour such as PA resulted in the creation of the implementation intentions (Gollwitzer & Sheeran, 1999; Gollwitzer, 1993). Aarts, Dijksterhuis, & Midden (1999) argued that having strong intentions to carry out a behaviour does not necessarily lead to the enactment of that behaviour. However, forming an implementation intentions of when, where and how to carry out the behaviour will enhance the accessibility of environmental prompts to act and hence increase memory to carry out the required behaviour (Sheeran & Orbell, 1999). Implementation intentions has been extensively used amongst students in the university setting (Conner et al., 2010; Milne et al., 2002; Murray et al., 2009; Prestwich et al., 2003) to develop their intentions to engage in PA. Therefore, the formation implementation intentions of days, times and locations to carry out PA may be useful in interventions aimed at encouraging university staff and students to engage in PA.

4.5.2. Development of additional items to assess the memory, attention and decision processes, and the social/professional role and identity domains of the TDF

The aim of this present study was to fully examine the applicability of the 14 domains of the TDF in assessing the enablers and barriers to PA amongst staff and students in a university setting, before selecting the prominent domains to focus on. The Determinants of Physical Activity Questionnaire (DPAQ) (Taylor, Lawton, & Conner, 2013), a validated scale to assess the TDF domains in the PA context, indicated that ‘social/professional role and identity’, and the ‘Memory, attention and decision processes’ domains of the TDF were not applicable in the PA context. Therefore, it was imperative to find out if these two domains may be useful in the PA context. Even though the TDF is relatively new and has been barely employed in the PA context, a review of pertinent literature (Flannery et al., 2018; Haith-Cooper et al., 2018; Quigley et al., 2019) suggested that these two domains were relevant in the PA context. These findings from previous studies were corroborated by this present study, which showed that the ‘memory, attention and decision processes’ domain and the ‘professional/social role and identity’ domain where barriers and enablers to PA among university staff and students, even though the later was more prominent. Therefore, some quotes from the group interviews informed the development of six items (see section 4.4.3) to measure the ‘memory, attention and decision processes’ domain (Quotes MADP1 to MADP3) and the ‘professional/social role and identity’ domain (Quotes SPRI1 to SPRI6), in order to assess the entire 14 domains. These six items were included together with the DPAQ in the survey (i.e., composite questionnaire) used to determine which domains of the TDF predict PA amongst the inactive administrative staff and post-graduate research (PhD) students (i.e. study 2 in chapter 5).

4.6. Conclusion

This study presents insights into the identified barriers and enablers to PA engagement from the viewpoints of staff and students from one UK University. Previous studies have generally emphasised the significance of understanding the enablers and barriers to PA in diverse settings, including staff and students in a university setting to inform the development of effective interventions. However, currently, no known study to the researcher’s knowledge has yet applied the TDF to examine the barriers and enablers to PA among staff and students in a university setting, therefore, this is probably the first study. Even though the results of this study indicate that all the 14 domains of the TDF were either enablers and/or barriers to PA engagement amongst university staff and students, six prominent domains, i.e. (1) environmental context and resources; (2) social influences; (3) knowledge; (4) beliefs about capabilities; (5) professional/social role and identity; and (6) intentions, that represented 71.1% of the 14 domains of the TDF, were identified as both enablers and barriers to PA engagement amongst university staff and students. Furthermore, six items were developed through participants quotes from the group interviews, to assess the ‘professional/social role and identity’ and the ‘memory, attention and decision processes’ domains of the TDF not measured by the DPAQ, a validated scale that assesses the domains of the TDF in the PA context. These six items were then incorporated together with the DPAQ in the composite questionnaire (i.e. survey) used to assess the predictors of physical inactivity amongst inactive university administrative staff and PhD students (i.e. studies 2). From the evidence available, the 14 domains of the TDF were relevant in the PA context in the university setting, therefore, understanding the barriers and enablers to PA may be useful in developing effective strategies to increase PA levels, especially among the inactive staff and students. Future studies are required to further examine the effectiveness of the six items developed to assess the ‘professional/social role and identity’ and the ‘memory, attention and decision processes’ domains of the TDF, on a larger sample of university staff and students.

Chapter 5. An exploration of the Predictors of Physical Inactivity among Inactive University Administrative Staff and PhD Students Using the Theoretical Domains Framework.

5.1. Introduction

Chapter 4 identified the six prominent TDF domains that were barriers and enablers to PA among university staff and students, which included (1) environmental context and resources, (2) social influence, (3) beliefs about capabilities, (4) knowledge, (5) intentions, and (6) social/professional role and identity and demonstrated that these six domains accounted for 71.1% of the emerging themes from the group interviews. Furthermore, the previous chapter also presented the development of six items to measure the 'social/professional role and identity' and memory, attention, and decision processes' domains of the TDF not measured by the Determinants of Physical Activity Questionnaire (DPAQ), the validated scale selected to determine which domains of the TDF predict physical inactivity amongst inactive university staff and students. These additional six items were incorporated in the survey used in this present chapter to measure the predictors of physical inactivity amongst inactive administrative staff and PhD students. This chapter describes the processes involved in survey studies aimed at assessing the PA levels of university staff and students (preliminary survey) to determine the groups that are most physically inactive, as well as identifying the predictors of physical inactivity amongst administrative staff and students using the TDF (main survey). The chapter begins by presenting a brief background, context, and rationale for these survey studies, with an initial presentation of the methods and the results of the preliminary survey followed by the methods and results of the main survey. Finally, discussion and conclusion, i.e. where the results from the preliminary and main surveys were synthesised to inform the intervention studies, are discussed in detail.

5.2. Background

Several intervention programmes have increasingly been used to promote PA engagement among university staff and/or students (Grimstvedt et al., 2010; Byrne, 2011; Gilson et al., 2013; Brown et al., 2014; Butler et al., 2015). However, most of these interventions were either supported by older psychological theories such as the Health Belief Model (Okazaki et al., 2014), the Theory of Planned Behaviour (Skår et al., 2011), the Social cognitive Theory

(Magoc et al., 2011), and the Transtheoretical Model (Quintiliani et al., 2010) or no theory (Claxton & Wells, 2009; LeCheminant et al., 2011). Even though these older theories or models have been and are still being used extensively to support interventions, a major drawback is that they usually inform development of interventions that envisage or describe behaviours (Kok, Schaalma, Ruiter, Van Empelen, & Brug, 2004) rather than understanding behaviour change (Brug, Oenema, & Ferreira, 2005). Therefore, vital concepts such as skills (Fishbein et al., 2001), environment (Prochaska & DiClemente, 1992), or action planning (Schwarzer, 1992) may be disregarded by a number of previous studies. Furthermore, very limited interventions employ theoretical frameworks and below 50.0% reported using them (Dombrowski, Sniehotta, & Avenell, 2007), with little information concerning how the theory-driven interventions were developed (Michie et al., 2008). Findings from previous studies (Michie et al., 2005; Michie & Abraham, 2004; Taylor, Conner, & Lawton, 2012) suggest that bespoke PA interventions that are underpinned by theories or models may be largely effective, therefore this study was supported by one of the newer theoretical frameworks known as the Theoretical Domains Framework (TDF). See chapter two for critical review of the TDF.

To appropriately design theory-informed interventions aimed at increasing PA in a university setting, it is expedient to examine those factors that predict physical inactivity (i.e., barriers to PA), which may then be targeted for possible interventions. In this research project, the findings from study 1 (see chapter 4), which aimed at examining the barriers and enablers of PA amongst university staff and students, indicated that six of the 14 domains of the TDF where prominent barriers and enablers to PA. Therefore, this present study (study 2) will further confirm which of the TDF domains, as presented in study 1, predict PA inactivity among inactive university staff and students. Generally, barriers may hinder the execution of behaviour change and have been hitherto categorised as associated with several factors comprising the individual (e.g. attitudes, habits, skills, knowledge), social context (influences of other people), as well as environmental context (e.g. resources available, weather, etc.) (Michie, van Stralen, & West, 2011). The prospective significance of barriers to change in the PA context has been emphasised by numerous studies in the university setting. These studies reported various predictors of physical inactivity such as lack of time, self-efficacy, social support, money, sports facilities and awareness of available PA options, and knowledge; age; gender; weather; work, study and family commitments; and health conditions (Bardus, Blake, Lloyd, & Suzanne Suggs, 2014; Bethancourt et al., 2014; Blake & Gartshore, 2016; Das, Sartore-Baldwin, & Mahar, 2016; de Sousa, Fonseca, & Barbosa, 2013; Wattanapisit, Fungthongcharoen, Saengow, & Vijitpongjinda, 2016). However, most of these studies were carried out among university staff and/or students using the older theories or models. It is worth mentioning that no known study has employed the TDF to inform development of behaviour change interventions in the PA domain in a university setting, and thus remains a major gap in this context.

On the other hand, the limited PA interventions that have been supported with the TDF focused on other populations such as overweight and obese pregnant women (Flannery et al., 2018), asylum seekers (Haith-Cooper et al., 2018), and older adults living with HIV (Quigley et al., 2019). It could thus be argued that the correct evaluation of the predictors of physical inactivity at individual level using a theoretical framework has the prospects to allow for bespoke interventions that focus on those predictors indicating an individual's barriers to PA (Taylor, Lawton, & Conner, 2013). Therefore, theory-driven studies aimed at assessing the predictors of physical inactivity among university staff and students are needed to inform effective approaches to increase PA levels in these populations. The first aim of this study is to assess the PA levels among university staff and students, to identify the groups that are most physically inactive. The second aim of this study is to assess the physical inactivity levels among the most physically inactive staff and student groups in order to understand the predictors of physical inactivity, with the specific aim of identifying intervention targets.

5.3. Methods for the preliminary survey

5.3.1. Study design

Prior to the commencement of this present study, a preliminary survey was conducted from October to December 2018 to determine the PA levels of University staff and students, in order to identify those that were most physically inactive, who would most likely benefit from prospective interventions.

5.3.2. Ethical consideration

Prior to the commencement of this preliminary survey study, ethical approval was obtained from the Health Science Research Ethics Committee (HS-REC) of the University of Derby

(Ref no: 09-1718-LNs). The participants were presented with information about the purpose of the research; informed of their rights to withdraw, how their data will be stored and used; assured of their confidentiality; and required to provide informed consent prior to completing the survey. Strict measures to safeguard confidentiality were followed as all participants were given individual unique identification numbers (see Appendix 12 for ethical approval letter).

5.3.3. Study participants and selection

Participants included a total of 155 university staff and 219 students (N=374) recruited from a university located in the East Midlands region of the United Kingdom. Eligibility for the study included being a current staff and/or student at the University who is 18 years and above. All university staff and students that did not meet these inclusion criteria were excluded from this study. No further inclusion or exclusion criteria were established for the study.

5.3.4. Sample size estimation

An *a-priori* power analysis employing G* Power computer programme (Faul et al., 2007) indicated that using ANOVA with an alpha of 0.05, identified that a population of 358 participants comprising 179 staff and 179 students will be needed to detect a moderate effect size ($f^2 = 0.15$) with 80% power. Even though the number of students recruited, i.e., 219 (122%), surpassed this minimum sample size required, the number of staff recruited, i.e., 155 (87%), was below this minimum requirement. However, the overall total of staff and students recruited for this study, i.e., 374 (104%), was above the minimum sample size required.

5.3.5. Outcome measures

The surveys used to collect data from university staff and students were administered online via Qualtrics (Q Plus, USA), and were made up of questionnaires comprising two sections, i.e.:

- the first section of the survey requested the demographic information of staff and students (e.g., current level of study and job role);
- the second section relates to PA, which involved the collection of data on PA levels using a validated Global Physical Activity Questionnaire (GPAQ) (WHO, 2012).

5.3.5.1. Physical Activity

The GPAQ, a 16-item scale developed by the WHO (WHO, 2012), was used to collect PA levels of university staff and students. The GPAQ combines the strengths of the long and short versions of the International Physical Activity Questionnaire (IPAQ) by incorporating diverse domains yet being significantly shorter (16 items) in comparison with the long version of IPAQ (27 items). As reported by the WHO, the GPAQ has been administered in over 100 nations globally and therefore its validity has been established in diverse populations (Wanner et al., 2017). Previous research has indicated that the reliability coefficients of the GPAQ were good, ranging from moderate to significant strength (kappa 0.67-0.73 and Spearman's rho 0.67-0.81) (Bull, Maslin, & Armstrong, 2009; Chu et al., 2015; Herrmann et al., 2013). This measure has likewise been validated with objective instruments of PA (e.g., accelerometers) (Hoos et al., 2013; Cleland et al., 2014; Mumu et al., 2017; Wanner et al., 2017) as well as the most widely used subjective PA measures such as the IPAQ (Bull, Maslin and Armstrong, 2009; Herrmann et al., 2013; Ruiz-Casado et al., 2016), demonstrating its robustness in measuring PA levels..

5.3.6. Procedure

Several approaches were used to recruit participants for this study. Firstly, invitation posters and flyers (Appendix 15) were disseminated to strategic and high footfall areas (e.g., main receptions, libraries, sports centre, restaurants, and notice boards in various colleges) of the six university campuses. These posters/flyers included QR codes that prospective participants could scan to directly access the online survey. Secondly, invitation posters (Appendix 15) were advertised in the university's internal communication platforms known as Derby Daily and Inform. Thirdly, invitation e-mails were sent to all staff and students at the University, containing a hyperlink to the online survey (Appendix 16). Finally, recruitment was also conducted through face-to-face contacts with staff and students (e.g., use of iPads and paper modes of administration). During the face-to-face administration of the surveys, the respondents (i.e., university staff and students) were required to read the participants' information sheet incorporated in the survey to understand everything about the study before giving their informed consent and completing the survey. The survey took approximately10 minutes to complete. At the end of the survey, respondents interested in entering a prize draw, with the opportunity to win a £50, a £30 or a £20 Amazon voucher, were asked to provide their email addresses, with which they will be contacted should they win.

5.3.7. Data analysis

The IBM SPSS Statistical Software Version 25.0 was used to conduct all data analyses and the significance level set at 0.05. Descriptive statistics was utilised to describe the basic features of the data. The minutes/week staff and students spent in moderate and vigorous activities, as well as the sum of both intensities (i.e., moderate-to-vigorous physical activity) were calculated utilising the World Health Organisation guide (WHO, 2012). Furthermore, the staff and students' MET-minute/week (metabolic equivalent) of the total and domain-specific activities (i.e., work, transport, and recreational activities) were calculated. One MET is equivalent to the energy expended during rest (i.e., 3.5 mL O_2/kg/min) (WHO, 2012). The recommended PA levels would be considered as 600 MET-min/week of total PA levels or above, which is equivalent to the minimum recommendation of 150 minutes of moderate intensity PA at least five days a week (WHO, 2012). The assumptions for an ANOVA were violated for both the university staff and students, thus an equivalent non-parametric test, i.e., Kruskal-Wallis H test were carried out to examine whether there were significant differences in the PA levels between staff in different job roles and whether there were significant differences in the PA levels between students in different study levels.

5.4. Result

5.4.1. Prevalence of physical inactivity

Table 5.1 reports the total MET-min/week of PA among university staff from a preliminary survey carried out to determine the most physically inactive staff groups.

Table 5. 1: Physical activity levels among various groups of university staff

Job Role	**N (%)**	**Mean physical activity (MET-minutes/week) (SD)**
Senior management	6 (3.9%)	5714.0 ± 6112.7
Management, professional and specialist	21 (13.5%)	3891.4 ± 2821.0
Teaching and research	39 (25.2%)	2255.4 ± 2664.8
Administrative support	29 (18.7%)	1330.3 ± 1253.9
Operational	60 (38.7%)	8657.0 ± 8758.0
Total	**155**	**4915.9 ± 6595.9**

The results of the preliminary survey (Table 5.1) indicated that the university administrative staff were the most physically inactive, with a mean PA of 1330.3 ± 1253.9 MET-minutes/week, compared to other staff groups and would thus benefit most from the intended interventions aimed at increasing their PA levels.

Table 5.2 reports the total MET-min/week of PA among university students from a preliminary survey carried out to determine the most physically inactive student groups.

Table 5. 2: Physical activity levels among various groups of university students

Current level of study	**N (%)**	**Mean physical activity (MET-minutes/week) (SD)**
Foundation level	9 (4.1%)	3286.7 ± 2983.4
Undergraduate year 1	13 (5.9%)	3201. 5 ± 3635.4
Undergraduate year 2	9 (4.1%)	7504.4 ± 3803.1
Undergraduate year 3	44 (20.1%)	4244.8 ± 3921.4
Postgraduate taught (Masters)	106 (48.4%)	3377.8 ± 3588.9
Postgraduate taught (MPhil)	2 (0.9%)	5980.0 ± 4101.2
Postgraduate research (PhD)	36 (16.4%)	1305.9 ± 1001.1
Total	**219**	**3390.6 ± 4114.7**

The results indicated that the university PhD students were the most physically inactive, with a mean PA of 1305.9 ± 1001.1 MET-minutes/week, in comparison with other student groups and would therefore benefit most from the intended interventions aimed at increasing their PA levels (see Table 5.2).

To confirm how significant the differences in mean PA are across the different staff's job roles and students' study levels, statistical analyses were performed. Lavene's test for homogeneity of variance was significant ($F_{4,150}$ =12.762, p= 0.001), signifying that the population variances were unequal, thus violating the assumption for an ANOVA. Therefore, an equivalent non-parametric test was carried out. A Kruskal-Wallis H test indicted that there was a statistically significant difference in PA levels between staff in different job roles, $\chi^2_4 = 41.408$, $p = 0.001$, with mean rank physical activity levels of 103.13 for operational staff; 86.33 for senior management staff; 84.24 for management, professional and specialist staff, 58.27 for teaching and research staff; and 46.31 for administrative support staff, as illustrated in Figure 5.1.

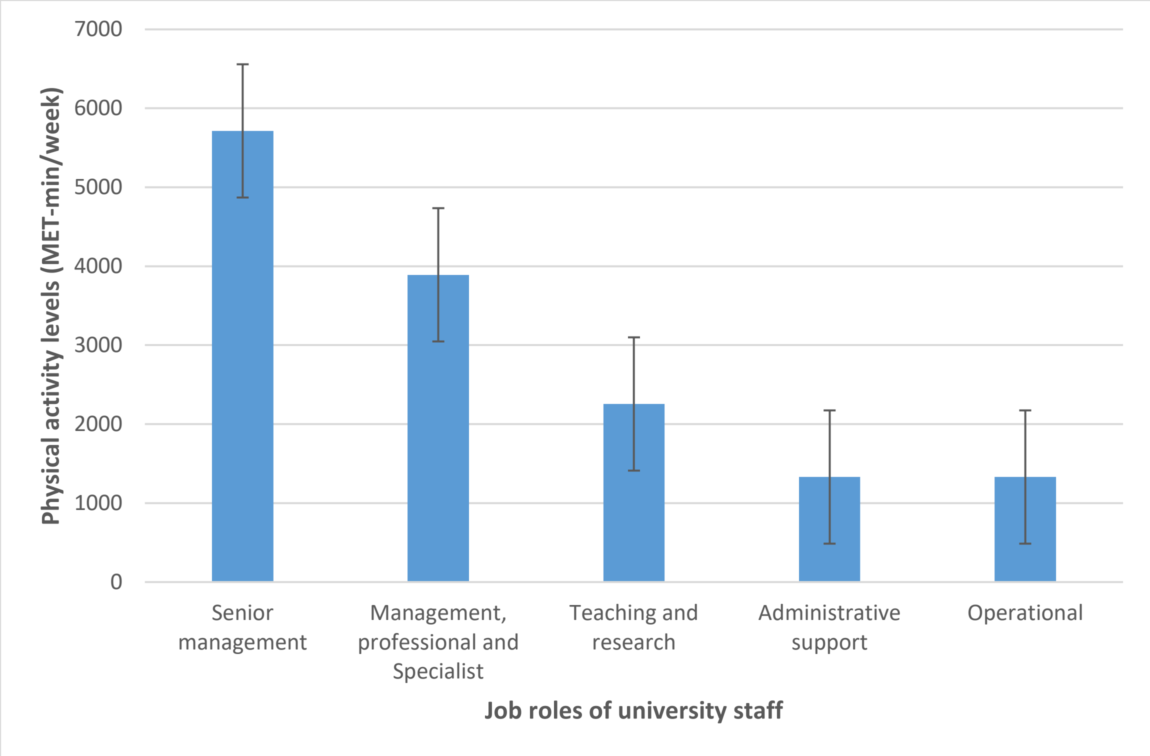

Figure 5.1: Physical activity levels of university staff according to their job roles

Furthermore, as with the university staff, the Lavene's test for homogeneity of variance was significant ($F_{6,212}$ = 8.007, p= 0.001), suggesting that the population variances were unequal, thus violating the assumption for an ANOVA. A Kruskal-Wallis H test showed that that there was a statistically significant difference in PA levels between students at in different study levels χ^2_6 = 26.986, p = 0.001, with mean rank physical activity levels of 171.75 for postgraduate taught (MPhil) students; 138.39 for undergraduate year 2 students; 130.39 for undergraduate year 3 students, 113.34 for postgraduate taught (Masters) students; 102.85 for undergraduate year 1 students; 117.50 for foundation level students; and 65.15 for postgraduate research (PhD students) as illustrated in Figure 5.2.

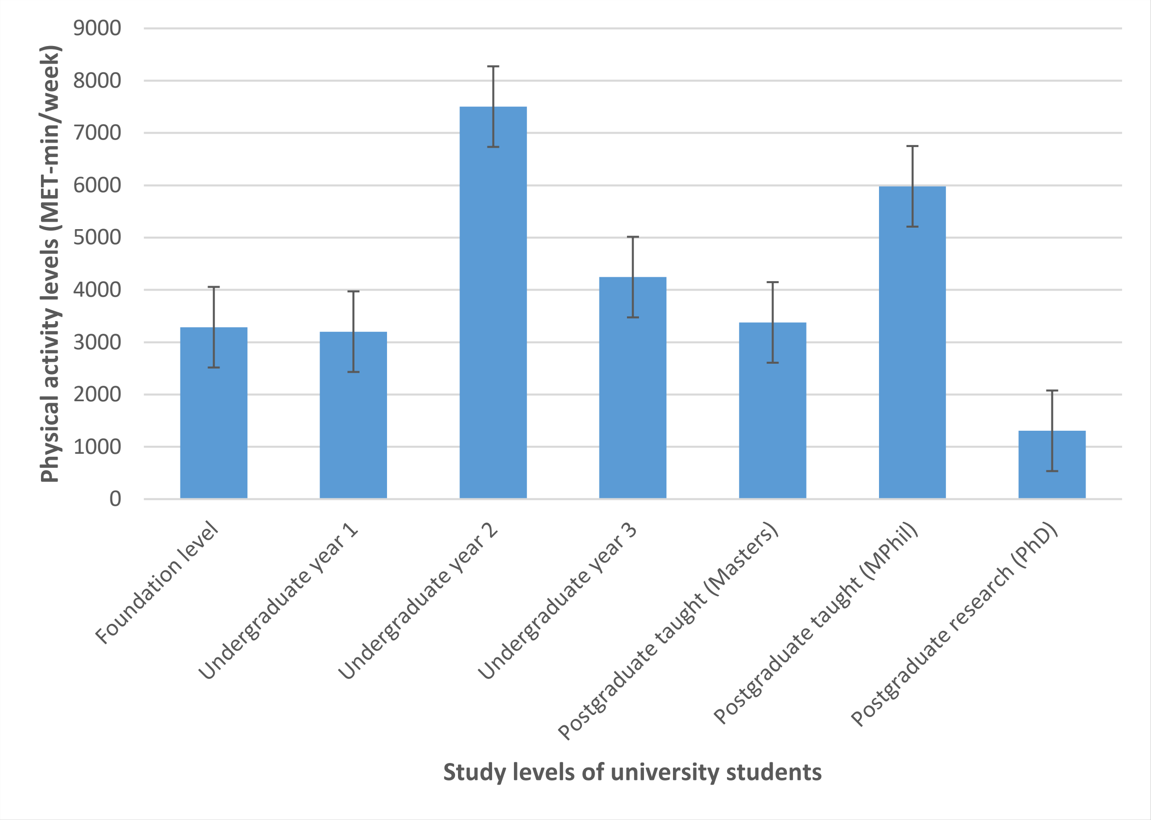

Figure 5.2: Physical activity levels of university students according to their level of study

5.5. Methods for the main survey

5.5.1. Study design

A quantitative study was carried out employing online surveys to examine the predictors of physical inactivity amongst inactive university administrative staff and post-graduate research (PhD) students. Data collection for the second survey was carried out from February to April 2019 in the university's seven campuses. Since the 2018 survey was a variant of the 2019 survey no further specific ethics was needed.

5.5.2. Ethical consideration

The 2018 survey was a variant of the 2019 survey and therefore did not need specific ethics. All the ethical implications considered in the preliminary survey study, as presented in section 5.3.2., were also fully adhered to in this main survey study to ensure that the confidentiality of the participants was adequately protected (see Appendix 12 for ethical approval letter).

5.5.3. Study participants and selection

Participants included 121 inactive administrative staff and 114 PhD students recruited from a university located in the East Midlands region of the United Kingdom. Eligibility for the study included being a current administrative staff and/or postgraduate PhD students of the University of Derby who is 18 years and above; any administrative staff and/or PhD students that score below 600 MET-minute/week of moderate intensity of PA. Furthermore, if an individual is on the university payroll, then they will be classified as administrative staff. Whereas if they are registered as a PhD student who is supplementing their study with hours of work in the administrative centres then they will be classified as PhD student. All administrative staff and PhD students that did not meet these inclusion criteria were excluded from this study. No further inclusion or exclusion criteria were established for the study.

5.5.4. Sample size estimation

An a-priori power analysis employing G* Power computer programme (Faul et al., 2007) indicated that using linear multiple regression with an alpha of 0.05, 135 administrative staff and PhD students each will be needed to detect a moderate effect size ($f^2 = 0.15$) with 80% power. This implies that a minimum of 270 administrative staff and PhD students will be needed in this study. However, 235 administrative staff and PhD students took part in this study, which was 87% of the minimum number of participants required.

5.5.5. Outcome measures

The surveys used to collect data from university administrative staff and PhD students were administered online via Qualtrics (Q Plus, USA), and were made up of a composite of questionnaires comprising four sections, i.e.:

- the first section of the survey requests demographic information of the administrative staff and PhD students (e.g., age, gender, ethnicity, study type, study mode, study level, study site, college and employment status, and work site);
- the second section relates to PA, which involves gathering data on PA levels using a validated Global Physical Activity Questionnaire (GPAQ) (WHO, 2012);

- the third section relates to the assessment of the determinants of PA as detailed by the Theoretical Domains Framework (TDF), using a validated Determinants of Physical Activity Questionnaire (DPAQ) (Taylor et al., 2013); and
- the final section relates to the assessment of the three domains of the TDF not assessed by the DPAQ. The 'social/professional role and identity' and the 'memory, attention and decision processes', domains were assessed using the additional six items developed from the group interviews (study 1), while the 'reinforcement' domain was assessed using an already available scale, i.e., the motivation subscale of the Motivation for Physical Activity Questionnaire(Deci & Ryan, 2004).

A description of each of the measures is provided below.

5.5.5.1. Physical activity

The GPAQ, a 16-item scale that assesses PA in three different domains, namely work, recreational activities and active transport domains, was used to measure PA in this current study. The rationale for selecting the GPAQ to measure PA levels has been critically discussed in section 5.3.5.

5.5.5.2. Predictors of physical inactivity

Three different scales, i.e., the validated 34-item Determinants of Physical Activity Questionnaire (DPAQ) (Taylor *et al.,* 2013), the 4-item motivation subscale of the Motivation for Physical Activity Questionnaire (Deci & Ryan, 2004), as well as the 6 items developed through study 1 were employed to assess the 14 domains of the Theoretical Domains Framework (TDF) to determine the domains that predict physical inactivity among the inactive participants. The only known validated scale, i.e., the DPAQ, developed to assess the TDF domains measured 11 of the 14 domains of the TDF, and the three domains not measured include the professional/social role and identity; reinforcement; and memory, attention and decision processes domains. Therefore, the reinforcement domain was measured using a validated Motivation for Physical Activity Questionnaire (Deci & Ryan, 2004), while there are no known validated measures for the remaining two domains, and thus 6-items were developed through study 1 to measure these domains.

Each item of the DPAQ was assessed utilising a 7-point Likert scale ranging from 1= strongly agree to 7= strongly disagree. For instance, items consist of ‘I know what the recommended levels of PA’ illustrate the knowledge domain; and ‘I’ve never really had sports’ skills, so I don’t do PA’ illustrate the skills domain. One of the major strengths of the DPAQ is its established excellent psychometric properties, with its internal consistency (Cronbach’s alpha) ranging from 0.57 to 0.86 and test-retest reliabilities ranging from 0.45 to 0.91(Taylor, Lawton, & Conner, 2013). Another strength of the DPAQ is that it was validated among staff and students across 49 universities in the UK, which is consistent with the population of this current study. Finally, the development procedure of the DPAQ has underlined the possibility of adapting and employing the TDF in other health domains, with a level of flexibility to detect determinants of behaviour change employing survey (i.e. questionnaire) (Taylor, Lawton, & Conner, 2013).

The reinforcement domain, which is one of the three domains not originally assessed by the validated DPAQ was measured utilising a four-item motivation subscale of the Motivation for Physical Activity Questionnaire (Deci & Ryan, 2004). Each of the items of this scale was assessed using a 7-point Likert scale ranging from 1= not at all true to 7= very true. For example, the participants were asked to answer the following questions by deciding how true they were: I try, would try, to be physically active regularly… ‘because it is interesting to see my own improvement’, because I enjoy PA’, ‘because it’s fun’, and ‘because it is a challenge to accomplish my goal’. It was very challenging finding a validated scale to measure the reinforcement domain of the TDF, therefore the motivation subscale of the Motivation for Physical Activity Questionnaire was selected, even though no validation study for this scale was found. In order to establish the usefulness of this scale in assessing reinforcement in the study population, reliability tests were carried out using a sample of 121 administrative staff and 114 PhD students. The 4-item subscale of the Motivation for Physical Activity Questionnaire showed a good internal consistency (Cronbach’s alpha) of 0.94 and 0.95 for university administrative staff and PhD students, respectively, demonstrating that these items consistently measure reinforcement. The SPSS output for the reliability tests is presented in Appendix 13.

The ‘memory, attention & decision processes’ and ‘professional/social role and identity’ domains were then assessed using 6 items developed through study 1 based on review of relevant literature and quotes from earlier conducted group interviews, in order to fully assess the relevance and applicability of the TDF in the PA context in the university setting. Each of the six items were assessed using a 7-point Likert scale ranging from 1= strongly agree to 7= strongly disagree. A sample of 121 administrative staff and 114 PhD students completed an online survey (i.e., study 2), which also included these six items aimed at identifying the domains of the TDF that predict physical inactivity among them. Since the other measurement scales in the survey were already validated, reliability tests for these 6 items were then carried out. The 6-items showed a good internal consistency (Cronbach's alpha) of 0.75 and 0.81 for university administrative staff and PhD students, respectively, signifying that these six items reliably measure the 'memory, attention & decision processes' and 'professional/social role and identity' domains of the TDF. See chapter four, section 4.5.2 for more information on the development of these additional 6 items. The SPSS output for the reliability tests is illustrated in Appendix 14.

5.5.6. Procedure

Firstly, invitation emails (Appendix 17) were advertised in the university's internal communication platforms known as Derby Daily and Inform, as well as the PGR network (a web-based forum for postgraduate research students). Secondly, invitation e-mails were sent to administrative staff and PhD students at the University of Derby, which contained a hyperlink to the survey (Appendix 18), where participants were presented with a comprehensive information page outlining the aims and objectives of the study, the nature of participation outlining their voluntary participation, anonymity and right to withdraw before being asked to consent to participate and generate a unique participation code. Thirdly, recruitment was also conducted through face-to-face contacts with administrative staff and PhD students (e.g., paper mode of administration). During the face-to-face administration of the surveys, the respondents were required to read the participants' information sheet incorporated in the survey to understand everything about the study before giving their informed consent and completing the survey. The survey took about 25 minutes to complete. Finally, at the end of the survey, respondents interested in entering a prize draw, with the opportunity to win a £50, a £30 or a £20 Amazon voucher, were asked to provide their email addresses, with which they will be contacted should they win.

5.5.7. Data analysis

The IBM SPSS Statistical Software Version 25.0 was used to conduct all data analyses and the significance level set at 0.05. Independent t-test, Two-way Analysis of Variance (ANOVA) and multiple regression analysis were employed in the data analyses. Independent t-test was employed for variables with only two groups; Two-way ANOVA was employed for variables with more than two groups, while multiple regression was employed for continuous dependent and independent variables. Data were firstly screened for missing values or outliers and assumptions for homogeneity of variances, linearity and normality carried out utilising Lavene's tests and Kolmogorov Smirnov. Non-parametric tests will be considered should any of the assumptions for parametric tests is violated. Descriptive statistics were employed to illustrate the basic socio-demographic characteristics, and expressed as mean (SD), median, percentages and frequency distributions in order to describe the characteristics of the study populations. Independent-samples t-tests were utilised to assess PA levels amongst male and female administrative staff and PhD students, and to determine if there were differences in mean of PA between inactive administrative staff working part-time and full-time, and between inactive PhD students studying part-time and full-time. A two-way ANOVA was carried out to evaluate the effect of age and ethnicity on PA levels among inactive administrative staff and PhD students. Finally, a multiple regression analysis was carried out to ascertain which of the 14 domains of the Theoretical Domains Framework (TDF) predicted physical inactivity among inactive university administrative staff and PhD students.

5.6. Result

5.6.1. Socio-demographic characteristics of the respondents

A total of 411 participants, i.e., 213 university administrative staff and 198 PhD students accessed the online survey. Out of these, 189 administrative staff (89%) and 184 PhD students (93%) fully completed the survey. Of those that completed the survey, a total of 235, i.e., 121 administrative staff (64%) and 114 PhD students (62%) were physically inactive (i.e. scored below 600 MET-minutes/week of moderate PA as measured by the GPAQ and thus eligible for this study. As lustrated in table 5.3, the administrative staff's age ranged from 26.3 to 55.3 years (mean= 45.92 ± 7.01 years), with over three-quarter (81.9%) of them belonging to the 'intermediate' adult group, 10.7% belonging to the 'older' adult group and the least 7.4%

belonging to the 'young' adult group. More females (84.3%) were represented in the study population than males (15.7%).

Table 5. 3: Socio-demographic profile of the university administrative staff

Variables	**Category**	**N (%)**
Gender (n=121)	Male	19 (15.7)
	Female	102 (84.3)
Age (n= 121)	Young adults (18-35 years)	9 (7.4)
	Intermediate adults (36-55 years)	99 (81.9)
	Older adults (56 years and older)	13 (10.7)
	Mean Age	**45.92 ± 7.01 years**
Ethnicity (n= 121)	White	115 (94.3)
	Black/African/Caribbean/Black British	4 (3.3)
	Asian/Asian British	-
	Mixed/Multiple ethnic groups	2 (1.6)
	Other ethnic groups	1 (0.8)
Employment status (n= 121)	Full-time	101 (83.5)
	Part-time	21 (16.5)
Campus located (n=121)	Kedleston road campus	101 (83.5)
	Markeaton campus	4 (3.3)
	Britannia Mills campus	1 (0.8)
	Chesterfield campus	4 (3.3)
	Buxton campus	3 (2.5)
	Friar Gate campus	1 (0.8)
	Leek campus	2 (1.6)
	Not stated	5 (4.1)

The largest proportion of administrative staff were from the White ethnic group (94.3%), followed by the Black/African/Caribbean/Black British (3.3%), Mixed/multiple ethnic groups (1.6%), while the least were from the other ethnic group (0.8%). However, none was from the Asian/Asian British ethnic group. Most of the administrative staff were on full-time employment (83.5%) compared to those on part-time (16.5%). Finally, the highest proportion of the administrative staff indicated that they were based at the Kedleston road campus (83.5%) while the least were based at Britannia Mills (0.8%) and Friar Gate (0.8%) campuses, with 5% of the participants not stating the campus they are located.

Table 5. 4: Socio-demographic profile of the university PhD students

Variables	**Category**	**N (%)**
Gender (n=114)	Male	63 (55.3)
	Female	51 (44.7)
Age (n= 114)	Young adults (18-35 years)	31 (27.2)
	Intermediate adults (36-55 years)	79 (69.3)
	Older adults (56 years and older)	4 (3.5)
	Mean Age	**39.91 ± 8.04 years**
Ethnicity (n= 114)	White	81 (71.1)
	Black/African/Caribbean/Black British	14 (12.3)
	Asian/Asian British	16 (14.0)
	Mixed/Multiple ethnic groups	2 (1.8)
	Other ethnic groups	-
	Not stated	1 (0.8)
Employment status (n= 114)	Full-time	58 (50.9)
	Part-time	56 (49.1)
Campus located (n=114)	Kedleston road campus	97 (85.1)
	Markeaton campus	16 (14.0)
	Britannia Mills campus	-
	Chesterfield campus	-
	Buxton campus	-
	Friar Gate campus	1 (0.9)
	Leek campus	-

On the other hand, as indicated in table 5.4, the PhD students' age ranged from 25.0 to 57.6 years (39.91± 8.04 years), with over two-thirds (69.3%) belonging to the intermediate adult group, over one-quarter (27.2%) belonging to the young adult group and the least 3.5%

belonging to the older adult group. In contrast with the administrative staff, slightly more male PhD students (55.7%) were represented in the study population than males (44.7%). The largest proportion of the PhD students were also from the White ethnic group (71.7%), followed by the Asian/Asian British (14.0%), the Black/African/Caribbean/Black British (12.3%), while the least were from the Mixed/multiple ethnic groups. However, none was from the other ethnic group. Finally, the highest proportion of PhD students also indicated that they were based at the Kedleston road campus (85.1%) while the least were based at Friar Gate campus (0.9%).

5.6.2. Association between gender and physical inactivity

Independent-samples t-tests were carried out to compare PA levels among inactive male and female university administrative staff and PhD students to understand those that physically inactive. There was no significant variance in the scores for male (416.8 ±89.5 MET-minutes/week) and female (391.8 ±113.8 MET-minutes/week) administrative staff; t_{119} = 0.908, p = 0.37. On the other hand, there was significant difference in the scores for male (432.1 ±98.7 MET-minutes/week) and female (373.7 ±113.8 MET-minutes/week) PhD students; t_{112} = 2.930, p = 0-004. These results suggested that there was no difference in PA levels between the genders for the inactive administrative staff. On the contrary, there was a difference in the PA levels between the genders for the inactive PhD students.

5.6.3. Predictors of physical inactivity

All the assumptions of multiple regression (i.e. linear relationship between the independent variables and the dependent variable, absence of multicollinearity in the data, ensuring that the values of the residuals are independent, ensuring that the variance of the residual is constant (homoscedasticity), ensuring that the values of the residuals are normally distributed, and ensuring that there are no influential cases biasing the model) were met for both the administrative staff and PhD students' data. Therefore, multiple regressions were carried out to examine whether the 14 domains of the TDF were good predictors of physical inactivity among the inactive university administrative staff and students. For the administrative staff, the collinearity statistics indicated that there was no multicollinearity in the data (VIF scores ranged from 1.661 to 6.201 and the tolerance ranged from 0.161 to 0.602). The Durbin-Watson value of 2.179 demonstrated that the variables were independent, and thus the regression model can be generalised to the same samples.

Table 5. 5: Regression model summary for administrative staff

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change statistics**					**Durbin-Watson**
					R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**	
1	.580	.336	.249	95.72	.336	3.837	14	106	.000	2.179

As illustrated in Table 5.5, the regression model explained 33.6% of the variability in the data ($R^2 = 0.336$, adjusted $R^2 = 0.249$), showing that the combined influence of the 14 domains of the TDF were a good predictor of physical inactivity among inactive administrative staff, $F_{14,106} = 3.837$, p= 0.001. There was a significant positive relationship between physical skills and PA, $t_{106} = 2.198$, p= 0.030 (see Table 5.5). However, no significant relationships were revealed between the remaining 13 domains of the TDF and PA (p>0.05) among the administrative staff. As indicated in Table 5.6, the model predicts that one unit increase in physical skills would correspond with an increase in PA of 31.22 MET-minutes/week, signifying that a decrease in physical skills would lead to an increase in physical inactivity levels among inactive administrative staff.

Table 5. 6: Regression coefficient for administrative staff

Model	**Unstandardized Coefficient**		**Standardized Coefficient**	**t**	**Sig.**	**95.0% Confidence Interval for B**		**Correlations**			**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**	**Zero-order**	**Partial**	**Part**	**Tolerance**	**VIF**
Mean physical skills	31.22	283.76	.355	2.198	.030	3.05	59.38	.426	.209	.174	.602	4.162

For PhD students, the collinearity statistics also indicated that there was no multicollinearity in the data (VIF scores ranged from 1.301 to 5.866 and the tolerance ranged from 0.170 to 0.769).

The Durbin-Watson had a value of 1.559, indicating that the variables were independent, suggesting that the regression model can be generalised to the same samples (see Table 5.7).

Table 5. 7: Regression model summary for PhD students

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change statistics**					**Durbin-Watson**
					R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**	
1	.758	.575	.514	76.08	.575	9.552	14	99	.000	1.559

As illustrated in Table 5.7, the regression model accounted for 57.5% of the variability in the data ($R^2 = 0.575$, adjusted $R^2 = 0.514$), indicating that the combined influence of the 14 domains of the TDF were a good predictor of physical inactivity among inactive PhD students, $F_{14,99}$ = 9.552, p= 0.001. There were significant positive relationships between knowledge and PA, t_{99} = 2.018, p= 0.046 and between intentions and PA, t_{99} = 4.240, p= 0.001. However, no significant relationships were revealed between the remaining 12 domains of the TDF and PA (p>0.05) among the inactive PhD students (see Table 5.7). The model predicts that one unit increase in 'knowledge' would equate to an increase in PA of 12.39 MET-minutes/week and that one unit increase in 'intentions' would equate to an increase in PA of 70.04 MET-minutes/week, signifying that a decrease in knowledge or intentions would lead to an increase in physical inactivity levels among inactive PhD students, as exhibited in Table 5.8.

Table 5. 8: Regression coefficients for PhD students

Model	**Unstandardized Coefficient**		**Standardized Coefficient**	**t**	**Sig.**	**95.0% Confidence Interval for B**		**Correlations**			**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**	**Zero-order**	**Partial**	**Part**	**Tolerance**	**VIF**
Knowledge	12.39	6.14	.151	2.018	.046	.210	24.56	.261	.199	.132	.769	1.301
Intentions	70.04	16.52	.384	4.240	.000	37.26	102.82	.598	.392	.278	.523	1.913

5.7. Discussion

It is imperative to determine the factors that predict physical inactivity which could be targeted at developing effective interventions that would work towards increasing PA among those that are inactive (Gichu et al., 2018). Therefore, this study aimed to assess physical inactivity levels and the domains of the TDF that predicted physical inactivity among inactive administrative staff and PhD students, so as to inform the development of suitable bespoke interventions to help increase their PA levels. The outcomes of this present study add to the theory-based research on the predictors of physical inactivity among staff and students in a university setting.

5.7.1. Prevalence of physical inactivity

Preliminary surveys carried out by the researcher among a total of 374 participants (i.e., the 155 university staff and 219 students) indicated that the administrative staff and PhD students were the most physically inactive among the various staff and student groups and would thus benefit more from interventions aimed at increasing their PA levels. Therefore, this current survey study focused specifically on these identified inactive administrative staff and PhD students. In this study, physically inactive participants were identified as those reporting moderate intensity of PA below 600 MET-minutes/week (i.e. 150 minutes of moderate amount of PA weekly), as advocated by the World Health Organisation (WHO, 2012a). The findings of this study indicated that 64.0% of administrative staff were reported to be physically inactive compared to 62.0% of PhD students. Previous studies have established the high proportion of physical inactivity among university staff and students, with a significant proportion of them not meeting the recommended levels of PA. For example, a survey study conducted by Pengpid et al. (2015) among 17,928 undergraduates from 24 universities in 23 low, medium and high-income nations, indicated that the predominance of physical inactivity globally varied between 21.9% in Kyrgyzstan and 80.6% in Pakistan, which falls within the range of what was reported among the administrative staff and PhD students in this study with regards to a UK based university. Although there are limited published research available reporting the physical inactivity levels of university staff alone or in combination with students, several studies reported physical inactivity among university staff ranging from 42% (Cooper & Barton, 2015) to 60.5% (Agha & Al-Dabbagh, 2010), which was lower than what was reported in this study.

One of the findings of the current study was that administrative staff were generally more physically inactive (395.70 MET-min/week) compared to PhD students (405.96 MET-min/week). Furthermore, the administrative staff engaged in more sedentary activities than the PhD students (576.17 minutes/day vs. 567.63 minutes/day, respectively). These reported differences in PA levels and sedentary activities between the administrative staff and PhD students may be due to their job roles, with administrative roles being more desk-based compared with PhD students who work between laboratories, research centres, as well as undertake desk-based tasks (Fountaine, Piacentini, & Liguori, 2014; George et al., 2014). These findings are consistent with the findings of an online survey carried out by Rissel, Mulley, & Ding (2013) among all staff and students of a university in Australia, which revealed that university students were more physically active than staff. Contrary to the findings of this study, a study carried out by (Sims et al., 2017) indicated that staff reported engaging in more PA than students. It could therefore be argued that the divergence in the physical inactivity levels reported among university staff and students globally may be as a result of the unavailability of standardised measure for PA levels (Murphy et al., 2017). Although majority of studies conducted in the university settings have used the International Physical Activity Questionnaire (IPAQ) (Rissel et al., 2013; Bang et al., 2017; Liu & Dai, 2017; Sultoni & Suherman, 2017) to measure PA, recently there has also been a proliferation of studies that use the GPAQ (Khera & Sharma, 2012; Regmi, Sharma & Mahato, 2016; Shah et al., 2016; Wattanapisit et al., 2016; Zamani Sani et al., 2016) to measure PA levels and sedentary behaviour among university staff and students.

5.7.2. Influence of gender on physical inactivity

Results of this study demonstrated that female PhD students were significantly more physically inactive than their male contemporaries. This is congruent with the findings of previous studies (Awadalla et al., 2014; Mohammed et al., 2014; Fagaras, Radu & Vanvu, 2015; Rajappan, Selvaganapathy & Liew, 2015; Dayi et al., 2017; Liu & Dai, 2017; Murphy et al., 2018) carried out among university students, which indicated that female students were more physically inactive than their male contemporaries. Furthermore, a recent population-based survey carried out by Guthold et al. (2018) involving 1.9 million participants across 168 countries also indicated that females (31.7%) were more physically inactive than males (23.4%). The reasons why females are more physically inactive than males can be explained by some psychosocial factors such as social support, self-efficacy and motivation (Edwards & Sackett, 2016), as outlined in the COM-B model (Michie, Atkins & West, 2014) and the TDF (Atkins et al., 2017) used to underpin this study.

The impact of social support (i.e. support from friends, family and colleagues) has been associated with PA engagement and has also revealed significant gender differences (Wendel-Vos et al., 2007). Strong evidence suggests that males report higher social support than females, which may influence them to engage more in PA (Edwards & Sackett, 2016). However, limited studies have reported the relationship between PA associated social support and gender differences, with the trend observed in younger people continuing into adulthood (Hankonen et al., 2010) and males and females reporting access to diverse kinds of support (Aparicio-Ting et al., 2014). Therefore, it may be argued that the higher social support received by males compared to females may be the reason why they are more physically activity than females. However, more research is required in this area before irrefutable associations can be presumed; more emphasis on adult samples is necessitated, and an examination of the divergent effects of different forms of social support could assist to further elucidate the prospective enablers of PA for females not engaging in sufficient PA across all ages (Edwards & Sackett, 2016).

Self-efficacy, i.e. the beliefs in a person's capability to effectively accomplish an anticipated behaviour (Bandura, 1986, 1997), has been associated with more engagement in PA. Spence et al. (2010) posited that gender certainly mediate the association between self-efficacy and PA, with the associations being more prominent among females. Nevertheless, with higher reported self-efficacy levels, males were observed to be participating in higher PA compared to their female contemporaries. With regards to the self-efficacy theory (Bandura, 1977) and associated literature, it was argued that this association may occur because of females are contending with less mastery experience possibilities, more risks for associated injuries, and fewer support to participate in PA (Edwards & Sackett, 2016). Apart from social influences and self-efficacy, motivation has been associated with behaviour change. However, limited studies have examined the effect of motivation on PA based on gender differences (Pauline, 2013).

Strong evidence shows that the divergences in motivation for PA do occur between the genders, signifying a potential contributing factor to behaviour change. A study carried out by Pauline (2013) amongst university students, revealed a significant gender main effects for reported PA and exercise motivation, with males being more inclined to participate in moderate to vigorous PA than females. Furthermore, males were considerably more inclined to report public recognition, competition, challenge, relationship, strength, and health problems as reasons for participating in PA. On the other hand, females were more driven by weight control, look, positive health, stress management, and agility influences (Pauline, 2013). These findings were corroborated by another study by Egli et al. (2011) carried out among university students. Therefore, knowing the reasons why females are generally more physically inactive than males could be a first step in the development of interventions to increase their PA levels.

In contrast, no significant differences were found between male and female administrative staff with regards to physical inactivity signifying that gender did not determine engagement in PA. This is in conformity with the findings of a study by Joshua et al. (2012) which indicated that gender did not significantly determine engagement in PA. However, contrary to the findings of this study, other studies carried out among university staff (Cooper & Barton, 2015) and adults from different households (Gichu et al., 2018) revealed that women were more prone to be physically inactive than men. It could thus be argued that this might be due to the population sample sizes and the percentage of male (15.7%) and female (84.3%) participants in the current study possibly masking any measurable effect, even though this percentage is comparable with the gender split in the university's population (i.e., 16.9% male vs. 83.1% female). Gender remains a vital factor that can influence involvement in health promoting behaviour, therefore, gender sensitive interventions should be used to encourage both genders to engage in PA.

5.7.3. Predictors of physical inactivity among inactive administrative staff and PhD students

The most important findings of this study were associated with the relationships between the 14 domains of the TDF and physical inactivity. However, one of the major findings of this current study revealed that the combined influence of the 14 domains of the TDF were good predictors of physical inactivity among inactive university administrative staff and PhD students. In this study, 'physical skills' was identified as the only significant predictor of physical inactivity among the inactive university administrative staff, and was positively associated with PA. As such, this finding, suggests that as ‘physical skills’ increases participation in PA increases, i.e., physical inactivity decreases. However, as ‘physical skills’ decreases as reported in this study physical inactivity increases. No other significant relationships were seen between the remaining 13 domains of the TDF and physical inactivity among the inactive university administrative staff (p>0.05).

In agreement with the findings of this study, Flannery et al. (2018) indicated the lack of physical skills was a major reason for being physically inactive. This may be because the lack of the fundamental movement skills (i.e., skills that include different parts of the body such as hands, arms, legs, feet, trunk and head) and motor skills (i.e. action that need the use of muscles in particular ways to accomplish anticipated outcomes) may decrease the confidence (i.e. self-efficacy) of people to engage in PA. Therefore, increasing peoples’ physical literacy (i.e. the development of basic movement skills such as catching, throwing, jumping, running and hopping) and their basic motor skills in order to increase their confidence (i.e. self-efficacy) in being able to participate in PA and exercise would increase their participation in PA and exercise (Giblin, Collins, & Button, 2014). Furthermore, even though no study has examined the predictors of physical inactivity among university staff using the TDF, Haith-Cooper et al. (2018) revealed that most of participants had the physical skills to participate in some forms of PA; however, others lacked the physical skills to participate in some other types of PA and desired to acquire new skill. Therefore, training people to learn new skills to engage in sports and exercise could be an effective approach to encourage PA engagement among those that are inactive (Fennell, Peroutky & Glickman, 2016; Centers for Disease Control and Prevention, 2017).

On the other hand, findings of this study also revealed that *knowledge* and *intentions* were the only significant predictors of physical inactivity among the inactive university PhD students. *Knowledge* and *intentions* were positively associated with PA in PhD students, suggesting that as both variables increase, participation in PA also increases (i.e., physical inactivity decrease). However, as knowledge about PA and intentions to engage in PA decreases as reported in this study physical inactivity increases. No other significant relationships were seen between the remaining 12 domains of the TDF and physical inactivity among the inactive university administrative staff (p>0.05). As with the administrative staff, no known studies to the researcher's knowledge have used the TDF and/or COM-B model to underpin the identification of the predictors of physical inactivity among students in a university setting. However, other studies as mentioned earlier have used these models in the PA context among adults in other settings. Lack of knowledge as a predictor of physical inactivity has extensively been studied and findings generally revealed that the knowledge about PA has been generally low, which may be associated with increased physical inactivity levels reported globally. Haith-Cooper et al. (2018) indicated that knowledge was one of the major TDF domains that influence engagement in PA among asylum seekers, which is congruent with the findings of this present study. Most of the participants in Haith-Cooper et al's (2018) study lacked knowledge of the recommended PA guidelines. In support of this finding, another study by Flannery et al. (2018) also indicated that of all the 14 TDF domains, the knowledge domain was the most commonly stated barrier to PA engagement, probably because most of the participants may not have known the benefits of PA, the detrimental impacts of Physical inactivity and the PA recommendations for good health, and may therefore not see the need to engage in PA (Fredriksson et al., 2018). This signifies that the lack of knowledge about PA may be linked with increase in physical inactivity behaviours.

The prominence of knowledge as a predictor of physical inactivity cannot be overemphasised, because previous studies have established an association between lack of knowledge about PA and increase in levels of physical inactivity behaviours. For instance, a study conducted by Fredriksson et al. (2018) indicated that individuals that have knowledge about the benefits of PA were more physically active than those that do not. Their findings also revealed that 55.6% of the participants were unable to identify the recommended PA levels to gain health benefits (Fredriksson et al., 2018). In support of these findings, previous studies (Abdeta, Seyoum, & Teklemariam, 2019; Hunter et al., 2014; Knox, Musson, & Adams, 2015) revealed that there was general lack of awareness about PA recommended guideline for adults, which may result in the increase of physical inactivity levels. Low awareness regarding the benefits of PA and the PA recommendations indicates that strategies to increase the knowledge about PA should be advocated more, because this knowledge offers guidance on regularity, forms and length of PA required to gain health benefits (Fredriksson et al., 2018).

Lack of intentions as a predictor of physical inactivity has also been extensively researched, even though most of these studies have been conducted in other settings other than the university setting as mentioned earlier. Quigley et al. (2019) indicated that the intentions domain was one of the six prominent domains of the TDF that could act as both a barrier and enabler to PA engagement, which was consistent with the finding of this study. In support of the finding of this present study, previous studies (Flannery et al., 2018; Haith-Cooper et al., 2018) have also reported the significance of the intentions domain of the TDF as a strong predictor of PA engagement, signifying that people with low or no intentions to engage in PA are more likely to be physical inactivity than those with strong intentions. This is probably because intentions have been established to be a major prognosticator of behaviour (Ajzen, 1991).

Even though the intention is a strong prognosticator of PA performance, a gap in intention-behaviour association has been reported, i.e., even people with strong intentions concerning a specific goal are often unsuccessful at achieving them (Gollwitzer, 1990). According to Orbell & Sheeran (1998), this failure in achieving a set objective, even with strong intentions, may be expounded by the fact that the phases of elaborating and performing a specific intention are, in fact, two separate processes. Gollwitzer (1999) argued that two phases were required to achieve a behaviour, i.e., the motivational phase, wherein an optimistic intention to carry out a specified behaviour is developed, and a volitional phase (i.e., the post-intention phase), wherein the person carries out the intention previously developed. The implementation intentions concept was therefore founded based on this volitional phase (Gollwitzer & Brandstätter, 1997). Implementation intentions involves formulating plans on where, when, and how to carry out a specified behaviour and presumes that the more real the plans for carrying out a behaviour, the better the likelihoods of achieving it (Gollwitzer & Sheeran, 1999). For example, the findings of a study by Murray, Rodgers & Fraser (2009) indicated that implementation intentions may help to maintain adherence and self-efficacy to engage in exercise. This is consistent with the findings of another study by Kwak *et al.* (2007) which suggested that the participants in the experiment group were more inclined to take the stairs immediately after forming implementation intentions in comparison with those in the control group. This implies that forming an implementation intention of where, when, and how to participate in PA, will increase the likelihood of engaging in PA, because implementation intentions mentally links expected critical situations with efficient goal-focused responses (Gollwitzer & Sheeran, 1999).

When an implementation intention is formed, a link is created between mental depictions of specific prompts (favourable or precarious conditions) and ways of achieving objectives (mental or behavioural responses) in an act of will. This mental associations formed by implementation intentions enable goal achievement based on mental processes that involve both the expected situation (i.e., the if-element of the plan) and the anticipated actions (i.e. the then-element of the plan). Since forming an implementation intention entails the selection of a critical imminent condition, the mental depiction of this condition becomes extremely stimulated, and thus more accessible (Gollwitzer & Sheeran, 1999). Therefore, interventions aimed at educating university students about the benefits of PA, the detrimental effects of physical inactivity and the PA recommendations, as well as forming implementation intentions of where, when and how to carry out the PA, and ways to overcome potential barriers to PA engagement, may be an effective approach to improve levels of PA among inactive university students.

5.8. Conclusion

This study examined the predictors of physical inactivity among inactive administrative staff and PhD students in one university in the UK using the Theoretical Domains Framework (TDF). In spite of the recognised health benefits of PA, 64.0% of administrative staff and 62.0% of PhD students were physically inactive, i.e., engaging in less than 600 METS-minute/week of moderate intensity PA. Physical inactivity among the administrative staff was directly associated with gender, with females being more inclined to be physically inactive than the males. However, gender did not have any significant effect on the PhD students' PA levels. In contrast with findings from previous studies, ethnicity did not have any significant influence on physical inactivity behaviours among university staff and PhD students. Even though the 14 domains of the TDF were good predictors of physical inactivity among inactive university administrative staff and PhD students, *physical skills* domain was identified as the only significant predictor of physical in activity among inactive administrative staff, while *knowledge* and *intentions* domains were identified as the only significant predictors of physical inactivity among inactive PhD students. These identified domains could be targeted with interventions to increase PA among inactive university administrative staff and PhD students. Therefore, the findings of this study will inform the development of bespoke interventions to increase levels of PA among inactive university administrative staff and PhD students, and could also be considered in the broader context of the health and wellbeing agenda for staff and students in this and other universities.

5.9. Chapter summary

The key findings from study one (i.e., group interview) and study two (survey) are presented in Table 5.9.

Table 5.9: Summary of the key findings of study one and study two

Study	**Key findings**
Study 1 (Group interviews)	• The 14 domains of the TDF were either enablers and/or barriers to PA amongst university staff and students, however, six prominent domains, i.e., Environmental Context & Resources; Intentions; Social Influences; knowledge; Beliefs about Capabilities; and Social/Professional Role & Identity, accounted for 71.1% of the emerging themes. • Six additional items were also developed from the participants quotes: 3 items to measure the "Memory, Attention & Decision Processes" domain and 3 items to measure "Social/Professional Role & Identity" domain that are not measured by the validated scale (i.e., DPAQ) that assesses the domains of the TDF in the PA context.
Study 2 (Survey): Preliminary survey Main survey	• Results of a preliminary survey carried out among the entire University of Derby staff and students indicated that the administrative staff (64.0%) and PhD students (62.0%) were the most physically inactive compared to other staff and student groups, respectively and will therefore benefit most from prospective interventions. • Results of the main survey indicated that the only significant domain of the TDF that predicted physical inactivity among university administrative staff was 'physical skills', while the domains of the TDF that predicted physical inactivity among PhD students were 'knowledge' and 'intentions'.

The six additional items developed using the participants' quotes from the group interviews in study one, to measure the 'memory, attention and decision processes' and social/professional role and identity' domains of the TDF, and the validated 4-item motivation subscale of the

Motivation for PA questionnaire (MPAQ) to measure 'reinforcement' domain of the TDF, not measured by the validated Determinant of Physical Activity Questionnaire (DPAQ), were incorporated into the composite questionnaire together with the DPAQ to quantitatively assess the entire 14 domains of the TDF using surveys (i.e. study two). Chapter 4, section 4.4.3. page 110-112 and Chapter 5, section 5.5.5.2. page 134 outline the six additional items and the quotes which supported their development, and the subscale of the MPAQ, respectively.

A preliminary survey distributed amongst the university staff and students indicated that the administrative staff (64.0%) and PhD students (62.0%) were the most physically inactive in comparison with other university staff and students, respectively. Therefore, these inactive administrative staff and students would benefit more from interventions aimed at changing their behaviours towards PA, and thus selected as the study population.

As indicated in the Chapter 3 (general methodology) in section 3.4.1, an exploratory sequential mixed methods design was chosen for this research project, because it allowed the utilisation of the results from qualitative data collection and analysis (study one) to inform instruments (i.e., the survey) used to collect quantitative data (study two). For example, the six additional items developed through the participants' quotes in the group interviews conducted in study one were incorporated in the survey (to measure two domains of the TDF, i.e., "Memory, Attention & Decision Processes" and "Social/Professional Role & Identity" domains not measured by the validated DPAQ) used to collect quantitative data in study two.

Findings from study one indicated that six prominent domains of the TDF were the major barriers and enablers to PA amongst university staff and students, i.e., Environmental context, and resources; Intentions; Social influences; Knowledge; Beliefs about capabilities; and Social/professional role and identity. Study two, which was more specific to the populations under investigation, suggested that only three domains, i.e. 'physical skills' for administrative staff, and 'Knowledge' and 'intentions' for PhD students were significant predictors of physical inactivity among these groups. Michie, Atkins & West (2014) argued that in trying to change behaviours, it is more beneficial to target a few prominent domains and gradually initiate change rather than trying to target too many domains quickly. Both 'Knowledge' and 'intentions' domains of the TDF were prominent in both study one and study two, as such these domains were selected as core to the intervention targets. 'Physical skills' was selected as an intervention target because this was the only significant predictors of physical inactivity among university administrative staff (i.e., target population) and thus worth exploring further.

Although findings from study one and two were synthesised in selecting the domains of the TDF that interventions would target, more emphasis was placed on the quantitative findings (study two), which specifically focused on the study populations i.e., administrative staff and PhD students, and would thus better inform the interventions. A comparable research design has been employed by other research teams (Salvo et al., 2018). Even though it might seem ideal to target all the six prominent domains of the TDF identified as barriers and enablers to PA amongst university staff and students in study one for potential intervention, this may not be feasible when available resources and the scope of the research are considered. The implications from study one will be discussed further in chapter 8.

Chapter 6- Effects of a Theory-Based Supervised Exercise Intervention on Physical Skills and Physical Activity Levels of University Administrative Staff

6.1. Introduction

The findings from the previous chapter (i.e., chapter 5) established the domains of the TDF that will be targeted by the bespoke brief behaviour change interventions to be carried out amongst university administrative staff and postgraduate research (PhD) students. The intervention studies are presented in separate chapters of these thesis, i.e., university administrative staff (chapter 6) and PhD students (chapter 7). A key outcome of Chapter 5 was the finding that 'physical skills' was a predictor of physical inactivity amongst administrative staff. Using this outcome, supported with the BCW, COM-B behaviour model and TDF, this chapter presents the design, development, and implementation of an intervention to address this barrier (i.e., lack of physical skills) to engagement in PA in order to elicit positive pro-active behaviour.

Therefore, this chapter describes the processes involved in the development, implementation and evaluation of an intervention aimed at improving the physical skills of university administrative staff to engage in exercise. The chapter begins by presenting a brief background, context and rationale for the study followed by the methods used in carrying out the interventions. Finally, the results, discussion and conclusion are presented in detail.

6.2. Background:

Currently, the TDF has been employed in the identification of enablers and barriers to exercise and PA in asylum applicants (Haith-Cooper et al., 2018) and to examine the barriers and enablers to PA amongst overweight women (Flannery et al., 2018). The majority of studies to date have employed COM-B and/or TDF used qualitative approaches; however, its use in the PA domain among the adult population is limited and has never been used in the PA domain in the university context. We are not aware of any study that has yet utilised the BCW, COM-B and/or TDF to develop and implement interventions aimed at increasing physical skills among inactive university administrative staff, therefore this will be the first study, to our knowledge, to do so. Even though there are no studies that specifically aim at developing physical skills among inactive adults, the Centers for Disease Control and Prevention (2017) recommends that individuals who lack skills should take an exercise class to develop new physical skills.

Furthermore, Fennell, Peroutky & Glickman (2016), aimed to assess the efficacy of supervised exercise intervention in comparison with a period of unsupervised exercise among university faculty and staff members establishing that supervised exercise programmes for previously inactive people were more effective at improving fitness and PA in comparison with unsupervised exercise. This indicates that supervised participation in exercise and PA may help inactive administrative staff to develop their physical skills. Therefore, the aim of this study is to examine if the intervention to increase physical skills among university administrative staff elicited pro-physical activity behaviour change, as well as to examine if a brief intervention could result in established behaviour change.

6.3. Methods

6.3.1. Study design

This study employed a 4-week brief intervention adapted from a study by Plotnikoff et al. (2005) that involved the allocation of participants into two conditions. The intervention was carried out from September to November 2019 and assessments undertaken at two-time points; pre-intervention (week 0) and post-intervention (week 4) at the end of the 4-week intervention.

6.3.2. Ethical consideration

Ethical approval (Appendix 17) was obtained from the Human Science Research Ethics Committee (HS-REC) of the University of Derby (ETH1819-0099) before the commencement of this study. Participants were presented with information about the purpose of the research; informed of their rights to withdraw; how their data will be stored and used; assured of their confidentiality; and requirement to sign an informed consent prior to completing the surveys and assessment instruments. Strict measures to safeguard confidentiality were followed as all participants were requested to use the individual unique identification numbers, they generated in study 2 (survey study).

6.3.3. Sample size estimation

An a priori power analysis utilising G* Power (Faul et al., 2007) suggested that a total sample of 52 participants (i.e. administrative staff) would be required to detect a small to medium effect size (d=0.35) with 80% power with a t-test, alpha at 0.05. This is consistent with a current meta-analysis of PA interventions by Ma & Ginis (2018) which indicated that the overall interventions have a small to medium-sized effect (i.e. 0.35) on PA behaviour.

6.3.4. Development of interventions

This current study employed the eight-phase approach outlined by Michie, Atkins & West (2014) in the development of the behaviour change interventions, as illustrated in Figure 6.1. These phases include describing the problems in behavioural terms, choosing the intended behaviour, enumerating the intended behaviour and ascertaining those things that must change (stage 1); ascertaining the intervention functions and policy categories (stage 2); and ascertaining the behaviour change techniques and the ways the interventions would be delivered (stage 3) (Michie, Atkins & West, 2014).

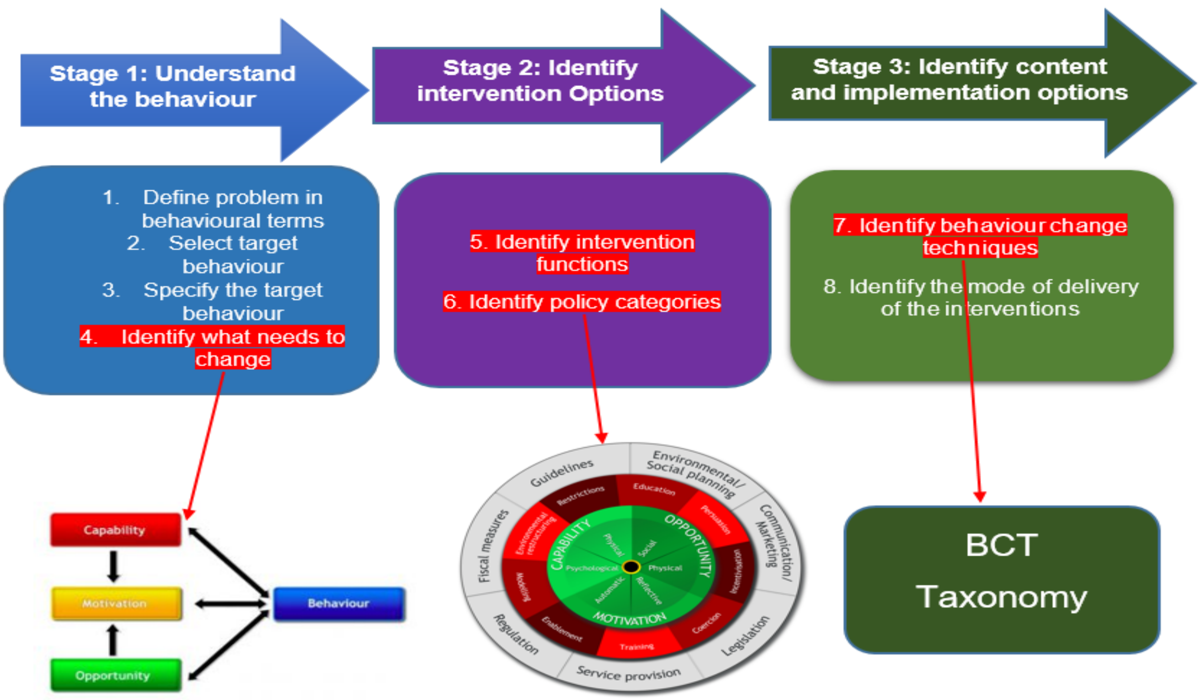

Figure 6.1: The eight phases of the behaviour change wheel used in the intervention design (Michie, Atkins & West, 2014)

6.3.4.1. Stage one: understanding the behaviour

The first phase involved description the problem of focus in behavioural terms. The behaviour targeted and the people involved in the behaviour were clearly defined (Michie, Atkins & West, 2014). A survey study conducted among university staff, described in chapter five, as well as a critical review of literature, showed that high levels of physical inactivity among university staff, especially the administrative staff, was a major behavioural problem and therefore interventions are required to increase PA levels. The second and third phases involved the selection and specification of the target behaviour. This involved outlining the new target behaviour (i.e., increasing PA) and specifying who needs to do it, what they have to differently do to accomplish transformation in the behaviour, where and when they require to engage in the behaviour, and how frequently they would engage in the behaviour and with whom (see Table 6.1).

Table 6.1: Specification of the target behaviour for university administrative staff

Specification of target behaviour	**Actions**
Who needs to do it?	University of Derby administrative staff
What do they have to do differently to accomplish the change required?	Acquire new skills to engage in a sport
When and where do they require to engage in the behaviour?	Mondays (6pm) and Fridays (1pm) at the sports centre in the university campus.
How frequently and with whom?	At least once a week with a professional badminton trainer.

Then the fourth phase involved the identification of those things that must change. Michie, Atkins & West (2014) recommended using focus groups or interviews, as well as surveys supported with the COM-B model as a foundation for the discussions, in order to facilitate a deeper insight of the behaviours that require to change for the targeted behaviour to take place. In this present research, group interviews were conducted among various university staff (study 1) to examine their barriers and enablers to PA engagement, with regards to their capability, opportunity and motivation (COM-B), which was further expounded employing the theoretical domains framework (TDF). Furthermore, online surveys were distributed among the university administrative staff, who were found to be the most physically inactive compared to other university staff (study 2), to determine the domains of the TDF that predict physical inactivity among those that are inactive. With the data collected, the COM-B and the TDF domains that required targeting in the intervention, in this case physical skills (physical capability), is presented in Table 6.2.

Table 6.2: The Matrix of links between the COM-B, domains of TDF, intervention functions and BCTs for the administrative staff intervention

Behavioural analysis employing COM-B- predictors of physical inactivity	TDF domains linked to COM-B components	Intervention functions	Behaviour Change Techniques (BCTv1)	Description of intervention strategies
Administrative staff: CAPABILITY- Physical Capability: Lack of physical skills to engage in sport or physical activity.	Physical skills Develop the administrative staff's skills to engage in a sport.	Training, enablement, modelling, persuasion	Training: demonstration of the behaviour; instruction on how to carry out a behaviour; behavioural practice/rehearsal; self-monitoring of behaviour; monitoring of behaviour by people without evidence of feedback Enablement: self-monitoring of behaviour Modelling: demonstration of behaviour Persuasion: use of follow-up prompts/cues	Training, modelling, and enablement: An expert led badminton sessions, where the participants were coached on how to play badminton. The researcher also observed them throughout the intervention to see how their skills improve. They were also expected to complete weekly activity log to self-monitor their physical activity Persuasion: Weekly reminder to prompt participants to attend the badminton sessions and to complete the weekly activity log

6.3.4.2. Stage two: identification of the intervention options

The fifth and sixth phases in stage two of Michie, Atkins & West, (2014) BCW model necessitates the identification of intervention functions and policy categories. The intervention functions most likely to affect behaviour change (i.e., increase PA), following the behavioural analysis using the COM-B model and the TDF, were selected as illustrate in Table 6.3. The pertinent intervention functions were then rated employing the APEASE (i.e. Affordability, Practicability, Effectiveness/ cost effectiveness, Acceptability, Side effects/safety profile & Equity) criteria (Michie, Atkins & West, 2014).

Table 6.3: Applying practical criteria to guide the selection of the intervention functions for the administrative staff intervention (Michie, Atkins & West, 2014)

Candidate intervention functions	**Are the candidate intervention functions affordable, practicable, effective/cost-effective, acceptable, safe and equitable, and likely to have impact in this context?**
Education	Not relevant or applicable
Enablement	Yes
Training	Yes
Modelling	Yes
Environmental Restructuring	Not relevant or applicable
Persuasion	Yes
Incentivisation	Not relevant or applicable
Coercion	Not relevant or applicable
Restriction	Not relevant or applicable

The criteria used in selecting four of the nine intervention functions outlined by the BCW is presented above (Table 6.3). These four intervention functions (i.e. training, modelling, enablement, and persuasion) have been used extensively to support the delivery of interventions aimed at improving PA behaviour among different populations in diverse settings

(Munir et al., 2018; Ojo et al., 2019; Webb, Foster, & Poulter, 2016). Training is an intervention function that involves imparting skills, both mental and physical, on individuals to enable them engage in a specific behaviour (Michie, Atkins & West, 2014). For example, training individuals on how to engage in a sport or exercise to increase their PA levels. Modelling is an intervention function that entails offering examples of how to perform a behaviour for individuals to aspire to or emulate (Michie, Atkins & West, 2014), such as showing individuals how to engage in a sport or exercise, which could be either peer-led or expert-led. Enablement is an intervention function that involves improving means or decreasing obstacles to enhance ability or potential to engage in a desired behaviour (Michie, Atkins & West, 2014). For instance, the use of behavioural support, such as utilising activity logs to facilitate PA engagement. Finally, persuasion is an intervention function that requires the utilisation of communication to stimulate positive or negative attitudes or induce action (Michie, Atkins & West, 2014). This could include the use of imagery to prompt engagement in PA or the utilisation of e-mails to remind individuals to engage in PA.

Table 6.4: Mapping of policy categories to intervention functions (Michie, Atkins & West, 2014)

Behaviour Change Wheel (Policy categories)	Intervention Functions								
	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Communication/ marketing									
Guidelines									
Fiscal Measures									
Regulation									
Legislation									
Environmental/ Social planning									
Service provision									

After the intervention functions had been selected, the next phase involved the identification of the policy categories (i.e., environmental/social planning, communication/marketing, fiscal measures, guidelines, regulation, service provision and legislation) that will be used to deliver the interventions. Out of the seven policy categories detailed in the BCW, as shown in Table

6.4, only two (i.e., communication/marketing and service provision) were found applicable to support the intervention functions in this context. The other policy categories are usually provided by the government (Michie, Atkins & West, 2014) and hence not applicable in the current research project. There are guidelines to adopt to facilitate success of interventions (Department of Health, 2011b; World Health Organisation, 2015), but there are no fiscal measures, regulations, or legislation to force people to be physically active.

6.3.4.3. Stage three: identification of the content and implementation options

The seventh phase in the stage three of the intervention design involved the identification of the Behaviour Change Techniques (BCTs). A BCT as defined by Michie, Atkins & West (2014, p.145) is *"an active component of an intervention designed to change behaviour".* The major features of a BCT are that it can be observed, replicated, and an irreducible constituent of an intervention intended to transform behaviour and a postulated active component in the intervention (Michie & Johnston, 2013). From the list of 93 BCTs (see Appendix 18) developed by Michie et al. (2013), the most suitable were chosen for the intervention that would result in the anticipated change (i.e. increase PA engagement among inactive university administrative staff).

The following criteria were applied in the selection of the BCTs to deliver the intervention:

- establishing the evidence of the effectiveness of the BCTs in the context of acquiring new skills to engage in a sport;
- assessing the relevance of acquiring new skills to engage in a sport and its practicability in the university setting; and
- evaluating the feasibility and affordability of the BCTs to help guide the selection of the BCTs that will effectively deliver the intervention.

The BCTs linked to the nine intervention functions in the BCW (Michie, Atkins & West, 2014) are presented in Appendix 19. The long list of BCTs were thoroughly reviewed using the criteria mentioned earlier and narrowed down to those BCTS that were more likely to be appropriate in the delivery of the selected four intervention functions (i.e. training, enablement, modelling and persuasion) were reviewed (Michie, Atkins & West, 2014). See Appendix 20 for the seven selected BCTs and their labels.

The eighth and final phase involved the identification of the modes of delivery of the intervention. In addition to the identification of BCTs, decisions need to be made concerning the ways that the interventions would be delivered. Mode of delivery is one of the seven dimensions of interventions identified (Davidson et al., 2003). The others are content, provider, setting, recipient, intensity and fidelity. In reports of interventions, there is often insufficient distinction between intervention content and mode of delivery, for example, telephone or face-to-face (Michie, Atkins& West, 2014). Just as for intervention content and implementation through policy levers, it is important to reflect on the full panoply of potential approaches to deliver the interventions prior to making decisions about the most suitable for the specific behaviour targeted, the population and the setting. A simple taxonomy of modes of delivery (Michie, Atkins & West, 2014), as shown in Appendix 21, was used to select the delivery mode to apply. The delivery modes selected for this study were: face-to-face approach (e.g., group focus); and distance population-level approach outdoor media (e.g. invitation posters), print media (e.g. invitation leaflets) and digital media (e.g. internet).

6.3.5. Intervention processes and outcome measures

The overall design and methodology of this current study is specific to inactive University of Derby administrative staff. This intervention was designed to improve physical skills among the inactive administrative staff, with an overall aim of increasing their PA levels.

6.3.5.1. Inclusion and exclusion criteria

Current administrative staff of the University of Derby that is 18 years and above who scored below 600 MET-min/week of moderate intensity PA, on the GPAQ, were included in the study. If an individual is on the university payroll, then they would be classified as administrative staff. Anybody who did not meet the mentioned inclusion benchmarks were excluded from the study. Additionally, any administrative staff with potential medical contraindications to regular PA, as measured by the Health Screening Questionnaire, was excluded from this study unless they have written confirmatory clearance from their general practitioner.

6.3.5.2. Recruitment of participants

Multiple strategies were used to recruit participants. Firstly, invitation posters and flyers (Appendix 22) were disseminated to highly visible and high footfall locations (e.g., main reception) across the University's city campus. Secondly, invitation e-mails, with a link that will take the participants directly to the screening questionnaire (Appendix 23), were sent to the administrative staff through the Human Resources department, via heads of departments and directly to the administrative staff inviting them to take part in this study. Thirdly, recruitment was carried out through face-to-face contacts with the administrative staff, as well as through on-site communication opportunities such as advertisement of the invitation poster on Derby Daily (an in-house daily online newsletter). Finally, the administrative staff that participated in previous studies associated with this programme of research were also invited to take part in this study.

During the face-to-face recruitment, the potential participants (i.e., administrative staff) were required to read the participants' information sheet incorporated in the screening questionnaire that details all they need to know about the study. After this, they were required to give an informed consent, generate a unique identification number, and provide an e-mail address with which they will be contacted throughout the intervention period before they can complete the questionnaire. These multiple recruitment strategies were chosen to increase the number of participants signing up for the study. This is in line with previous studies, which revealed that effective recruitment should involve multiple approaches (Castro et al., 2011; McCann et al., 2013).

6.3.5.3. Screening and allocation of participants to treatment groups

The screening questionnaire, which was delivered online through Qualtrics comprised of a demographic information page; the Global Physical Activity Questionnaire (GPAQ) to determine participants' levels of PA; and the Health Screening Questionnaire. The prospective participants were required to provide an email address if they showed interest in taking part in the study. The participants (administrative staff) that were inactive, i.e. those who reported engaging in below 600 MET-minutes/week of moderate intensity PA, as measured by the GPAQ and did not have any illness that will prevent them from participating in PA, were eligible to take part in this study, and were therefore invited.

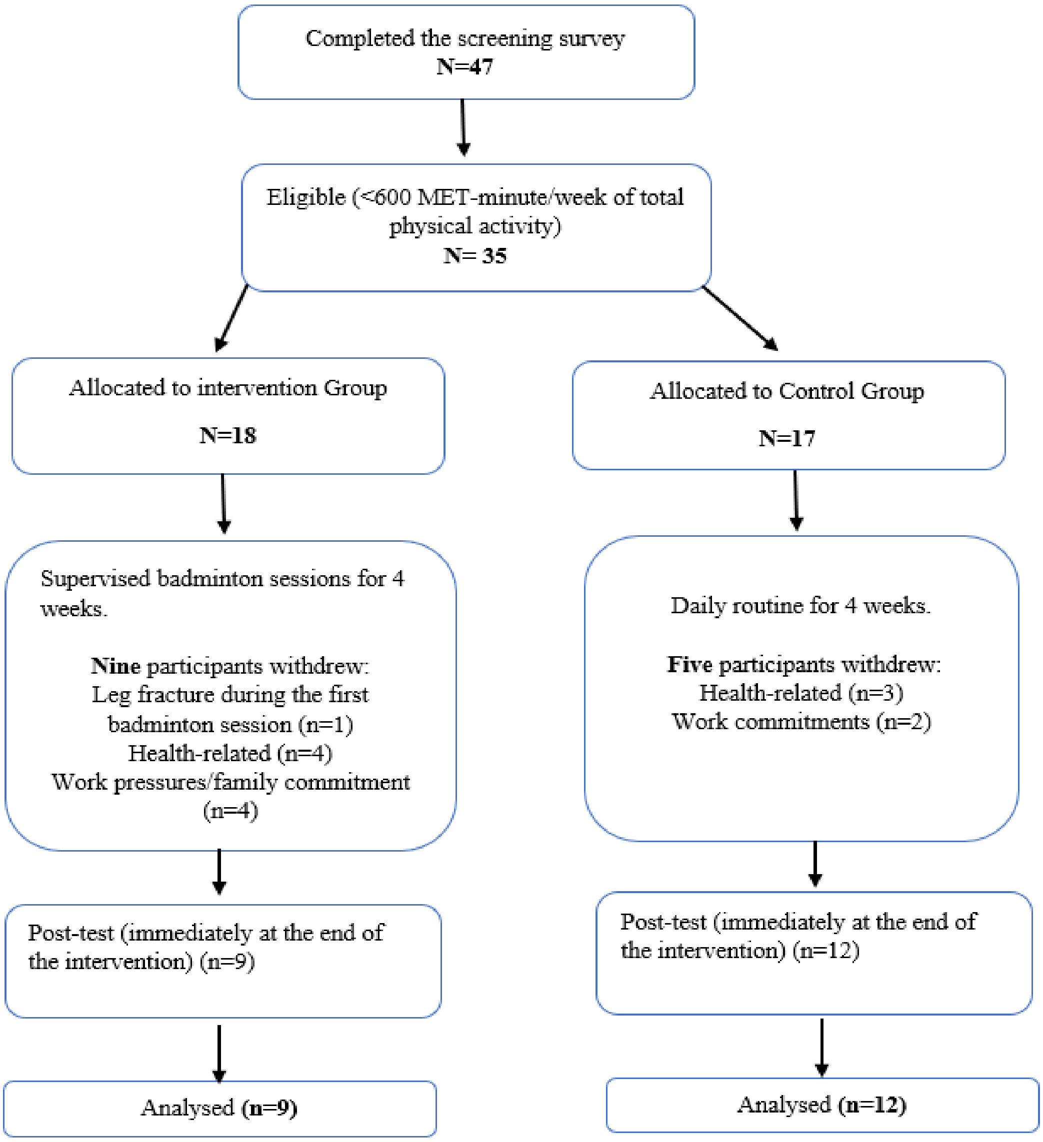

Figure 6.2: Flow chart showing recruitment and randomisation of administrative staff

As illustrated in Figure 6.2, out of the 47 university administrative staff that completed the screening questionnaire, 35 (74%) were eligible to take part in the study and were therefore assigned to either experimental (n=18) or control (n=17) groups. However, nine participants withdrew from the experimental and five participants from the control groups and therefore, nine participants in the experimental and 12 participants in the control groups completed the study. The reasons for their withdrawal are presented in Figure 6.2. The treatment group allocations were carried out using the Latin Square design. This is an approach of assigning treatments so that they occur in a balanced manner within a square block, in which treatments occur only once in every column and row (see section 3.6.2 in Chapter 3). In applying Latin Square design, the number of the columns and rows must correspond to the number of treatment groups, therefore, in this study the two treatment groups were coded as 1-

experimental group and 2-control group. After recruitment, a list of all the participants were generated, then the first participant on the list was assigned to the treatment group and the next to the control group. This process of allocation continued until all the participants were allocated to either of the treatment groups.

6.3.6. Interventions

An earlier survey carried out among inactive university administrative staff to identify the predictors of physical inactivity (i.e., chapter 5) indicated that lack of physical skills to engage in sports/exercise was a major predictor of physical inactivity in this population. It was thus imperative to establish a way to improve their physical skills to engage in sports/exercise through a supervised exercise session, which is ultimately expected to increase their PA levels. This intervention was informed by the work of Fennell, Peroutky & Glickman, (2016), which focused on ascertaining the efficacy of a supervised vs. a non-supervised exercise intervention on PA behaviour among inactive university faculty and staff members. Therefore, this 4-week intervention focused on increasing the university administrative staff's physical skills to engage in supervised exercise sessions. During the planning phase of this intervention, 20 administrative staff were randomly approached and after informing them about the purpose of the intended intervention, they were provided a list of sports/exercise sessions offered through the University's sports centre to select one that they would want to acquire the skills to engage in. The sports/exercise included in this list were table tennis, squash, yoga, badminton, netball, basketball, lawn tennis, climbing, football and studio cycling. Of the 20 administrative approached, 14 selected badminton, two selected table tennis, two selected yoga, one selected climbing, and one selected studio cycling. Since 14 (i.e., 70%) of these administrative staff selected badminton as a sport they would want to acquire the skills to play, badminton was chosen for this intervention.

After collection of the baseline measures, as shown in Appendix 25, the participants in the experimental group were invited through e-mail (Appendix 26) to engage in coached badminton at the university's sports centre at least once a week for the four weeks of the intervention, either on Mondays (5-6pm) or Fridays (1-2pm), while the participants in the control group were asked to continue with their normal routine (Appendix 27). However, prior to taking part in the badminton sessions, the participants were requested to complete an 8-item Health Screening Questionnaire (Appendix 28). The participants that answer 'No' to all the questions were allowed to take part in the badminton sessions, those that answers 'Yes' to any of the questions were not eligible to participate unless they confirmed that their condition was well managed and would not lead to any PA associated risks or if they provided medical clearance from their GP stating that they can. The intervention in this study was delivered by a qualified badminton instructor (National Governing Body, level 2) and the researcher. Four intervention functions (i.e., training, modelling, enablement, and persuasion) were used, which were found to be pertinent and thus mapped to six behaviour change techniques (BCTs) (i.e., demonstration of the behaviour, instruction on how to carry out a behaviour, behavioural practice/rehearsal, self-monitoring of behaviour, monitoring of behaviour by people without evidence of feedback, and use of follow-up prompts/cues) as detailed by the BCW (see Table 6.2).

For the experimental group, the badminton sessions were delivered by a qualified instructor that works in the University's sports centre, and the researcher was also available in all the training sessions to support the participants, mark the attendance register and administer the Health Screening Questionnaire. A qualified badminton instructor delivered the training and modelling intervention functions through the use of several BCTs such as instruction on how to carry out the behaviour (i.e., providing instructions to the participants on how to play badminton); demonstration of the behaviour (i.e. showing to the participants how to play badminton); and behavioural practice/rehearsal (i.e., allowing the participants to practice playing badminton on their own with close supervision). The participants in the control group were not provided with any form of intervention but requested to carry on with their normal routine.

To deliver the enablement intervention function through the use the BCT, 'self-monitoring of behaviour', the researcher e-mailed activity logs (Appendix 29) to the participants in the two treatment groups (i.e., experimental group and the control group) weekly. They were requested to complete these activity logs every week all through the period of the intervention, to self-monitor their PA behaviour. The BCT, 'self-monitoring of behaviour without evidence of feedback', was also used by the researcher through the observation of the participants at each badminton session, to assess how they improved in their skills to play badminton during the intervention period, without providing any form of feedback. This was done to establish if the intervention was effective at improving the participants' skills to play badminton and invariably increasing their PA levels. Finally, to deliver the persuasion intervention function using the BCT, 'use of follow-up prompts/cues', the researcher sent different e-mails to participants in the two treatment groups every week as reminders; the email to the experimental group to remind them to come for the badminton training sessions (Appendix 30), while the e-mail to the control group to just tell them to continue with their normal routine (Appendix 31). After this study ended, participants were requested to complete an online post-intervention survey that included a debriefing page (Appendix 32), and the participants in the control group were given the opportunity to also attend 4-week supervised badminton sessions.

6.3.7. Outcome measures

6.3.7.1. Physical activity levels

The outcome measures were evaluated at week 0 (baseline) and at week 5 (post-intervention), as illustrated in Figures 6.2. The GPAQ (WHO, 2012a) and activity logs were employed to measure the levels of PA of the administrative staff. The psychometric properties of the GPAQ have been critically discussed in Chapter five (see section 5.3.5.1). The PA logs were provided for participants to record the type, intensity, day, time and place they engage in PA weekly.

6.3.7.2. Physical skills scores

The 3-item physical skills subscale of the validated Determinants of Physical Activity Questionnaire (DPAQ) (Taylor et al., 2013) was used to measure physical skills pre- and post-intervention. This psychometric instrument even though validated among university staff and students, was validated among the participants in this study since only a sub-scale of the entire instrument was used. Although the internal consistency (i.e., Cronbach's alpha) of the DPAQ has been reported in Chapter 5 (see section 5.3.5.2), it was expedient to also check the internal consistency of the physical skills sub-scale of the DPAQ, which was used in this study, among the study participants. The internal consistency of the physical skills subscale of the DPAQ was tested amongst 20 administrative staff prior to the collection of baseline measures. The physical skills sub-scale of the DPAQ showed an excellent psychometric property, with a Cronbach's alpha coefficient of 0.95 (ranging from 0.89 to 0.97) (see Appendix 33 for the SPSS output).

6.4. Data Analysis

The descriptive statistics were presented as frequencies, percentages, means and standard deviations. The minutes/week the participants spent in moderate and vigorous activities were calculated using the World Health Organisation guide (WHO, 2012a) and presented as MET-minute/week (metabolic equivalent). IBM SPSS statistical software 25.0 (Chicago, IL, USA) was employed to perform all statistical analyses, with the significant level set at 0.05. One-way

ANOVAs were used to compare participants' socio-demographic characteristics at baseline across the treatment groups to ensure that the allocation of participants to the two treatment groups was properly conducted. Pre-post differences were measured using mixed-methods design ANOVA. The effect sizes were reported as partial eta square (η_p^2), using the following Cohen's classification of effect sizes: small (0.01), medium (0.06) and large (0.14) (Cohen, 1988).

6.5. Results

6.5.1. Socio-demographic features of the study participants

The socio-demographic features of the administrative staff are as detailed in Table 6.5.

Table 6.5: Socio-demographic characteristics of the administrative staff

Variables	**Treatment Groups**		**All**
	Experimental Group (n=9)	**Control Group (n=12)**	**(n=21)**
Socio-demographic factors			
Age(years), mean (SD)	36.0 ± 9.7	40.4 ± 10.5	38.6 ± 10.2
Gender:			
Male	4 (44.4%)	4 (33.3%)	8 (38.1%)
Female	5 (55.6%)	8 (66.7%)	13 (61.9%)
Ethnicity:			
White	9 (100%)	11 (91.7%)	20 (95.2%)
Black/African/Caribbean/Black British	-	1 (8.3%)	1 (4.8%)
Asian/Asian British	-	-	-
Mixed/Multiple ethnic groups	-	-	-
Other ethnic groups	-	-	-
Employment status:			
Full-time	8 (88.9%)	10 (83.3%)	18 (85.7%)
Part-time	1 (11.1%)	2 (16.7%)	3 (14.3%)
Campus located:			
Kedleston road campus	9 (100%)	9 (75.0%)	18 (86%)
Markeaton campus	-	-	-
Britannia Mills campus	-	1 (8.3%)	1 (4.7%)
Chesterfield campus	-	-	-
Buxton campus	-	1 (8.3%)	1 (4.7%)
Friar Gate campus	-	1 (8.3%)	1 (4.7%)
Leek campus	-	-	-

The average age of the participants was 38.6 ± 10.16 years, with females representing almost two-thirds (61.9%) of the study population. Most of the participants were from the White ethnic group (95.2%), only 4.8% from the Black/African/Caribbean/Black British ethnic group. Furthermore, most of the participants were in full-time employment (85.7%) at the Kedleston Road campus (86.0%), probably due to the opportunity to participate in PA because of the proximity of the location of the Sports Centre and facilities.

6.5.2. Confirmation of participants' allocation to treatment groups

One-way ANOVAs were used to compare the treatment groups of the administrative staff on the study's variables to ensure that the participants' allocation to the treatment groups was appropriately carried out. There were no significant differences between the experimental and the control groups with regards to gender ($F_{1,19}$ = 0.25, p= 0.63); age ($F_{1,19}$ = 0.97, p= 0.34); campus located ($F_{1,19}$ = 2.35, p=0.14); ethnicity ($F_{1,19}$ = 0.74, p=o.40); employment status ($F_{1,19}$ = 0.12, p=0.74); and physical skills scores ($F_{1,19}$ = 2.83, p= 0.11), assessed at baseline. However, there was a significant difference between the experimental (460.0 ± 78.74 MET-minutes/week) and control (331.7 ± 163.48 MET-minutes/week) groups on the mean total PA measures ($F_{1,19}$ = 4.68, p= 0.043), at baseline.

Since there was a significant difference in the pre-total PA levels between the treatment groups (i.e., experimental and control groups), a One-way ANCOVA was carried out to determine if there was a statistically significant difference between the treatment groups on post-total PA levels, controlling for pre-total PA levels. There was a statistically significant main effect of treatment groups on post-total PA levels after controlling for pre-total physical activity levels, $F_{1,18}$ = 6.38, p < 0.021, but there was no statistically significant main effect of the covariate, pre-total PA levels on the treatment groups post-total PA levels, $F_{1,18}$ = 0.1, p = 0.76. The size of the significant relationship (η2 = 0.262) was found to be higher than Cohen's (1988) benchmark for large effect size (η2 = 0.14), while the size of the non-significant relationship (η2 = 0.006) was found to be lower than the Cohen's (1988) benchmark for small effect size (η2 = 0.01). These results indicated that the treatment groups' difference in pre-total PA levels had no effect on their post-total PA levels, therefore, a mixed-methods design ANOVA was performed to examine the effects of the intervention and gender on total PA levels and time spent engaging in PA weekly.

6.5.3. Effects of the intervention on the study variables of the administrative staff

6.5.3.1. Effects of treatment groups and gender on total physical activity

A mixed-methods design ANOVA was performed to determine the effect of treatment groups ((independent variable 1 (IV1)), gender (IV2) and Time (IV3) on Total PA levels (dependent variable 1 (DV1)), with time (pre-intervention, post-intervention) as within-subjects factor and treatment groups (experimental group, control group) and gender (male, female) as between-subjects factors. The findings revealed a significant main effect of treatment groups, $F_{1,17}$ = 9.96, p=0.006, η_p^2 =0.369, and significant main effect of time, $F_{1,17}$ = 47.54, p=0.001, η_p^2 =0.737. However, there was no significant main effect of Gender, $F_{1,17}$ = 0.005, p=0.943, η_p^2 =0.001. This was qualified by significant interactions between treatment groups and time, $F_{1,17}$ = 9.90, p= 0.006, η_p^2 =0.368. On the other hand, the predicted interaction between gender and treatment groups, $F_{1,17}$ = 0.182, p=0.675, η_p^2 =0.011, and between gender and time, $F_{1,17}$ = 0.005 were not significant. All other main effects and interactions were not significant and thus irrelevant. This suggested that even though the experimental and control groups increased in total PA levels over time, this increase was significantly higher among the experimental group in comparison with the control group, signifying that improvement of physical skills scores lead to more engagement in PA (see Figure 6.3). However, there were no significant differences among the male and female participants with regards to total PA levels over time (see Figure 6.5).

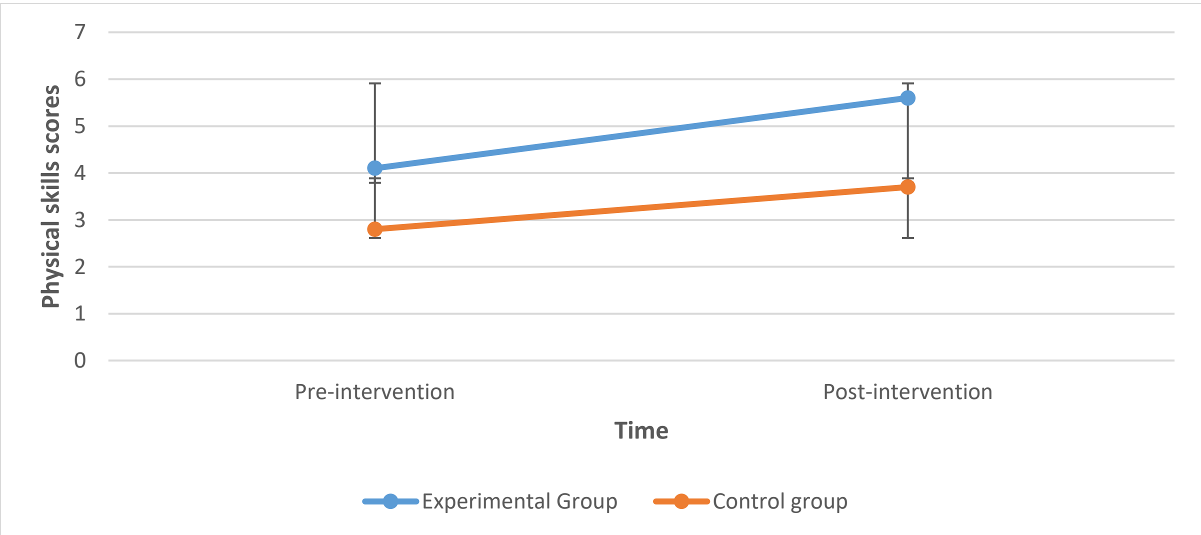

Figure 6.3: Physical skills scores for administrative staff according to treatment groups pre- and post-intervention

See Appendix 34 for the descriptive statistics of the mean physical skills scores and total PA levels according to treatment group and gender. Figure 6.3 and 6.4 indicated that both mean physical skills scores and total PA levels increased respectively from pre-intervention to post-intervention, but the increases were more in the experimental group in comparison with the control group.

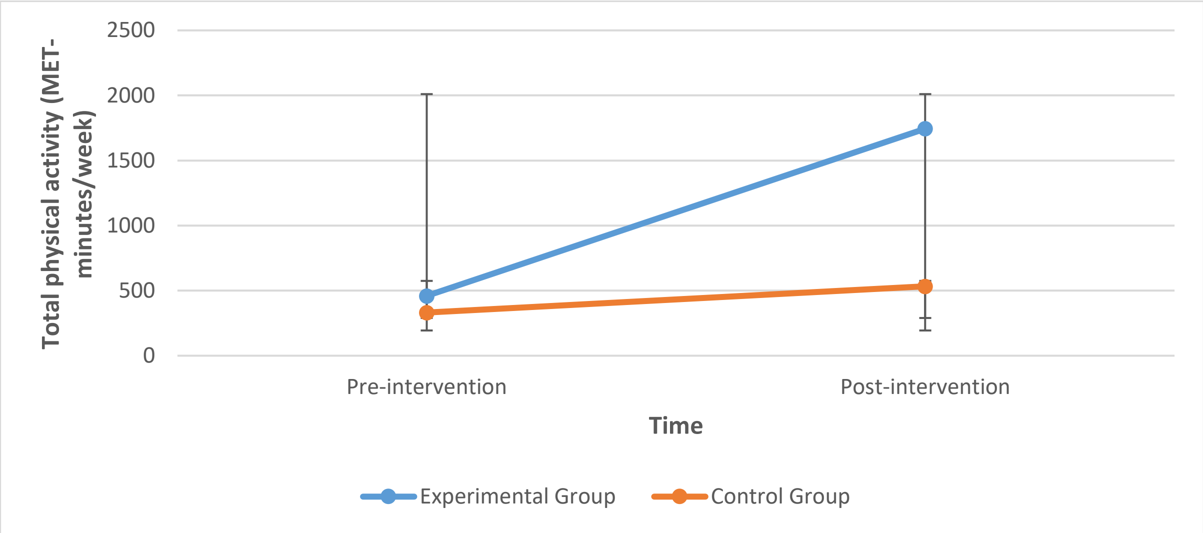

Figure 6.4: Total physical activity levels for administrative staff according to treatment groups pre- and post-intervention.

The mean physical skills scores and the mean total PA levels were comparable between the male and female participants pre- and post-intervention, as illustrated in figures 6.5 and 6.6, respectively.

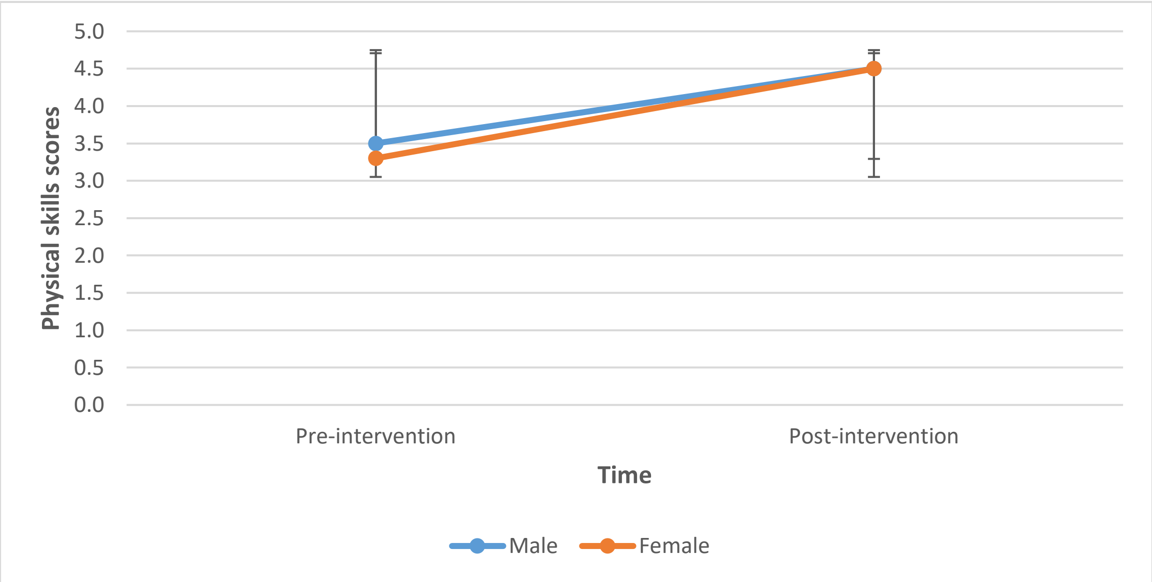

Figure 6.5: Physical skills scores by gender among administrative staff

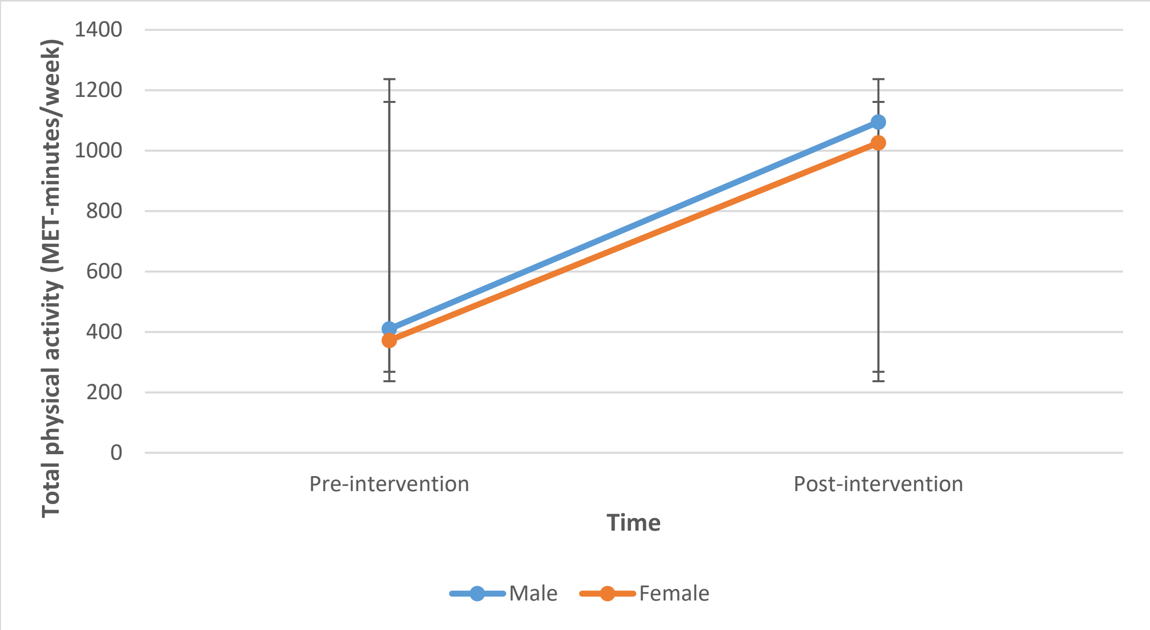

Figure 6.6: Total physical activity levels by gender among administrative staff

6.5.3.2. Effects of treatment and gender on physical activity participation

A mixed-methods design ANOVA was carried out to examine the effects of Treatment Groups (IV1), Gender (IV2) and Time (IV3) on Time Spent in PA weekly (DV), with Treatment Groups (experimental group and control group) and Gender (male and female) as between-subjects factors and Time (4 levels: week 1, week 2, week 3 and week 4) as within-subjects factor. The Mauchly's test, $x^2(5) = 8.66$, p= 0.81 did not indicate any violation of sphericity. There was significant main effect of Treatment Groups ($F_{1,17} = 11.11$, p=0.004, $\eta_p^2 = 0.395$), but there was no significant main effect of Gender ($F_{1,17} = 0.58$, p=0.457, $\eta_p^2 = 0.033$). However, there was no significant interaction between Treatment Groups and Gender ($F_{1,17} = 0.388$, p=0.542, $\eta_p^2 = 0.022$). Furthermore, there was a significant main effect of Time ($F_{3,51} = 4.22$, p<0.010, $\eta_p^2 = 0.199$). There was a significant interaction between Time and Treatment Groups ($F_{3,51} = 3.60$, p= 0.020, $\eta_p^2 = 0.175$), as shown in Figure 6.7. However, there were no significant interactions between Time and Gender ($F_{3,51} = 0.38$ p=0.769, $\eta_p^2 = 0.022$) (see Figure 6.8), and there was also no significant interaction between Time, Treatment Groups and Gender ($F_{3,51} = 0.87$ p=0.462, $\eta_p^2 = 0.049$). Follow-up Bonferroni pairwise comparisons test indicated that there was a significant difference between week 1 and week 4 (p=0.033), but no differences between other weeks (p<0.05), on time spent in PA weekly.

There was also no significant difference between the male and female participants ($p=0.46$) on time spent in PA weekly. Furthermore, independent-samples t-tests were carried out to compare the Time Spent in PA Weekly (DV) across the Treatment Groups (IV). There was a significant difference in time spent in PA weekly between the experimental group (mean= 238.9 ± 58.88 minutes/week) and control group (mean=132.5 ± 62.76 minutes/week) at week 2; $t_{19} = 3.95$, $p=0.001$; a significant difference between experimental group (mean= 252.8 ± 64.81 minutes/week) and control group (mean=120.4 ± 80.69 minutes/week) at week 3; $t_{19} = 4.03$, $p=0.001$; and ; a significant difference between the experimental group (mean= 257.8 ± 77.54 minutes/week) and control group (mean= 148.8 ± 109.1 minutes/week) at week 4; $t_{19} = 2.55$, $p=0.020$. However, there was no significant difference in time spent in PA weekly between the experimental group (mean= 163.9 ± 66.65 minutes/week) and control group (mean=125.4 ± 89.51 minutes/week) at week 1; $t_{19} = 1.08$, $p=0.29$. Specifically, these results suggested that participants in the experimental group spent more time in PA weekly all through the 4-week intervention period, apart from week 1 when there was no difference between these groups.

Gender did not play a significant role in time spent in PA weekly Gender ($F_{3,51} = 0.87$ $p=0.462$, $\eta_p^2 =0.049$). The descriptive statistics of the administrative staff showing the mean time spent in PA weekly according to treatment groups and gender is presented in Appendix 35.

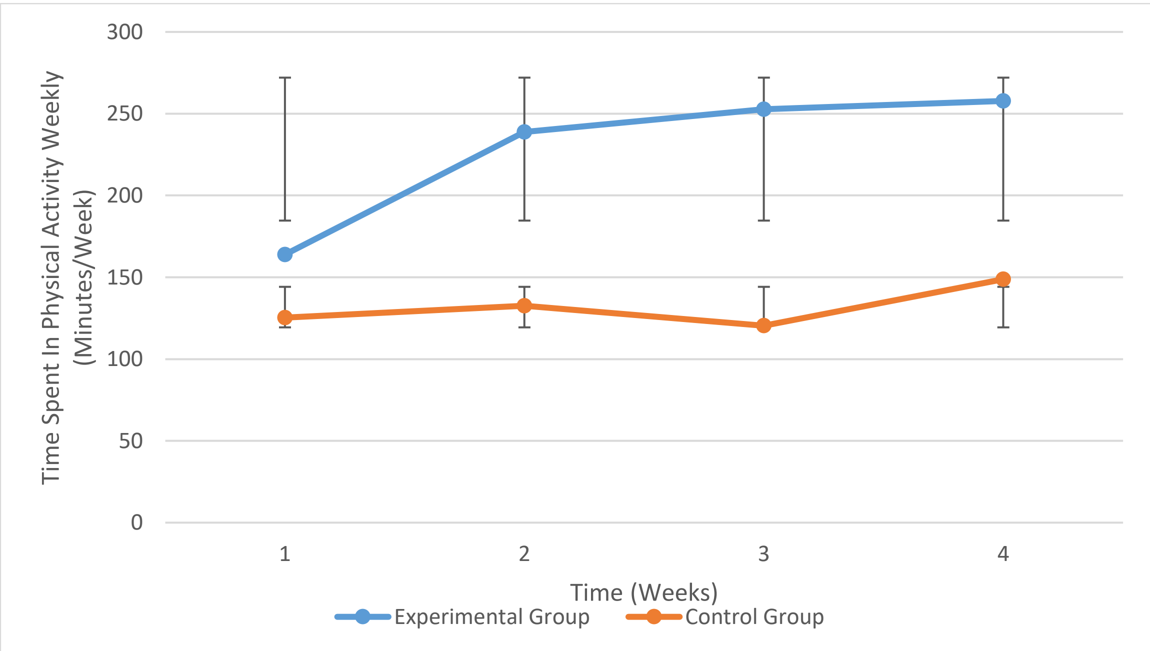

Figure 6.7: Time spent in physical activity weekly among administrative staff according to treatment groups

As illustrated in Figure 6.7, apart from week 1, participants in the experimental group spent more time in PA weekly than the control group. While in the experimental group, the time spent in PA weekly increased sharply from week 1 to week 2 after which it increased slightly from week 2 to week 4, in the control group, it slightly increased from week 1 to week 2, then declined from week 2 to week 3, after which it increased again to week 4.

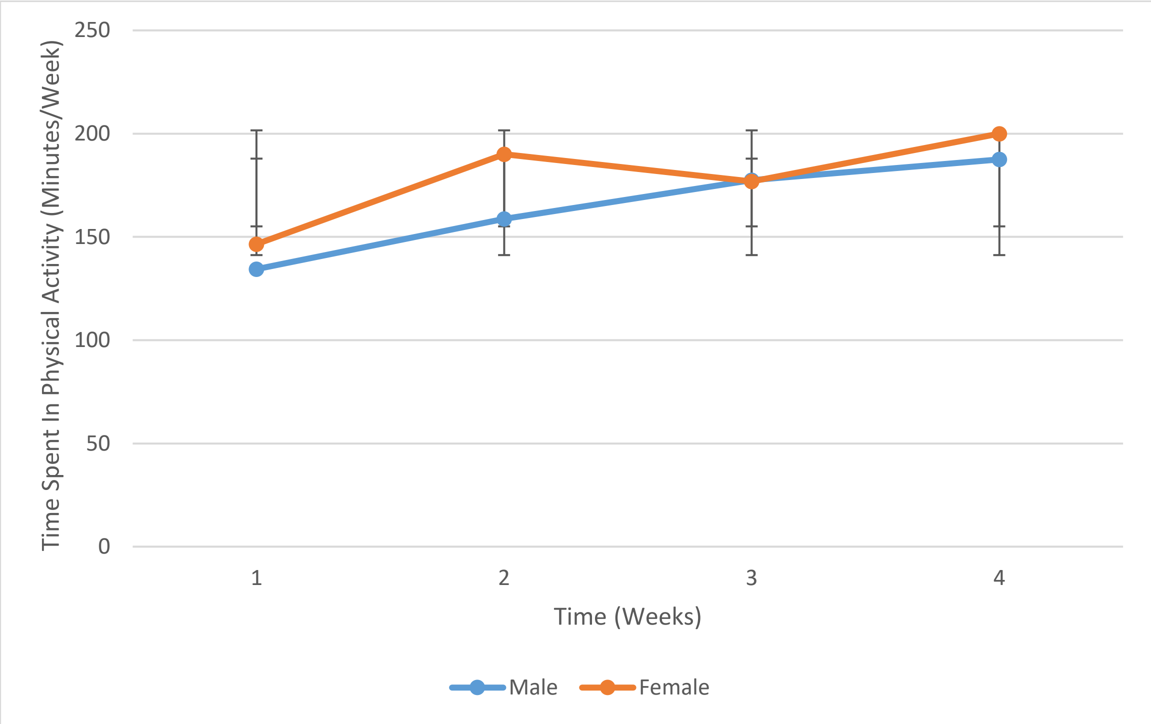

Figure 6.8: Time spent in physical activity weekly among administrative staff according to gender

As shown in Figure 6.8, there was no significant differences (p=0.46) in the time spent by the male and female participants in PA weekly across the four weeks of the intervention.

6.6. Discussion

To our knowledge, this is the first study to be conducted in the university setting using the Behaviour Change Wheel (BCW), the COM-B model of behaviour and the Theoretical Domains Framework (TDF) to improve the physical skills of inactive administrative staff, with the specific goal of increasing their levels of PA.

6.6.1. Impact of physical skills on total physical activity and time spent in physical activity among the administrative staff.

A major finding of this present study is that the participants in the experimental group (i.e. those that received supervised badminton training) recorded higher physical skills scores and also recorded higher PA levels and spent more time in PA weekly than the control group. The effect sizes for the interactions between treatment groups and total PA (η_p^2 =0.368) and between treatment groups and time spent in PA weekly (η_p^2 =0.175) were observed to exceed the Cohen's (1988) benchmark for a large effect (i.e. η_p^2= 0.14) (Cohen, 1988). Therefore, this shows that improving people's physical skills to participate in a form of exercise or PA, especially those that are inactive, has a significant influence on their overall PA levels as well as time spent engaging in PA. It was not surprising that the participants with higher physical skills scores reported higher PA levels than those with lower physical skills scores, because the COM-B model and TDF, which underpinned this study, posit that the improvements in skills (i.e. physical capability) to enact a behaviour increase the likelihood to carry out the behaviour (Michie, Atkins & West, 2014).

Even though it was very challenging finding empirical evidence to support these findings, because of the scarcity of research that have assessed the association between physical skills and PA engagement, especially among university staff, the Centers for Disease Control and Prevention (2017) advocated that individuals who lack skills to participate in sports or PA should take a class to develop new skills as a way to increase their overall PA levels. Furthermore, Fennell, Peroutky & Glickman (2016), focused on evaluating the efficacy of supervisor-led exercise intervention weighed against a period of non-supervised exercise amongst university faculty and staff members, suggested that supervisor-led exercise sessions for formerly inactive individuals were more efficacious at enhancing fitness and PA in comparison with non-supervised exercise. Therefore, this re-enforced the findings of this present study, which indicated that supervised sports or PA may help the inactive administrative staff to develop their physical skills, which will ultimately improve the time they spend engaging in PA and their overall PA levels. This study focused on improving the administrative staff's physical skills using supervised badminton sessions, since it was readily available in the university's sports centre and also provided a uniform way of assessing participants' PA levels. However, further studies could focus on the entire university staff and allow them to engage in any exercise or PA of their choice.

6.6.2. Impact of gender on physical skills, total physical activity and time spent in physical activity.

Although participants in the experimental group performed better than the control group with regards to the physical skills scores, total PA and time spent in PA weekly post-intervention, no differences were found among these variables based on gender. The effect sizes for the interactions between gender and treatment groups (η_p^2 =0.022) and between gender, treatment groups and time spent in PA weekly (η_p^2 =0.0.049) were observed to be slightly higher than the Cohen's (1988) benchmark for a small effect (i.e. η_p^2= 0.01) (Cohen, 1988). Therefore, this indicated that gender had no significant effects on total PA levels as well as time spent in PA weekly between the treatment groups. However, these findings are unique, because findings from previous studies have generally revealed differences in gender, with men being more inclined to engage in sport or PA, thereby enhancing their physical skills, total PA and time spent in PA more compared to women (Tsai et al., 2015). Existing evidence suggests that the reasons for this disparity could be that women find engaging in exercise or PA less motivating and pleasurable in comparison to their male contemporaries (Chuang, 2009; Tsai et al., 2015). Conversely, in this present study, it is possible that the intervention effects may have been masked considering the very low male participants (38.1%) compared to the female participants (61.9%).

Even though both men (61.0%) and women (63.0%) are inspired to participate in exercise or PA to enhance their overall wellbeing, gender variances may be recognised with regard to the things that influence people to take part in exercise or PA (European Union, 2016). While men tend to participate more in sports or exercise because of the fun they derive from it (33.0%), to be in the company of their friends (23.0%) or to increase their physical performance (26.0%), women are generally more interested in weight control (26.0%), to enhance their bodily appearance (24.0%) or to counter the impacts of ageing (17.0%) (European Union, 2016). A study by Azevedo et al. (2007), which examined the influence of gender on recreational PA among Brazilian adults also showed that irrespective of the guideline employed, females remained more inactive than males.

On the other hand, in conformity with the findings of this study, a cross-sectional study by Oyeyemi et al. (2013) carried out among adults in the Northern part of Nigeria showed no substantial difference in the levels of PA between male (68.0%) and female participants (69.3%). Unlike the gender split in this present study where female participants made up about two-thirds (61.9%) of the total sample, the reverse was the case in the study by Oyeyemi et al. (2013), where male participants made up 57.9% of the total sample, thereby reinforcing the findings of this study. However, since both studies were conducted in different settings, among participants with different socio-economic characteristics, and did not use the same standardised instrument and approach to assess PA levels among the participant, it is likely that these similar results were produced by chance. Even though this study did not show any gender difference in total PA levels and time spent in weekly PA, further study should examine the impact of gender differences on sports or PA engagement among university staff using a larger sample, equal representation of both genders and objective measures.

6.7. Conclusion

This is the first study to our knowledge to evaluate the effectiveness of a 4-week intervention, informed by the BCW, COM-B model and TDF, aimed at changing the university administrative staff's behaviour towards PA, through the improvement of their physical skills to engage in exercise. The results of this study showed that the improvement of the physical skills of administrative staff to engage in supervised exercise in a sports facility on the university campus was associated with an increase in their PA levels as well as time spent in PA weekly. Additionally, no gender differences were found in the physical skills scores, the total PA levels and time spent in PA weekly among the administrative staff. Therefore, brief interventions underpinned by the BCW, the COM-B model and the TDF may be employed as a university-wide strategy to improve staff's physical skills to engage in exercise, as a way of increasing their PA levels, as well as improving their overall wellbeing, using the opportunities inherent in the university setting.

Chapter 7: Combining Education and Intentions Interventions to Promote Physical Activity Participation among Inactive University PhD Students

7.1. Introduction

The previous chapter presented the processes involved in the development, implementation, and evaluation of a brief 4-week behaviour change intervention aimed at improving the physical skills of university administrative staff to engage in PA. The findings demonstrate that participants in the experimental group (i.e., those that attended a supervised badminton session at the University's sports centre) had significantly higher total PA levels and engaged in more PA weekly compared to the control group (those that received no form of intervention). This demonstrated that improving the physical skills of university administrative staff to engage in a sport or exercise increased their PA levels as well as time spent engaging in PA weekly.

This chapter presents the processes involved in the development, implementation, and evaluation of a brief 4-week behaviour change intervention aimed at increasing the university PhD students' knowledge about PA and/or intentions to participate in PA. This chapter also presents a brief background, context, and rationale for the study. Furthermore, the methods employed in conducting the intervention, results, discussion, and conclusion are described.

7.2. Background

The focus of this current study is on the knowledge and/or intentions of the University postgraduate research (PhD) students to engage in PA. The COM-B behaviour model and the TDF posit that the awareness about the health benefits of PA and the detrimental impacts of physical inactivity increases the intentions for people to engage in more routine PA (Michie, Atkins & West, 2014). However, the knowledge about the recommended PA levels, the benefits of PA and the detrimental impacts of PA are generally low among adults (Fredriksson et al., 2018; Knox, Musson, & Adams, 2015). For example, Hunter et al. (2014) investigated the correlates of awareness about the PA recommendations in the UK, and revealed that about 47.0% of respondents did not know the PA recommendations. In support of this finding, a study carried out in England indicated that nearly two-third (62.3%) of adults failed to provide any estimate of the PA guidelines (Knox et al., 2015). Even though the awareness of behavioural recommendations are vital requisites for actual behaviour and behavioural change (Macdowall, Bonnell & Davies, 2006; World Health Organisation, 2012), earlier investigations on the association between awareness about the PA recommendations and actual PA indicates conflicting findings (Morrow et al., 2004; Cameron et al., 2007; Plotnikoff et al., 2007). Cameron et al. (2007) and Plotnikoff et al. (2007) reported that awareness about the recommended physical activity guideline predicted levels of physical activity, with individuals who knew of the recommended guideline being considerably more physically active in comparison with those that did not know. On the other hand, Morrow *et al.* (2004) found no relationship between knowledge of the recommended guideline and the actual PA levels. Likewise, the findings of intervention research that improved the knowledge of the participants are equally conflicting. The findings of Loughlan & Mutrie (1997) showed that PA levels increased significantly following the intervention, while the findings of a study by Plotnikoff et al. (2007) indicated no substantial change. A likely reason for the conflicting findings may be that the knowledge of PA recommended guideline does not directly impact on behaviour; individuals must initially develop intentions to engage in PA.

However, several interventions have employed the improvement of knowledge about PA as an efficacious approach to raise levels of PA in universities. For instance, the findings of a study conducted by Ghaffari et al. (2013) among university students to assess the influence of an educational intervention on PA-associated knowledge, behaviour and attitude suggested that the educational intervention resulted in a considerable rise in the average scores of knowledge, attitude and PA immediately and at 1 month follow up among the participants in the experimental group compared to the control group. In conformity with this study, the findings of recent research by Abdeta, Seyoum, & Teklemariam (2019) to examine the awareness about the PA recommendations and influences linked with PA engagement amongst Ethiopian adults, revealed that appropriate awareness about PA recommendations was linked with PA engagement. Finally, the findings of Hui, Hui, & Xie (2014), which aimed to determine the association between awareness about PA and levels of PA in Chinese adults indicated that the awareness about PA was positively linked with levels of PA. Therefore, employing educational interventions to increase the awareness about PA amongst inactive PhD students may be an effective approach to increase their levels of PA. In addition to knowledge about PA, the intentions to engage in PA has been shown to influence the actual engagement in PA (Fredriksson et al., 2018).

Intentions are premeditated resolutions to perform a behaviour or a tenacity to perform in a specified manner (Atkins et al., 2017). Having a strong intention does not necessarily translate to an enactment of behaviour, however, strong evidence suggests that by forming implementation intentions, a person is likely to enact the specified behaviour (Gollwitzer, P.M. & Sheeran, 1999; Gollwitzer, 1993). The implementation intentions concept is a volitional approach that has increasingly gained experiential support in the current years (Armitage & Arden, 2010). Over the years, several investigations have also established the efficacy of implementation intentions at increasing functional activity following joint replacement surgery (Sheeran & Orbell, 1999), increasing healthy diets (Verplanken & Faes, 1999), decreasing intake of saturation fat (Andrew Prestwich, Ayres, & Lawton, 2008), promoting workplace health and safety (Sheeran & Silverman, 2003), interrupting the performance of mundane behaviour (Aarts et al., 1999), reducing smoking habits (Armitage, 2016), promoting stair use (Kwak et al., 2007), and increasing PA and exercise (Milne, Orbell and Sheeran, 2002; Chatzisarantis & Hagger, 2008; Murray, Rodgers & Fraser, 2009). For instance, an investigation by Murray, Rodgers & Fraser (2009) aimed at examining the influence of implementation intentions on an exercise intervention among university students in Canada, indicated that implementation intentions may help to maintain adherence and self-efficacy to engage in exercise. Kwak et al. (2007) who studied academic hospital employees in the Netherlands, establishing that participants in the experimental group were more inclined to use the stairs straightaway after forming implementation intentions in comparison with those in the control group. This implies that forming an implementation intention of where, when and how to participate in PA, will increase the likelihood of engaging in it.

In general, the duration of interventions that employ implementation intentions to increase PA engagement has generally ranged between 2 to 4 weeks (Conner, Sandberg. & Norman, 2010; Milne et al., 2002; Prestwich, Lawton & Conner, 2003), apart from the intervention by Murray, Rodgers & Fraser (2009) which was conducted for 11 weeks. Furthermore, a meta-analytic evaluation aimed at assessing the efficacy of implementation intentions on PA indicated that the use of implementation intentions was more efficacious amongst students, especially when plans on how to overcome potential obstacles were also made (Belanger-Gravel, Godin & Amireault, 2011).

The aim of this study is to examine whether the improvement of knowledge about PA and/or intentions to participate in PA will increase PA levels among inactive PhD students.

7.3. Methods

7.3.1. Study design

This was a 4-week pre-post study design adapted from a study by Prestwich, Lawton & Conner (2003) which involved the allocation of participants into four treatment groups. The intervention was conducted from September to November 2019, with outcome measures taken at baseline (pre-intervention) and immediately after the 4-week intervention period (post-intervention).

7.3.2. Ethical consideration

Ethical approval from the Human Science Research Ethics Committee (HS-REC) of the University of Derby (ETH1819-0099) was secured before the commencement of this study (Appendix 17). The ethical consideration involved in this study is as presented in chapter 6, section 6.3.2.

7.3.3. Sample size estimation

An *a priori* power analysis using G* power (Faul et al., 2007) showed that a total sample of 87 participants (i.e. PhD students) would be required to detect a small effect size (d=0.27) with 80% power employing a t-test with alpha at 0.05. This is in line with a study by Prestwich, Lawton & Conner, (2003), which utilised similar study design and employed a sample size of 86.

7.3.4. Development of intervention

The principles of the experimental design were the same as per chapter 6, i.e. the eight phases detailed by the BCW (Michie, Atkins & West, 2014) were also used in the development of this intervention, and as such will not be repeated (see section 6.3.3 of chapter 6). In phase one, an earlier survey study carried out among university staff (chapter 5) and critical review of literature indicated that physical inactivity was high among university students, especially the PhD students. Therefore, this was a major behavioural problem that necessitates intervention to increase PA engagement. In phase two and three the new target behaviour was outlined, which is increase in PA levels and the specification of the target behaviour with required actions as Illustrated in Table 7.1.

Table 7.1: Specification of the target behaviour for university PhD students

Specification of target behaviour	**Actions**
Who needs to do it?	University of Derby PhD students
What do they have to do differently to accomplish the change required?	Increase knowledge about physical activity recommendations, benefits of physical activity and detrimental impacts of physical inactivity, as well as intentions to engage in physical activity
When and where do they require to engage in the behaviour?	Anytime and anyplace, that is convenient for them to engage in physical activity
How frequently and with whom?	As often as they can engage in physical activity on their own.

In the fourth phase, earlier conducted group interviews (chapter 4) and survey (chapter 5) were used to identify those things that need to change for the target behaviour to occur. Based on the data gathered, the COM-B components and the TDF domains, i.e., knowledge (psychological capability) and intentions (reflective motivation), which the interventions need to be target are presented in Table 7.2.

Table 7.2: The Matrix of links between COM-B behaviour model, TDF domains, intervention functions and behaviour change techniques for the PhD students' intervention

Behavioural analysis employing COM-B- predictors of physical inactivity	**TDF domains linked to COM-B components**	**Intervention functions**	**Behaviour Change Techniques (BCTv1)**	**Description of intervention strategies**
PhD students: CAPABILITY- Psychological capability: Limited knowledge about the recommended physical activity guidelines, the detrimental effects of physical inactivity and the benefits of physical activity	Knowledge Develop knowledge about the recommended physical activity levels, the health impacts of physical inactivity and the benefits of physical activity; knowing how to increase physical activity level.	Education, enablement, persuasion.	Education: credible source; information about the health consequences; self-monitoring of behaviour; follow-up prompts/cues. Persuasion: use of follow-up prompts/cues	Education and enablement: Educational materials about the physical activity recommendations, the harmful impact of physical inactivity and the beneficial effects of physical activity were sent to the participants at the start of the intervention. They were also expected to complete weekly activity log to self-monitor their physical activity Persuasion: Weekly reminders to prompt participants to read the educational materials and to complete the weekly activity log
MOTIVATION- Reflective Motivation:	Intentions Develop intentions to engage in physical activity regularly	Enablement, persuasion	Enablement: goal setting (behaviour); action planning; review behaviour goal(s); relapse prevention;	Enablement: Participants were given the implementation intentions and If-Then templates to help them plan where, when and place they intend to engage in

PhD students need encouragement to increase their intentions to engage in physical activity.			identifying barriers/problem resolution Persuasion: use of follow-prompts/cues	physical activity weekly and also plan on how to overcome anticipated barriers. Persuasion: Weekly reminder to prompt participants to remember to plan their weekly activity using the implementation intentions and If-Then template, and to complete the weekly activity log

In the fifth and sixth phases, the intervention functions most likely to increase PA engagement (i.e., change behaviour) were identified using the APEASE criteria (see section 6.3.3.2 of chapter 6), as shown in Table 7.3.

Table 7.3: Applying practical criteria to guide the selection of the intervention functions for the PhD students' intervention (Michie, Atkins & West, 2014)

Candidate intervention functions	Are the candidate intervention functions affordable, practicable, effective/cost-effective, acceptable, safe and equitable, and likely to have impact in this context?
Education	Yes
Enablement	Yes
Training	Not relevant or applicable
Modelling	Not relevant or applicable
Environmental Restructuring	Not relevant or applicable
Persuasion	Yes
Incentivisation	Not relevant or applicable
Coercion	Not relevant or applicable
Restriction	Not relevant or applicable

The criteria used in selecting three of the nine intervention functions employed in this study, as outlined by the BCW, is presented in Table 7.3. These three intervention functions (i.e. education, enablement, and persuasion) have been used to support the delivery of PA behaviour change interventions in diverse populations and in diverse settings (Munir et al., 2018; Ojo et al., 2019; Webb et al., 2016). Education is an intervention function that involves increasing awareness or understanding about a specific behaviour (Michie, Atkins & West, 2014). For example, providing information to people about the recommended PA level, the detrimental impacts of physical inactivity and the benefits of routine PA, to encourage participation in PA (Fredriksson et al., 2018). The other two intervention functions have been already discussed (see chapter 6, section 6.3.4.2). Then of the seven policy categories outlined in the BCW (Michie, Atkins & West, 2014), only communication/marketing was found appropriate to support the intervention functions enumerated earlier. See Figure 6.4 in chapter 6 for the mapping of policy categories to intervention functions.

In the seventh phase, 12 Behaviour Change Techniques (BCTs) (Appendix 36) were found to be the most suitable at increasing the engagement in PA among inactive university PhD students. Finally, in the eighth phase, using the taxonomy of modes of deliver, as illustrated in Appendix 13, the delivery modes chosen for this study were: face-to-face approach (individual level); and distance population-level approach outdoor media (e.g., invitation posters), print media (e.g. invitation leaflets) and digital media (e.g. internet).

7.3.5. Intervention processes and outcome measures

PhD students were identified to be the most physically inactive compared to other student groups, and their barriers were identified as being knowledge and intentions (established by study 2 in chapter 5). Therefore, this brief behaviour change intervention aims to address these issues in this population.

7.3.5.1. Inclusion and exclusion criteria

Current PhD students at the University of Derby who are18 years and over and scored below 600 MET-min/week of moderate intensity PA, as measured by the GPAQ, were included in the study. PhD students who are picking up some hours of work in the administrative centres were classified as PhD students. Anybody who did not meet the mentioned inclusion criteria were excluded from the study. Furthermore, any PhD student with possible medical contraindications to routine PA, as measured by the Health Screening Questionnaire (Appendix 20), was excluded from this study except a clearance is obtained from their GP.

7.3.5.2. Recruitment of participants

The multiple strategies used in recruiting participants for the administrative staff intervention (see section 6.3.4.2 in chapter 6) was also used in this current study. Prior to the recruitment of participants, the educational information that was used in the intervention was tested among six Post-Doctoral researchers to check their readability, clarity and attractiveness. Apart from minor formatting and use of pictures to make the educational materials more appealing to read, no major amendments were required to be made.

Thereafter, multiple strategies were employed in the recruitment of participants to take part in this study. Firstly, invitation posters and flyers (Appendix 22) were disseminated to highly visible locations, such as the main receptions of the various university campuses. Secondly, invitation e-mails (Appendix 37), with a link that will take the participants directly to the screening questionnaire (Appendix 38), were sent through the research office and directly to the PhD students. Thirdly, recruitment was carried out through face-to-face contacts with PhD students, as well as through on-site communication opportunities such as advertisement of the invitation poster on the PGR network (online platform for postgraduate research students). Finally, the PhD students that participated in previous studies in this programme of research were also invited to take part in this study.

7.3.5.3. Screening and allocation of participants to treatment groups

The processes involved in screening the participants are as reported in section 6.3.4.3 of chapter 6. Out of the 88 PhD students that completed the screening questionnaire, 73 (83%) were eligible to take part in this study and were therefore assigned to the following treatment groups: education and intentions group (n=19), education only group (n=18), intentions only group (n=18) and control group (n=18). The Latin square design was used to assign participants to the four different treatment groups. In employing the Latin Square design, the number of columns and rows must tally with the number of treatment groups. In this present study, the four treatment groups were coded as 1-education and intentions group, 2-education only group, 3 -intentions only group, and 4- control group.

Table 7.4: Latin square table showing the randomisation of treatment groups

	Column 1	Column 2	Column 3	Column 4
Row 1	1	3	2	4
Row 2	2	1	4	3
Row 3	4	2	3	1
Row 4	3	4	1	2

Since, four treatment groups were used in this study, a 4x4 squares table was constructed (see Table 7.4), in which each treatment group occurred in each column and row (Gao, 2005). The four rows and four columns comprised of different permutations of the treatment groups. After recruitment, a list of all the participants were generated, then the participants were allocated to the treatment groups based on the permutations of treatment groups in the rows and then according to the permutations of treatment groups in the columns. This process continued until all the participants had been assigned to the treatment groups. Of these participants that were assigned to different treatment groups, six participants withdrew at baseline, i.e. two each from the education and intentions, intentions, and control groups. The reasons for withdrawal are as illustrated in Figure 7.1.

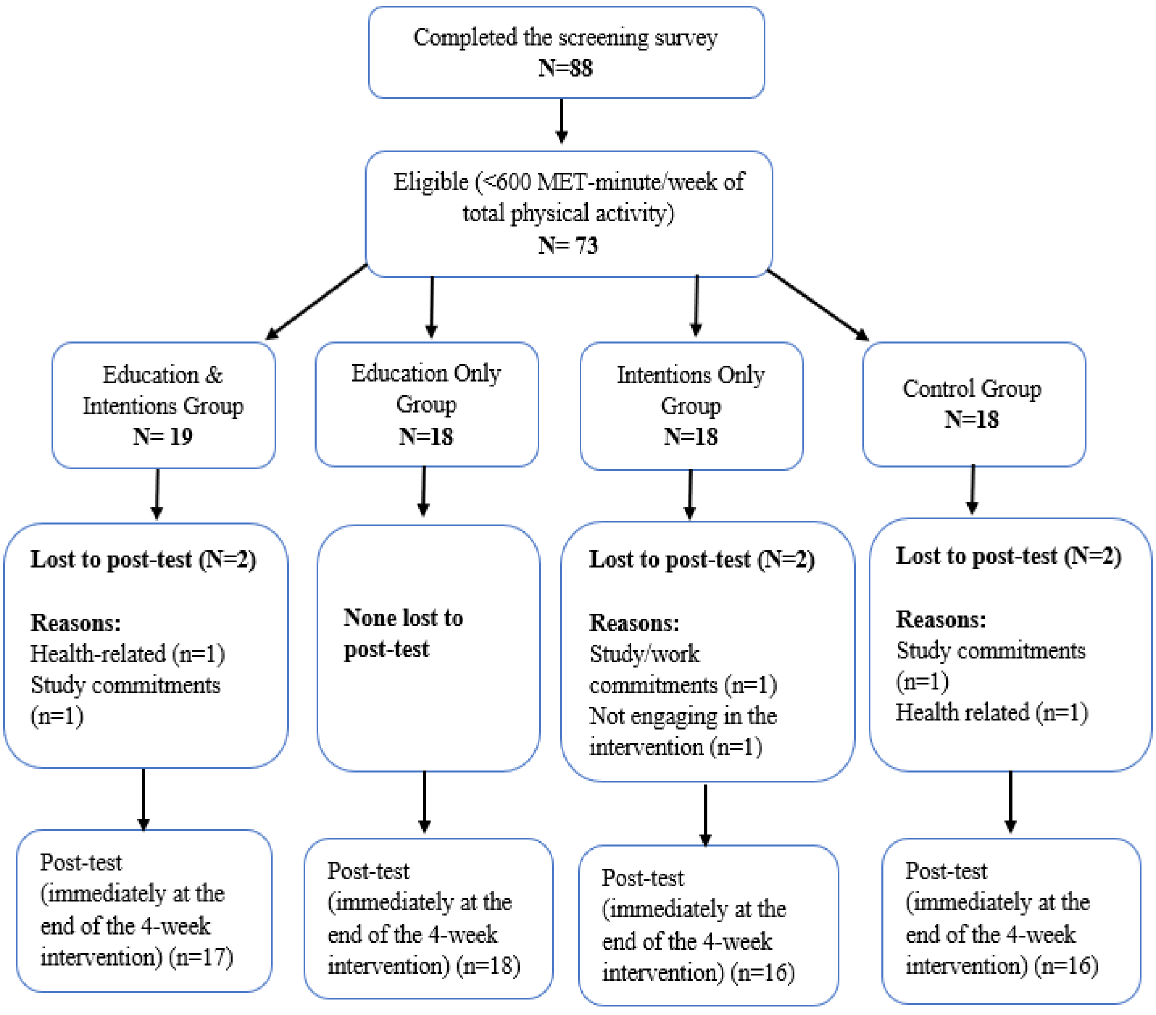

Figure 7.1: Flow chart showing recruitment and randomisation of PhD students

7.3.6 Interventions

The results of a previous group interview (chapter 4) and a confirmatory survey (study 5) carried out among university PhD students indicated that ‘knowledge’ and ‘intentions’ were prominent barriers to PA engagement. Therefore, it was important to determine ways to improve ‘knowledge’ about PA, as well as the ‘intentions’ to engage in PA among the university PhD students, as strategies to improve PA levels in this population. The choice of the intervention to improve ‘knowledge’ about PA among the PhD students was informed by research of Fredriksson et al. (2018), that determined the ways different levels of knowledge about PA impacted on PA behaviour. Furthermore, the choice of the intervention to improve ‘intentions’ of the PhD students to engage in PA was informed by studies conducted by Milne et al., (2002) and Prestwich, Lawton & Conner (2003). In these studies, the implementation intentions and ‘If-Then’ templates were successful in increasing PA levels amongst the participants. Therefore, this 4-week behaviour change intervention focused on increasing the university PhD students’ knowledge (psychological capability) about the PA recommended guidelines, benefits of PA and detrimental impacts of physical inactivity, as well as the intentions (reflective motivation) to engage in PA, with the specific objective of improving their overall levels of PA. The intervention in this study was delivered online (using e-mail) utilising three intervention functions (i.e. education, persuasion, and enablement), which were found to be appropriate (i.e. using the APEASE criteria as presented in Table 7.3) and therefore mapped to 9 BCTs (i.e. credible source, information about health consequences, self-monitoring of behaviour, follow-up prompts/cues, goal setting (behaviour), action planning, review behaviour goals, relapse prevention, and identifying barriers/problem resolution), as outlined by the BCW (see Table 7.2).

Following the collection of the baseline measures, as shown in Appendix 39, the educational and/or intentions interventions were delivered based on the group participants were assigned to. The education intervention function was delivered using BCTs, such as credible source and information about health consequences (i.e., providing educational materials about the PA recommendations, the harmful impact of physical inactivity and the beneficial effects of PA from reliable sources, e.g. WHO and NHS, to the participants). The enablement intervention function was delivered using BCTs, such as action planning, goal setting (behaviour), review behaviour goals, and self-monitoring of behaviour. Self-monitoring of behaviour was achieved through providing the participants implementation intentions template to help them set goals, plan where, when, and how they would engage in PA, review how they have met their goals weekly, and record the place, time and the type and intensity of PA activity engaged in using PA logs. The enablement intervention function was also delivered using BCTs, such as relapse prevention and identifying barriers/problem resolution, i.e., providing the participants with the If-Then template to help them plan for possible obstacles that would prevent them from engaging in the planned PA, how they would prevent any possible relapse and how to resolve such problems. Finally, the persuasion intervention function was delivered using the BCT, follow-up prompts/cues, i.e., sending weekly e-mails as reminders to prompt participants to read the educational materials, to remember to plan their weekly activity using the implementation intentions and If-Then templates, and to complete the weekly activity logs.

Therefore, the treatment groups were allocated resources as follows:

- The ‘education and intentions’ group were sent both educational materials (Appendix 40) to read, and the implementation intentions (Appendix 41) to plan days, times and places they intend to engage in PA, and the If-Then templates (Appendix 42) to plan how to overcome possible barriers and plan for any problems that may arise.
- The ‘education group’ were sent only educational materials once.
- The ‘intentions’ group were sent the implementation intentions and the If-Then templates and requested to use them to plan days, times and places they intend to engage in PA and also plan how they intend to overcome possible barriers and plan for any problems that may arise.
- The ‘control’ group were not given any intervention but requested to carry on with their usual routine.

The educational intervention involved the presentation of educational information about PA (i.e. PA recommended guidelines, the benefits of PA, the detrimental impact of physical inactivity and ways to achieve the recommended PA levels) delivered once at the beginning of the intervention (Abula et al., 2018). The intentions intervention involved providing the participants with a template to form their weekly implementation intentions with regards to when, where and how they would engage in PA. The If-Then template was also be provided to the participant to help them how to overcome possible barriers weekly for the four weeks of the intervention (Milne et al., 2002; Prestwich, Lawton & Conner, 2003). Participants in all the four treatment groups were requested to complete weekly activity logs during the intervention period. Furthermore, weekly e-mail reminders were sent to all participants in the different treatment groups, as a way to self-monitor their PA behaviour (Appendix 43). After the study ended, the participants were sent post-intervention survey (Appendix 44) to complete, and then the participants in the control group were sent all the intervention materials that were given to participants in the different treatment groups.

7.3.7. Outcome measures:

7.3.7.1. Knowledge about the recommended physical activity level

This was measured using a 2-item questions that has been used widely by previous studies (Abdeta et al., 2019; Abula et al., 2018; Knox et al., 2015) to assess knowledge about PA. The participants were asked "Do you know what the national recommendations are for taking part in PA, in terms of minutes per week of moderate intensity PA?" The participants that respond 'no' were considered as 'don't know', as required in the protocol of this validated scale. The participants that respond 'yes' were then be asked, "what are the national recommendations for taking part in PA, in terms of minutes per week of moderate intensity PA?" Answers of 150 minutes weekly, which is in line with existing PA recommendation, were regarded as correct. Participants that provided answers below 150 minutes weekly were regarded as underestimated, while those that provided answers above 150 minutes weekly were regarded as overestimated (Knox et al., 2015).

7.3.7.2. Levels of awareness of physical activity for health

This was assessed employing the Levels of Knowledge of Physical Activity for Health Questionnaire (LKPAHQ), which was previously used by Fredriksson et al. (2018). This questionnaire classified the knowledge of PA into four levels. Level 1 measured the awareness that PA has health benefits, while physical inactivity has detrimental impact on health. For example, level 1 awareness evaluated participants with the following two questions. The first question was, 'In your opinion, is participating in regular PA beneficial for people's health? 'Would you say that it is' (options of five responses, from to 'very beneficial' to 'not beneficial at all', with lower counts indicating higher awareness). While the second question was, "In your opinion, is not participating in regular PA harmful to people's health? Would you say that it (options of five responses, from 'very harmful to 'not harmful at all', with lower counts indicating higher awareness). Level 2 measured the awareness of certain health problems associated with physical inactivity. For example, participants were asked to choose health problems that were associated with physical inactivity from a list of choices involving correct answers such as high blood pressure and cardiovascular disease, and wrong answers such as malaria. The level 2 awareness was computed as a summation of the number of health problems they appropriately detected as possessing benefit from improved PA.

The level 3 measured the participants' exact awareness about the PA required for health and the risk reduction to developing certain chronic diseases by participating in regular PA. This level was grouped into two distinct variables represented as (a) and (b). The level 3a was measured employing multiple choice questions, with options of five responses, of which just one answer was right. For example, 'To the best of your knowledge, how much PA is sufficient to achieve health benefits in adults? Do you think it is…', with a right answer choice as '30 minutes of moderate intensity PA on 5 or more days a week' and the wrong answer choices such as, '30 minutes of vigorous intensity PA on 2 days a week'. The level 3a was coded as 'right' or 'wrong' (i.e., a binary). The level 3b was measured employing four items requesting participants to answer some questions such as, 'On a range of 0-100%, by what percentage do you think participating in regular PA would reduce a person's risk of developing type II diabetes/cardiovascular disease/depression/colon cancer?' The mean responses across the four items were then calculated and participants coded into four categories: I do not know; underestimate (below 27.5%); correct (from 27.5% to 47.5%); and overestimate (above 47.5%). These cut off points were founded on previous studies (Brown et al., 2012; Moore et al., 2012), which showed that the risk of developing these diseases attributable to inactivity ranged from 30 to 45%, and allowing a 2.5% possibility for miscalculation on both sides.

Finally, the level 4 measured the knowledge and acceptance that the risks of physical inactivity and benefits of PA, inherent in levels 1 to 3, apply to a person's risk of contracting such health problem. This level 4 awareness was measured employing four items, for example, 'In your opinion, would not participating in regular PA increase your risk of developing type II diabetes/cardiovascular disease/depression/colon cancer at some point during your lifetime? Options of five responses, from 'Yes, a very high risk' to 'No increased risk' were provided. Mean of responses were computed to produce level 4 awareness summary score, ranging from 1 to 5, with lower scores suggesting higher knowledge of individual risk of physical inactivity.

7.3.7.3. Intentions to engage in physical activity and past behaviours

These were measured using the Behavioural Intentions Questionnaire (BIQ) and the Past Behaviour Questionnaire (PBQ) developed by Courneya & McAuley (1993). The BIQ was used to measure the intentions of the participants to engage in PA using a 4-item scale. For example, "I intend to engage in PA __________ times during the next 4 weeks". Then the PBQ was used after four weeks to measure if the participants engaged in the PA they intended to do, using the same questions retrospectively. For example, "I engaged in PA_______ times during the past 4 weeks" (see Table 7.5).

Table 7.5: The 4-item scale used to measure the intentions to participate in physical activity

	Behavioural Intentions Questionnaire (BIQ)	**Past Behaviour Questionnaire (PBQ)**
	Pre-intervention (Baseline)	**Post-intervention (week 5)**
Intentions 1	I intend to engage in physical activity __________ times during the next 4 weeks.	I engaged in physical activity______ times during the past 4 weeks.
Intentions 2	I intend to engage in physical activity during the next 4 weeks with the following regularity (7-points Likert scale ranging from 'Not at all' to 'everyday').	I engaged in physical activity during the past 4 weeks with the following regularity (7-points Likert scale ranging from 'Not at all' to 'everyday').
Intentions 3	I do/do not intend to engage in physical activity at least 12 times during the next 4 weeks (answer options were 'I do' or 'I do not').	I did_____did not____ engage in physical activity at least 12 times during the past 4 weeks (answer options were 'I did' or 'I did not').
Intentions 4	I intend to engage in physical activity at least 12 times during the next 4 weeks (7-points Likert scale ranging from 'Definitely' to 'Definitely not').	I engaged in physical activity at least 12 times during the past 4 weeks (7-points Likert scale ranging from 'Definitely' to 'Definitely not').

7.4. Data Analysis

The descriptive statistics were presented as percentages, frequencies, means and standard deviations. The minutes/week the participants spent in moderate and vigorous activities were computed using the WHO guide (WHO, 2012a) and presented as MET-minute/week (metabolic equivalent). IBM SPSS statistical software 25.0 (Chicago, IL, USA) was employed to perform all statistical analyses, with the significant level set at 0.05. All the assumptions for various parametric tests were checked before each analysis and when this was violated Kruskal-Wallis H non-parametric test was used. One-way ANOVAs were used to compare participants' socio-demographic characteristics at baseline were across the treatment groups to ensure that randomisation was properly conducted. Pre-post differences were measured using mixed-methods design ANOVA. Binary logistic regression was carried out for the dichotomous variable. Independent samples t-test was employed for categorical independent variables with two categories, while one- way ANOVA was employed for those with more than two categories. Chi-square tests were employed to compare relations between categorical variables. Finally, cross-tabulation were used to compare days, times and places specified in the implementation intentions participants formed at baseline against days, times and places that the PA was enacted. The effect sizes were reported as partial eta square (η_p^2), using the following Cohen's classification of effect sizes: small (0.01), medium (0.06) and large (0.14) (Cohen, 1988).

7.5. Results

7.5.1. Socio-demographic features of the study participants

Table 7.6: Socio-demographic characteristics of the PhD students

	Treatment Groups				**All**
	Education and Intentions Group (N=17)	**Education Only Group (N=18)**	**Intentions Only Group (N=16)**	**Control Group (N=16)**	**(N=67)**
Age (years), mean (SD)	34.2 ± 8.43	40.4 ± 10.51	37.3± 8.20	33.5 ± 4.57	36.45± 8.58
Gender:					
Male	9 (56.0%)	9 (50.0%)	5 (31.2%)	8 (50.0%)	31 (46.0%)
Female	8(44.0%)	9 (50.0%)	11 (68.8%)	8 (50.0%)	36 (54.0%)
Ethnicity:					
White	9 (52.9%)	13 (72.2%)	11 (68.7%)	13 (81.0%)	46 (68.7%)
Black/African/Caribbean/Black	4 (23.5%)	3 (16.6%)	2 (12.5%)	1 (6.0%)	10 (14.9%)
British	2 (11.8%)	1 (5.6%)	3 (18.8%)	2 (13.0%)	8 (11.9%)
Asian/Asian British	-	-	-	-	-
Mixed/Multiple ethnic groups	2 (11.8%)	1(5.6%)	-	-	3 (4.5%)
Other ethnic groups	-	-		-	-
Study type:					
Full-time	13 (76.5%)	13 (72.2%)	14 (87.5%)	13 (81.0%)	53 (79%)
Part-time	4 (23.5%)	5 (27.8%)	2 (12.5%)	3 (19.0%)	14 (21%)
Campus located:					
Kedleston road campus	15 (88.2%)	16 (88.9%)	13 (81.0%)	15 (94.0%)	59 (88.1%)
Markeaton campus	2 (11.8%)	2 (11.1%)	3 (19.0%)	-	7 (10.4%)
Britannia Mills campus	-	-	-	-	-
Chesterfield campus	-	-	-	-	-
Buxton campus	-	-	-	-	-
Friar Gate campus	-	-	-	1 (6.0%)	1 (1.5%)
Leek campus	-	-	-	-	-

As illustrated in Table 7.6, the average age of the participants was 36.5 ± 8.58 years, with females representing 54.0% of the study population. Over two-thirds of the participants were from the White ethnic group (68.7%), followed by the Black/African/Caribbean/Black British (14.9%) and the Asian/Asian British group (11.9%) and then the other ethnic groups (4.5%).

Additionally, over three-quarters of the participants were studying full-time (79.0%) at the Kedleston road campus (88.1%).

7.5.2. Confirmation of participants' allocation to treatment groups

One-way ANOVAs were used to compare the treatment groups of PhD students on the study's variables to ensure that the participants' allocation to various treatment groups were appropriately carried out. There were no significant differences between the Education and intentions, education only, intentions only and control groups with regards to gender ($F_{3,66}$ = 0.63, p= 0.60); age ($F_{3,66}$ = 2.55, p= 0.0640; campus located ($F_{3, 66}$ = 0.43, P= 0.73); ethnicity ($F_{3,66}$ = 1.55, P= 0.21); mode of study ($F_{3,66}$ = 0.42, P= 0.74); and total PA level ($F_{3,66}$ = 0.63, P= 0.48), assessed at baseline.

7.5.3. Effects of the intervention on the study variables of the PhD students

7.5.3.1. Effects of interventions and gender on total physical activity levels

A mixed-methods design ANOVA was carried out to examine the effects of Treatment Groups (independent variable 1 (IV1), Gender (IV2) and Time (IV3) on Total PA Levels (Dependent Variable (DV), with Treatment Groups (education and intentions, education only, intentions only and control groups) and Gender (male and female) as between-subjects factors and Time (2 levels: pre-intervention and post-intervention) as within-subjects factor. There was a significant main effect of Treatment Groups ($F_{3,59}$ = 3.41, p=0.023, η_p^2 =0.148), with education and intentions group (mean= 1067.6 ± 140.94 MET-minutes/week) recording the highest Total PA levels, followed by intentions only group (mean= 1039.0 ± 156.44 MET-minutes/week), education only group (874.4 ± 136.73 MET-minutes/week) and control group (mean=483.8 ± 145.03 MET-minutes/week), as illustrated in Figure 7.2. In contrast, there was no significant main effect of Gender ($F_{3,59}$ = 0.11, p=0.741, η_p^2 =0.002). There was also no significant interaction between Treatment Groups and Gender ($F_{3,59}$ = 0.42, p=0.738, η_p^2 =0.021) on Total PA levels (See Figure 7.3).

Furthermore, there was a significant main effect of Time ($F_{1,59}$ = 46.32, p<0.001, η_p^{2} =0.440). There was significant interaction between Treatment Groups and Time ($F_{3,63}$ = 3.95, p=0.012, η_p^2 =0.167). Conversely, there was no significant interaction between Gender and Time ($F_{1,59}$ = 0.126, p=0.724, η_p^2 =0.002), and there was no significant interaction between Treatment Groups, Gender and Time ($F_{3,59}$ = 0.398, p=0.755, η_p^2 =0.020). Follow-up Bonferroni pairwise comparisons test indicated that there was a significant difference between pre- and post-intervention (p<0.001); between the education and intentions group and the control group (P=0.03), but there were no significant differences between the other groups (p>0.05). There was also no significant difference between the male and female participants (p=0.74). The results indicated that even though the total PA levels increased in all treatment group pre-post intervention, the increase was highest among the education and intentions group, followed by the intentions group, education group and control group. There were no significant differences in the total PA between male or female participants. The descriptive statistics showing the mean total PA by treatment groups and gender is presented in Appendix 45. As illustrated in Figure 7.2, even though at pre-intervention, the mean total PA level was marginally higher in the control group in comparison with the other treatment groups, at post-intervention the increase in total PA levels were highest in the education and intentions group and the intentions only group, followed by the education only group, with the control group recording the lowest.

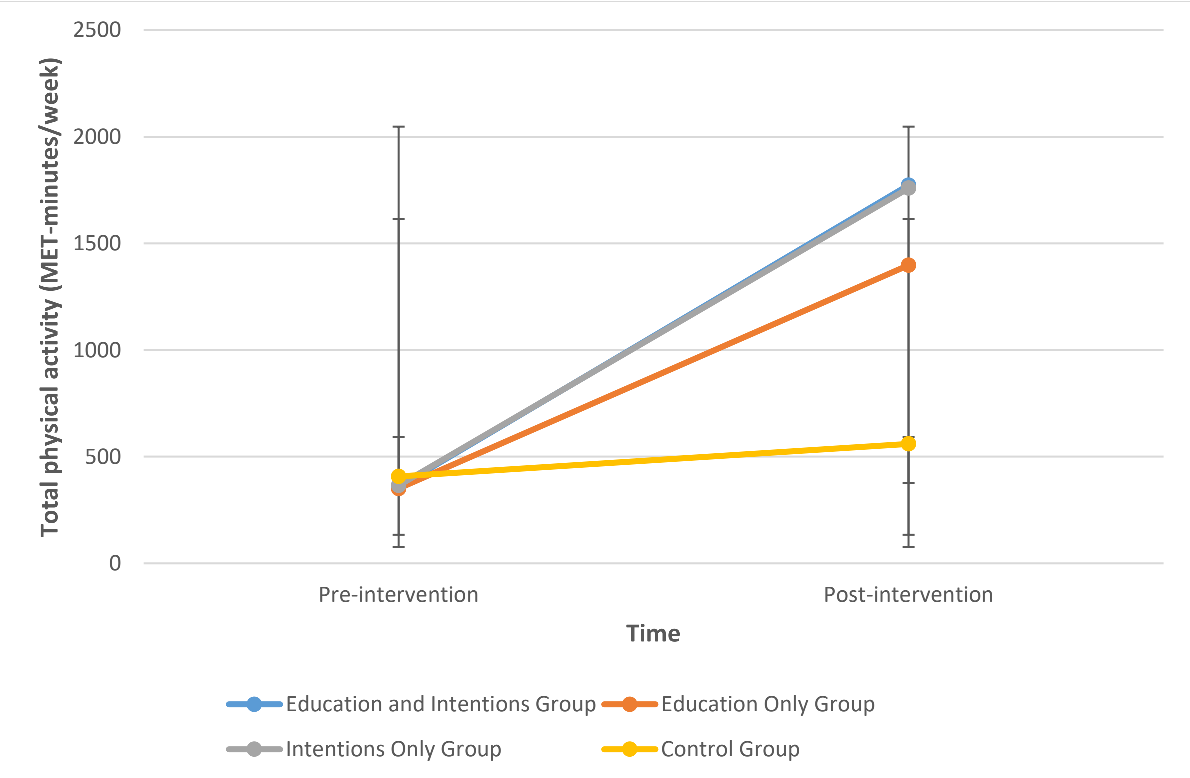

Figure 7.2: Total physical activity levels among PhD students according to treatment groups

There was no significant difference in total PA levels between the male and female participants, pre- and post-intervention, as exhibited in Figure 7.3.

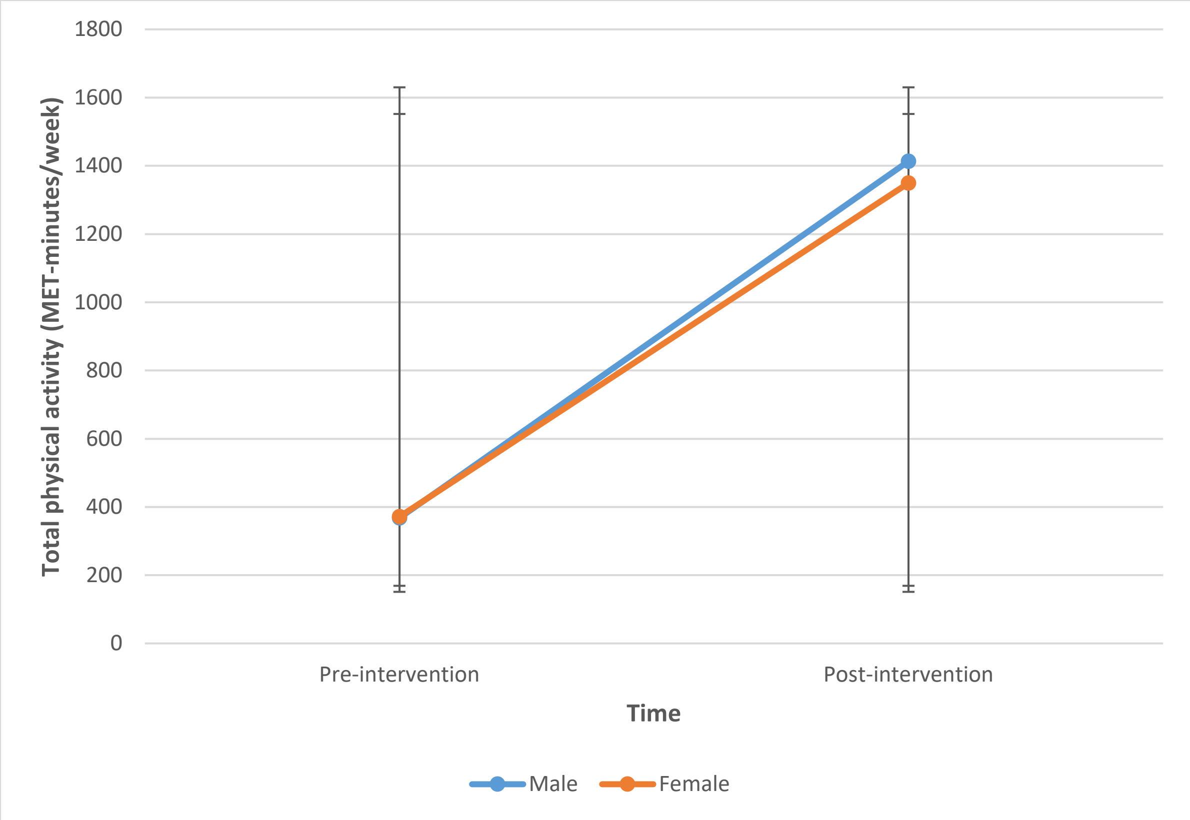

Figure 7.3: Total physical activity levels among PhD students according to gender

7.5.3.2. Effects of interventions and gender on time spent in physical activity weekly

A mixed-methods design ANOVA was carried out to examine the effects of Treatment Groups (IV1), Gender (IV2) and Time (IV3) on Time Spent in PA (DV), with Treatment Groups (education and intentions, education only, intentions only and control groups) and Gender (male and female) as between-subjects factors and Time (4 levels: weeks 1, 2, 3 and 4) as within-subjects factor.

There was a significant main effect of Treatment Groups ($F_{3,59} = 15.75$, $p<0.001$, $\eta_p^2 = 0.445$), with education and intentions group (mean= 194.9 ± 6.76 minutes/week) recording the highest time spent in PA weekly, followed by intentions only group (mean=179.9 ± 7.50 minutes/week), education only group (mean= 174.8 ± 6.56 minutes/week) and control group (mean=131.0 ± 6.95 minutes/week) (see Figure 7.4). There was also a significant main effect of Gender ($F_{1,59} = 9.63$, $p<0.003$, $\eta_p^2 = 0.140$), with male participants (mean=180.9 ± 5.14) generally reporting more time spent in PA weekly than the female participants (mean=159.4 ± 4.67) (see Figure 7.5). Furthermore, there was a significant main effect of Time ($F_{3,177} = 120.35$, $p<0.001$, $\eta_p^2 = 0.671$), with mean time spent in PA weekly of 132.0 ± 4.43 minutes/week at week

1, 159.3 ± 3.77 minutes/week at week 2, 186.3 ± 4.31 minutes/week at week 3 and 203.0 ± 4.49 minutes/week at week 4. There was a significant interaction between Time and Gender ($F_{3,177}$ = 13.37, p<0.001, η_p^2 =0.185). In contrast, there was no significant interaction between Time and Treatment Groups ($F_{9,177}$ = 0.698, p=0.710, η_p^2 =0.034); and there was no significant interaction between Time, Treatment Groups and Gender ($F_{9,177}$ = 0.96, p=0.479, η_p^2 =0.046). Follow-up Boferroni pairwise comparisons test indicated that there were significant differences between education and intentions group and control group (p<0.001); between education only group and control group (p<0.001) and between intentions only group and control group (p<0.001), but there were no differences between the other groups (p>0.05). There was also a significant difference between male and female participants (p=0.03); between week 1 and week 2 (p<0.001); between week 1 and week 3 (p<0.001), between week 1 and week 4 (p<0.001), week 2 and 3 (p<0.001), between week 2 and week 4 (p<0.001) and between week 3 and week 4 (p<0.001). This showed that although all the four treatment groups increased in the time, they spent in PA weekly from week 1 to week 4, the other three treatment groups generally performed better than the control group. The male participants also spent more time engaging in PA weekly compared to the female participants.

Furthermore, independent-samples t-tests were carried out to compare the Time Spent in PA weekly (DV) and Gender (IV). There was no significant difference in Time Spent in PA weekly between male (mean=131.5 ± 31.71 minutes/week) and female (mean=131.0 ± 47.17 minutes/week) participants at week 1; t (65) = 0.048, p=0.96; and there was also no significant difference between male (mean= 162.6 ± 32.96 minutes/week) and female (mean=154.6 ± 43.48 minutes/week) participants at week 2; t (65) = 0.84, p=0.41. On the other hand, there was a significant difference in Time Spent in PA weekly between male (mean= 199.2 ± 35.45 minutes/week) and female (mean=173.2 ± 50.51 minutes/week) participants at week 3; t (65) = 2.40, p=0.019; and there was also a significant difference between male (mean=225.6 ± 41.33 minutes/week) and female (mean=179.9 ± 42.52 minutes/week) participants at week 4; t (65) = 4.45, p=0.29. These results suggested that both male and female participants performed similarly in the time they spent in PA weekly up till week 3 and 4 where the male participants performed better than their female counterparts. The descriptive statistics showing the mean time PhD students spent in PA according to treatment groups are presented in Appendix 46.

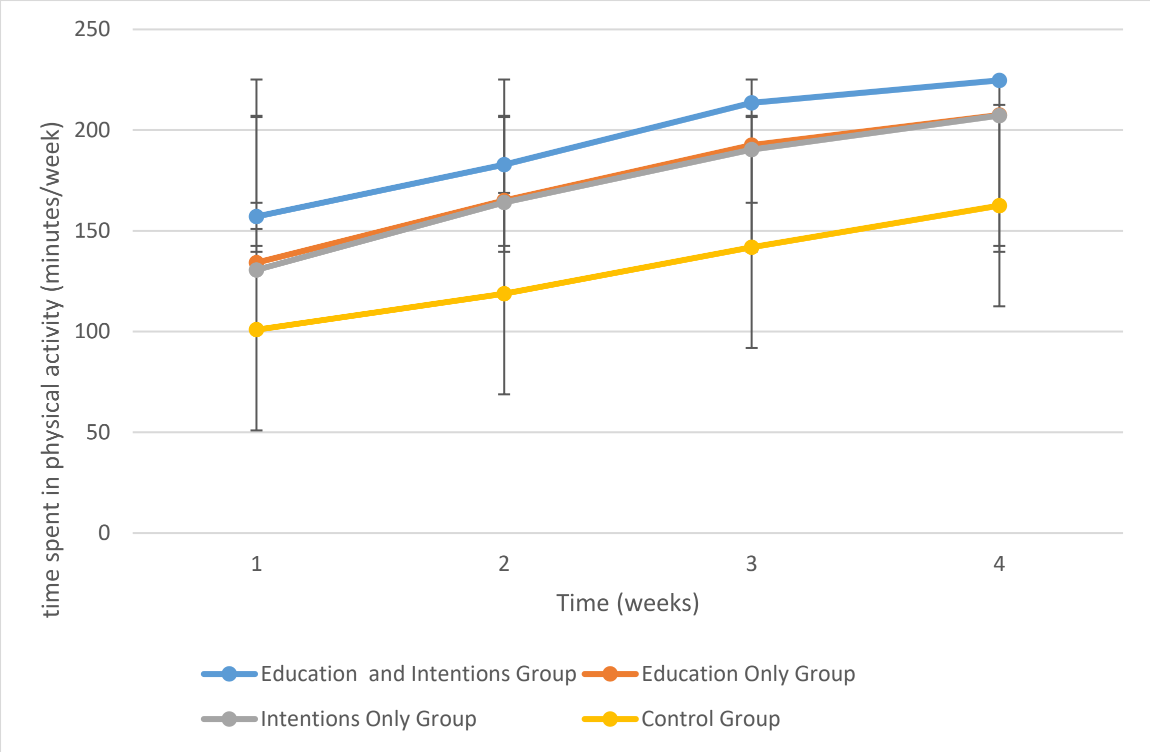

Figure 7. 4: Time spent in physical activity weekly among PhD students according to treatment groups

The time spent in PA weekly increased progressively from week 1 to 4, with the participants in the education and intentions group recording the highest time, education only and intentions only group not differing much, while the control group clearly reported the lowest time (see Figure 7.4). Additionally, Figure 7.5 clearly showed that at week 1 and 2 both genders spent similar time in PA weekly, however from week 3 to week 4, the male participants performed better the female counterparts.

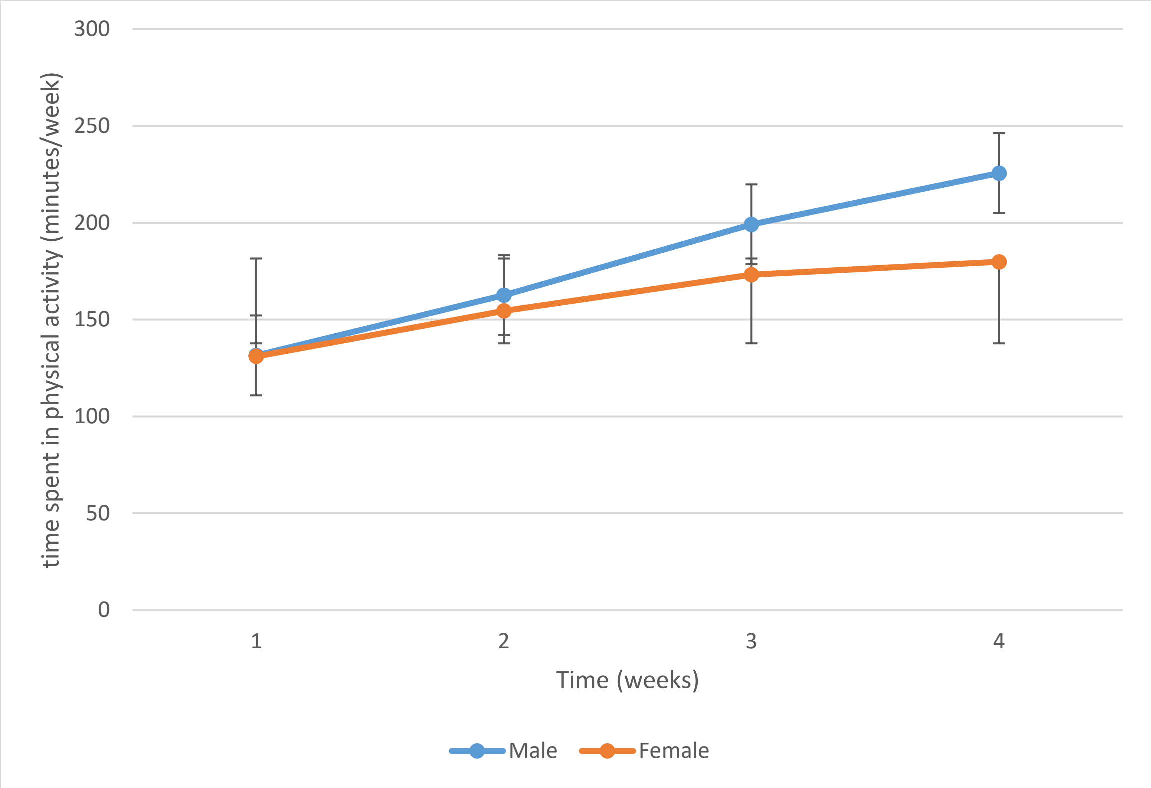

Figure 7.5: Time spent in weekly physical activity among PhD students according to gender

7.5.3.3. Effect of knowledge about physical activity on physical activity engagement among PhD students

The descriptive statistics of the four levels of knowledge about PA is presented in Appendix 47. In the level 1 knowledge, the majority of the participants acknowledged that engaging in routine PA was beneficial to their health and that not engaging in routine PA was harmful to their health at pre- and post-intervention, with a small proportion (1.5%) being indifferent post-intervention. Both male and female participants were observed to have similar level 1 knowledge. For level 2 knowledge, the female participants were only able to correctly identify 12.4 ± 5.37 out of 22 diseases (56.4%) compared will 11.9 ± 4.63 (54.1%) identified by the male participants, pre-intervention. However, post- intervention, the case was reversed with more male participants (16.8 ± 2.70) being able to identify these diseases than the female participants (15.6 ± 3.86). Overall, the level 2 knowledge improved considerably from pre-intervention (12.2 ± 5.01) to post-intervention (16.1 ± 3.41).

Furthermore, for level 3a knowledge, more males (83.9%) incorrectly identified how much PA was required for health compared to females (75.0%) pre-intervention. However, post-intervention, more females (47.2%) were incorrect compared to males (38.7%). The participants that answered incorrectly to level 3a knowledge question reduced significantly from 79.1% pre- intervention to 43.3% post intervention. For level 3b knowledge, only about half of the participants, at both pre- and post-intervention (50.7%), could correctly identify the likelihood of contracting certain chronic diseases if the PA recommendations were not achieved, with females (58.3%) performing better than males (41.9%) pre-intervention. While, at post-intervention males (58.1%) performed better than females (44.4%). Generally, more participants overestimated the health effect of PA on diseases at both pre-intervention (37.3%) and post intervention (35.8%), while a much smaller proportion of 11.9% and 13.9%, respectively underestimated. Lastly, participants scored 2.3 out of 5 (pre-intervention) and 1.5 out of 5 (post-intervention) for level 4 knowledge, demonstrating a greater awareness of the personal risks of developing diseases during their lifetime if they are physically inactive.

Table 7.7: Beliefs in the ability to engage in physical activity among PhD students

S/N	**Beliefs in physical activity engagement**	**Male (N=31)**	**Female (N=36**	**All (N=67)**
1	Strongly disagree	2 (6.5%)	4 (11.1%)	6 (9.0%)
2	Disagree	3 (9.7%0	4 (11.1%)	7 (10.4%)
3	Neither disagree nor agree	2 (6.5%	3 (8.3%)	5 (7.5%)
4	Agree	6 (19.4%)	11 (30.6%)	17 (25.4%)
5	Strongly agree	18 (58.1%)	14 (38.9%)	32 (47.8%)
6	I don’t know	-	-	-

Almost three quarters of the participants (73.2%), i.e., 77.5% males and 69.5%, agreed or strongly agreed that they were doing sufficient PA to get the health benefits. However, only a very small proportion of the participants (19.4%), i.e., 16.7% males and 22.2% females disagreed or strongly disagreed, with 7.5% participants (6.5% males and 8.3% females) neither disagreeing nor agreeing (see Table 7.7).

7.5.3.4. Effects of level 1 knowledge on total physical activity among PhD students

Independent-samples t-tests were carried out to compare PA levels among participants that answered very beneficial and those that answered somewhat beneficial to the first level 1 knowledge question assessing their agreement to the benefits of regular PA on people’s health, pre- and post-intervention. There was no significant difference ($t_{(65)} = -0.58$, $p=0.56$) in the levels of total PA among participants that answered very beneficial (368.0 ± 111.14 MET-minutes/week) and those that answered somewhat beneficial (406.7 ± 144.68 MET-minutes/week) to the first level 1 knowledge question pre-intervention; and there was also no significant difference ($t_{(65)} = 0.78$, $p=0.44$) in the levels of total PA among participants that answered very beneficial (1402.5 ± 1224.77 MET-minutes/week)) and those that answered somewhat beneficial (720.0 ± 848.53 MET-minutes/week) to the first level 1 knowledge question post-intervention, as illustrated in Table 7.8. This result indicated that understanding the health impacts of regular PA on people's health does not have any effect on people's total PA levels.

Table 7.8: Mean total physical activity levels among participants on first level 1 knowledge question

Variable	**Level 1 knowledge (benefits of engaging in routine physical activity on people's health)**	**n**	**Mean Physical activity level (mean (SD))**	**P value**
Pre-intervention				0.56
Total physical activity (MET-minutes/week)	Very beneficial	64	368.0 ± 111.14	
	Somewhat beneficial	3	406.7 ± 144.68	
Post-intervention				0.44
Total physical activity (MET-minutes/week)	Very beneficial	64	1402.5 ± 1224.77	
	Somewhat beneficial	2	720.0 ± 848.53	

Furthermore, since the Lavene's test for homogeneity of variances was violated for the second level 1 knowledge question ($p= 0.010$), a non-parametric test was used. A Kruskal-Wallis H test suggested that there was no significant difference in total PA levels among the participants on the second level 1 knowledge question, $X^2(1) = 0.38$, $p=0.54$, with mean rank of total PA level of 31.7 for those that answered very harmful and 35.1 for those that answered somewhat harmful pre-intervention; and there was no significant difference in total PA levels among the participants on the second level 1 knowledge question, $X^2(2) = 1.58$, $p=0.46$, with mean rank of total PA level of 33.0 for those that answered very harmful, 42.7 for those that answered somewhat harmful, and 35.0 for those that answered not very harmful post-intervention (see Table 7.9). These results indicated that having knowledge about the risk of not participating in PA on people's health had no effect on total PA levels pre- and post-intervention.

Table 7.9: Mean ranks of total physical activity levels among the participants on the second level 1 knowledge question

Variable	Level 1 Knowledge (risk of not engaging in routine physical activity on people's health)	n	Mean Rank	P value
Pre-intervention				0.54
Total physical activity (MET-minutes/week)	Very harmful	49	31.7	
	Somewhat harmful	15	35.1	
	Neither	-	-	
	Total	64		
Post-intervention				0.46
Total physical activity (MET-minutes/week)	Very harmful	59	33.0	
	Somewhat harmful	7	42.7	
	Neither	1	35.0	
	Total	67		

7.5.3.5. Effects of level 2 knowledge on total physical activity among PhD students

A mixed-design ANOVA was conducted to determine the effects of Treatment Groups (IV1) and Time (IV2) on Level 2 knowledge (DV1) and Total PA Levels (DV2), with Treatment Groups (education and intentions, education only, intentions only and control groups) as between-subjects factor and Time and Level 2 Knowledge (Two levels each: pre-and post-intervention) as within-subjects factor.

There was a significant main effect of treatment groups ($F_{3,63} = 3.73$, p=0.016, η_p^2 =0.151) on total PA levels, with the education and intentions group (mean= 540.1 ± 69.01 MET-minutes/week) performing better than the other groups, followed by the intentions only group (mean= 537.4 ± 71.13 MET-minutes/week), the education only group (mean= 444.8 ± 67.06 MET-minutes/week) and the control group (mean= 248.8 ± 71.13 MET-minutes/week). There was a significant main effect of Time ($F_{1,63} = 152.61$, p<0.001, η_p^2 =0.708), with mean total PA of 369.7 ± 111.76 MET-minutes/week pre-intervention and 1379.1 ± 1207.05 MET-minutes/week post-intervention; and also a very significant main effect of level 2 knowledge ($F_{1,63}$ = 52.51, p<0.001, η_p^2 =0.455), with mean of 12.8 ± 5.01 pre-intervention and 16.13 ± 3.41 post-intervention.

Additionally, there were significant interactions between Time and Treatment Groups (F (3, 63) = 3.75, p=0.015, η_p^2 =0.152); between Time and Level 2 Knowledge (F (1, 63) = 51.62, p<0.001, η_p^2 =0.450); between Treatment Group and Level 2 Knowledge (F (3, 63) = 4.40, p=0.007, η_p^2 =0.173); and between Treatment Groups, Time and Level 2 Knowledge (F (3, 63) = 4.37, p<0.007, η_p^2 =0.172). Follow-up Bonferroni pairwise comparisons demonstrated that there were very significant differences in Time (p<0.001), and Level 2 Knowledge (p<0.001) pre-intervention and post-intervention. There were significant differences between the education and intentions group and control group (p=0.027); between intentions only group and the control group (p=0.034), but there were no differences between other groups (p>0.05).

This indicated that the total PA level increased as participants' awareness about health conditions associated with physical inactivity (level 2 knowledge) increased (see Appendix 48). Pre-intervention, participants in the education only group scored the highest in total level 2 knowledge, followed by control group, education only group and intentions only group. However, post-intervention, the total level 2 knowledge scores were highest among the participants in the education and intentions group and education only group, followed by intentions only group and control group. in the education and intentions group performed better in the level 2 knowledge and engaged more in PA, followed by the intentions only, education only and control groups. The differences between education and intentions group and education only group and between intentions only group and control group were marginal post-intervention, as illustrated in Figure 7.6.

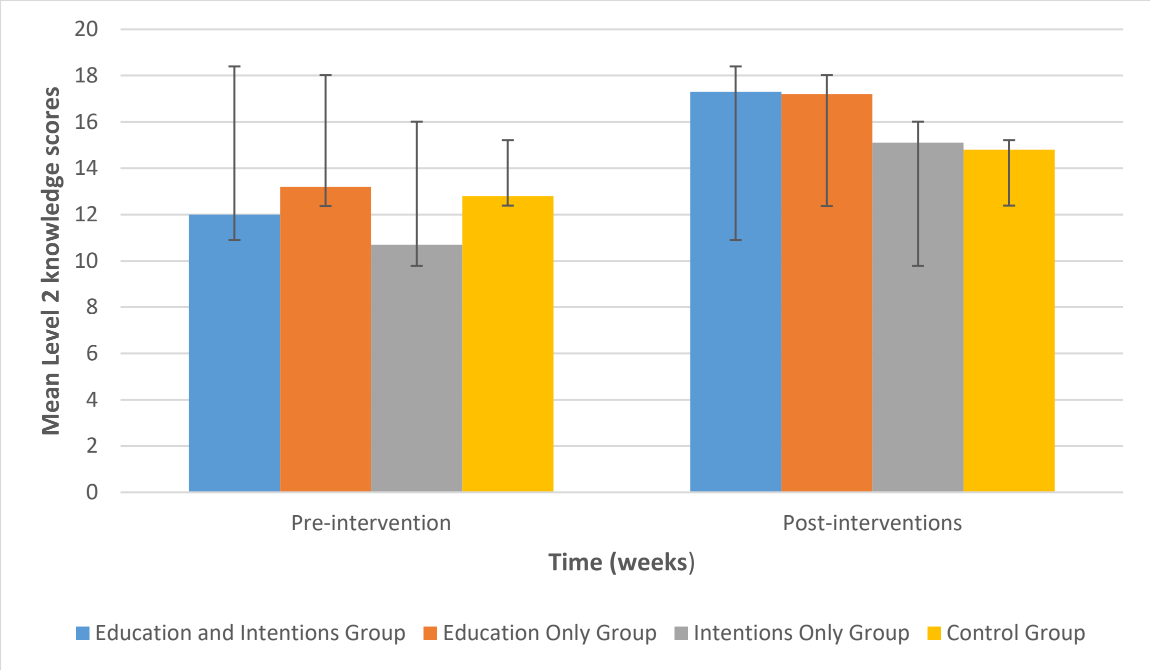

Figure 7.6: Level 2 knowledge of the PhD students across treatment groups

7.5.3.6. Effects of level 3a knowledge on physical activity and time spent in physical activity weekly

A logistic regression was carried out with total PA (IV1) and time spent in PA weekly (IV2) as predictor variables and level 3a knowledge (DV) as the outcome variable. The model significantly predicted the level 3a knowledge: $X^2(5) = 12.425$, $p= 0.029$. The model accounted for between 16.9% and 26.4% of variance in level 3a knowledge, with 98.1% of those who incorrectly identified how much PA is required for health and 28.6% of those who correctly identified how much PA is required for health, and 83.6% overall. The results indicated that having level 3a knowledge (i.e., correctly identifying the amount of PA required for health) did not increase the total PA level and time spent in PA weekly, as presented in Table 7.10.

Table 7.10: Results of logistic regression showing association of level 3b knowledge with total physical activity and time spent in physical activity weekly

Variables	**B**	**S.E.**	**Wald's X^2**	**df**	**P value**	**Exp (B)**
Total physical activity (MET-minutes/week)	-0.01	0.001	2.069	1	0.150	0.999
Time spent in physical activity in week 1 (minutes/week)	0.017	0.014	1.461	1	0.227	1.017
Time spent in physical activity in week 2 (minutes/week)	0.022	0.016	1.995	1	0.158	1.022
Time spent in physical activity in week 3 (minutes/week)	-0.010	0.014	0.491	1	0.484	0.990
Time spent in physical activity in week 4 (minutes/week)	-0.002	0.011	0.049	1	0.824	0.977

7.5.3.7. Effects of level 3b knowledge on physical activity and time spent in physical activity weekly

A one-way ANOVA design was employed to examine if there was a difference in Total PA Levels (DV) across participants who correctly responded to the percentage of reduction in a person's risk of contracting certain chronic diseases by engaging in routine PA, underestimated, or overestimated (IV), pre- and post-intervention. There was no significant difference between the participants pre-intervention ($F_{2,64}$ =0.41, p=0.67) and there was no significant difference between participants post-intervention ($F_{2,64}$ =0.69, p=0.51), as illustrated in Table 7.11. These results indicated that correctly identifying, underestimating or overestimating the percentage reduction in a person's risk of contracting certain chronic diseases by participating in regular PA (level 3b knowledge) had no effect on total PA levels or time spent in PA weekly.

Table 7.11: Descriptive statistics of level 3b knowledge pre- and post-intervention

Level 3b knowledge (percentage reduction in an individual's risk of developing certain chronic diseases by participating in regular physical activity)	**Pre-intervention**			**Post-intervention**		
	n	**Mean (SD)**	**p value**	**n**	**Mean (SD)**	**p value**
Underestimated	8	400.0 ± 100.85	0.67	9	953.3 ± 1229.06	0.51
Correct	34	370.59 ± 104.01		34	1485.3 ± 594.06	
Overestimated	25	358.9 ± 126.80		24	1388.3 ± 1749.68	
Total	67	369.7 ± 111.76		67	1379.1 ± 1207.05	

Additionally, a mixed-methods design ANOVA was performed to determine the effects of Treatment Groups (IV1) Level 3b Knowledge (IV2) pre-intervention and Time (IV3) on Time Spent in PA weekly (DV), with Treatment Groups (education and intentions, education only, intentions only and control groups) and Level 3b Knowledge (Underestimated, correct and overestimated) as between-subjects factors and Time (4 levels: weeks 1, 2, 3 and 4) as within-subjects factor. The Mauchly's test ($x^2(5) = 0.701$, $p= 0.002$) indicated a violation of sphericity, thus the degrees of freedom were corrected employing Greenhouse-Geisser sphericity estimate ($\varepsilon = 0.80$). There was a significant main effect of Treatment Groups ($F_{3,55} = 5.41$, $p=0.002$, $\eta_p^2 =0.228$), with mean time spent in PA weekly of 196.1 ± 8.32 minutes/week for education and intentions group, 173.4 ± 9.18 minutes/week for education only group, 169.8 ± 9.75 minutes/week for intentions only group and 138.3 ± 11.91 minutes/week for control group. On the other hand, there was no significant main effect for Level 3b Knowledge ($F_{2,55} = 0.30$, $p=0.744$, $\eta_p^2 =0.011$), with mean of 174.1 ± 12.12 minutes/week for participants that underestimated, 169.5 ± 5.49 minutes/week for participants that were correct and 164.6 ± 6.53 minutes/week for participants that underestimated. There was also no significant interaction between Treatment Group and Level 3b Knowledge ($F_{6,55} = 0.50$, $p=0.801$, $\eta_p^2 =0.052$).

There was also a significant main effect of time ($F_{2.4,132.0} = 62.03$, $p<0.001$, $\eta_p^2 =0.530$), with mean time spent in PA of 132.5 ± 5.91 minutes/week at week 1, 159.1 ± 4.99 minutes/week at week 2, 183.1 ± 6.07 minutes/week at week 3 and 202.9 ± 6.76 minutes/week at week 4. There were no significant interactions between Time and Treatment Group ($F_{7.2,132.0} = 0.28$, $p<0.963$,

η_p^2 =0.015); between Time and Level 3b Knowledge ($F_{4.8,132.0}$ = 0.48, p<0.781, η_p^2 =0.017); and between Time, Treatment Group and Level 3b Knowledge ($F_{14.4,132.0}$ = 1.25, p<0.246, η_p^2 =0.012). Follow-up Bonferroni pairwise comparison test indicated that there were very significant differences in time spent in PA weekly between week 1 and 2 (p<0.001), between week 1 and 3 (p<0.001), between week 1 and 4 (p<0.001), between week 2 and 3 (p<0.001), between week 2 and 4 (p<0.001) and between week 3 and 4 (p=00.1). There were also significant differences in time spent in PA weekly between education and intentions group and control group (p=0.001), however, there were no differences between the other treatment groups (p>0.05). In contrast, there were no significant differences between those who underestimated level 3b knowledge and those that were correct (p>0.05); between those that underestimated and those that overestimated (p>0.05); and between those that overestimated and those that were correct.

These findings suggested that even though the time spent in PA weekly increased from week 1 to week 4, the increase was seen more in participants in the education and intentions group, with no differences observed between other treatment groups. Furthermore, there was no effect on time spent in PA weekly by underestimating, overestimating or correctly identifying the percentage reduction in a person's risk of contracting chronic diseases by engaging in regular PA (level 3b knowledge). As illustrated in Figure 7.7, the participants in the education and intentions group spent more time in PA than the participants in other treatment groups, while education only and intentions only groups were comparable, with the control group recording the least. The descriptive statistics showing level 3b knowledge and time spent in PA weekly according to treatment groups among PhD students is presented in Appendix 49.

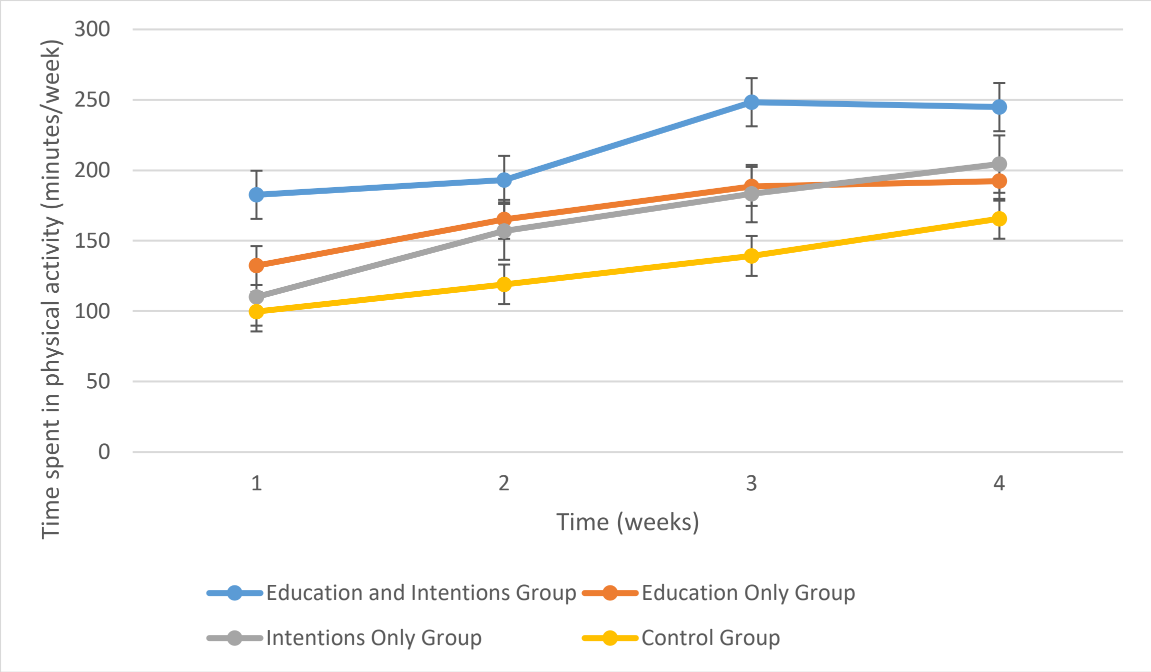

Figure 7.7: Time spent in physical activity weekly according to treatment groups

There were no differences in the time spent engaging in PA weekly between the participants that underestimated, overestimated, or correctly identified the percentage reduction in a person's risk of contracting chronic diseases by engaging in regular PA (see Figure 7.8).

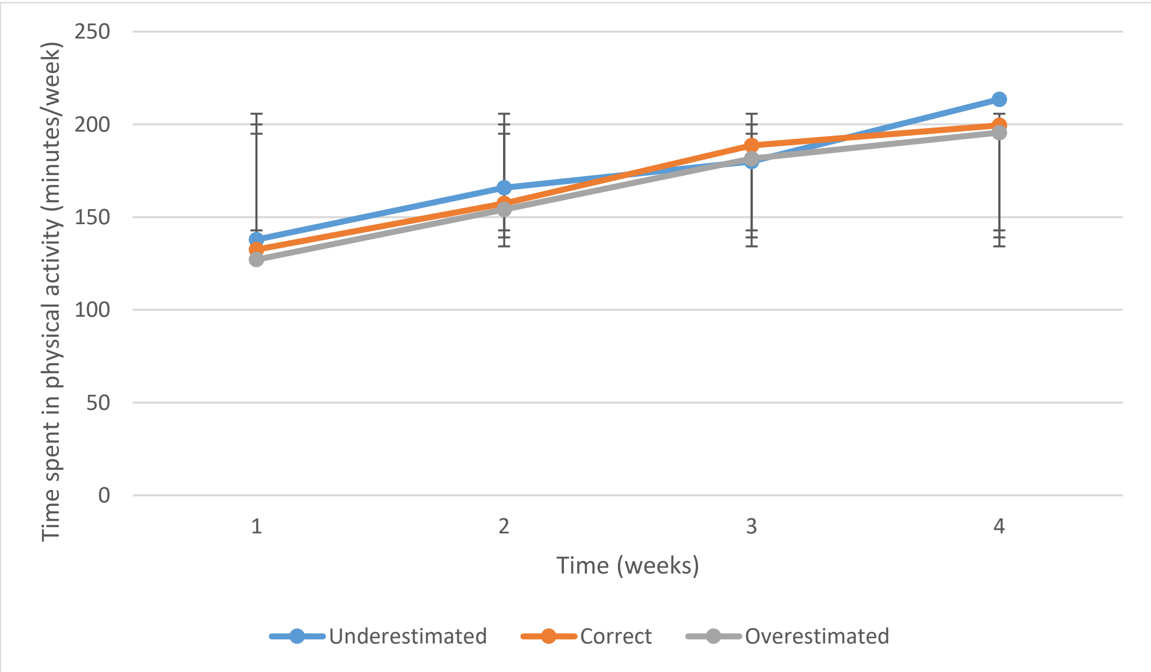

Figure 7.8: Time spent in physical activity weekly according to level 3b knowledge of PhD students

7.5.3.8. Effects of level 4 knowledge on physical activity

A mixed design ANOVA was performed to determine the effects of Treatment Groups (IV1) Level 4 Knowledge (IV2) and Time (IV3) on Total PA levels (DV), with Treatment Groups (education and intentions, education only, intentions only and control groups) as between-subjects factor and Time (2 levels: pre- and post-intervention) and Level 4 Knowledge (2 levels: pre- and post-intervention) as within-subjects factors. The results suggested that there was a significant main effect of Treatment Groups ($F_{3,63} = 3.75$, $p=0.015$, $\eta_p^2 = 0.151$). There was a significant effect of Time ($F_{1,63} = 156.5$, $p<0.001$, $\eta_p^2 = 0.713$) and also a significant main effect of Level 4 Knowledge ($F_{1,63} = 51.97$, $p<0.001$, $\eta_p^2 = 0.452$).

Additionally, there were significant interactions between Treatment Groups and Time ($F_{3,63} = 3.74$, $p<0.015$, $\eta_p^2 = 0.151$); between Treatment Groups and Level 4 Knowledge ($F_{3,63} = 4.38$, $p<0.007$, $\eta_p^2 = 0.172$); between Level 4 Knowledge and Time ($F_{3,63} = 52.16$, $p<0.001$, $\eta_p^2 = 0.453$); and between the Treatment Groups, Time, and Level 4 Knowledge ($F_{3,63} = 4.38$, $p<0.007$, $\eta_p^2 = 0.173$). Follow-up Bonferroni pairwise comparisons test indicated that there were very significant differences in total PA ($p<0.001$), and level 4 knowledge ($p<0.001$) pre-intervention and post-intervention. There were significant differences between the education and intention group and control group ($p=0.027$); between intentions only group and the control group ($p=0.033$), but there were no differences between the other groups ($p>0.05$). The descriptive statistics is presented in Appendix 50. This suggested that the total PA levels increased as participants' awareness about the risks of contracting certain chronic illnesses attributable to physical inactivity (level 4 knowledge) increased. Overall, participants in the education and intentions group performed better in level 4 knowledge and engaged more in PA, followed by the intentions only, with no significant differences found among other treatment groups, as exhibited in Figure 7.9.

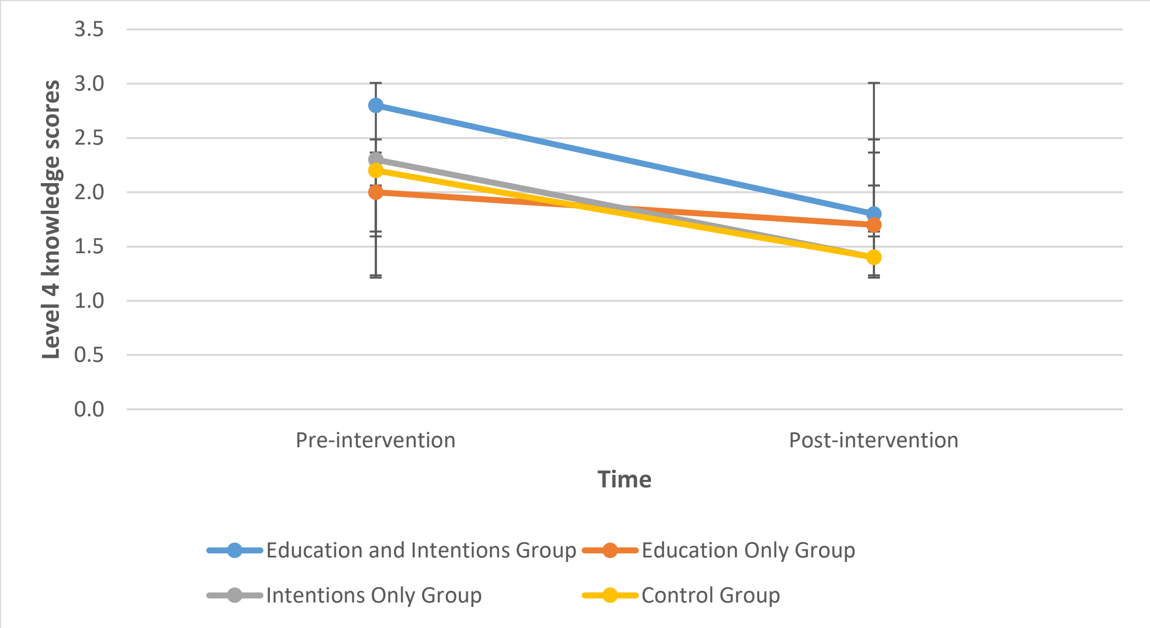

Figure 7.9: Effects of level 4 knowledge according to treatment groups among PhD students

7.5.3.9. Effects of intentions to engage in physical activity on physical activity levels

The descriptive statistics of intentions 1 (i.e., number of times participants planned to engage in PA during the next four weeks) is presented in Appendix 51.

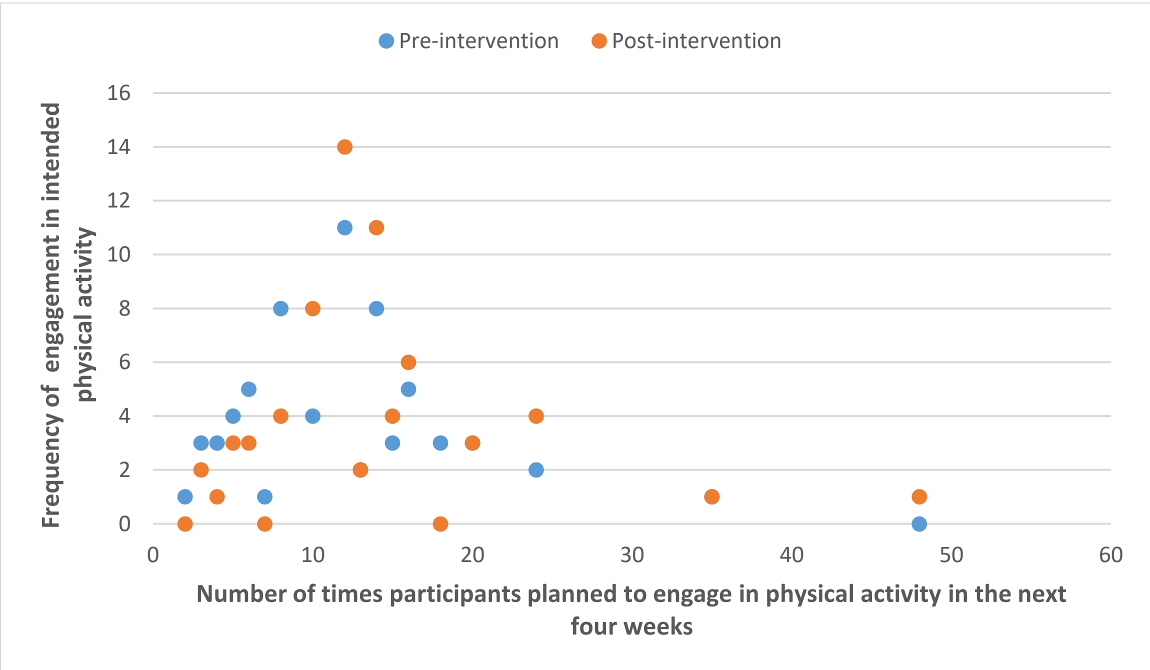

Figure 7.10: Scatter plot showing the frequency of engagement in physical activity in the next 4 weeks as planned by the PhD students (intentions 1)

As illustrated in Figure 7.10, most participants that planned to engage in PA between 2 and 8 times in the next 4 weeks (intentions 1) did not achieve it. However, most participants that intended to engage in PA at least 10 times or above during the next four weeks either met or surpassed their targets.

A mixed-methods design ANOVA was performed to determine the effects of Treatment Groups (IV1), Intentions 1 (IV2) and Time (IV3) on Total PA levels (DV), with Treatment Groups (education and intentions, education only, intentions only and control groups) as the between-subjects factor Time and intentions 1 (two levels each: pre- and post-intervention) as the within-subjects factors. There was a significant main effect of Treatment Groups ($F_{3,63}$ = 3.73, $p<0.016$, η_p^2 =0.151). There was very significant main effect of Time ($F_{1,63}$ = 154.5, $p<0.001$, η_p^2 =0.710) and a significant main effect of Intentions 1 ($F_{1,63}$ = 52.1, $p<0.001$, η_p^2 =0.453).

Furthermore, there were also significant interactions between Time and Treatment Groups ($F_{3,63}$ = 3.76, p=0.015, η_p^2 =0.152); between Intentions 1 and Treatment Groups ($F_{3,63}$ = 4.37, p=0.007, η_p^2 =0.172); between intentions 1 and Time ($F_{3,63}$ = 52.03, $p<0.001$, η_p^2 =0.452); and between Intentions 1, Time, and Treatment Groups ($F_{3,63}$ = 4.39, $p<0.007$, η_p^2 =0.173). Follow-up Bonferroni pairwise comparisons test indicated that there were significant differences between the education and intentions group and control group (p=0.029), and between intentions only group and control group (p=0.032). However, there was no significant difference between education only group and control group (p=0.297). Furthermore, there was a significant difference between total PA pre- and post-intervention ($p<0.001$); between intentions 1 at pre- and post-intervention ($p<0.001$). The participants in all treatment groups surpassed the number of times they planned to engage in PA during the 4-week intervention period. Therefore, the results suggested that planning the number of times to engage in PA (intentions 1) will increase the probability of engaging in it. As illustrated in Figure 7.11, participants in all the treatment groups achieved the number of times they planned to engage in PA, with the intentions only group recording the highest, followed by the education only group, then the control group, with the education and intentions group recording the least. See Appendix 52 for the descriptive statistics of intentions 1 to engage in PA among PhD students.

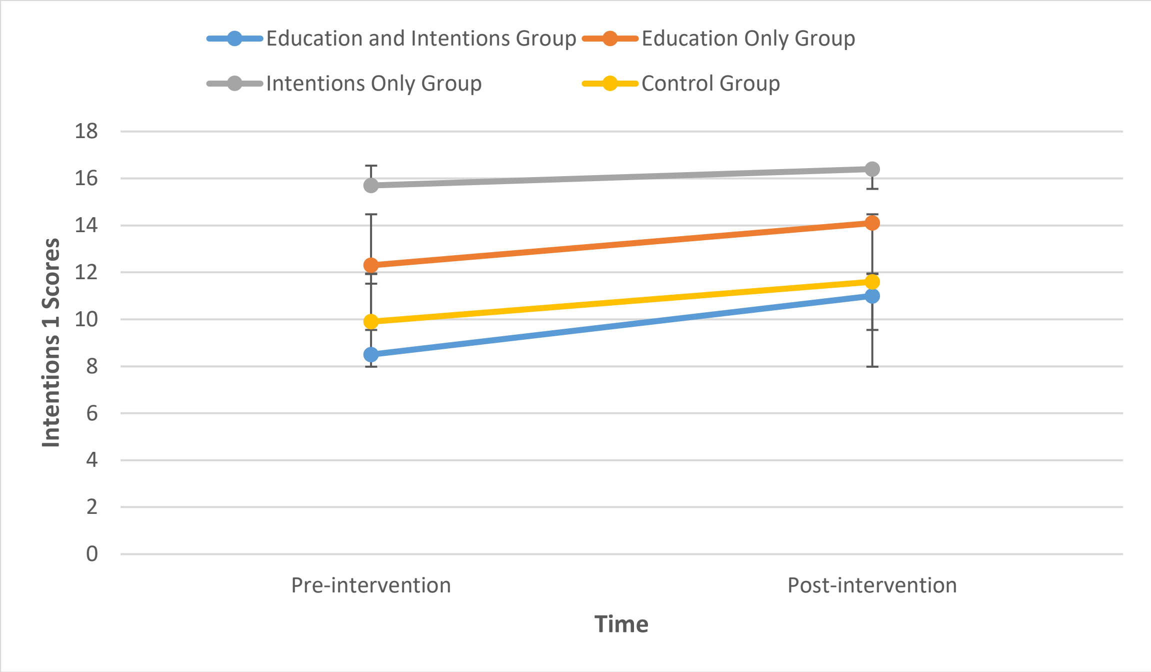

Figure 7.11: Intention 1 scores among PhD students according to the treatment groups

Participants were requested to rate the regularity they intend to participate in PA in the next four weeks. Apart from those that said they would sometimes or frequently engage in PA; the other participants did not maintain the regularity they said they would pre-intervention (intentions 2). Most of the participants (71.6%) who stated that they intend to participate in PA at least 12 times during the next four weeks, did engage in it (79.1%), while those (28.4%) who stated that they do not intend to engage decreased marginally (20.9%) post-intervention (intentions 3). Finally, those participants (76.1%) who stated with some certainty that they would participate in PA at least 12 times in the next 4 weeks (intentions 4) did engage in it post-intervention (83.6%), while those who stated that they would probably not or definitely not engage reduced considerably from 23.8% pre-intervention to 20.4% post-intervention (See Appendix 53).

Furthermore, chi-square tests of independence were carried out to examine the relationships between intentions 2, 3 and 4 pre- and post-intervention. The relation between making a prior intention to participate in PA at a certain regularity during the next four weeks and participating in it as intended (intentions 2) was significant, X^2 (1) = 77.724, p<0.001, with a Cramer's V coefficient of 0.482 signifying a very strong association. The relation between making an intention to participate/not participate in PA no less than 12 times during the next four weeks pre-intervention and participating/not participating in it during the four weeks as planned (intentions 3) was significant, X^2 (1) = 16.160, p<0.001, with a Cramer's V coefficient of 0.491 signifying a very strong association. Lastly, the relation between the certainties of the intention to participate in PA no less than 12 times during the next four weeks and engaging in it as planned (intentions 4) was significant, X^2 (1) = 48.443, p<0.003, Cramer's V coefficient of 0.380 signifying a very strong association. These findings indicated that the majority of participants that had the intentions to participate in PA for a specified number of times across a 4-week period and stated the regularity of engagement with some certainties were committed to participating in it.

7.5.3.10. Effects of implementation intentions on physical activity engagement

To understand the effects of forming implementation intentions on PA engagement among the treatment groups (i.e. the education and intentions and the intentions only groups) that received this intervention, the days, time, and places that the participants indicated in their implementation intentions were cross tabulated against the days, times and places they carried out the PA. As illustrated in Table 7.12, 87.5% of the participants in the intentions only group engaged in PA at the times, days and places indicated in their implementation intentions, while 82.4% of participants in the education and intentions group adhered to this. Apart from engaging in PA at the stipulated times, days and places stated in their implementation intentions, 52.9% of participants in the education and intentions group and 37.5% of participants in the intentions only group also engaged in further PA at other different times, days and places.

Furthermore, in planning ahead to overcome potential obstacle to engage in PA (using the If-Then template) as formed in their implementation intentions, about 50% of participants in both the education and intentions group (52.9%) and intentions only group (50.0%) stated that if the weather was bad, they would walk to the park, walk home from the university, use the stairs, walk the dog over the weekend, go for yoga session or workout in the gym. In contrast, more participants in the intentions only group (43.8%) made plans on how to overcome obstacles if they were busy compared to the education and intentions group (29.4%). Other plans the participants in the education and intentions group made included what to do when they are tired at the end of the day, when it is not convenient for them to go and family commitments. While, in the intentions only group, one participant also made plans for when it becomes challenging to go and swim (see Table 7.13).

Table 7.12: Days, times and places specified to carry out physical activity in implementation intentions at pre-intervention by days, times and places physical activity enactment were reported post-intervention (n=33).

Days of enactment	Monday	Tuesday	Wednesday		Thursday	Friday	Saturday	Sunday
Days specified in implementation intentions								
Monday	26							
Tuesday		6						
Wednesday			22					
Thursday					4			
Friday						21		
Saturday							3	
Sunday								2
Time specified in implementation intentions	Morning		Lunch-time			Afternoon		Evening
Time of enactment								
Morning	13							
Lunch-time			12					
Afternoon						3		
Evening								19
Place of enactment	University of Derby sports centre	University of Derby campus	Parks	Park Farm	Fitness centres	Queen's leisure centre	Home	Pride Park
Place specified in implementation intentions								
University of Derby sports centre	13							
University of Derby campus		6						
Parks			6					
Park Farm				1				
Fitness centres					3			
Queen's leisure centre						1		
Home							5	
Pride Park								1

Table 7.13: Summary of the If-Then plans of participants to overcoming obstacles to engage in physical activity

Treatment groups	**IF…**		**Then…**
Education and Intentions group **(n=17)**		Percentage (%)	
	the weather is bad (n=9)	52.9%	I will walk to the park, walk home, use the stairs, do something else in the gym.
	I am too busy (n=5)	29.4%	I will walk home from the university, go after work.
	it is not convenient for me to go (n=1)	5.9%	I will walk home on these days
	I am too tired at the end of the day (n=1)	5.9%	I will go to the gym and do something, anything, maybe a class.
	my children are having activities at school/church or require my personal assistance (n=1)	5.9%	I will engage in DIY, gardening, light exercise activities at home.
Intentions only group **(n=16)**	the weather is bad (n= 8)	50.0%	I will work out at the gym, walk the dog during weekends, go for yoga session, use the stairs
	I am too busy (n=7)	43.8%	I will walk home from the university on these days, use the stairs all day, walk to the park at lunchtime,
	It is challenging to find time to go and swim (n=1)	6.2%	I will do some gardening at home on those days

These findings suggested that forming an implementation intention of times, days, days and places to carry out PA and also planning about how to overcome potential obstacles using the If-Then template, increased the participants' enactment of the PA planned. This is because it allowed the participants to assign control of PA engagement to the environmental prompts detailed in their implementation intentions and encountering these prompts resulted in the instinctive initiation of PA.

7.6. Discussion

7.6.1. Impact of interventions on total physical activity and time spent in physical activity

This is the first study, to our knowledge, that assessed psychological interventions to increase overall levels of PA as well as time spent in weekly PA among PhD students in a university setting using both motivational and volitional interventions underpinned by the BCW, the COM-B behaviour model and the TDF.

Four interventions were assessed:

- educational intervention (i.e. motivational) based on the TDF (Atkins et al., 2017);
- intentions intervention (i.e. volitional) based on the implementation intentions concept (Gollwitzer & Sheeran, 1999; Gollwitzer, 1993);
- combination of the educational and intentions interventions (i.e., motivational and volitional); and
- control group intervention.

In examining the impact of the intervention on total PA levels, one of the major findings of this present study showed a significant main effect of treatment groups (η_p^2 =0.148), a significant main effect of time (η_p^2 =0.440), and a significant interaction between treatment groups and time (η_p^2 =0.167), which were higher than the Cohen's benchmark for large effect size (i.e. η_p^2= 0.14) (Cohen, 1988). The large effect sizes reported in these findings suggested that even though the participants in all the treatment groups increased in their total PA levels across the intervention period, the greatest increases occurred among the participants in the education and intentions group and intentions only group, who formed implementation intentions regarding time, days, and places they would enact the planned PA, followed by the education only group. The least increase in total PA levels was observed in the control group compared to the three treatment groups. Likewise, in examining the impact of intervention on time spent in PA weekly, the findings indicated that the effect sizes of the main effect of treatment groups (η_p^2 =0.445) and the main effect of time (η_p^2 =0.671) were significantly higher than the Cohen's benchmark for large effect size (i.e. η_p^2= 0.14) (Cohen, 1988). The large effect sizes reported in these findings demonstrated that the participants in the education and intentions group considerably spent more time engaging in PA weekly, followed by the intentions only group, then the education only group, with the least time spent engaging in PA reported in the control group. The participants who received the educational and intentions packages through the 4-week intervention were more than twice likely to participate in PA compared to the participants in the control group.

In assessing the impact of intentions on total PA levels, the findings showed very large effect sizes (i.e. significant main effect of treatment groups (η_p^2 =0.151); significant main effect of Time (η_p^2 =0.710); significant main effect of intentions 1 (η_p^2 =0.453), and significant interactions between treatment groups and time (η_p^2 =0.152); between intentions 1 and treatment group (η_p^2 =0.172); and between intentions 1, treatment groups and time (η_p^2 =0.173)), which were significantly higher than the Cohen's benchmark for large effect size of 0.14 (Cohen, 1988). The large effect sizes reported in these findings demonstrated that the majority of participants who had the intentions to engage in PA for a specified number of times during the 4-week intervention period, and also planned on how regularly they would engage in PA, were most likely to achieve their plans. Furthermore, majority of participants that formed implementation intentions about the days, time, and places to carry out PA, as well as plans to overcome any potential obstacles, enacted the PA on the days, times and places specified. This strengthens previous findings with regards to the mechanisms through which implementation intentions induce behaviour. Findings from previous studies (Gollwitzer, 1993; Orbell, Hodgkins, & Sheeran, 1997; Sheeran & Orbell, 1999) revealed that participants who had very good memory for the days, times and places detailed in their implementation intentions were more likely to enact the behaviour as specified. In support of the findings of this study, previous studies that have used implementation intentions either alone (Armitage & Sprigg, 2010; Budden & Sagarin, 2007; Kwak et al., 2007; Murray, Rodgers & Fraser, 2009) or in combination with other interventions (Chatzisarantis & Hagger, 2008; Milne, Orbell, & Sheeran, 2002; Orbell, Hodgkins & Sheeran, 1997; Prestwich, Lawton & Conner, 2003) to improve PA engagement have been generally very successful. This is also in line with the COM-B model and the TDF which posit that intention (i.e., reflective motivation) is a strong prognosticator of behaviour change.

The findings of this study corroborates those of other research insomuch as the intervention used herein demanded of participants to form coherent implementation intentions, i.e. detailed strategies concerning where, when and how to carry out a behaviour and ways to overcome possible barriers, have been demonstrated to be efficacious in transforming a broad array of health, societal, and organisational behaviours (Prestwich & Kellar, 2014). Strong evidence suggests that implementation intentions are an efficacious approach to support health-associated habits, however mixed findings are seen as regards PA (Belanger-Gravel, Godin & Amireault, 2011). Even though a meta-analysis by Belanger-Gravel, Godin & Amireault (2011) to examine the impact of implementation intentions on PA engagement indicated small to medium effect sizes, various studies (Milne et al., 2002; Murray, Rodgers & Fraser, 2009; Prestwich, Lawton & Conner, 2003) revealed that this approach was more effective amongst student, especially if supported with ways to prevent possible obstacles that may prevent achievement of planned PA. Previous research (Gollwitzer & Sheeran, 2006; Sheeran & Orbell, 1999; Webb & Sheeran, 2008) suggests that implementation intentions reduces the likelihood of individuals not remembering to begin goal-focused behaviour at the point of commencement. This is due to the fact that implementation intentions produces an intensified accessibility of the cognitive representation of the indicated situational prompts (i.e. environmental cues) and stimulate direct (involuntary) control of the planned behaviour via these prompts (Gollwitzer, 1993). Therefore, it may be argued that goal intentions that have been complemented by implementation intentions in relation to when and where an anticipated behaviour will be enacted are more likely to be performed (Gollwitzer & Sheeran, 1999).

Another major finding of this study suggested that even though the overall knowledge about benefits of participating in regular PA (95.5%) and the harmful impacts of not participating in regular PA (88.1%) (Level 1 knowledge) were generally high, there were no significant differences in levels of total PA amongst participants, signifying that Level 1 knowledge is not an influencing factor to behaviour change. This is congruent with previous research, which indicated that awareness concerning the health benefits of PA had minimal predictive effect on behaviour, although this construct is incorporated in prominent theories aimed at changing behaviour (Rhodes & Courneya, 2003). The evidence from this study indicates that this is likely because majority of individuals just possess an unclear awareness of the association between PA and health, however employing a more nuanced method to understanding individuals' awareness may make this relationship clearer (Fredriksson et al., 2018). This is also in line with findings of a study by Morrow et al. (2004), which suggested that even though 94.0% of the participants had awareness concerning the health benefits of PA (Level 1 knowledge), this knowledge did not translate to an increase in PA engagement.

Evaluation as to the impact of level 2 knowledge on total PA levels, the findings demonstrated very large effect sizes (i.e. significant main effect of treatment groups (η_p^2 =0.151); significant main effect of Time (η_p^2 =0.708); significant main effect of level 2 knowledge post-intervention (η_p^2 =0.455), and significant interactions between treatment groups and time (η_p^2 =0.152); between level 2 knowledge and time (η_p^2 =0.450); between level 2 knowledge and treatment group (η_p^2 =0.173); and between level 2 knowledge, treatment groups and time (η_p^2 =0.172)), which were significantly higher than the Cohen's benchmark for large effect size of 0.14 (Cohen, 1988). The large effect sizes reported in these findings suggested that the participants with more awareness about the diseases linked to physical inactivity (level 2 knowledge) were more inclined to participate in PA than those with less awareness. Even though, pre-intervention, the participants were just capable of identifying 12.4 out of 22 diseases, post-intervention this significantly increased to 16.1%. The findings of this study also revealed that there were very significant differences in total PA levels and level 2 knowledge pre- and post-intervention between the education and intentions group and control group and between the intentions group and the control group, with no differences occurring in other groups. This corroborates results from a study by Hui & Morrow (2001), which indicted that individuals with limited awareness about the diseases linked with physical inactivity were less likely to achieve the recommended levels of PA. A current study conducted by Fredriksson et al. (2018) among Australian adults to assess the ways diverse levels of awareness about PA relate to PA performance also revealed that people with more awareness about the diseases linked with physical inactivity would be considerably more physically active compared to those with lower awareness levels, which reinforces the findings of this present study. Therefore, higher Level 2 knowledge is a factor in creating the desired behaviour, i.e. knowing about the harm of inactivity can help drive positive behaviours towards being more active (Fredriksson et al., 2018).

This study demonstrated that about 43.3% of the participants were unable to correctly identify the recommended PA levels sufficient for health benefits (level 3a knowledge) post-intervention which was a significant improvement from 79.1% reported pre-intervention. The lack of knowledge about the PA recommendations have generally been high in various countries (Abdeta, Seyoum, & Teklemariam, 2019; Abula et al., 2018; Fredriksson et al., 2018; Kay et al., 2014; Knox et al., 2011), ranging from 55.6% among Australian Adults (Fredriksson et al., 2018) to 95.6% among Chinese university students (Abula et al., 2018). However, the moderate level 3a knowledge (56.7%), indicated in this study, did not improve the total PA levels nor the time spent in PA weekly among the study participants. Fredriksson et al. (2018) previously found that there was no association between the awareness about the PA recommendations sufficient for health benefits (level 3a knowledge) and PA engagement, thereby reinforcing the findings of this study. In the UK, the recommended national guidelines for PA required for health benefits (level 3a knowledge) have been promoted extensively and disseminated using several approaches (Davies et al., 2019; Department of Health, 2011a, 2011b; NHS, 2019), nevertheless this present study reveals that this level of awareness is not linked with PA engagement. In contrast, a study conducted among Canadian adults by Plotnikoff et al. (2011) indicated that people with more awareness about the recommended PA guidelines were the most physically active. Even though there were conflicting findings, the findings of this present study may be because even when people know the recommended PA levels needed for good health, they still do not participate in adequate PA probably due to their beliefs that they are already doing enough, as supported by this study, which indicated that 73.2% of the participants believed they were doing enough PA to acquire the health benefits.

Additionally, no significant association was found between knowledge about the percentage reduction of a person's risks of contracting certain chronic diseases by participating in routine PA (level 3b knowledge) and PA engagement, even though 50.7% participants were correct, 35.8% overestimated and 13.4% underestimated the percentage reduction of a person's risks of contracting certain chronic diseases by partaking in regular PA. Limited studies have investigated the effect of level 3b knowledge on PA, however a study by Fredriksson et al. (2018) revealed that 44.7% of the participants overestimated, while only 8.8% of the participants underestimated the health impact of PA on diseases. This implies that promoting the precise figures of increased likelihood of developing chronic diseases is not likely to improve PA engagement, because people who overrated the reduction in health risk from being physically active were considerably more active compared to people that underrated the risk (Fredriksson et al., 2018). This may negatively have an influence on the PA engagement among people presently overrating the disease risk decrease of PA.

Finally, in examining the impact of level 4 knowledge on total PA levels, the findings revealed very large effect sizes (i.e. significant main effect of treatment groups (η_p^2 =0.151); significant main effect of Time (η_p^2 =0.713); significant main effect of level 4 knowledge post-intervention (η_p^2 =0.452), and significant interactions between treatment groups and time (η_p^2 =0.151); between level 4 knowledge and time (η_p^2 =0.453); between level 4 knowledge and treatment group (η_p^2 =0.172); and between level 4 knowledge, treatment groups and time (η_p^2 =0.173)), which were significantly higher than the Cohen's benchmark for large effect size of

0.14 (Cohen, 1988). The large effect sizes reported in these findings indicated that there was a significant relationship between the knowledge of the increased risk of developing certain chronic diseases in a person's lifetime for not engaging in regular PA (level 4 knowledge) and PA engagement. The participants in this study scored 1.5 out of 5 (with lower scores indicating higher knowledge of individual risk of PA) suggesting that participants with higher level 4 knowledge were more inclined to engage in PA compared to those with lower knowledge. Furthermore, the participants in the education and intentions group performed better in level 4 knowledge and participated in more PA, followed by the intentions only group, education only group, and lastly the control group. In contrast, an investigation by Fredriksson et al. (2018) did not show any considerable association between level 4 knowledge and PA engagement, suggesting that participants who scored high on level 4 knowledge may possibly believe that physical inactivity would result in a raised risk of them developing chronic diseases, conversely because this risk might not be sensed as serious they might not have had a rationale to be physically active. Therefore, it may be argued that the participants in this current study who scored high in level 4 knowledge engaged more in PA, because they perceived the risks of not engaging in regular PA to be very serious, with increased risk of contracting chronic illnesses at some point during their lifetime. The TDF posits that people with stronger beliefs about the consequences of a behaviour (i.e. reflective motivation) are more likely to take part in a health promoting behaviour such as PA engagement (Atkins et al., 2017), thereby strengthening the results of this study. Therefore, prospective studies aimed at increasing PA levels among inactive university students should consider integrating the increased risk of physical inactivity to developing certain chronic diseases in a person's lifetime into the educational materials.

7.6.2. Impact of gender on total physical activity and time spent in physical activity weekly.

This study demonstrated that gender had no significant effect on total PA levels amongst participants in the various treatment groups both pre- and post-intervention. Even though most studies conducted in the university settings have reported that male students have higher PA levels than female student, a current study by Wilson et al., (2019) carried out amongst university students in the United States, in support of the findings of this present study, revealed that there was no significant gender difference in reported moderate PA. However, the study also indicated that men recorded considerably higher vigorous PA, as well as in exercise aimed at strengthening muscles (Wilson et al., 2019). This may be because all the participants in this present study were physically inactive, i.e., they had to score below 600 MET-minutes/week of moderate intensity PA, as measured by the GPAQ, to qualify to participate, which may have influenced the findings.

In contrast, in examining the impact of gender on time spent in PA weekly, the findings revealed very large effect sizes (i.e. significant main effect of gender (η_p^2 =0.140), and significant interactions between gender and time (η_p^2 =0.185)), which were significantly higher than the Cohen's benchmark for large effect size of 0.14 (Cohen, 1988). The large effect sizes reported in these findings indicated that there was a significant effect of gender on time spent in PA weekly, with male participants generally performing better than their female counterparts, especially from the third to the fourth week of intervention. This may be because the male participants started engaging in more vigorous PA from the third week of the intervention compared to the female participants. However, these findings are in line with previous research carried out amongst students in different universities around the world (Acs et al., 2017; Alkahtani & Awad, 2016; Çiçek, 2018; El Ansari et al., 2014; Magoc et al., 2016), which also reported that male students participate in more PA compared to their female contemporaries. Additionally, Hickey & Mason (2017) researching in an American university established that the male students engaged in more hours and types of PA compared to female students, which is in line with the findings of this present study. This may probably be because females largely see fewer motives and more obstacles to participate in PA compared to males (Hickey & Mason, 2017).

The findings from the present study suggest that even though female participants generally spent less time in PA weekly than the male participants, some may have engaged in more intense PA due to the intervention effect, which might have counterbalanced the conventional notion that males are generally more physically active than their female contemporaries. Another reason for these inconsistent findings may be due to the overestimation (Lee, Yu, et al., 2011; Prince et al., 2008) or underestimation (Celis-Morales et al., 2012; Grimm et al., 2012; Lagersted-Olsen et al., 2014) of PA synonymous with self-report measures, which was used in this present study. Studies using self-reporting methods also consider incorporating more objective measures of PA levels, e.g., accelerometers, pedometers or utilising integrated motion trackers available in most smart phones. Therefore, further studies could assess the effect of gender on PA and time spent in PA weekly among a wider student population using objective measures.

7.7. Conclusion

No study to our knowledge has attempted to design, implement and assess the impacts of a 4-week combined education and intentions intervention, underpinned by the BCW, COM-B model and TDF, to increase PA levels among PhD students in a university setting. This study provides new insight into the efficacy of a theory-based brief intervention aimed at improving the university PhD students' knowledge and intentions to engage in PA. The findings demonstrated that the intention to engage in PA is key, i.e., both education and intentions group, as well as intentions only group, performed better than the control group. Therefore, if there is improved education/knowledge, as well as better intentions then the outcome of pro-physical activity behaviour is stronger, which is more likely to result in action to be taken. Furthermore, gender had no influence on the PA levels of the PhD students, but had an effect on the time spent engaging in PA weekly. Therefore, brief interventions underpinned by psychological theories such as the BCW, COM-B model and TDF, with focus on improved education/knowledge, as well as intentions, can be used as a university-wide approach to increase PA engagement among students, as a way of improving their overall wellbeing. Furthermore, in designing future interventions to increase PA engagement amongst university students, it is also imperative to consider the influence of gender differences.

Chapter 8. General Discussion

8.1. Introduction

The previous chapter presented the development, implementation, and evaluation of a 4-week brief behaviour change intervention aimed at increasing the knowledge about PA and intentions to engage in PA among university PhD students. The results indicated that the highest total PA levels and time spent in PA weekly were reported by participants in the education and intention group, followed by the intention only group, education only group, with the control group reporting the least. This demonstrated that forming implementation intentions of where, when, and how to carry out PA and planning on how to overcome likely barriers, as well as improving awareness about PA recommendations, detrimental effects of physical inactivity and health benefits of PA, was effective at increasing PA levels among PhD students. The overall purpose of this dissertation was to examine the physical inactivity levels in a university setting in order to understand individuals' barriers and enablers to engagement in PA, with the specific aim of changing behaviours toward PA. Therefore, the purpose of this final chapter is to: (i) synthesise the key findings of the studies in this research project (i.e., study 1 (chapter 4), study 2 (chapter 5), study 3 (chapter 6) and study 5 (chapter 7)), (ii) assess the impact, novelty, and contribution the body of work makes towards creation of knowledge in the PA field using behaviour change models, (iii) identify strengths and weaknesses of this research, (iv) present the general implications of this research, (v) convey the future research directions, and (vi) present the general conclusions.

8.2. Synthesis of findings from the thesis

This programme of research commenced by examining the barriers and enablers of PA amongst university staff and students (Chapter 4) using group interviews, based on the COM-B behaviour model and the Theoretical Domains Framework (TDF). Subsequently, findings from the initial work identified the development of additional six items, which were used to assess two of the three domains of the TDF (i.e. Memory, Attention and Decision Processes and Social/Professional Roles and Identity) not assessed by the validated instrument (i.e. the Determinants of Physical Activity Questionnaire (DPAQ)) (Taylor, Lawton, & Conner, 2013) available to measure the 14 domains of the TDF in the PA context. The other domain, i.e. is reinforcement was measured using the motivation subscale of the Motivation for Physical Activity Questionnaire (Deci & Ryan, 2004). The survey involving the DPAQ, and the six additional items developed through the research was administered online to determine the predictors of physical inactivity among inactive university administration staff and PhD students (Chapter 5). Thereafter, 4-week bespoke interventions, informed by these predictors identified in Chapter 5, were developed using the Behaviour Change Wheel (BCW) and implemented among the university administrative staff (chapter 6) and PhD students (Chapter 7).

The purpose of the first study (i.e., study one in Chapter 4), was to ascertain the key enablers and barriers to PA amongst university staff and students employing the COM-B model and TDF to guide the assessment. This study identified that all the six components of the COM-B model, which were mapped to the 14 domains of the TDF were effective at predicting PA. However, six prominent domains of the TDF that accounted for almost three quarters (i.e. 71.1%) of the emerging themes were identified as enablers and barriers to PA engagement amongst university staff and students, and these included: (1) environmental context and resources (Bethancourt et al., 2014; Deliens et al., 2015; Donaldson-Feilder et al., 2017; Hashim, 2012; Lacaille et al., 2011); (2) social influences (Flannery et al., 2018; Haith-Cooper et al., 2018); (3) knowledge (Fredriksson et al., 2018; Ghaffari et al., 2013); (4) beliefs about capabilities; (5) professional/social role and identity (Flannery et al., 2018; Quigley et al., 2019); and (6) intentions (Gollwitzer, 1993, 1999; Murray, Rodgers & Fraser, 2009; Prestwich, Lawton & Conner, 2003; Sheeran & Orbell, 1999). As identified in study one, environmental context, and resources (i.e. any state of an individual's circumstance or surroundings that promotes or hinders the improvement of skills and capabilities, autonomy, social proficiency and adaptive conduct) (Michie et al., 2008) was the most frequently identified barrier and enabler to PA engagement amongst university staff and students. This is in line with previous research which identified that environmental context, and resources such as availability of an onsite sports centre, availability of changing facilities and safe bicycle sheds, nearness of university campus to a park, motivational signs by the lifts, advertisement of PA opportunities, and provision of PA initiatives were major enablers to PA engagement (Grimstvedt et al., 2010; Lacaille et al., 2011; Bauman et al., 2012; Hashim, 2012; Bellicha et al., 2015; Deliens et al., 2015; Van Cauwenberg et al., 2015; Burrows, O'Mahony & Geraghty, 2018). On the other hand, weather, inaccessibility to certain sports facilities, lack of advertisements of available PA opportunities, social timetabling at the sports centre, lack of time, work commitments, study commitments, family commitments, financial constraints, health conditions, and distance to exercise facilities, were reported as major barriers to PA engagement (Iván Martínez-Lemos, Puig-Ribera & García-García, 2014; Cooper & Barton, 2015; Deliens et al., 2015; Aceijas et al., 2016; Hoare et al., 2017). Therefore, from a university perspective, understanding the environmental, context and resources that will encourage or discourage people from participating in PA may ultimately be the starting point in designing future interventions aimed at effectively increasing PA engagement amongst university staff and students. For example, the proximity of the university's main campus to a park, open spaces and the availability of an on-site sports centre may be considered in designing future interventions to promote PA among staff and students.

Social influences (i.e. those relational processes that could cause people to change their opinions, mind-sets, or conducts; (Michie et al., 2008) was cited by university staff and students as a major enabler and barrier to their engagement in PA. For example, while some of the participants stated they would engage in more routine PA if accompanied by family, friends, or colleagues, others stated not engaging in enough PA because of the lack of these supports. The findings of this present study are reinforced by previous studies (Daskapan et al., 2006; Ramírez-Vélez et al., 2014; Deliens et al., 2015; Kamal & Radzani, 2016; Brett & Pires-Yfantouda, 2017; Dayi et al., 2017; Sultoni & Suherman, 2017) carried out among university staff and students, indicating that social support from friends, family, or colleagues could act as either an enabler or a barrier to PA participation. Evidence suggests that social influences help to increase participation in PA through the improvement of peoples' self-efficacy to overcome barriers to PA engagement, as well as increase in motivation through the improvement of peoples' enjoyment of PA (McNeill et al., 2006; Ishii, Oka & Shibata, 2011; Laird, Fawkner & Niven, 2018). Therefore, future intervention designs and research aimed at increasing PA engagement amongst university staff and students should consider integrating a social support element, such as group sports or exercise.

Knowledge (i.e. being aware of something's existence; (Michie et al., 2008) was reported by university staff and students as a major determinant of PA engagement. Lack of knowledge about the recommended PA guidelines for adults was reported by the participants as a major barrier to engaging in regular PA. Although most participants in this present study were aware of the consequences of physical inactivity and health benefits of PA, only two of the 40 participants (i.e. 5%) could accurately state the national recommended PA guidelines for adults. This is consistent with findings of previous studies carried out in different countries as well as in the university settings. For example, several studies conducted in different countries indicated that the level of knowledge about the PA recommendations for adults generally ranged from 4.4% in China (Abula et al., 2018) to 36.1% in the U.S. (Kay et al., 2014), while the level of knowledge about the PA recommendations in the UK, where this study was conducted, ranged from 8.4% to 18.0% (Hunter et al., 2014; Knox et al., 2013). Furthermore, the level of knowledge about the recommended PA guidelines for adults in the university settings ranged from 4.4% to 9.3% (Anand et al., 2011; Abula et al., 2018), demonstrating that the level of awareness about the recommended PA guidelines for adults was generally low globally, as well as in the university settings. The university, by default, is endowed with well tutored and knowledgeable people, which has been previously demonstrated to influence people's participation in PA. According to Joshua et al. (2012), individuals with higher educational qualifications tend to be more physically active, and knowledgeable of the required PA levels. For the level of knowledge about the recommended PA guidelines to be very low among the populations in this present study, as with previous studies, is a major concern that needs to be urgently addressed. Therefore, future intervention designs could integrate a PA module in the curricula for students and educate staff about PA as a strategy to increase the knowledge base and educational information about PA across the university settings.

Beliefs about capabilities (i.e. acceptance of the truth, certainty, or authenticity concerning a talent, skill, or competence that an individual can put to positive use; (Michie et al., 2008) was also indicated by the participants as an enabler and a barrier to PA engagement. For instance, some participants, in this present study, stated that they engage in regular PA because they have the confidence in their ability to engage in PA (i.e. self-efficacy). In contrast, some other participants stated that they lacked the self-confidence in their ability to engage in PA, because of the difficulty in engaging in PA and lack of physical skills to engage in sports or exercise, which was a major barrier preventing them from actually engaging in regular PA. The lack of self-efficacy mentioned as a barrier to PA engagement in this present study, especially amongst the university staff is worrisome, but consistent with the findings from previous investigations (Edmunds, Hurst & Harvey, 2013; Saadan et al., 2015). This demonstrates that the higher the self-efficacy a person has about engaging in a certain behaviour, the higher the probability of engaging in the behaviour (Pekmezi, Jennings & Marcus, 2009). The significance of self-efficacy in changing health behaviours has been established (Pekmezi, Jennings & Marcus, 2009), and thus not surprising that it has been prominently reported as a vital correlate of PA performance (McAuley & Blissmer, 2000). Self-efficacy exerts its effects on PA performance by increasing the motivation of people to engage in PA regardless of barriers, challenges and disappointments (McAuley et al., 2011). Therefore, since self-efficacy has been established as a major predictor of PA performance and compliance, future studies should consider integrating some strategies to improve university staff and students' self-efficacy to participate in PA, such as: goal setting; prescribing activity; rehearsing PA behaviours; utilising pedometers/activity logs to self-monitor PA; modelling utilising videotapes of peer role models and using peer role models to conduct group PA sessions; emphasising the physiological benefits of PA; using social support of friends, colleagues and family to foster and support PA participation; praising people for any progress made, and accrediting all achievements to peoples' individual willpowers; assisting people to anticipate and positively elucidate physical discomfort linked to PA, and utilising relaxation exercise to decrease anxiety. Such approaches would be invaluable in encouraging university staff and students to engage in more routine PA.

Social/professional role and identity (i.e. a logical set of behaviours and exhibited personal attributes of a person in a public or work environment; (Michie et al., 2008) was also mentioned as an enabler and a barrier to PA engagement among the participants. Some of participants stated that PA was essential in their course as students and in their job role as staff. Some participants also believed that taking up opportunities to be physically active was an essential aspect of their identity, which could have a positive impact on their PA engagement. However, some other participants stated that even though there were numerous opportunities in the university for them to be active, they believe that the university authority does not see PA as an important attribute for them, which could hinder their engagement in PA. Some participants also believe that the university was only focused on the undergraduates, which could be a barrier for students in other levels of study to engage in PA. Although this concept has not been studied in a university setting, it has been investigated in the PA context among diverse populations in different settings, such as overweight pregnant women in a hospital setting (Flannery et al., 2018), elderly patients living with HIV in a community setting (Quigley et al., 2019), and primary health care practitioners in primary health care setting (Sissons, Grant, Kirkland, & Currie, 2020). It is thus imperative to determine how peoples' social and professional identity can be manipulated, to promote the enabling influences while trying to decrease potential barriers. Therefore, in designing interventions aimed at encouraging pro-physical activity behaviours in a university setting, it is worth considering issues concerning the professional, social role and identity of the staff and students, as a strategy of improving their engagement in PA.

Finally, intention (i.e. a deliberate decision to carry out a behaviour or resolution to behave in a particular manner; Atkins et al., 2017) was stated as an enabler and a barrier to PA engagement amongst the participants. Although intention has been established as an important concept in commonly used health behaviour theories such as the transtheoretical model (Prochaska & DiClemente, 1983), protection motivation theory (Rogers, 1983), theory of planned behaviour (Ajzen, 1991), social cognitive theory (Bandura, 2001), health action process approach (Schwarzer, Lippke & Luszczynska, 2011), and in recent times the theoretical domains framework (TDF) (Cane, O'Connor & Michie, 2012), as well as a predictor of PA participation, the findings of this study indicated that some participants had no plans to engage in PA or undertake additional PA. This may be because having strong intentions to engage in a behaviour may not necessarily lead to enactment of that behaviour (Aarts, Dijksterhuis & Midden, 1999; Conroy et al., 2011). For instance, people frequently set PA targets that they intend to accomplish, but later find themselves disappointed or annoyed by their failure to engage in or continue to participate in the PA (Conroy et al., 2011). The significance of intentions in carrying out a behaviour such as PA lead to the conception of the implementation intentions (Gollwitzer & Sheeran, 1999; Gollwitzer, 1993).

Implementation intentions are if-then plans that allow individuals to efficiently deal with self-regulatory obstacles that may weaken goal striving (Gollwitzer, 1993; Gollwitzer & Sheeran, 1999; Gollwitzer & Sheeran, 2006). Strong evidence suggests that the formation of if-then plan fosters successful management of numerous challenges in goal striving and improves goal achievement rates (Gollwitzer & Sheeran, 1999). Therefore, forming implementation intentions of where, when, and how to carry out a behaviour as well as planning on how to overcome any potential barriers will increase the likelihood of successfully carrying out the intended behaviour (Gollwitzer, 1993; Gollwitzer & Brandstätter, 1997). This is because the formation of implementation intentions (i.e. if-then plans) mentally links the crucial situational prompts (i.e. good prospects to take action, vital moments) with responses that are efficacious in accomplishing goals or anticipated end results (Gollwitzer & Sheeran, 1999). For example, "if situation B is confronted, then I will initiate behaviour C in order to achieve goal A" (Gollwitzer & Sheeran, 1999). Implementation intentions has been effectively employed in the university settings as a strategy to increase the engagement in PA as well as sustaining PA participation (Conner et al., 2010; Milne et al., 2002; Murray et al., 2009; Prestwich et al., 2003). Therefore, future intervention designs and research in the university settings could incorporate the If-Then templates to plan where, when, and how to engage in PA, as well as to plan for how to overcome possible barriers, as an effective strategy to increase staff and students' intention to engage in PA, which will ultimately increase their participation in PA.

Understanding why people do not take part in enough PA is multifaceted, including personal, social, environmental, and policy components. Studies that increase knowledge concerning these factors possess more potentials to better inform PA promotion. Therefore, identifying the enablers and barriers to PA engagement among university staff and students is the first step in detecting prospective intervention opportunities, which would inform the planning and development of theoretically underpinned interventions applicable to the university setting (Young et al., 2003). Although six domains of the TDF were identified as enablers and/or barriers to PA engagement among university staff and students (study one), only two domains (i.e. 'knowledge' and 'intentions') matched the domains that were identified as predictors of physical inactivity amongst PhD students, while only 'physical skills' domain was identified as the predictor of physical inactivity amongst administrative staff (study two- confirmatory study), and thus informed the intervention targets. However, it is recommended that future designs of PA interventions in the university settings should include strategies to encourage the enablers while addressing these six barriers to PA engagement identified in this present study. These interventions should include improving access to on-site sports facilities; improving information strategies about available on-campus sports facilities; providing cheaper and/or more flexible sports subscriptions; providing one hour paid break for staff to engage in PA; promoting team exercise/sport; improving knowledge about the consequences and detrimental impacts of physical inactivity, and the health benefits of PA through education; recognising PA as an important part of students' course and staff job role; and forming implementation intentions of where, when and how to carry out the PA as well as planning on how to overcome possible barriers using the If-Then template.

The COM-B model and TDF have been generally used in various intervention designs in the health domain. In recent times, there has been an increase in the use of the COM-B model and TDF in the PA context in diverse populations in diverse settings. However, the four studies, to date, that have used the COM-B model and/or TDF to identify the barriers and enablers of exercise and PA among different populations in diverse settings have commonly employed a qualitative approach (i.e. semi-structured individual interviews). These studies focused on identifying the barriers and enablers of exercise and PA among nurses (Power, Kiezebrink, Allan, & Campbell, 2017), obese pregnant women (Flannery et al., 2018), asylum seekers (Haith-Cooper et al., 2018), and older adults living with HIV (Quigley et al., 2019) in hospital and community settings. Currently there is no research that has employed a qualitative approach (i.e. semi-structured group interviews) underpinned by the COM-B model and TDF to identify the enablers and barriers to PA engagement amongst university staff and students; therefore, study one in this research project, to the researcher's knowledge, is the first to do so. The findings of study one indicated that six domains of the TDF, as presented earlier, were major enablers and barriers to PA engagement amongst university staff and students. In so doing, it has provided a well-defined application of the study's findings to practice as well as in the future design of intervention and research in the university settings. Therefore, study one provides an original contribution to the understanding of the enablers and barriers to PA engagement, from the university staff and students' perspectives and contributes to the broader literature investigating the perceived barriers and enablers to PA engagement in university settings.

Furthermore, since the only validated scale, the DPAQ, developed to assess the TDF domains in PA context does not assess two domains of the TDF, i.e. the 'Memory, Attention and Decision Processes' and the 'Social/Professional Role and Identity domains', additional six items (see section 4.5.2 in Chapter 4) were developed from the quotes of participants in study one (chapter 4) to assess these domains, in order to fully test the applicability of this instrument in the PA context in a university setting. The DPAQ supplemented by the six additional items identified from study one was used in study two (Chapter 5) to assess the predictors of physical inactivity among inactive university administrative staff and students. Prior to the commencement of study two, a preliminary survey was carried out among the entire university staff and students, which indicated that the university administrative staff and PhD students were the most physically inactive groups compared to other staff and student groups, respectively, and were therefore selected as the populations of focus in this thesis. Study two, presented in Chapter 5, evaluated physical inactivity levels among university administrative staff and PhD students, in order to understand the predictors of physical inactivity, with the specific aim of identifying intervention targets. The major finding of this study is that 64.0% of administrative staff and 62.0% of PhD students were physically inactive; reporting less than 600 MET-minutes/week (i.e. 150 minutes of moderate amount of PA weekly) as recommended by the World Health Organisation (World Health Organisation, 2012a) which is in line with previous studies (Fountaine et al., 2014; Pengpid et al., 2015). This is a concern, because in a university setting people have the opportunity to be active (sports centre facility onsite), are typically well educated and have flexible working hours. So, given these elements, the fact that a significant proportion of staff and students are still physically inactive needs to be an area of focus in UK universities through their staff and student health and wellbeing strategies.

The Higher Education Statistics Agency, in the UK, reported that in the 2016-17 academic year, there were 2,737,590 students and staff (i.e. about 2,317,880 students and 419,710 staff) (Higher Education Statistics Agency, 2018a, 2018b). Therefore, about 60.0% (i.e. 1,642,554) of this population being inactive is a national issue that needs to be urgently addressed. A current report by the Health Education Policy Institute (HEPL), in highlighting the issues of academic staff mental health, showed an increase (ranging from 50% to 316%) in university staff referrals to counselling and occupational health facilities across 59 universities in the UK (Morrish, 2019). Furthermore, some cases of suicides have been reported amongst academic staff (Morrish, 2019) and students (Gorczynski, 2018) arising due to work pressures and workload were reported. In line with these findings, Gorczynski (2018) posited that 43% of university administrative staff showed indications of moderate mental illness, which was twice the prevalence seen among the overall population. However, since a strong link has been established between PA and positive mental health (Chekroud et al., 2018; Harris, 2018), promoting pro-physical activity behaviours among university staff and students may be an effective strategy to improve their PA levels and overall mental health and wellbeing.

Another finding from study two, is that the female PhD students were more physically inactive than their male counterparts, which is in line with findings from previous studies carried out in the university setting (Awadalla et al., 2014; Mohammed et al., 2014; Fagaras, Radu and Vanvu, 2015; Rajappan, Selvaganapathy and Liew, 2015; Dayi et al., 2017; Liu and Dai, 2017; Murphy et al., 2018). On the contrary, there was no effect of gender on physical inactivity levels reported among the administrative staff, as reinforced with findings from Joshua et al. (2012). In contrast to the findings of this study, previous studies have generally reported that women were more physically inactive than men (Cooper & Barton, 2015; Gichu et al., 2018). However, the findings of study two may have been influenced by disproportion in the gender split among the administrative staff, with females accounting for 84.3% of the total study participants. It is evident that even with these findings, gender remains an important factor that could affect participation in regular PA, therefore, gender sensitive interventions should be used to encourage both females and males to engage in PA.

The combined influence of the 14 domains of the TDF were good predictors of physical inactivity among inactive university administrative staff and PhD students, as reported in study two (chapter 5). However, physical skills domain (i.e. physical capability) was identified as the only significant predictor of physical inactivity among the inactive university administrative staff, and was positively associated with PA, signifying that as physical skills increase participation in PA increases (i.e. physical inactivity decreases). Whereas knowledge (i.e. psychological capability) and intentions (i.e. reflective motivation) were identified as the only significant predictors of physical inactivity among the inactive university postgraduate research (PhD) students, and were also positively associated with PA, indicating that as knowledge and intentions increase, PA engagement increases.

The findings of study two suggest that the TDF is effective at ascertaining the predictors of physical inactivity in a university setting. Although just a small number of the domains of the TDF, as determined in study two, were essentially established to be significant predictors of physical inactivity, it is very clear that the TDF is a reliable framework to assess physical inactivity in a university setting. The findings of just a small number of significant predictors of physical inactivity could be because of the questionnaire and items utilised to characterise the domains of the TDF. Therefore, future investigations are needed to further validate the applicability of the TDF in predicting physical inactivity among inactive staff and students in university settings employing these questionnaires and items. Furthermore, future studies could as well investigate the predictors of physical inactivity in the whole university populations as a starting point in the development of efficacious and sustainable tailored interventions to promote pro-physical activity behaviours and improve the general wellbeing in these populations. The application of an all-encompassing psychological framework (i.e. the TDF), to underpin this present study, provided an insight into the predictors of physical inactivity among university administrative staff and PhD students, which informed the development of theory and evidence-based interventions to increase PA levels in these populations. Utilising the TDF also added considerable strength to this present study, since the TDF was theoretically created employing numerous behavioural theories. This would support the identification of probably appropriate TDF domains and in the selection of appropriate theories to examine physical inactivity more broadly in future. Therefore, based on the barriers to PA identified in study one and the predictors of physical inactivity identified in study two, 4-week brief bespoke interventions, underpinned by the BCW, COM-B model and TDF, were carried out amongst the inactive university administrative staff (study three in chapter 6) and the inactive university PhD students (study four in chapter 7).

The few studies that have used the COM-B model and the TDF to support the identification of barriers and enablers of exercise and PA, have generally used a qualitative approach, involving semi-structured individual interviews (Flannery et al., 2018; Haith-Cooper et al., 2018; Power et al., 2017; Quigley et al., 2019). These studies were conducted among nurses, obese pregnant women, asylum seekers, and older people living with HIV in the hospital and community settings. Presently, there is no study that has utilised a quantitative method (i.e. survey) informed by the COM-B model and the TDF to determine the predictors of physical inactivity amongst administrative staff and PhD students in a university setting; therefore, study two in this research project, to the researcher's knowledge, provided new insights in the field of PA research. The findings of study two suggested that 'physical skills' was the only significant predictor of physical inactivity amongst university administrative staff, while 'knowledge' and 'intentions' were the only significant predictors of physical inactivity among PhD students. This provides a distinct application of this present study's findings to practice and in future intervention developments and studies in the university settings. Therefore, study two provides an original contribution to the understanding of the predictors of physical inactivity, from the university administrative staff and PhD students' viewpoints and adds to a wider literature examining the predictors of physical inactivity in university settings, thereby demonstrating the novelty of this study.

The results of study 3 (chapter 6) indicated that the administrative staff who attended a supervised badminton session (i.e. the experimental group) reported higher physical skills scores, higher total PA and more time spent in PA weekly compared to the control group, indicating that increase in physical skills is associated with increase in PA engagement. Most studies that have examined the association between physical skills and participation in PA have generally been qualitative exploratory study. For example, Flannery et al. (2018) stated that the lack of physical skills was a major reason for being physically inactive, which the findings of the present study affirm. Furthermore, Quigley et al. (2019) reported lack of physical skills as one of the barriers to engagement in exercise and PA. In support of these findings, the COM-B model and TDF, which underpinned this study, posit that the improvements in skills (i.e. physical capability) to enact a behaviour increase the likelihood to carry out the behaviour (Michie, Atkins & West, 2014). However, the only study conducted among university faculty and staff members (Fennell, Peroutky & Glickman, 2016) assessed the effectiveness of supervisor-led exercise intervention weighed against a period of non-supervised exercise at changing behaviour towards PA. Their results indicated that that supervisor-led exercise sessions for previously inactive people were more efficient at raising fitness and PA levels than non-supervised exercise (Fennell, Peroutky & Glickman, 2016). This may be due to the improvements of the fundamental movement skills and motor skills, which may have increased the confidence (i.e. self-efficacy) of the participants to engage in PA, demonstrating that improving the physical literacy and motor skills of university staff, by training them to learn new sports or PA skills, may enhance their confidence in being able to engage in PA (Giblin et al., 2014), and could present an effective approach to promote PA engagement among those that are inactive (Fennell, Peroutky & Glickman, 2016; Centers for Disease Control and Prevention, 2017). Therefore, the university administrators should consider implementing supervised exercises or physical activity, using in-house sports facilities, to help administrative staff and other staff in general to increase their levels of PA, as a strategy to improve their overall wellbeing.

The findings of study 4 (chapter 7) suggested that the PhD students that were allocated to the education and intervention group recorded higher total PA levels, as well as time spent in PA weekly, followed by the intentions only group, then the education only group and the least was the control group, indicating that intentions was a key predictor of PA. These findings are reinforced by the COM-B model and the TDF which posit that intentions (i.e. reflective motivation) is a strong predictor of behaviour change (Michie, Atkins & West, 2014). Several studies supported by the TDF have established intentions as a predictor of PA, though most of these studies have been conducted in settings other than universities. Work by Quigley et al. (2019) stated that the intentions domain was one of the six prominent domains of the TDF that might act as a barrier and/or an enabler to PA engagement, which was congruent with the finding of this study. Other studies (Flannery et al., 2018; Haith-Cooper et al., 2018) have also reported the significance of the intentions domain as a strong predictor of PA engagement, demonstrating that individuals with low or no intentions to participate in PA are more likely to be physical inactivity than those with strong intentions. Therefore, the improvement in intentions to engage in PA or exercise amongst participants in the present study may have been as a result of the increase in their motivation to engage in PA. Furthermore, the implementation intentions the participants in the education and intentions group and the intentions only group formed concerning where, when and how to participate in PA, may have increase their likelihood of engaging in PA more compared to the participants in other treatment groups, because implementation intentions mentally links expected critical situations with efficient goal-focused responses (Gollwitzer & Sheeran, 1999), thereby ensuring successful enactment of intended behaviour.

Knowledge was another factor that was found to complement intentions in the improvement of PA engagement among university PhD students, as reported in study four (chapter 7). Knowledge (i.e. psychological capability) has been identified by the COM-B and TDF as an enabler of PA (Abdeta et al., 2019; Abula et al., 2018; Michie, Atkins & West, 2014). This may be because the participants in the education and intentions groups were also exposed to some educational information, which may have improved their knowledge about the benefits of PA, the detrimental impacts of physical inactivity and the PA recommendations for good health, and may have therefore increased their drive to engage in PA (Fredriksson et al., 2018), signifying that the knowledge about PA may be linked with increase in PA behaviours. Previous studies have either assessed education interventions (Abdeta, Seyoum, & Teklemariam, 2019; Abula et al., 2018; Kay et al., 2014; Knox et al., 2013) or intentions interventions (Armitage & Sprigg, 2010; Budden & Sagarin, 2007; Kwak et al., 2007; Murray, Rodgers & Fraser, 2009) alone or combined intentions interventions with other interventions (Chatzisarantis & Hagger, 2008; Milne, Orbell, & Sheeran, 2002; Orbell, Hodgkins & Sheeran, 1997; Prestwich, Lawton & Conner, 2003) to promote PA among staff and students in the university setting, yet no study has combined education and intentions interventions as a strategy to increase PA levels, specifically among PhD students, which is a novelty of this study. Therefore, interventions aimed at educating university students about PA (i.e. benefits of PA, detrimental impacts of physical inactivity and the PA recommendations), as well as forming implementation intentions of where, when, and how to carry out the PA may be an effective strategy to increase PA levels among them, as a way to improve the overall students' wellbeing.

The major aspects of the interventions, presented in Chapters 6 and 7, that could have resulted in the effective increase in participants' total PA levels, as well as time spent in PA weekly was engaging the administrative staff in a supervised badminton session carried out in the university's sports centre at no cost to them, and also involving various heads of department to improve uptake of the intervention. This 'free at the point of use by the end user' approach used in this study provided opportunities (i.e. physical opportunity) for the administrative staff, who would have normally not signed up to the badminton session on their own, to be active, as posited by the COM-B model and TDF (Michie et al., 2014). Even though this was not included in this study design, future studies could investigate the impact of charging the participants for the use of the sports facilities on their engagement. It would also be interesting to compare people incurring personal cost to participation and those getting free of charge participation.

Furthermore, for the PhD students, using educational materials to improve their awareness about health problems associated with physical inactivity (Level 2 knowledge) and about the risk of developing chronic diseases in their lifetime if they do not participate in regular PA (Level 4 knowledge) (Fredriksson et al., 2018), as well as forming implementation intentions of days, times, and places to carry out PA and planning how to overcome possible barriers (Gollwitzer & Sheeran, 2006; Milne et al., 2002; Murray, Rodgers & Fraser, 2009; Prestwich, Lawton & Conner, 2003; Prestwich & Kellar, 2014; Sheeran & Orbell, 1999) were strongly associated with participation in PA. Knowledge (psychological capability) and intentions (reflective motivation) are constructs of the COM-B model and TDF that have been established to influence the enactment of behaviours (Atkins et al., 2017; Michie, Atkins & West, 2014). In the present study, the combination of education and intentions intervention improved participation in PA through a heightened knowledge about health conditions linked with physical inactivity and the possible risk of contracting chronic illnesses due to inactivity (Fredriksson et al., 2018), as well as an intensified accessibility of the cognitive representation of the indicated situational prompts (i.e. environmental prompts), which accelerate direct (involuntary) control of the intended behaviour via these prompts (Gollwitzer, 1993). The synergy between the intention and knowledge therefore has an impact on changing the PhD students' behaviours towards more pro-physical activity behaviours, i.e. more engagement in PA.

Several studies have generally used the COM-B model and/or the TDF to inform intervention targets in diverse contexts, among different populations, in healthcare settings (Beenstock et al., 2012; Bussières et al., 2012; McSherry et al., 2012; Patey et al., 2012; Thomas & Mackintosh, 2014; Mirbaha et al., 2015; Debono et al., 2017; McParlin et al., 2017; Hallsworth et al., 2019; Sissons et al., 2020), as well as in an elementary school setting (Weatherson et al., 2017) and community settings (Alexander, Brijnath & Mazza, 2014; Haith-Cooper et al., 2018). However, only three studies, so far, have used the BCW, COM-B model and the TDF to design behaviour change interventions in workplace settings (Munir et al., 2018; Ojo et al., 2019) and a healthcare setting (Webster & Bailey, 2013). These studies generally involved the identification of intervention targets, without actually implementing and evaluating the interventions, apart from the study by Munir et al. (2018) that developed and implemented the intervention. Although in this study by Munir et al. (2018), which involved the reduction of time spent sitting amongst office-based National Health Service (NHS) employees in Leicester city, in the UK, interventions were developed and implemented, the effectiveness of the interventions are currently being investigated. Presently, there is no study, to the researcher’s knowledge, that has used the BCW, COM-B model and the TDF to effectively develop, implement and evaluate a brief 4-week bespoke behaviour change intervention aimed at increasing PA levels among administrative staff and PhD students in a university setting; these are the first studies to do so. The findings of study three (i.e. administrative staff) and study four (i.e. PhD students) indicated that the interventions put in place, as presented earlier, were effective at increasing the total PA levels, as well as time spent engaging in PA weekly in these populations. This offers a clear application of the findings of these studies to practice and in future development, implementation and evaluation of behaviour change interventions aimed at increasing PA levels among staff and students in the university settings. Therefore, study three and four, which were carried out concurrently, provide original contributions to the PA context in the university setting and also contribute to the wider literature evaluating the effectiveness of behaviour change interventions supported by the BCW, COM-B model and TDF in university settings; thus establishing the novelty of these intervention studies.

The effect sizes of the interventions in study three and study four of this present research project were large, thereby demonstrating the effectiveness of these interventions at increasing PA levels among university administrative staff and students. It is important to compare these findings to those of other studies that used similar intervention designs.

These interventions may have been effective because an overarching model and framework, i.e. COM-B model and TDF, were used to identify barriers and enablers to PA as well as predictors of physical inactivity amongst study participants which were then specifically targeted. Furthermore, interventions were developed, implemented, and evaluated using a current psychological framework, i.e. the BCW, which enabled the mapping of the identified barriers to PA and predictors of physical inactivity stated by the study participants to appropriate intervention functions, behaviour change techniques (BCTs) and modes of delivery. These systematic processes involved in developing, implementing, and evaluating the intervention studies in this present research project were appropriately outlined, to improve future replications or improvements of these interventions. There is limited published research that used comparable intervention designs in university settings, as no study, to date, has used the BCW, COM-B model and TDF to fully underpin the development, implementation, and evaluation of PA interventions in the PA context in a university. At best, only few studies have used the BCW, COM-B model and/or TDF to inform PA intervention designs in diverse settings (Flannery et al., 2018; Haith-Cooper et al., 2018; Munir et al., 2018; Ojo et al., 2019; Quigley et al., 2019). On the other hand, of these studies, only one study used the BCW, COM-B model and TDF to develop and implement an intervention aimed at changing behaviour towards PA (Munir et al., 2018); with none evaluating the impacts of the interventions. Therefore, to determine how using the COM-B model and TDF to underpin the interventions in this present research project have impacted on these interventions, it is imperative to compare the findings of these interventions to other interventions that have used other theories or no theories at all (i.e. atheoretical). Interventions aimed at promoting PA engagement amongst the university staff and students, though mostly observed to be efficacious at increasing PA levels, have largely revealed heterogenous findings, particularly amongst the physically inactive populations (Maselli et al., 2018). The findings of a current systematic review by Maselli et al. (2018) suggested that the heterogeneity in findings of interventions aimed at encouraging PA engagement among university students, may be because of several reasons, such as the different nations where these interventions were conducted; utilisation of different research designs, intervention duration, and range of participant; utilisation of different instruments to measure PA and report the study findings; participants' dropout rates; and the employment of different theoretical models/frameworks or none at all (atheoretical) to support the interventions; (Maselli et al., 2018). The paucity of published research makes it challenging to draw compelling conclusions regarding the effectiveness of these interventions at increasing PA levels in a university setting.

The major reasons for the heterogeneity in the findings reported by previous studies may be because most interventions carried out in the university settings to increase PA levels, especially amongst inactive staff and students, have generally been supported with diverse older psychological theories or frameworks, or are atheoretical. For example, most PA interventions in the university settings have been supported by the theory of planned behaviour (TPB) (Epton et al., 2014; Parrott et al., 2008; Skår et al., 2011); social cognitive theory (Bopp et al., 2018; Boyle et al., 2011; Bray et al., 2011; D. K. Brown et al., 2014); social ecological model (SEM) (Gilson et al., 2007, 2009; Bopp, Kaczynski & Wittman, 2011); and transtheoretical model (TTM) (Quintiliani et al., 2010; Kattelmann et al., 2014). While, some other interventions reported using more than one theory and/or framework, such as the TTM and SCT (Greene et al., 2012), TPB and ST (Epton et al., 2014), and HBM and SCT (Okazaki et al., 2014). Even though some of these interventions supported with either one or more older psychological theories and/or frameworks reported being effective at increasing PA levels, most of them did not provide the behaviour change strategies through which these increases were exerted, thus limiting the possibility of replicating these studies. However, some of these studies reported small intervention effects; for instance, a study by Epton et al. (2014), aimed at evaluating the effectiveness and cost-effectiveness of a theory-based health behaviour intervention underpinned by the TPB and ST, which was delivered online amongst new university students, showed a small effect on PA engagement. This is in line with another study by Kattelmann et al. (2014), suggesting that a bespoke theory-based, web-delivered interventions supported by TTM had small increases in vigorous PA among university female students post-intervention, which was not sustained at follow-up evaluation.

Likewise, numerous studies (Haines et al., 2007; Claxton & Wells, 2009; Meyer et al., 2010; LeCheminant et al., 2011; Cavallo et al., 2012; Thorgersen-Ntoumani et al., 2014; Mansoubi et al., 2016) carried out in university settings to increase PA levels and overall wellbeing did not clearly indicate employing any psychological theories and/or frameworks to support their interventions, which might have generally influenced the divergences in the findings reported. Numerous atheoretical interventions carried out to increase PA levels in university settings have reported positive findings (Haines et al., 2007; Claxton & Wells, 2009; Thorgersen-Ntoumani et al., 2014; Mansoubi et al., 2016). For example, a walking intervention carried out among university faculty and employees by Haines et al. (2007) showed significant improvements in employees' PA levels, as well as their health and wellbeing. Even though, no theory was clearly stated as underpinning this intervention, it might have been effective because of the utilisation of a pedometer, educational programme and weekly e-mail prompts, which may have motivated the employees to engage in PA (Haines et al., 2007). In support of this, another study conducted by Claxton & Wells (2009), aimed to assess the effectiveness of PA homework on university students' PA levels, suggested that PA homework was effective at increasing students' PA levels. On the other hand, some atheoretical interventions carried out in the university settings to increase PA levels have also reported little to no effects (Cavallo et al., 2012; LeCheminant et al., 2011). For instance, Cavallo et al. (2012) showed that among university students there were no significant differences in sensed social support or PA between the intervention group (i.e. combination of education, social networking, monitoring of PA) and control (i.e. education only) group over the study period. Furthermore, LeCheminant et al.

(2011) established that among first year university students pedometer counts decreased significantly over the academic year, demonstrating a decrease in PA engagement amongst university freshmen. These findings are not surprising, since these interventions were not supported by psychological theories and/or frameworks, thus making it more challenging in identifying and targeting the specific factors influencing PA behaviours. Even though both interventions supported by the older psychological theories and/or frameworks and those that are atheoretical described the processes through which the interventions were delivered, they did not report the BCTs that were used to effect those changes in behaviour towards PA; thus, making it challenging to understand why some of these interventions were effective, while others were ineffective. It is possible that the participants' needs were not considered before implementing these interventions, which might have caused their ineffectiveness. Therefore, future theory-driven university-based PA interventions must carry out behavioural analyses using overarching psychological models/frameworks such as the COM-B model and/or TDF to identify specific participants' needs as well as enablers and barriers to PA, so as to identify more accurate intervention targets. In addition, future PA interventions in university settings should also employ larger sample size, apply overarching psychological theories such as the COM-B to systematically develop, implement and evaluate the interventions and clearly report all the BCTs used to deliver the interventions. This would help in providing more accurate intervention targets and better understanding of why the interventions are effective at increasing PA or not, which would enhance replicability of these interventions and further improvements of the quality of these interventions should they be carried out again in future.

8.3. Strengths and limitations of the research project

A common strength of the body of research undertaken herein is the underpinning by newer overarching psychological models/theories, i.e. the Behaviour Change Wheel (BCW); the COM-B behaviour model and the Theoretical Domains Framework (TDF). Earlier models such as the theory of planned behaviour, the transtheoretical model health belief model and social cognitive theory, that have been used to consistently inform PA promotion interventions, do not address the fundamental roles of impulsivity, disposition, emotional processing, will power and associative learning (Michie et al., 2014). Conversely, current advancements of synthesising the older models have resulted in the enhancements of these newer models/theories, with broader influences such as cognitive, automatic, reflective and contextual factors (Michie et al., 2014). Therefore, it becomes important to employ integrative overarching models and frameworks that do not possess the limitations of the older ones.

A common limitation shared by the studies presented in Chapters 5, 6 and 7 is use of self-report questionnaires to measure PA and thus prone to over-estimation of PA, underestimation of physical inactivity, recall biases and social desirability (Celis-Morales et al., 2012; Crutzen & Göritz, 2011; Grimm et al., 2012; Lagersted-Olsen et al., 2014; Lee et al., 2011; Prince et al., 2008). Nevertheless, self-report questionnaires were used in the present study because other comparable studies have also used them. Additionally, the feasibility with regards to time, cost and support needed for participants to use more objective measures, e.g. pedometers, accelerometers, or utilisation of integrated smartphone technologies, e.g. activity trackers, were not feasible in terms of cost-benefits.

A limitation of study one (Chapter 4), is the small sample size, especially among first year students, with only three people participating in the group interview. It is important to state that this was an exploratory study, which was not intended to gain a representative sample and group membership in itself. However, the group interview was convened to make participants feel more comfortable being interviewed with others who are similar to themselves. Therefore, it was the exploration of factors across the groups that were of interest. Some other studies have also used similar sample size (Martinez et al., 2016). Even with this limitation, this study provided an insight into the barriers and enablers to PA among university staff and students.

A limitation of study 2 (Chapter 5), is that the participants were recruited through convenience sampling, with majority of the administrative staff being females (84.3%) and from the White ethnic group (94.3% for administrative staff and 71.1% for PhD students), which may make it challenging to generalise the findings. Additionally, the survey was conducted in the winter/spring period between February and April, which might have led to the unusually high physical inactivity levels reported among the respondents, which was even higher than the city, regional and national averages (Chan & Ryan, 2009; Tucker & Gilliland, 2007; Wagner et al., 2019). However, objective measures such as accelerometers or pedometers would have provided the actual patterns of PA in this study and reduced self-report biases, but due to the cost of such instruments and the likely inconveniences on the participants, the GPAQ was employed.

A major strength of study 3 (Chapter 6) and (Chapter 7), is the high rate of participant retention (100%). Even though there was a high participant's withdrawal at baseline, especially among the administrative staff (40.0%) compared with the PhD students (8.2%), the remaining participants were committed to the intervention programme all through the study period. The intervention was so effective that three participants that were attending the badminton session aimed at developing their physical skills, signed up as members of the sport club, and four other participants started attending the badminton sessions regularly, even after the end of the study. Therefore, it is evident from this study that a brief intervention has the long-term effect of inducing sustained pro-physical activity behaviours in previously inactive individuals.

The sample sizes of some of the studies reported within this thesis may be viewed as small and could be seen as a limitation when considering the scaling up of the findings towards population generalisations. Likewise, no follow-up occurred post-intervention, which may limit the evidence of the sustained impact of the behaviour change elicited and evidenced during the study period. However, Prestwich, Lawton & Conner (2003) found that a 4-week study to examine the effect of implementation intentions and decision balance sheet on exercise promotion among students and staff of a university in the UK did not report any follow-up of participants post-intervention. In support of this, another 2-week study carried out by Milne et al. (2002) among undergraduate students in a university in the UK, to assess the effectiveness of volitional and motivational interventions in encouraging engagement in exercise, only took measures at two time points and reported no follow-up of the participants post-intervention. However, future studies are necessitated to assess the effect of physical skills development intervention, as well as knowledge and intentions improvement among university administrative staff and PhD students, respectively, with follow-up assessments post-intervention.

8.4. General implications of this research

The first major implication of this research is that it sets the foundation for future research in PA by applying a framework which can be adapted to different settings and also has the potentials to inform the development of effective strategies to improve PA levels in the universities as well as other settings. Therefore, the findings of this research could be considered in a broader context of the health and wellbeing agenda for staff and students in the university where this research was conducted as well as other universities across the UK.

A second important implication of this present research derives from the findings which suggest that interventions supported by overarching psychological theories such as the BCW, the TDF and COM-B model were effective at changing behaviour towards PA in a university setting. Considering the prevalence of hypokinetic conditions (i.e. diseases associated with lack of PA such as type 2 diabetes, obesity, hypertension, lower back pain, depression, osteoarthritis, and some cancers) and associated detrimental impacts on peoples' health and mental wellbeing, the findings from this present research could be adopted by local government authorities across the UK as strategies to increase peoples' engagement in PA, in order to tackle the rising prevalence of mental conditions associated with inactive lifestyles. This would further validate the effectiveness and the replicability of these strategies in other settings.

A third implication of this research is around reducing costs of physical inactivity associated diseases to the health system. The huge economic impact of physical inactivity on the health systems globally has been established (Torjesen, 2016). For example, in the UK, the NHS spends £1.2 billion annually on physical inactivity associated diseases (British Heart Foundation, 2017). On the other hand, PA has been shown to have some health benefits and reduce the risk of developing chronic diseases associated with physical inactivity (Lee, 2003; Teychenne et al., 2008; Roumen et al., 2009; Sattelmair et al., 2011). The strategies used in this present research significantly increased PA levels among the research participants. Therefore, the healthcare policymakers in the UK could adopt the findings of this present research to increase peoples' PA levels as a cost-saving strategy for the NHS.

The final implication of this research stems from the most significant finding, suggesting that improving the intentions to engage in PA through the use of implementation intentions successfully increased PA levels amongst university PhD students. Since the focus of behaviour change towards more pro-active lifestyle have to address the 'intentions' dimension, university administrators across the UK could incorporate the implementation intentions' component of this present research into students' learning, as a compulsory module for university undergraduate and postgraduate. This would help increase students' PA levels, as well as their academic achievements and overall health.

8.5. Future direction of research

This present research showed some important findings that could help inform future directions of interventions aimed at encouraging pro-physical activity behaviours in both universities and other settings. This research explored the enablers and barriers to PA among university staff and students as well as the predictors of physical inactivity among university administrative staff and PhD students, using the COM-B model and TDF. These informed the development of effective bespoke interventions, using the Behaviour Change Wheel (BCW), which increased PA levels in these groups. Therefore, further work is needed to expand the understanding of the enablers and barriers to PA as well as the predictors of physical inactivity by examining different staff and student groups across universities in the UK, using the COM-B model and TDF, to validate the fundamental mechanisms that resulted in the increases in PA levels reported in this research.

This research was conducted in only one university in the UK with its own demographics and cultural context. Thus, in order to extrapolate these findings, it is imperative to replicate this research in universities with various contexts, e.g., in other countries, or different mission groups (e.g., Russell Group as well as modern post-92, universities within the UK) to assess the transferability and applicability of these type of interventions in a global setting. Cross-country comparisons are important to understand the effectiveness of the interventions and factors that are likely to affect the transferability of the interventions, such as population demographics, intervention acceptance and the availability of skills and resources to deliver the interventions by indigenous providers (Wang, Moss, & Hiller, 2006).

Several treatment groups were used in the bespoke interventions involving university administrative staff and students in this present research. However, further research could also include an atheoretical group (i.e., those allowed to engage in any form of PA or exercise of their choice) as one of the treatment groups, to further examine the impacts that this group would have on PA engagement. Furthermore, this present study did not do any follow-up after the intervention ended, therefore, future studies should carry out this research in larger samples and conduct at least 6-month follow-up assessment to determine if the change in behaviour towards PA can be sustained for long-term after intervention is withdrawn.

Finally, it would also be beneficial to extend this research beyond the university settings, given the prevalence of Covid-19, with majority of employees working from home and thus less likely to engage in sufficient PA. Further studies could therefore replicate this research among university employees working from home to validate its effectiveness at improving their PA levels.

8.6. Conclusion

This research project was developed to promote PA engagement among university administrative staff and postgraduate research (PhD) students. The development, implementation, and evaluations of the interventions in this research project were supported with overarching psychological theories- the Behaviour Change Wheel (BCW), COM-B model and the Theoretical Domains Framework (TDF).

This present research employed a sequential exploratory mixed-methods design (with the qualitative phase informing the quantitative phase) to assess the effectiveness of a brief bespoke intervention at increasing university administrative staff and PhD students' PA levels. The employment of both qualitative and quantitative research approaches in this present research extended the general understanding of university staff and students' opinions and perspectives about their perceived enablers and barriers to PA engagement as well as those factors that predict physical inactivity. The utilisation of qualitative approach was crucial in gaining better knowledge about the influences of PA participation among university staff and students, such as environmental context and resources, intentions, social influences, knowledge, beliefs about capabilities, and social/professional role and identity. This qualitative study also helped to inform the development of six additional items that were incorporated in the survey used to quantitatively collect data. In addition, the employment of quantitative approach was also crucial in identifying the predictors of physical inactivity among university administrative staff (i.e., physical skills) and PhD students (i.e., knowledge, and intentions). Even though more priority was given to the quantitative study, the combination of the findings from the qualitative and quantitative studies informed the specific intervention targets (i.e., Physical skills, knowledge, and intentions) in this present research. Therefore, using overarching psychological theories such as COM-B model and TDF to understand the barriers and enablers of PA as well as the predictors of physical inactivity provides a strong basis on which to develop effective PA interventions.

The multicomponent interventions in this research involved the use of supervised badminton sessions for administrative staff, and use of educational materials, implementation intentions and If-Then templates for the PhD students, with both groups self-monitoring their PA behaviour using PA logs weekly, and weekly email reminders sent to them. A major finding of this research project revealed that a theory-based intervention that included supervised badminton session, self-monitoring of PA and prompting through weekly e-mails significantly increased administrative staff's total PA level as well as time spent in PA weekly. Another major finding indicated that a theory-based intervention that involved reading educational materials about PA, forming implementation intentions regarding where, when, and how to perform PA and how to overcome possible obstacles, and completing weekly PA log, and prompting through weekly e-mails significantly increased PhD students' total PA level as well as time spent in PA weekly. In both interventions, there were no significant gender differences in total PA levels and time spent in PA weekly between the treatment groups, apart from week three where male PhD students engaged in more PA weekly compared to their female contemporaries. This present research was the first to employ the BCW, COM-B model and the TDF to develop, implement and evaluate 4-week bespoke behaviour change interventions that were found very effective at increasing PA levels among university administrative staff and PhD students, which is a key novelty of this thesis.

The psychological theories, i.e., BCW, COM-B model and TDF, used to underpin the intervention development in this research project proved beneficial in encouraging pro-physical activity behaviours among university administrative staff and PhD student. This further established that theory-based, behaviour-oriented interventions were efficacious at promoting PA behaviour change in university staff and students. Furthermore, assessing specific participants' needs and characteristics, and utilising a bottom-up approach, enables a better application of theory, leading to improved effectiveness of the intervention. Therefore, the continuous promotion of theory-based PA interventions in universities and other settings are needed.

References:

Aarts, H., Dijksterhuis, A., & Midden, C. (1999). To plan or not to plan? Goal achievement or interrupting the performance of mundane behaviors. *European Journal of Social Psychology*, *29*(8), 971–979. https://doi.org/10.1002/(sici)1099-0992(199912)29:8<971::aid-ejsp963>3.3.co;2-1

Abdeta, C., Seyoum, B., & Teklemariam, Z. (2019). Knowledge of the physical activity guidelines and factors associated with physical activity participation among adults in Harar town , eastern Ethiopia. *BMJ Open Sport & Exercise Medicine*, *5*, e000463. https://doi.org/10.1136/bmjsem-2018-000463

Abdullah, A. S. M., Wong, C. M., Yam, H. K., & Fielding, R. (2005). Factors related to non-participation in physical activity among the students in Hong Kong. *International Journal of Sports Medicine*, *26*(7), 611–615. https://doi.org/10.1055/s-2004-821315

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology*, *27*(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Abula, K., Gröpel, P., Chen, K., & Beckmann, J. (2018). Does knowledge of physical activity recommendations increase physical activity among Chinese college students? Empirical investigations based on the transtheoretical model. *Journal of Sport and Health Science*, *7*(1), 77–82. https://doi.org/10.1016/j.jshs.2016.10.010

Aceijas, C., Bello-Corassa, R., Waldhausl, S., Lambert, N. & Cassar, S. (2016). Barriers and determinants of physical activity among UK university students. *European Journal of Public Health*, *26*(Suppl 1), 430.

Ackroyd, S. (2004). Methodology for management and organisation studies: Some implications of critical realism. In S. Fleetwood, S. & Ackroyd (Ed.), *Critical realist applications in organisation and management studies*. London: Routledge.

Acs, P., Bergier, J., Salonna, F., Junger, J., Gyuro, M., Simon-Ugron, Á., Welker, Z. & Makai, A. (2017). Gender Differences in Physical Activity among the University Students in the Visegrad (V4) Countries. *Studia Universitatis Babeş-Bolyai Educatio Artis Gymnasticae*, *62*(1), 5–17. https://doi.org/10.24193/subbeag.62(1).01

Adams, J., & White, M. (2002). A systematic approach to the development and evaluation of an intervention promoting stair use. *Health Education Journal*, *61*(3), 272–286. https://doi.org/10.1177/001789690206100308

Adams, J., & White, M. (2005). Why don’t stage-based activity promotion interventions work? *Health Education Research*, *20*(2), 237–243. https://doi.org/10.1093/her/cyg105

Agha, S. Y., & Al-Dabbagh, S. A. (2010). Level of physical activity among teaching and support staff in the education sector in Dohuk, Iraq. *Eastern Mediterranean Health Journal*, *16*(12), 1278–1284. Retrieved from https://www.lib.uwo.ca/cgi-bin/ezpauthn.cgi?url=http://search.proquest.com/docview/848716528?accountid=15115%5Cnhttp://vr2pk9sx9w.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rfr_id=info:sid/ProQ%3Anursing&rft_val_fmt=info:o

Ajzen, I. (1991). The theory of planned behavior. *Orgnizational Behavior and Human*

Decision Processes, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Akazawa, N., Okawa, N., Kishi, M., Hino, T., Tsuji, R., Tamura, K., & Moriyama, H. (2020). Quantitative features of intramuscular adipose tissue of the quadriceps and their association with gait independence in older inpatients: A cross-sectional study. *Nutrition*, *71*. https://doi.org/10.1016/j.nut.2019.110600

Al-Isa, A. N., Campbell, J., Desapriya, E., & Wijesinghe, N. (2011). Social and health factors associated with physical activity among Kuwaiti college students. *Journal of Obesity*, *2011*, 1–6. https://doi.org/10.1155/2011/512363

Albarracín, D., Gillette, J. C., Earl, A. N., Glasman, L. R., & Durantini, M. R. (2005). A Test of Major Assumptions About Behavior Change: A Comprehensive Look at the Effects of Passive and Active HIV- Prevention Interventions Since the Beginning of the Epidemic. *Psychological Bulletin*, *131*(6), 856–897. https://doi.org/10.1037/0033-2909.131.6.856.A

Albarracin, D., & Glasman, L. R. (2016). Multidimensional targeting for tailoring: a comment on Ogden (2016). *Health Psychology Review*, *10*(3), 251–255. https://doi.org/10.1080/17437199.2016.1190294

Alexander, K. E., Brijnath, B., & Mazza, D. (2014). Barriers and enablers to delivery of the Healthy Kids Check: an analysis informed by the Theoretical Domains Framework and COM-B model. *Implementation Science : IS*, *9*(1), 60. https://doi.org/10.1186/1748-5908-9-60

Alkahtani, S., & Awad, N. (2016). Comparing the Physical Activity Patterns of Male and Female Students in the Preparatory Year in Saudi Arabia. *Journal of Obesity & Weight Loss Therapy*, *06*(02). https://doi.org/10.4172/2165-7904.1000308

Alkhajah, T. A., Reeves, M. M., Eakin, E. G., Winkler, E. A. H., Owen, N., & Healy, G. N. (2012). Sit-stand workstations: A pilot intervention to reduce office sitting time. *American Journal of Preventive Medicine*, *43*(3), 298–303. https://doi.org/10.1016/j.amepre.2012.05.027

Alwan, A. (2011). *Global status report on noncommunicable diseases 2010* (A. Alwan, Ed.). Geneva: World Health Organisation.

American Diabetes Association. (2019). Blood Sugar and Exercise. Retrieved January 8, 2020, from American Diabetes Association website: https://www.diabetes.org/fitness/get-and-stay-fit/getting-started-safely/blood-glucose-and-exercise

Anand, T., Tanwar, S., Kumar, R., Meena, G.S. & Ingle, G. K. (2011). Knowledge, attitude, and level of physical activity among medical undergraduate students in Delhi. *Indian Journal of Medical Sciences*, *65*(4), 133–142.

Anastasia, S., Tiziana, S., Doaa, A., Mona, A., & Arja, A. R. (2017). Pedometers as an Effective Tool for Measuring Physical Activity in Young Females in Saudi Arabia. *International Journal of Community & Family Medicine*, *2*(133).

Andersen, E., Høstmark, A. T., Holme, I., & Anderssen, S. A. (2013). Intervention effects on physical activity and insulin levels in men of Pakistani origin living in oslo: A randomised controlled trial. *Journal of Immigrant and Minority Health*, *15*(1), 101–110. https://doi.org/10.1007/s10903-012-9686-3

Andersen, R. E., & Jakicic, J. M. (2009). Interpreting the physical activity guidelines for health and weight management. *Journal of Physical Activity & Health*, *6*(5), 651–656. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19953843

Anderson, L. M., Quinn, T. A., Glanz, K., Ramirez, G., Kahwati, L. C., Johnson, D. B., … Katz, D. L. (2009). The Effectiveness of Worksite Nutrition and Physical Activity Interventions for Controlling Employee Overweight and Obesity: A Systematic Review. *American Journal of Preventive Medicine*, *37*(4), 340–357. https://doi.org/10.1016/j.amepre.2009.07.003

Aparicio-Ting, F.E., Friedenreich, C.M., Kopciuk, K.A., Plotnikoff, R.C. & Bryant, H. E. (2014). Intrapersonal and Social Environment Correlates of Leisure-Time Physical Activity for Cancer Prevention: A Cross-Sectional Study Among Canadian Adults. *Journal of Physical Activity and Health*, *11*(4), 790–800. https://doi.org/10.1123/jpah.2012-0110

Armitage, C. J. (2005). Can the Theory of Planned Behavior Predict the Maintenance of Physical Activity? *Health Psychology*, *24*(3), 235–245. https://doi.org/10.1037/0278-6133.24.3.235

Armitage, C. J. (2016). Evidence That Implementation Intentions Can Overcome the Effects of Smoking Habits. *Health Psychology*, *35*(9), 935–943.

Armitage, C. J., & Arden, M. A. (2010). A volitional help sheet to increase physical activity in people with low socioeconomic status: A randomised exploratory trial. *Psychology and Health*, *25*(10), 1129–1145. https://doi.org/10.1080/08870440903121638

Armitage, C. J., & Sprigg, C. A. (2010). The Roles of Behavioral and Implementation Intentions in Changing Physical Activity in Young Children With Low Socioeconomic Status. *Journal of Sport and Exercise Psychology*, *32*, 359–376.

Armstrong, D., Gosling, A., Weinman, J., & Marteau, T. (1997). The place of inter-rater reliability in qualitative research: An empirical study. *Sociology*, *31*(3), 597–606. https://doi.org/10.1177/0038038597031003015

Ashford, S., Edmunds, J., & French, D. P. (2010). What is the best way to change self-efficacy to promote lifestyle and recreational physical activity ? A systematic review with meta-analysis. *British Journal of Health Psychology*, *15*(2), 265–288. https://doi.org/10.1348/135910709X461752

Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., … Michie, S. (2017). A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Science*, *12*(77), 1–18. https://doi.org/10.1186/s13012-017-0605-9

Australian Bureau of Statistics. (2012). *Australian health survey: first results, 2011-12 / Australian Bureau of Statistics.* Canberra: Australian Bureau of Statistics.

Awadalla, N.J., Aboelyazed, A.E., Hassanein, M.A., Khalil, S.N. Aftab, R.Gaballa, I.I. & Mahfouz, A. A. (2014). Assessment of physical inactivity and perceived barriers to physical activity among health college students, south-western Saudi Arabia. *Eastern Mediterranean Health Journal*, *20*(10), 596–604.

Azevedo, M. R., Araújo, C. L. P., Reichert, F. F., Siqueira, F. V., da Silva, M. C., & Hallal, P. C. (2007). Gender differences in leisure-time physical activity. *International Journal* *of Public Health*, *52*(1), 8–15. https://doi.org/10.1007/s00038-006-5062-1

Baghianimoghaddam, M. H., Bakhtari-Aghdam, F., Asghari-Jafarabadi, M., Allahverdipour, H., Dabagh-Nikookheslat, S., & Nourizadeh, R. (2016). The effect of a pedometer-based program improvement of physical activity in tabriz university employees. *International Journal of Preventive Medicine*, 3–9. https://doi.org/10.4103/2008-7802.177897

Baicker, K., Cutler, D., & Song, Z. (2010). Workplace wellness programs can generate savings. *Health Affairs*, *29*(2), 1–8. https://doi.org/10.1377/hlthaff.2009.0626

Baker, G., Gray, S., Wright, A., Fitzsimons, C., Nimmo, M., Lowry, R., & Mutrie, N. (2008). The effect of a pedometer-based community walking intervention “Walking for Wellbeing in the West” on physical activity levels and health outcomes: a 12-week randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, *5*(1), 44. https://doi.org/10.1186/1479-5868-5-44

Bandura, A. (1977). Self-efficacy: Toward a Unifying Theory of Behavioral Change. *Psychological Review*, *84*(2), 191–215.

Bandura, A. (1986). *Social foundations of thought and action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: Freeman.

Bandura, A. (2001). Social Cognitive Theory of Mass Communication Social Cognitive Theory of Mass Communication. *Media Psychology*, *3*(3), 265–299. https://doi.org/10.1207/S1532785XMEP0303

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education and Behaviour*, *31*, 143–164.

Bang, K.-S., Lee, I., Kim, S., Lim, C. S., Joh, H.-K., Park, B.-J., & Song, M. K. (2017). The Effects of a Campus Forest-Walking Program on Undergraduate and Graduate Students’ Physical and Psychological Health. *International Journal of Environmental Research and Public Health*, *14*(7), 728. https://doi.org/10.3390/ijerph14070728

Bardus, M., Blake, H., Lloyd, S., & Suzanne Suggs, L. (2014). Reasons for participating and not participating in a e-health workplace physical activity intervention. *International Journal of Workplace Health Management*, *7*(4), 229–246. https://doi.org/10.1108/IJWHM-11-2013-0040

Barengo, N.C., Hu, G., Lakka, T.A., Pekkarinen, H., Nissinen, A. & Tuomilehto, J. (2004). Low physical activity as a predictor for total and cardiovascular disease mortality in middle-aged men and women in Finland. *European Heart Journal*, *25*(24), 2204–2211. https://doi.org/10.1016/j.ehj.2004.10.014

Barker, F., Mackenzie, E., Elliott, L., Jones, S., & De Lusignan, S. (2014). Interventions to improve hearing aid use in adult auditory rehabilitation (Review). *Cochrane Database of Systematic Reviews*, (8), CD010342. https://doi.org/10.1002/14651858.CD010342.pub2.www.cochranelibrary.com

Bauman, A., Milton, K., Kariuki, M., Fedel, K., & Lewicka, M. (2017). Is there sufficient evidence regarding signage-based stair use interventions? A sequential meta-Analysis. *BMJ Open*, *7*(11), 1–8. https://doi.org/10.1136/bmjopen-2016-012459

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F., & Martin, B. W. (2012).

Correlates of physical activity: Why are some people physically active and others not? *The Lancet*, *380*(9838), 258–271. https://doi.org/10.1016/S0140-6736(12)60735-1

BeBastiani, S.D., Carroll, D.D., Cunnigham, M., Lee, S. & Fulton, J. (2014). Knowledge of the Adult and Youth 2008 Physical Activity Guidelines for Americans. *Journal of Physical Activity and Health*, *11*, 495–501. https://doi.org/10.1249/01.mss.0000536583.73943.e9

Beenstock, J., Sniehotta, F. F., White, M., Bell, R., Milne, E. M. G., & Araujo-soares, V. (2012). What helps and hinders midwives in engaging with pregnant women about stopping smoking ? A cross-sectional survey of perceived implementation difficulties among midwives in the North East of England. *Implementation Science*, *7*, 36. Retrieved from http://download.springer.com/static/pdf/725/art%253A10.1186%252F1748-5908-7-36.pdf?originUrl=http%3A%2F%2Fimplementationscience.biomedcentral.com%2Farticle%2F10.1186%2F1748-5908-7-36&token2=exp=1489509486~acl=%2Fstatic%2Fpdf%2F725%2Fart%25253A10.1186%2525

Belanger-Gravel, A., Godin, G. & Amireault, S. (2011). A meta-analytic review of the effect of implementation intentions on physical activity. *Health Psychology Review*, 1–32. https://doi.org/10.1080/17437199.2011.560095

Bélanger-Gravel, A., Godin, G., Bilodeau, A., & Poirier, P. (2013). The effect of implementation intentions on physical activity among obese older adults: A randomised control study. *Psychology and Health*, *28*(2), 217–233. https://doi.org/10.1080/08870446.2012.723711

Bellicha, A., Kieusseian, A., Fontvieille, A. M., Tataranni, A., Charreire, H., & Oppert, J. M. (2015). Stair-use interventions in worksites and public settings - A systematic review of effectiveness and external validity. *Preventive Medicine*, *70*, 3–13. https://doi.org/10.1016/j.ypmed.2014.11.001

Bennett, G. G., Wolin, K. Y., Puleo, E. M., Mâsse, L. C., & Atienza, A. A. (2009). Awareness of national physical activity recommendations for health promotion among US adults. *Medicine and Science in Sports and Exercise*, *41*(10), 1849–1855. https://doi.org/10.1249/MSS.0b013e3181a52100

Berlin, J.A. & Colditz, G. A. (1990). A Meta-Analysis of Physical Activity in the Prevention of Coronary Heart Disease. *American Journal of Epidemiology*, *132*(4), 612–628. https://doi.org/10.1093/oxfordjournals.aje.a115704

Berman, E. (2017). An Exploratory Sequential Mixed Methods Approach to Understanding Researchers' Data Management Practices at UVM: Integrated Findings to Develop Research Data Services. *Journal of EScience Librarianship*, *6*(1), e1104. https://doi.org/10.7191/jeslib.2017.1104

Bernard, H. R. (2002). *Research methods in anthropology: Qualitative and quantitative approaches* (3rd ed.). Walnut Creek, CA: Alta Mira Press.

Bethancourt, H. J., Rosenberg, D. E., Beatty, T., & Arterburn, D. E. (2014). Barriers to and Facilitators of Physical Activity Program Use Among Older Adults. *Clinical Medicine & Research*, *12*(1–2), 10–20. https://doi.org/10.3121/cmr.2013.1171

Biddle, S.J., Gorely, T., Marshall, S.J., Murdey, I. & Cameron, N. (2004). Physical activity and sedentary behaviours in youth: issues and controversies. *The Journal of the Royal Society for the Promotion of Health*, *124*(1), 29–33. https://doi.org/10.1177/146642400312400110

Biddle, SJ., Gorely, T. & Stensel, D. J. (2004). Health-enhancing physical activity and sedentary behaviour in children and adolescents. *Journal of Sports Sciences, 22*(8), 679–701.

Bize, R., Johnson, J.A. & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine*, *45*(6), 401–415. https://doi.org/10.1016/j.ypmed.2007.07.017

Blaikie, N. (2000). *Designing Social Research: the Logic of Anticipationtle*. Cambridge: Polity Press.

Blair, J., Czaja, R.F. & Blair, E. A. (2014). *Designing surveys: a guide to decisions and procedures* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Blake, R. L. (1989). Integrating quantitative and qualitative methods in family research. *Family Systems Medicine, 7*(4), 411–427. https://doi.org/10.1037/h0089788

Blake, H., & Gartshore, E. (2016). Workplace wellness using online learning tools in a healthcare setting. *Nurse Education in Practice*, *20*, 70–75. https://doi.org/10.1016/j.nepr.2016.07.001

Blake, H., Lee, S., Stanton, T., & Gorely, T. (2008). Workplace intervention to promote stair-use in an NHS setting. *International Journal of Workplace Health Management*, *1*(3), 162–175. https://doi.org/10.1108/17538350810926525

Bland, J.M. & Altman, D. G. (1997). Statistics notes: Cronbach's alpha. *BMJ*, *314,* 572. Retrieved from https://www.bmj.com/content/bmj/314/7080/572.full.pdf

Blaxter, L., Hughes, C. & Tight, M. (2006). *How to research* (3rd ed.). New York: Maidenhead Open University Press.

Blumberg, B., Cooper, D. R., & Schindler, P. S. (2005). *Business Research Methods.* Berkshire: McGrawHill Education.

Bonevski, B., Guillaumier, A., Paul, C., & Walsh, R. (2013). The vocational education setting for health promotion: A survey of students' health risk behaviours and preferences for help. *Health Promotion Journal of Australia*, *24*(3), 185–191. https://doi.org/10.1071/HE13047

Booth, F. W., Roberts, C. K., & Laye, M. J. (2012). Lack of exercise is a major cause of chronic diseases. *Comprehensive Physiology*, *2*(2), 1143–1211. https://doi.org/10.1002/cphy.c110025.Lack

Bopp, M., Bopp, C., & Schuchert, M. (2015). Active Transportation to and on Campus Is Associated with Objectively Measured Fitness Outcomes among College Students. *Journal of Physical Activity and Health*, *12*(3), 418–423. https://doi.org/10.1123/jpah.2013-0332

Bopp, M., Kaczynski, A., & Wittman, P. (2011). Active commuting patterns at a large, midwestern college campus. *Journal of American College Health*, *59*(7), 605–611. https://doi.org/10.1080/07448481.2010.518327

Bopp, M., Sims, D., Matthews, S. A., Rovniak, L. S., Poole, E., & Colgan, J. (2016). There′s an app for that: development of a smartphone app to promote active travel to a college campus. *Journal of Transport and Health*, *3*(3), 305–314. https://doi.org/10.1016/j.jth.2016.02.007

Bopp, M., Sims, D., Matthews, S. A., Rovniak, L. S., Poole, E., & Colgan, J. (2018). Development, Implementation, and Evaluation of Active Lions: A Campaign to Promote Active Travel to a University Campus. *American Journal of Health Promotion*, *32*(3), 536–545. https://doi.org/10.1177/0890117117694287

Borrelli, B. (2011). The assessment, monitoring, and enhancement of treatment fidelity in publich health clinical trials. *J Ournal of Public Health Dentistry*, *71*(Suppl 1), S52–S63. https://doi.org/10.1111/j.1752-7325.2011.00233.x.The

Boulé, N.G., Haddad, E., Kenny, G.P., Wells, G.A. & Sigal, R. J. (2001). Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *The Journal of the American Medical Association*, *286*(10), 1218–1227.

Boutelle, K. N., Jeffery, R. W., Murray, D. M., & Schmitz, M. K. H. (2004). Using Signs , Artwork , and Music to Promote Stair Use in a Public Building. *American Journal of Public Health*, *91*(12), 2004–2006. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446922/pdf/0912004.pdf

Boyle, J., Mattern, C. O., Lassiter, J. W., & Ritzler, J. A. (2011). Peer 2 Peer: Efficacy of a Course-Based Peer Activity among College Students. *Journal of American College Health*, *59*(6), 519–530. https://doi.org/10.1080/07448481.2010.523854

Bray, S. R., Beauchamp, M. R., Latimer, A. E., Hoar, S. D., Shields, A., & Bruner, M. W. (2011). Effects of a Print-mediated Intervention on Physical Activity during Transition to the First Year of University Effects of a Print-mediated Intervention on Physical Activity during Transition to the First Year of University. *Behavioral Medicine*, *37*, 60–69. https://doi.org/10.1080/08964289.2011.571306

Brennan, L. K., Baker, E. A., Haire-Joshu, D., & Brownson, R. C. (2003). Linking Perceptions of the Community to Behavior: Are Protective Social Factors Associated with Physical Activity? *Health Education & Behavior*, *30*(6), 740–755. https://doi.org/10.1177/1090198103255375

Brett, C. E., & Pires-Yfantouda, R. (2017). Enhancing participation in a national pedometer-based workplace intervention amongst staff at a Scottish university. *International Journal of Health Promotion and Education*, *55*(4), 215–228. https://doi.org/10.1080/14635240.2017.1329632

Bridle, C., Riemsma, R. P., Pattenden, J., Sowden, A. J., Mather, L., Watt, I. S., & Walker, A. (2005). Systematic review of the effectiveness of health behavior interventions based on the transtheoretical model. *Psychology and Health*, *20*(3), 283–301. https://doi.org/10.1080/08870440512331333997

British Heart Foundation. (2017). Physical inactivity and sedentary behaviour report 2017. In *British Heart Foundation*. Retrieved from file:///C:/Users/STF2408/Downloads/physical-inactivity-report---mymarathon-final (1).pdf

Brockman, R., & Fox, K. R. (2011). Physical activity by stealth? The potential health benefits of a workplace transport plan. *Public Health*, *125*(4), 210–216. https://doi.org/10.1016/j.puhe.2011.01.005

Brooks, J., & King, N. (2014). Doing Template Analysis : Evaluating an end-of life care service. *SAGE Research Methods Cases*, 1–20. https://doi.org/http://dx.doi.org/10.4135/978144627305013512755

Brooks, J., McCluskey, S., Turley, E., & King, N. (2015). The Utility of Template Analysis in Qualitative Psychology Research. *Qualitative Research in Psychology*, *12*(February 2015), 202–222. https://doi.org/10.1080/14780887.2014.955224

Brown, D. K., Barton, J. L., Pretty, J., & Gladwell, V. F. (2014). Walks4Work: assessing the role of the natural environment in a workplace physical activity intervention. *Scandinavian Journal of Work, Environment & Health*, *40*(4), 390–399. https://doi.org/10.5271/sjweh.3421

Brown, W., Bauman, A., Bull, F., & Burton, N. (2012). *Development of evidence-based physical activity recommendations for adults (18-64 years)*. Retrieved from https://www1.health.gov.au/internet/main/publishing.nsf/content/F01F92328EDADA5BCA257BF0001E720D/$File/DEB-PAR-Adults-18-64years.pdf

Brown, D.M.Y., Bray, S.R., Beatty, K.R., & Kwan, M. Y. W. (2014). Healthy Active Living: A Residence Community–Based Intervention to Increase Physical Activity and Healthy Eating During the Transition to First-Year University. *Journal of American College Health*, *62*(4), 234–242. https://doi.org/10.1080/07448481.2014.887572

Brown, H. E., Gilson, N. D., Burton, N. W., & Brown, W. J. (2011). Does physical activity impact on presenteeism and other indicators of workplace well-being? *Sports Medicine*, *41*(3), 249–262. https://doi.org/10.2165/11539180-000000000-00000

Brown, J.C., Winters-Stone, K. Lee, A. & Schmitz, K. H. (2012). Cancer, Physycl Activity, and Exercise. *Comprehensive Physiology*, *2*(4), 2775–2809. https://doi.org/10.1002/cphy.c120005.Cancer

Broyles, S. T., Mowen, A. J., Theall, K. P., Gustat, J., & Rung, A. L. (2011). Integrating social capital into a park-use and active-living framework. *American Journal of Preventive Medicine*, *40*(5), 522–529. https://doi.org/10.1016/j.amepre.2010.12.028

Brug, J., Oenema, A., & Ferreira, I. (2005). Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. *International Journal of Behavioral Nutrition and Physical Activity*, *2*(1), 2. https://doi.org/10.1186/1479-5868-2-2

Bucksch, J., & Helmert, U. (2004). Leisure time sports activity and all-cause mortality in West Germany (1984-1998). *Journal of Public Health*, *12*(6), 351–358. https://doi.org/10.1007/s10389-004-0069-7

Budden, J. S., & Sagarin, B. J. (2007). Implementation Intentions , Occupational Stress , and the Exercise Intention – Behavior Relationship. *Journal of Occupational Health Psychology*, *12*(4), 391–401. https://doi.org/10.1037/1076-8998.12.4.391

Bull, F. C., Maslin, T. S., & Armstrong, T. (2009). Global Physical Activity Questionnaire (GPAQ): Nine Country Reliability and Validity Study. *Journal of Physical Activity and Health*, *6*, 790–804. https://doi.org/10.1123/jpah.6.6.790

Burmeister, E., & Aitken, L. M. (2012). Sample size: How many is enough? *Australian*

Critical Care, *25*(4), 271–274. https://doi.org/10.1016/j.aucc.2012.07.002

Burrell, G. and Morgan, G. (2016). *Sociological Paradigms and Organisational Analysis.* Abingdon: Routledge.

Burrows, E., O'Mahony, M., & Geraghty, D. (2018). How urban parks offer opportunities for physical activity in Dublin, Ireland. *International Journal of Environmental Research and Public Health*, *15*(4). https://doi.org/10.3390/ijerph15040815

Bussières, A. E., Patey, A. M., Francis, J. J., Sales, A. E., & Grimshaw, J. M. (2012). Identifying factors likely to influence compliance with diagnostic imaging guideline recommendations for spine disorders among chiropractors in North America: a focus group study using the Theoretical Domains Framework. *Implementation Science*, *7*, 82. https://doi.org/10.1186/1748-5908-7-82

Butler, C.E., Clark, B.R., Burlis, T.L., Castillo, J.C. & Racette, S. B. (2015). Physical activity for campus employees: a university worksite wellness program. *Journal of Physical Activity and Health*, *12*(4), 470–476. https://doi.org/10.1123/jpah.2013-0185.Physical

Byrne, P. O. (2011). Health Research The Advantages and Disadvantages of Mixing Methods : An Analysis of Combining Traditional and Autoethnographic Approaches. *Qualitative Health Research*, 1381–1391. https://doi.org/10.1177/1049732307308304

Cagnie, B., Danneels, L., Van Tiggelen, D., De Loose, V., & Cambier, D. (2007). Individual and work related risk factors for neck pain among office workers: A cross sectional study. *European Spine Journal*, *16*(5), 679–686. https://doi.org/10.1007/s00586-006-0269-7

Cameron, C., Craig, C. L., Bull, F. C., & Bauman, A. (2007). Canada's physical activity guides: has their release had an impact?This article is part of a supplement entitled <i>Advancing physical activity measurement and guidelines in Canada: a scientific review and evidence-based foundation for the future of Canad. *Applied Physiology, Nutrition, and Metabolism*, *32*(S2E), S161-169. https://doi.org/10.1139/H07-106

Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A. L., Sandercock, P., Spiegelhalter, D., & Tyrer, P. (2000). Framework for design and evaluation of complex interventions to improve health Framework for trials of complex interventions. *British Medical Journal*, *321*(7262), 694–696. https://doi.org/10.1136/bmj.321.7262.694

Campbell, N. C., Murray, E., Darbyshire, J., Emery, J., Farmer, A., Griffiths, F., … Kinmonth, A. L. (2007). Designing and evaluating complex interventions to improve health care. *British Medical Journal*, *334*(7591), 455–459. https://doi.org/10.1136/bmj.39108.379965.BE

Can, S., & Karaca, A. (2019). Determination of musculoskeletal system pain, physical activity intensity, and prolonged sitting of university students using smartphone. *Biomedical Human Kinetics*, *11*(1), 28–35. https://doi.org/10.2478/bhk-2019-0004

Cancelliere, C., Cassidy, J. D., Ammendolia, C., & Côté, P. (2011). Are workplace health promotion programs effective at improving presenteeism in workers? a systematic review and best evidence synthesis of the literature. *BMC Public Health*, *11*(395), 1–11. https://doi.org/10.1186/1471-2458-11-395

Cancer Research UK. (2016). How physical activity prevents cancer. Retrieved January 18, 2018, from Cancer Research UK website: http://www.cancerresearchuk.org/about-cancer/causes-of-cancer/physical-activity-and-cancer/how-physical-activity-prevents-cancer

Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science : IS*, *7*(1), 37. https://doi.org/10.1186/1748-5908-7-37

Carey, R. N., Connell, L. E., Johnston, M., Rothman, A. J., De Bruin, M., Kelly, M. P., & Michie, S. (2019). Behavior Change Techniques and Their Mechanisms of Action: A Synthesis of Links Described in Published Intervention Literature. *Annals of Behavioral Medicine*, *53*(8), 693–707. https://doi.org/10.1093/abm/kay078

Carr, L. T. (1994). The strengths and weaknesses of quantitative and qualitative research: what method for nursing? *Journal of Advanced Nursing*, *20*, 716–721. Retrieved from https://pdfs.semanticscholar.org/a87b/ce9f2d5fe771005a2890c92da2cff8a03b32.pdf

Cassidy, C., Bishop, A., Steenbeek, A., Langille, D., Martin-Misener, R., & Curran, J. (2018). Barriers and enablers to sexual health service use among university students: A qualitative descriptive study using the Theoretical Domains Framework and COM-B model. *BMC Health Services Research*, *18*(1), 1–12. https://doi.org/10.1186/s12913-018-3379-0

Castelli, D. M., Glowacki, E., Barcelona, J. M., Clvert, H. G., & Hwang, J. (2015). Active education: Growing evidence on physical activity and academic performance. Retrieved September 2, 2020, from Active Living Research website: https://www.activeme360.com/wp-content/uploads/ALR_Brief_ActiveEducation_Jan2015.pdf

Cavallo, D. N., Tate, D. F., Ries, A. V., Brown, J. D., DeVellis, R. F., & Ammerman, A. S. (2012). A Social Media–Based Physical Activity Intervention. *American Journal of Preventive Medicine*, *43*(5), 527–532. https://doi.org/10.1016/j.amepre.2012.07.019

Celis-Morales, C. A., Perez-Bravo, F., Ibañez, L., Salas, C., Bailey, M. E. S., & Gill, J. M. R. (2012). Objective vs. self-reported physical activity and sedentary time: Effects of measurement method on relationships with risk biomarkers. *PLoS ONE*, *7*(5), e36345. https://doi.org/10.1371/journal.pone.0036345

Centers for Disease Control and Prevention. (2010). *Promoting physical activity: A guide for community action* (2nd ed.). Champaign, IL: Human Kinetics Publishers, Inc.

Centers for Disease Control and Prevention. (2017). Overcoming Barriers To Physical Activity. https://doi.org/10.1249/fit.0b013e318201c8ee

Chaiken, S. (1980). Heuristic versus systematic information processing and the use of source versus message cues in persuasion. *Journal of Personality and Social Psychology*, *39*(5), 752–766. https://doi.org/10.1037//0022-3514.39.5.752

Chakrabartty, S. N. (2013). Best Split-Half and Maximum Reliability. *IOSR Journal of Research & Method in Education (IOSRJRME)*, *3*(1), 01–08. https://doi.org/10.9790/7388-0310108

Chan, C. B., & Ryan, D. A. (2009). Assessing the effects of weather conditions on physical activity participation using objective measures. *International Journal of Environmental Research and Public Health*, *6*(10), 2639–2654. https://doi.org/10.3390/ijerph6102639

Chan, L. L. Y., Wong, A. Y. L., Wang, M. H., Cheung, K., & Samartzis, D. (2020). The prevalence of neck pain and associated risk factors among undergraduate students: A large-scale cross-sectional study. *International Journal of Industrial Ergonomics*, *76*, 102934. https://doi.org/10.1016/j.ergon.2020.102934

Chatzisarantis, N.L.D. & Hagger, M. S. (2008). The Effects of Self-Discordance, Self-Concordance, and Implementation Intentions on Health Behavior. *Journal of Applied Biobehavioral Research*, *13*(4), 198–214.

Chau, J. Y., Daley, M., Dunn, S., Srinivasan, A., Do, A., Bauman, A. E., & van der Ploeg, H. P. (2014). The effectiveness of sit-stand workstations for changing office workers' sitting time: results from the Stand@Work randomized controlled trial pilot. *The International Journal of Behavioral Nutrition and Physical Activity*, *11*, 127. https://doi.org/10.1186/s12966-014-0127-7

Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., Krystal, J. H., & Chekroud, A. M. (2018). Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: a cross-sectional study. *The Lancet Psychiatry*, *5*(9), 739–746. https://doi.org/10.1016/S2215-0366(18)30227-X

Choi, J., Kang, K., Kim, J.S. & Oh, B. (2016). Effects of Three-Week Stair Climbing Exercise for Weight Control :A case Series Study. *The Korean Society of Sports Medicine*, *34*(2), 185–189.

Chu, A. H. Y., Ng, S. H. X., Koh, D., Müller-Riemenschneider, F., & Brucki, S. (2015). Reliability and validity of the self- and interviewer-administered versions of the Global Physical Activity Questionnaire (GPAQ). *PLoS ONE*, *10*(9), 1–18. https://doi.org/10.1371/journal.pone.0136944

Chuang, O. L. (2009). Gender differences in sport participation, sport enjoyment and self-perceptions. *Journal of Physical Education*, *11*, 27–37.

Çiçek, G. (2018). Quality of life and physical activity among university students. *Universal Journal of Educational Research*, *6*(6), 1141–1148. https://doi.org/10.13189/ujer.2018.060602

Claxton, D. & Wells, G. M. (2009). The effect of physical activity homework on physical activity among college students. *Journal of Physical Activity and Health*, *6*(2), 203–210.

Cleland, C.L., Hunter, R.F., Kee, F., Cupples, M.E., Sallis, J.F. & Tully, M. A. (2014). Validity of the Global Physical Activity Questionnaire (GPAQ) in assessing levels and change in moderate-vigorous physical activity and sedentary behaviour. *BMC Public Health*, *14*, 1255–1266. https://doi.org/10.1186/1471-2458-14-1255

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Routledge Academic.

Coleman, K. J., & Gonzalez, E. C. (2001). Promoting Stair Use in a US – Mexico Border Community. *American Journal of Public Health*, *91*(12), 2007–2009. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446923/pdf/0912007.pdf

Compernolle, S., Desmet, A., Poppe, L., Crombez, G., De Bourdeaudhuij, I., Cardon, G., … Van Dyck, D. (2019). Effectiveness of interventions using self-monitoring to reduce sedentary behavior in adults: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1). https://doi.org/10.1186/s12966-019-0824-3

Conn, V. S., Hafdahl, A. R., Cooper, P. S., Brown, L. M., & Lusk, S. L. (2009). Meta-Analysis of Workplace Physical Activity Interventions. *American Journal of Preventive Medicine*, Vol. 37, pp. 330–339. https://doi.org/10.1016/j.amepre.2009.06.008

Conn, V. S., Valentine, J. C., & Cooper, H. M. (2002). Interventions to increase physical activity among aging adults: A meta-analysis. *Annals of Behavioral Medicine*, *24*(3), 190–200. https://doi.org/10.1207/S15324796ABM2403_04

Conner, M., Sandberg, T. & Norman, P. (2010). Using Action Planning to Promote Exercise Behavior. *Annals of Behavioral Medicine*, *40*(1), 65–76. https://doi.org/10.1007/s12160-010-9190-8

Connolly, P. (2007). *Quantitative data analysis in education: A critical introduction using SPSS*. London & New York, NY: Routledge.

Conroy, D.E., Elavsky, S., Hyde, A.L. & Doerksen, S. E. (2011). The Dynamic Nature of Physical Activity Intentions: A WithinPerson Perspective on Intention-Behavior Coupling. *Journal of Sports and Exercise Psychology*, *33*(6), 807–827. https://doi.org/10.1038/jid.2014.371

Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in web-or internet-based surveys. *Educational and Psychological Measurement*, *60*(6), 821–836. https://doi.org/10.1177/00131640021970934

Cooke, R., Dahdah, M., Norman, P., & French, D. P. (2016). How well does the theory of planned behaviour predict alcohol consumption? A systematic review and meta-analysis. *Health Psychology Review*, *10*(2), 148–167. https://doi.org/10.1080/17437199.2014.947547

Coolbaugh, C. L., Raymond Jr, S. C., & Hawkins, D. A. (2015). Feasibility of a Dynamic Web Guidance Approach for Personalized Physical Activity Prescription Based on Daily Information From Wearable Technology. *JMIR Research Protocols*, *4*(2), e67. https://doi.org/10.2196/resprot.3966

Cooper, K., & Barton, G. C. (2015). An exploration of physical activity and wellbeing in university employees. *Perspectives in Public Health*, *136*(3), 152–160. https://doi.org/10.1177/1757913915593103

Corti, L., Day, A. & Backhouse, G. (2000). Confidentiality and Informed Consent: Issues for Consideration in the Preservation of and Provision of Access to Qualitative Data Archives. *Forum: Qualitative Social Research*, *1*(3), Art. 7. Retrieved from http://nbn-resolving.de/urn:nbn:de:0114-fqs000372

Costello, E., Leone, J. E., Ellzy, M., & Miller, T. A. (2013). Older adult perceptions of the physicians' role in promoting physical activity. *Disability and Rehabilitation*, *35*(14), 1191–1198. https://doi.org/10.3109/09638288.2012.726314

Coulson, M. (2011). *The Complete Guide to Teaching Exercise to Special Populations*. London: Bloomsbury Publishing Plc.

Courneya, K. S., & McAuley, E. (1993). Predicting Physical Activity from Intention: Conceptual and Methodological Issues. *Journal of Sport and Exercise Psychology*, *15*(1), 50–62. https://doi.org/10.1123/jsep.15.1.50

Cox, K. L., Burke, V., Gorely, T. J., Beilin, L. J., & Puddey, I. B. (2003). Controlled comparison of retention and adherence in home- vs center-initiated exercise interventions in women ages 40-65 years: The S.W.E.A.T. Study (Sedentary Women Exercise Adherence Trial). *Preventive Medicine*, *36*(1), 17–29. https://doi.org/10.1006/pmed.2002.1134

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *Bmj Clinical Research Ed.*, *337*(September), a1655. https://doi.org/10.1136/bmj.a1655

Cresswell, J.W. & Plano Clark, V. L. (2011). *Designing and conducting mixed method research* (2nd ed.). Thousand Oaks, CA: Sage.

Creswell, J.W. & Plano Clark, V. L. (2018). *Designing and Conducting Mixed Methods Research* (3rd ed.; C. Thousand Oaks, Ed.). Sage Publications Ltd.

Crombie, A. P., Ilich, J. Z., Dutton, G. R., Panton, L. B., & Abood, D. A. (2009). The freshman weight gain phenomenon revisited. *Nutrition Reviews*, *67*(2), 83–94. https://doi.org/10.1111/j.1753-4887.2008.00143.x

Crotty, M. (1998). *The Foundations of Social Research*. London: Sage.

Crutzen, R., & Göritz, A. S. (2011). Does social desirability compromise self-reports of physical activity in web-based research? *International Journal of Behavioral Nutrition and Physical Activity*, *8*, 31. https://doi.org/10.1186/1479-5868-8-31

Cruwys, T., Haslam, S. A., Fox, N. E., & McMahon, H. (2015). "That's not what we do": Evidence that normative change is a mechanism of action in group interventions. *Behaviour Research and Therapy*, *65*, 11–17. https://doi.org/10.1016/j.brat.2014.12.003

Curran, J. A., Brehaut, J., Patey, A. M., Osmond, M., Stiell, I., & Grimshaw, J. M. (2013). Understanding the Canadian adult CT head rule trial: use of the theoretical domains framework for process evaluation. *Implementation Science*, *8*(1), 25. https://doi.org/10.1186/1748-5908-8-25

Curtis, K. E., Lahiri, S., & Brown, K. E. (2015). Targeting Parents for Childhood Weight Management: Development of a Theory-Driven and User-Centered Healthy Eating App. *JMIR MHealth and UHealth*, *3*(2), e69. https://doi.org/10.2196/mhealth.3857

Das, B. M., Rinaldi-Miles, A. I., & Evans, E. M. (2013). Exploring Faculty and Staff PA Barriers at a Large University. *Californian Journal of Health Promotion*, *11*(2), 61–72.

Das, B. M., Sartore-Baldwin, M., & Mahar, M. T. (2016). The Invisible Employee: University Housekeeping Employees' Perceptions of Physical Activity. *Journal of Physical Activity and Health*, *13*(9), 952–956. https://doi.org/10.1123/jpah.2015-0509

Daskapan, A., Tuzun, E. H. E., Eker, L., Arzu, D., Tuzun, E. H. E., Eker, L., … Eker, L. (2006). Perceived barriers to physical activity in university students. *Journal of Sports Science and Medicine*, *5*, 615–620. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3861763/

Datt, S. (2016). 8-step procedure to conduct qualitative content analysis in a research. Retrieved March 6, 2019, from Project Guru website: https://www.projectguru.in/publications/qualitative-content-analysis-research/

David, D.V. & Mackintosh, B. (2011). *Making a difference: Australian International Education.* Sydney: University of New South Wales Press.

Davidson, K. W., Goldstein, M., Kaplan, R. M., Kaufmann, P. G., Knatterud, G. L., Orleans, C. T., … Whitlock, E. P. (2003). Evidence-based behavioral medicine: what is it and how do we achieve it? *Annals Of Behavioral Medicine: A Publication Of The Society Of Behavioral Medicine*, *26*(3), 161–171. https://doi.org/10.1207/S15324796ABM2603_01

Davies, D. S. C., Atherton, F., McBride, M., & Calderwood, C. (2019). UK Chief Medical Officers ' Physical Activity Guidelines. In *Department of Health and Social Care*. Retrieved from https://www.gov.uk/government/publications/physical-activity-guidelines-uk-chief-medical-officers-report

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. *Health Psychology Review*, *9*(3), 323–344. https://doi.org/10.1080/17437199.2014.941722

Dayi, A., Acikgoz, A., Guvendi, G., Bayrak, L., Ersoy, B., Gur, C., & Ozmen, O. (2017). Determination of Factors Affecting Physical Activity Status of University Students on a Health Sciences Campus. *Medical Science Monitor*, *23*, 325–334. https://doi.org/10.12659/MSM.899816

De Carlo, M. (2018). *Scientific Inquiry in Social Work*. Open Social Work Education.

De Cocker, K. a, De Bourdeaudhuij, I. M., & Cardon, G. M. (2009). What do pedometer counts represent? A comparison between pedometer data and data from four different questionnaires. *Public Health Nutrition*, *12*(1), 74–81. https://doi.org/10.1017/S1368980008001973

de Sousa, T. F., Fonseca, S. A., & Barbosa, A. R. (2013). Perceived barriers by university students in relation the leisure-time physical activity. *Brazilian Journal of Kinanthropometry and Human Performance*, *15*(2), 164–173. https://doi.org/10.5007/1980-0037.2013v15n2p164

Debono, D., Taylor, N., Lipworth, W., Greenfield, D., Travaglia, J., Black, D., & Braithwaite, J. (2017). Applying the Theoretical Domains Framework to identify barriers and targeted interventions to enhance nurses' use of electronic medication management systems in two Australian hospitals. *Implementation Science*, *12*(1), 42. https://doi.org/10.1186/s13012-017-0572-1

Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behaviour*. New York: Plenum.

Deci, E.L. & Ryan, R. M. (2004). RM 4 – FM : Motivation for Physical Activity and Exercise / Working Out — Questionnaires *. Retrieved September 6, 2017, from Deci, E.L. & Ryan, R.M website: https://www.edu.gov.mb.ca/k12/cur/physhlth/frame_found_gr11/rm/4_fm.pdf

Deliens, T., Deforche, B., De Bourdeaudhuij, I., & Clarys, P. (2015). Determinants of physical activity and sedentary behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health*, *15*(1), 201. https://doi.org/10.1186/s12889-015-1553-4

Denzin, N. K., & Lincoln, Y. S. (1998). *The landscape of qualitative research: Theories and issues*. London: SAGE Publications.

Denzin, N.K. & Lincoln, Y. S. (2000). *Handbook of Qualitative Research* (2nd ed).

Thousand Oaks, CA: Sage Publications Inc.

Denzin, N. K., & Lincoln, Y. S. (2002). *The qualitative inquiry reader*. London: Sage Publications.

Department for Digital, Culture, Media and Sport. (2015). Sporting Future: A new strategy for an active nation. In *Departament of Education and Skills*. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486622/Sporting_Future_ACCESSIBLE.pdf

Department for Digital, Culture, Media and Sport. (2018). Data Protection Act 2018. Retrieved October 2, 2019, from Department for Digital, Culture, Media and Sport website: https://www.gov.uk/government/collections/data-protection-act-2018

Department of Health. (2011a). Physical activity quidelines for adults (19-64 years). Retrieved November 11, 2017, from Department of Health website: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213740/dh_128145.pdf

Department of Health. (2011b). Start Active , Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers. In *Department of Health, Physical Activity, Health Improvement and Protection*. Retrieved from https://www.sportengland.org/media/2928/dh_128210.pdf

Deutskens, E., De Ruyter, K., Wetzels, M. & 0sterveld, P. (2004). Corruption and unethical behavior: report on a set of Danish guidelines. *Marketing Letters*, *51*(1), 21–36. https://doi.org/10.1023/B

DeVellis, R. (2003). *Scale development: theory and applications: theory and application*. Thousand Oaks: Sage.

Diabetes Prevention Program Research Group. (2002). Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *New England Journal of Medicine*, *346*(6), 393–403. https://doi.org/10.1056/NEJMoa012512

Diabetes UK. (2019). Managing blood glucose: Guide to HbA1c. Retrieved January 8, 2020, from Diabetes UK website: https://www.diabetes.co.uk/what-is-hba1c.html

Dikko, M. (2016). Establishing Construct Validity and Reliability: Pilot Testing of a Qualitative Interview for Research in Takaful (Islamic Insurance). *Qualitative Report*, *21*(3), 521–528. Retrieved from http://nsuworks.nova.edu/tqr

Ding, D., Kolbe-Alexander, T., Nguyen, B., Katzmarzyk, P. T., Pratt, M., & Lawson, K. D. (2017). The economic burden of physical inactivity: A systematic review and critical appraisal. *British Journal of Sports Medicine*. https://doi.org/10.1136/bjsports-2016-097385

Dishman, R. K., DeJoy, D. M., Wilson, M. G., & Vandenberg, R. J. (2009). Move to Improve. A Randomized Workplace Trial to Increase Physical Activity. *American Journal of Preventive Medicine*, *36*(2), 133–141. https://doi.org/10.1016/j.amepre.2008.09.038

Dishman, R. K., Renner, K. J., Youngstedt, S. D., Reigle, T. G., Bunnell, B. N., Burke, K. A., … Meyerhoff, J. L. (1997). Activity wheel running reduces escape latency and alters brain monoamine levels after footshock. *Brain Research Bulletin*, *42*(5), 399–406. https://doi.org/10.1016/S0361-9230(96)00329-2

Dobson, P. J. (2001). The Philosophy of Critical Realism--An Opportunity for Information Systems Research. *Information Systems Frontiers*, *3*(2), 199. https://doi.org/10.1023/A:1011495424958

Dombrowski, S. U., Sniehotta, F. F., & Avenell, A. (2007). Current issues and future directions in Psychology and Health : Towards a cumulative science of behaviour change: Do current conduct and reporting of behavioural interventions fall short of best practice? *Psychology & Health*, *22*(8), 869–874. https://doi.org/10.1080/08870440701520973

Dombrowski, S. U., Sniehotta, F. F., Avenell, A., Johnston, M., MacLennan, G., & Araújo-Soares, V. (2012). Identifying active ingredients in complex behavioural interventions for obese adults with obesity-related co-morbidities or additional risk factors for co-morbidities: a systematic review. *Health Psychology Review*, *6*(1), 7–32. https://doi.org/10.1080/17437199.2010.513298

Donaldson-Feilder, E., Lewis, R., Pavey, L., Jones, B., Green, M., & Webster, A. (2017). Perceived barriers and facilitators of exercise and healthy dietary choices: A study of employees and managers within a large transport organisation. *Health Education Journal*, *76*(6), 661–675. https://doi.org/10.1177/0017896917712296

Dooris, M. (2006). Healthy settings: Challenges to generating evidence of effectiveness. *Health Promotion International*, *21*(1), 55–65. https://doi.org/10.1093/heapro/dai030

Dooris, M. (2009). Holistic and sustainable health improvement: The contribution of the settings-based approach to health promotion. *Perspectives in Public Health*, *129*(1), 29–36. https://doi.org/10.1177/1757913908098881

Dörnyei, Z. (2007). *Research methods in applied linguistics.* New York: Oxford University Press.

Driscoll, D., Appiah-Yeboah, A., Salib, P., & Rupert, D. (2007). Merging Qualitative and Quantitative Reasoning. *Ecological and Environmental Anthropology*, *3*(1), 18–28. https://doi.org/10.1016/j.jocn.2003.11.015

Drost, E. A. (2011). Validity and Reliability in Social Science Research. *Education Research and Perspectives*, *38*(1), 105–123. Retrieved from https://www3.nd.edu/~ggoertz/sgameth/Drost2011.pdf

Dugdill, L., Brettle, A., Hulme, C., Mccluskey, S., & Long, A. F. (2008). Workplace physical activity interventions: A systematic review. *International Journal of Workplace Health Management*, *1*(1), 20–40. https://doi.org/10.1108/17538350810865578

Duncan, E. M., Francis, J. J., Johnston, M., Davey, P., Maxwell, S., McKay, G. a, … Bond, C. (2012). Learning curves, taking instructions, and patient safety: using a theoretical domains framework in an interview study to investigate prescribing errors among trainee doctors. *Implementation Science*, *7*, 86. https://doi.org/10.1186/1748-5908-7-86

Dunn, A. L., Trivedi, M. H., & O'Neal, H. A. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. *Med Sci Sports Exerc*, *33*. https://doi.org/10.1097/00005768-200106001-00027

Dunstan, D.W., Thorp, A.A. & Healy, G. N. (2011). Prolonged sitting: is it a distinct coronary heart disease risk factor? *Current Opinion in Cardiology*, *26*(5), 412–419. https://doi.org/10.1097/HCO.0b013e3283496605

Dyson, J., Lawton, R., Jackson, C., & Cheater, F. (2011). Does the use of a theoretical approach tell us more about hand hygiene behaviour? The barriers and levers to hand hygiene. *Journal of Infection Prevention*, *12*(1), 17–24. https://doi.org/10.1177/1757177410384300

Dyson, J., Lawton, R., Jackson, C., & Cheater, F. (2013). Development of a theory-based instrument to identify barriers and levers to best hand hygiene practice among healthcare practitioners. *Implementation Science*, *8*(1), 111. https://doi.org/10.1186/1748-5908-8-111

Edmunds, S., Biggs, H., & Goldie, I. (2013). Let's Get Physical: The Impact of Physical Activity on Wellbeing. In *Mental Helath Foundation*. Retrieved from https://www.mentalhealth.org.uk/sites/default/files/lets-get-physical-report.pdf

Edmunds, S., Hurst, L. & Harvey, K. (2013). Physical activity barriers in the workplace: An exploration of factors contributing to non-participation in a UK workplace physical activity intervention. *International Journal of Workplace Health Management*, *6*(3), 227–240. https://doi.org/10.1108/09574090910954864

Edwards, E. S., & Sackett, S. C. (2016). Psychosocial Variables Related to Why Women are Less Active than Men and Related Health Implications. *Clinical MJedicine Insights: Women's Health*, *9*(Suppl 1), 47–56. https://doi.org/10.4137/CMWH.S34668

Egli, T., Bland, H.W., Melton, B.F. & Czech, D. R. (2011). Influence of Age, Sex, and Race on College Students' Exercise Motivation of Physical Activity. *Journal of American College Health*, *59*(5), 399–406. https://doi.org/10.1080/07448481.2010.513074

Ekeland, E., Heian, F. & Hagen, K. B. (2005). Can exercise improve self esteem in children and young people? A systematic review of randomised controlled trials. *British Journal of Sports Medicine*, *39*(11), 792–798. https://doi.org/10.1136/bjsm.2004.017707

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The Pleasure and Displeasure People Feel When they Exercise at Different Intensities. *Sports Medicine*, *41*(8), 641–671. https://doi.org/10.2165/11590680-000000000-00000

El Ansari, W., Khalil, K., Crone, D., & Stock, C. (2014). Physical activity and gender differences: correlates of compliance with recommended levels of five forms of physical activity among students at nine universities in Libya. *Central European Journal of Public Health*, *22*(2), 98–105.

El-Gilany, A., Badawi, K., El-Khawaga, G., & Awadalla, N. (2011). Physical activity profile of students in Mansoura University, Egypt. *Eastern Mediterranean Health Journal*, *17*(8), 694–702. Retrieved from http://www.emro.who.int/emhj/V17/08/17_8_2011_0694_0702.pdf

Elo, S. & Kyngas, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Emerson, N. D., Merrill, D. A., Shedd, K., Bilder, R. M., & Siddarth, P. (2017). Effects of an employee exercise programme on mental health. *Occupational Medicine*, *67*(2), 128–134. https://doi.org/10.1093/occmed/kqw120

Eng, J. (2003). Sample size estimation: How many individuals should be studied? *Radiology*, *227*(2), 309–313. https://doi.org/10.1148/radiol.2272012051

Engbers, L. H., Van Poppel, M. N. M., Chin A Paw, M. J. M., & Van Mechelen, W. (2005).

Worksite health promotion programs with environmental changes: A systematic review. *American Journal of Preventive Medicine*, *29*(1), 61–70. https://doi.org/10.1016/j.amepre.2005.03.001

Engelen, L., Gale, J., Chau, J. Y., & Bauman, A. (2017). Are motivational signs to increase stair use a thing of the past? A multi-building study. *Health Promotion Journal of Australia*, *28*(3), 178–184. https://doi.org/10.1071/HE16107

Epton, T., Norman, P., Dadzie, A.-S., Harris, P. R., Webb, T. L., Sheeran, P., … Shah, I. (2014). A theory-based online health behaviour intervention for new university students (U@Uni: LifeGuide): Results from a repeat randomized controlled trial. *BMC Public Health*, *14*, 563. https://doi.org/10.1186/s13063-015-1092-4

Erwin, W. J., & Wheelright, L. A. (2002). Improving mail survey response rates through the use of a monetary incentive. *Journal of Mental Health Counseling*, *24*(3), 247–255.

Escoto, K. H., French, S. A., Harnack, L. J., Toomey, T. L., Hannan, P. J., & Mitchell, N. R. (2010). Work hours, weight status, and weight-related behaviors: A study of metro transit workers. *International Journal of Behavioral Nutrition and Physical Activity*, *7*, 17–19. https://doi.org/10.1186/1479-5868-7-91

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), 1–4. https://doi.org/10.11648/j.ajtas.20160501.11

European Union. (2016). Gender Equality and Participation. Retrieved November 30, 2019, from European Union website: https://rm.coe.int/bis-factsheet-gender-equality-sport-participation-en/1680714b90

Evans, R. E., Fawole, H. O., Sheriff, S. A., Dall, P. M., Grant, P. M., & Ryan, C. G. (2012). Point-of-choice prompts to reduce sitting time at work: A randomized trial. *American Journal of Preventive Medicine*, *43*(3), 293–297. https://doi.org/10.1016/j.amepre.2012.05.010

Eysenbach, G., & Wyatt, J. (2002). Using the Internet for surveys and health research. *Journal of Medical Internet Research*, *4*(2), 76–94. https://doi.org/10.2196/jmir.4.2.e13

Fagaras, S.-P., Radu, L.-E., & Vanvu, G. (2015). The Level of Physical Activity of University Students. *Procedia - Social and Behavioral Sciences*, *197*(February), 1454–1457. https://doi.org/10.1016/j.sbspro.2015.07.094

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G * Power 3 : A flexible statistical power analysis program for the social , behavioral , and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191.

Fennell, C., Peroutky, K. & Glickman, E. L. (2016). Effects of Supervised Training Compared to Unsupervised Training on Physical Activity, Muscular Endurance, and Cardiovascular Parameters. *MOJ Orthopedics & Rheumatology*, *5*(4), 00184. https://doi.org/10.15406/mojor.2016.05.00184

Fishbein, M., Triandis, H.C., Kanfer, F.H., Becker, M., Middlestadt, S.E. & Eichler, A. (2001). Factors influencing behavior and behavior change. In & J. E. S. M. A.S. Baum, T.A. Revenson (Ed.), *Handbook of health psychology* (pp. 1–17). New Jersey: Lawrence Erlbaum.

Flannery, C., McHugh, S., Anaba, A. E., Clifford, E., O'Riordan, M., Kenny, L. C., … Byrne, M. (2018). Enablers and barriers to physical activity in overweight and obese pregnant women: An analysis informed by the theoretical domains framework and COM-B model. *BMC Pregnancy and Childbirth*, *18*(1), 1–13. https://doi.org/10.1186/s12884-018-1816-z

Fletcher, A. J. (2017). Applying critical realism in qualitative research: methodology meets method. *International Journal of Social Research Methodology*, *20*(2), 181–194. https://doi.org/10.1080/13645579.2016.1144401

Fletcher, G. M., Behrens, T. K., & Domina, L. (2008). Barriers and enabling factors for work-site physical activity programs: A qualitative examination. *Journal of Physical Activity & Health*, *5*(3), 418–429.

Fochsen, G., Josephson, M., Hagberg, M., Toomingas, A., & Lagerström, M. (2006). Predictors of leaving nursing care: A longitudinal study among Swedish nursing personnel. *Occupational and Environmental Medicine*, *63*(3), 198–201. https://doi.org/10.1136/oem.2005.021956

Fontes, A.C.D. & Vianna, R. P. T. (2009). Prevalence and factors related to low level physical activity among university students in a public university in the northeast region of Brazil. *Revista Brasileira de Epidemiologia*, *12*(1), 20–29.

Fountaine, C. J., Piacentini, M., & Liguori, G. A. (2014). Occupational Sitting and Physical Activity Among University Employees. *International Journal of Exercise Science*, *7*(4), 295–301. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/27182407%5Cnhttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC4831850

Fraser, S. W., & Greenhalgh, T. (2001). Complexity science: Coping with complexity: Educating for capability. *British Medical Journal*, *323*(7316), 799–803.

Freak-Poli, R. L. A., Cumpston, M., Peeters, A., Clemes, S. A., Freak-Poli Rosanne, L. A., Cumpston, M., … Clemes Stacy, A. (2013). Workplace pedometer interventions for increasing physical activity (Review). *Cochrane Database of Systematic Reviews*, *4*(4), CD009209. https://doi.org/10.1002/14651858.CD009209.pub2

Fredman, P. (2012). The European University Association Conference. *The Sustainability of European Universities*. Retrieved from http://www.eua.be/Libraries/eua-annual-conf-2012-warwick/FINAL_Pam_Fredman.pdf?sfvrsn=0

Fredriksson, S. V., Alley, S. J., Rebar, A. L., Hayman, M., Vandelanotte, C., & Schoeppe, S. (2018). How are different levels of knowledge about physical activity associated with physical activity behaviour in Australian adults? *PLoS ONE*, *13*(11), e0207003. https://doi.org/10.1371/journal.pone.0207003

Freedson, P., Bowles, H.R., Troiano, R. & Haskell, W. (2012). Monitors : Recommendations for Monitor. *Medicine and Science in Sports and Exercise*, *44*(1 Suppl 1), S1–S4. https://doi.org/10.1249/MSS.0b013e3182399b7e.ASSESSMENT

French, S.A., Harnack, L.J., Toomey, T.L. & Hannan, P. J. (2007). Association between body weight, physical activity and food choices among metropolitan transit workers. *International Journal of Behavioral Nutrition and Physical Activity*, *4*, 52. https://doi.org/10.1186/1479-Received

French, S. D., McKenzie, J. E., O'Connor, D. A., Grimshaw, J. M., Mortimer, D., Francis, J. J., … Green, S. E. (2013). Evaluation of a Theory-Informed Implementation Intervention for the Management of Acute Low Back Pain in General Medical Practice: The IMPLEMENT Cluster Randomised Trial. *PLoS ONE*, *8*(6). https://doi.org/10.1371/journal.pone.0065471

Frey, J.H. & Fontana, A. (1991). The group interview in social research. *The Social Science Journal*, *28*(2), 175–187.

Fulton, E. A., Brown, K. E., Kwah, K. L., & Wild, S. (2016). StopApp: Using the Behaviour Change Wheel to Develop an App to Increase Uptake and Attendance at NHS Stop Smoking Services. *Healthcare*, *4*(2), 31. https://doi.org/10.3390/healthcare4020031

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology, 13,* 117. https://doi.org/10.1186/1471-2288-13-117

Gao, L. (2005). Latin Squares in Experimental Design. In *Michigan State University*. Retrieved from http://www.mth.msu.edu/~jhall/classes/mth880-05/projects/latin.pdf

Gathersleben, B. & Appleton, K. M. (2007). Contemplating cycling to work: Attitudes and perceptions in different stages of change. *Transportation Research Part A*, *41*, 302–312.

Geiger-brown, J., Trinkoff, A. M., Nielsen, K., Lirtmunlikaporn, S., Brady, B., & Vasquez, E. I. (1999). Nurses ' Perception of Their Work A Qualitative Perspective. *AAOHN Journal*, *52*(1), 16–23. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/216507990405200108

George, E. S., Kolt, G. S., Rosenkranz, R. R., & Guagliano, J. M. (2014). Physical Activity and Sedentary Time: Male Perceptions in a University Work Environment. *American Journal of Men's Health*, *8*(2), 148–158. https://doi.org/10.1177/1557988313497217

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update* (4th ed). Boston: Allyn & Bacon.

Gerend, M.A. & Maner, J. K. (2011). Fear, Anger, fruits, and veggies: interactive effects of emotion and message framing on health behavior. *Health Psychology*, *30*(4), 420–423. https://doi.org/10.1037/a0021981.Fear

Gerend, M. A., & Shepherd, M. A. (2016). When Different Message Frames Motivate Different Routes to the Same Health Outcome. *Annals of Behavioral Medicine*, *50*(2), 319–329. https://doi.org/10.1007/s12160-015-9757-5

Ghaffari, M., Sharifirad, G., Malekmakan, E. & Hassanzadeh, A. (2013). Effect of educational intervention on physical activity-related knowledge, attitude and behavior of among first-grade students of male high schools. *Journal of Education and Health Promotion*, (2), 4. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3778575/

Giblin, S., Collins, D., & Button, C. (2014). Physical literacy: Importance, assessment and future directions. *Sports Medicine, 44*(9), 1177–1184. https://doi.org/10.1007/s40279-014-0205-7

Gichu, M., Asiki, G., Juma, P., Kibachio, J., Kyobutungi, C., & Ogola, E. (2018). Prevalence and predictors of physical inactivity levels among Kenyan adults (18-69 years): An analysis of STEPS survey 2015. *BMC Public Health*, *18*(Suppl 3), 1217. https://doi.org/10.1186/s12889-018-6059-4

Gilson, N., Brown, W. J., Faulkner, G., Mckenna, J., Murphy, M., Pringle, A., … Stathi, A. (2009). The International Universities Walking Project : Development of a Framework for Workplace Intervention Using the Delphi Technique. *Journal of Physical Activity and Health*, *6*, 520–528.

Gilson, N.D., Faulkner, G., Murphy, M.H., Meyer, M.R.U., Washington, T., Ryde, G.C., Arbour-Nicitopolous, K.P. & Dillon, K. A. (2013). Walk@Work: An automated intervention to increase walking in university employees not achieving 10,000 daily steps. *Preventive Medicine*, *56*, 283–287.

Gilson, N. D., Puig-Ribera, A., McKenna, J., Brown, W. J., Burton, N. W., & Cooke, C. B. (2009). Do walking strategies to increase physical activity reduce reported sitting in workplaces: a randomized control trial. *The International Journal of Behavioral Nutrition and Physical Activity*, *6*, 43. https://doi.org/10.1186/1479-5868-6-43

Gilson, N., McKenna, J., Cooke, C., & Brown, W. (2007). Walking towards health in a university community: a feasibility study. *Preventive Medicine*, *44*(2), 167–169. https://doi.org/10.1016/j.ypmed.2006.09.012

Glanz, K., & Bishop, D. B. (2010). The role of behavioral science theory in development and implementation of public health interventions. *Annual Review of Public Health*, *31*, 399–418. https://doi.org/10.1146/annurev.publhealth.012809.103604

Goering, P.N. & Streiner, D. L. (1996). Reconcilable differences: the marriage of qualitative and quantitative methods. *Canadian Journal of Psychiatry*, *41*(8), 491–497. https://doi.org/10.1177/070674379604100804.

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*, *8*(4), 597–607. Retrieved from https://nsuworks.nova.edu/tqr/vol8/iss4/6

Gollwitzer, P, M. (1990). Action phases and mind-sets. In R. . Higgins, E.T. & Sorrentino (Ed.), *Action phases and mind-sets* (pp. 53–92). New York: Guilford Press.

Gollwitzer, P. M. (1993). Goal Achievement : The Role of Intentions. *European Review of Social Psychology*, *4*(1), 141–185. https://doi.org/10.1080/14792779343000059

Gollwitzer, P. M., & Brandstätter, V. (1997). Implementation Intentions and Effective Goal Pursuit. *Journal of Personality and Social Psychology*, *73*(1), 186–199. https://doi.org/10.1037/0022-3514.73.1.186

Gollwitzer, P.M. & Sheeran, P. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, *54*(7), 493–503. https://doi.org/10.1037/0003-066X.54.7.493

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation Intentions and Goal Achievement: A Meta-analysis of Effects and Processes. *Advances in Experimental Social Psychology*, *38*(6), 69–119. https://doi.org/10.1016/S0065-2601(06)38002-1

Gómez-López, M., Gallegos, A. G., & Extremera, A. B. (2010). Perceived barriers by university students in the practice of physical activities. *Journal of Sports Science & Medicine*, *9*(3), 374–381.

Gorczynski, P. (2018, February). More academics and students have mental health problems than ever before. *The Conversation*. Retrieved from https://theconversation.com/more-academics-and-students-have-mental-health-problems-than-ever-before-90339

Greaney, M. L., Less, F. D., White, A. A., Dayton, S. F., Riebe, D., Blissmer, B., … Greene, G. W. (2009). College Students' Barriers and Enablers for Healthful Weight Management: A Qualitative Study. *Journal of Nutrition Education and Behavior*, *41*(4), 281–286. https://doi.org/10.1016/j.jneb.2008.04.354

Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., & Schwarz, P. (2011). Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health*, *11*, 119. https://doi.org/10.1186/1471-2458-11-119

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Greene, G. W., White, A. A., Hoerr, S. L., Lohse, B., Schembre, S. M., Riebe, D., … Phillips, B. W. (2012). Impact of an online healthful eating and physical activity program for college students. *American Journal of Health Promotion*, *27*(2), 47–59. https://doi.org/10.4278/ajhp.110606-QUAN-239

Grim, M., Hortz, B., & Petosa, R. (2011). Impact evaluation of a pilot web-based intervention to increase physical activity. *American Journal of Health Promotion*, *25*(4), 227–230. https://doi.org/10.4278/ajhp.081216-ARB-307

Grimm E. K., Swartz A. M., Hart T., M. N. E. & S. S. J. (2012). Comparison of the IPAQ-short form and accelerometry predictions of physical activity in older adults. *Journal of Aging and Physical Activity*, *20*(1), 64–79.

Grimstvedt, M. E., Kerr, J., Oswalt, S. B., Fogt, D. L., Vargas-Tonsing, T. M., & Yin, Z. (2010). Using signage to promote stair use on a university campus in hidden and visible stairwells. *Journal of Physical Activity & Health*, *7*(2), 232–238. https://doi.org/10.1123/jpah.7.2.232

Gu, K., Cowie, C.C. & Harris, M. I. (1999). Diabetes and decline in heart disease mortality in US adults. *The Journal of the American Medical Association*, *281*(14), 1291–1297.

Guthold, R., Louazani, S. A., Riley, L. M., Cowan, M. J., Bovet, P., Damasceno, A., … Armstrong, T. P. (2011). Physical activity in 22 African countries: Results from the world health organization STEPwise approach to chronic disease risk factor surveillance. *American Journal of Preventive Medicine*, *41*(1), 52–60. https://doi.org/10.1016/j.amepre.2011.03.008

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. *Lancet Global Health*, *6*, e1077–e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Haase, A., Steptoe, A., Sallis, J. F., & Wardle, J. (2004). Leisure-time physical activity in university students from 23 countries: Associations with health beliefs, risk awareness, and national economic development. *Preventive Medicine*, *39*(1), 182–190. https://doi.org/10.1016/j.ypmed.2004.01.028

Hager, M.S., Chatzisarantis, N.L.D. & Biddle, S. J. H. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24*(1), 3–32.

Haines, D. J., Davis, L., Rancour, P., Robinson, M., Neel-Wilson, T., & Wagner, S. (2007). A pilot intervention to promote walking and wellness and to improve the health of college faculty and staff. *Journal of American College Health*, *55*(4), 219–225. https://doi.org/10.3200/JACH.55.4.219-225

Haith-Cooper, M., Waskett, C., Montague, J., & Horne, M. (2018). Exercise and physical activity in asylum seekers in Northern England; Using the theoretical domains framework to identify barriers and facilitators. *BMC Public Health*, *18*(1), 1–11. https://doi.org/10.1186/s12889-018-5692-2

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., … Wells, J. C. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *The Lancet*, *380*(9838), 247–257. https://doi.org/10.1016/S0140-6736(12)60646-1

Hallsworth, K., Dombrowski, S. U., McPherson, S., Anstee, Q. M., & Avery, L. (2019). Using the theoretical domains framework to identify barriers and enabling factors to implementation of guidance for the diagnosis and management of nonalcoholic fatty liver disease: a qualitative study. *Translational Behavioral Medicine*, 1–15. https://doi.org/10.1093/tbm/ibz080

Hankonen, N., Absetz, P., Ghisletta, P., Renner, B., & Uutela, A. (2010). Gender differences in social cognitive determinants of exercise adoption. *Psychology and Health*, *25*(1), 55–69. https://doi.org/10.1080/08870440902736972

Hanna, F., Daas, R. N., El-Shareif, T. J., Al-Marridi, H. H., Al-Rojoub, Z. M., & Adegboye, O. A. (2019). The relationship between sedentary behavior, back pain, and psychosocial correlates among university employees. *Frontiers in Public Health*, *7*, 1–7. https://doi.org/10.3389/fpubh.2019.00080

Harber, V.J. & Sutton, J. R. (1984). Endorphins and exercise. *Sports Medicine*, *1*(2), 154–171. https://doi.org/10.2165/00007256-198401020-00004

Hardeman, W., Sutton, S., Griffin, S., Johnston, M., White, A., Wareham, N. J., & Kinmonth, A. L. (2005). A causal modelling approach to the development of theory-based behaviour change programmes for trial evaluation. *Health Education Research*, *20*(6), 676–687. https://doi.org/10.1093/her/cyh022

Harmer, C. J. (2008). Serotonin and emotional processing: Does it help explain antidepressant drug action? *Neuropharmacology*, *55*(6), 1023–1028. https://doi.org/10.1016/j.neuropharm.2008.06.036

Harris, M. A. (2018). The relationship between physical inactivity and mental wellbeing: Findings from a gamification-based community-wide physical activity intervention. *Health Psychology Open*, *5*(1), 1–8. https://doi.org/10.1177/2055102917753853

Harris, K. C., Kuramoto, L. K., Schulzer, M., & Retallack, J. E. (2009). Effect of school-based physical activity interventions on body mass index in children: A meta-analysis. *Canadian Medical Association Journal*, *180*(7), 719–726. https://doi.org/10.1503/cmaj.080966

Harry, B., & Lipsky, M. (2014). Qualitative Research on Special Education Teacher Preparation. In and B. L. Paul T. Sindelar, Erica D. McCray, Mary T. Brownell (Ed.), *Handbook of research on special education teacher preparation*. NewYork: Routledge.

Hashim, H. A. (2012). Perceived barriers to recreation sport participation in university students: A comparison between international and local students in the United States. *Pertanika Journal of Social Science and Humanities*, *20*(1), 197–203.

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence-Based Nursing*, *18*(3), 66–67. https://doi.org/10.1136/eb-2015-102129

Healy, G. N., Eakin, E. G., LaMontagne, A. D., Owen, N., Winkler, E. A. H., Wiesner, G., … Dunstan, D. W. (2013). Reducing sitting time in office workers: Short-term efficacy of a multicomponent intervention. *Preventive Medicine*, *57*(1). https://doi.org/10.1016/j.ypmed.2013.04.004

Healy, M., & Perry, C. (2000). Qualitative Market Research : An International Journal Emerald Article : Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm Comprehensive criteria to judge validity and reliability of qualitative r. *Qualitative Market Research*, *3*(3), 118–126.

Heath, G.W., Parra, D.C., Sarmiento, O.L., Andersen, L.B., Owen, N., Goenka, S., Montes, F. & Brownson, R. C. (2012). Evidence-based intervention in physical activity: lessons from around the world. *Lancet*, *380*(9838), 272–281. https://doi.org/10.1016/S0140-6736(12)60816-2.Evidence-based

Heckhausen, H. & Gollwitzer, P. M. (1987). Thought contents and cognitive functioning in motivational versus volitional states of mind. *Motivation and Emotion*, *11*, 101–120.

Held, C., Iqbal, R., Lear, S. A., Rosengren, A., Islam, S., Mathew, J., & Yusuf, S. (2012). Physical activity levels, ownership of goods promoting sedentary behaviour and risk of myocardial infarction: Results of the INTERHEART study. *European Heart Journal*, *33*(4), 452–466. https://doi.org/10.1093/eurheartj/ehr432

Hendi, O.M., Adbulaziz, A.A., Althaqafi, A.M., Hindi, A.M., Khan, A.A. & Atalla, A. A. (2019). Prevalence of Musculoskeletal Disorders and its Correlation to Physical Activity Among Health Specialty Students. *International Journal of Preventive Medicine, 10*(1), 48. https://doi.org/10.4103/ijpvm.IJPVM

Herrmann, S. D., Heumann, K. J., Der Ananian, C. A., & Ainsworth, B. E. (2013). Validity and reliability of the global physical activity questionnaire (GPAQ). *Measurement in Physical Education and Exercise Science*, *17*(3), 221–235. https://doi.org/10.1080/1091367X.2013.805139

Hickey, M., & Mason, S. (2017). Age and gender differences in particpation rates, motivators for, and barriers to exercise. *Modern Psychological Studies*, *22*(2). Retrieved from https://scholar.utc.edu/cgi/viewcontent.cgi?article=1270&context=mps

Higher Education Statistics Agency. (2018a). *Higher Education Staff Statistics: UK, 2016/17*. Retrieved from https://www.hesa.ac.uk/news/18-01-2018/sfr248-higher-education-staff-statistics

Higher Education Statistics Agency. (2018b). *Higher Education Student Statistics: UK, 2016/17 - Student numbers and characteristics*. Retrieved from https://www.hesa.ac.uk/news/11-01-2018/sfr247-higher-education-student-statistics/numbers

HM Government. (2014). *Moving More, Living More: The physical activity Olympic and Paralympic legacy for the nation*. Retrieved from http://dera.ioe.ac.uk/19339/2/Moving_more__living_more_annexes.pdf

Hoare, E., Stavreski, B., Jennings, G., & Kingwell, B. (2017). Exploring Motivation and Barriers to Physical Activity among Active and Inactive Australian Adults. *Sports*, *5*(3), 47. https://doi.org/10.3390/sports5030047

Hobbis, I. C. A., & Sutton, S. (2005). Are techniques used in cognitive behaviour therapy applicable to behaviour change interventions based on the theory of planned behaviour? *Journal of Health Psychology*, *10*(1), 7–18. https://doi.org/10.1177/1359105305048549

Hobbs, N., Godfrey, A., Lara, J., Errington, L., Meyer, T. D., Rochester, L., … Sniehotta, F. F. (2013). Are behavioral interventions effective in increasing physical activity at 12 to 36 months in adults aged 55 to 70 years? a systematic review and meta-analysis. *BMC Medicine*, *11*, 75. https://doi.org/10.1186/1741-7015-11-75

Hochbaum, G. M. (1958). *Public Participation in Medical Screening Programs: A Socio-psychological study (Public Health Service Publication No. 572)*. Washington, DC: Government Printing Office.

Hoos, T., Espinoza, N., Marshall, S. J., & Arredondo, E. M. (2013). Validity of the Global Physical Activity Questionnaire (GPAQ) in Adult Latinas. *Journal of Physical Activity and Health*, *9*(5), 698–705. https://doi.org/10.1016/j.biotechadv.2011.08.021.Secreted

Houston, S. (2001). Beyond social constructionism: Critical realism and social work. *British Journal of Social Work*, *31*(6), 845–861. https://doi.org/10.1093/bjsw/31.6.845

Howitt, D. & Cramer, D. (2017). *Research Methods in Psychology* (5th ed.). Harlow: Pearson Education Limited.

Howlett, N., Trivedi, D., Troop, N. A., & Chater, A. M. (2019). Are physical activity interventions for healthy inactive adults effective in promoting behavior change and maintenance, and which behavior change techniques are effective? A systematic review and meta-analysis. *Translational Behavioral Medicine*, *9*(1), 147–157. https://doi.org/10.1093/tbm/iby010

Hoy, D., March, L., Woolf, A., Blyth, F., Brooks, P., Smith, E., Vos, T., Barendregt, J., Blore, J., Murray, C., Burstein, R. & Buchbinder, R. (2014). The global burden of neck pain: estimates from the Global Burden of Disease 2010 study. *Annals of the Rheumatic Diseases*, *73*, 982–989. https://doi.org/doi: 10.1136/annrheumdis-2013-204344

Hsieh, H.F. & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, *15*(9), 1277–1288. https://doi.org/10.1177/1049732305276687

Huang, T. T.-K., Harris, K. J., Lee, R. E., Nazir, N., Born, W., & Kaur, H. (2003). Assessing Overweight, Obesity, Diet, and Physical Activity in College Students. *Journal of American College Health*, *52*(2), 83–86. https://doi.org/10.1080/07448480309595728

Hui, S. S. C., Hui, G. P. S., & Xie, Y. J. (2014). Association between physical activity knowledge and levels of physical activity in Chinese adults with type 2 diabetes. *PLoS ONE*, *9*(12). https://doi.org/10.1371/journal.pone.0115098

Hui, S. & Morrow, J. R. (2001). Level of Participation and Knowledge of Physical Activity in Hong Kong Chinese Adults and Their Association with Age. *Journal of Aging and Physical Activity*, *9*(4), 372–385.

Huijg, J. M., Gebhardt, W. a, Crone, M. R., Dusseldorp, E., & Presseau, J. (2014). Discriminant content validity of a theoretical domains framework questionnaire for use in implementation research. *Implementation Science*, *9*, 11. https://doi.org/10.1186/1748-5908-9-11

Humble, Á. (2016). Guide to Transcribing. Retrieved September 4, 2017, from Department of Family Studies and Gerontology, Mount Saint Vincent University website: http://www.msvu.ca/site/media/msvu/Transcription Guide.pdf

Hunter, R. F., Tully, M. A., Donnelly, P., Stevenson, M., & Kee, F. (2014). Knowledge of UK physical activity guidelines : Implications for better targeted health promotion. *Preventive Medicine*, *65*, 33–39.

Hurdiel, R., Watier, T., Honn, K., Pezé, T., Zunquin, G., & Theunynck, D. (2017). Effects of a 12-week physical activities programme on sleep in female university students. *Research in Sports Medicine*, *25*(2), 191–196. https://doi.org/10.1080/15438627.2017.1282354

Hutchinson, A. D., & Wilson, C. (2012). Improving nutrition and physical activity in the workplace: A meta-analysis of intervention studies. *Health Promotion International*, *27*(2), 238–249. https://doi.org/10.1093/heapro/dar035

Ince, M. L. (2008). Use of a Social Cognitive Theory-Based Physical-Activity Intervention on Health-Promoting Behaviors of University Students. *Perceptual and Motor Skills*, *107*(3), 833–836E. https://doi.org/10.2466/pms.107.3.833-836

Information Commissioner's Office. (2018). Guide to the General Data Protection Regulation (GDPR). https://doi.org/10.1111/j.1751-1097.1994.tb09662.x

Integrative Psychiatry. (2020). Serotonin and Serotonin Deficiency. Retrieved January 8, 2020, from Integrative Psychiatry website: https://www.integrativepsychiatry.net/seritonin-and-seritonin-deficiency.html

International Sport & Culture Association / Centre for Economics & Business Research. (2015). The economic cost of physical inactivity in Europe. In *International Sport & Culture Association / Centre for Economics & Business Research*. Retrieved from http://inactivity-time-bomb.nowwemove.com/report/

Irwin, J. D. (2004). Prevalence of University Students' Sufficient Physical Activity: A Systematic Review. *Perceptual and Motor Skills*, *98*(3), 927–943. https://doi.org/10.2466/pms.98.3.927-943

Ishii, K., Oka, K., & Shibata, A. (2011). A structural equation analysis of psychological, social, and environmental influences on physical activity among Japanese adults. *Japanese Journal of Physical Fitness and Sports Medicine*, *60*(1), 89–97. https://doi.org/10.7600/jspfsm.60.89

Iván Martínez-Lemos, R., Puig-Ribera, A. M., & García-García, O. (2014). Perceived Barriers to Physical Activity and Related Factors in Spanish University Students. *Open Journal of Preventive Medicine*, *4*(4), 164–174. https://doi.org/10.4236/ojpm.2014.44022

Iwasaki, Y., Honda, S., Kaneko, S., Kurishima, K., Honda, A., Kakinuma, A., & Jahng, D. (2017). Exercise Self-Efficacy as a Mediator between Goal-Setting and Physical Activity: Developing the Workplace as a Setting for Promoting Physical Activity. *Safety and Health at Work*, *8*(1), 94–98. https://doi.org/10.1016/j.shaw.2016.08.004

Jacob, S.A. & Furgerson, S. P. (2012). Writing Interview Protocols and Conducting Interviews: Tips for Students New to the Field of Qualitative Research. *Qualitative Research. The Qualitative Report*, *17*(42), 1–10. https://doi.org/10.1016/0168-1702(91)90033-R

Jakicic, J.M. & Davis, K. K. (2011). Obesity and Physical Activity. *Psychiatric Clinics of North America*, *34*(4), 829–840. https://doi.org/10.1016/j.psc.2011.08.009

Jerome, M., Janz, K. F., Baquero, B., & Carr, L. J. (2017). Introducing sit-stand desks increases classroom standing time among university students. *Preventive Medicine Reports*, *8*(November), 232–237. https://doi.org/10.1016/j.pmedr.2017.10.019

Jindo, T., Kai, Y., Kitano, N., Tsunoda, K., Nagamatsu, T., & Arao, T. (2020). Relationship of workplace exercise with work engagement and psychological distress in employees: A cross-sectional study from the MYLS study. *Preventive Medicine Reports*, *17*(June 2019), 101030. https://doi.org/10.1016/j.pmedr.2019.101030

Johnston, M. (2016). A science for all reasons: A comment on Ogden (2016)*. *Health Psychology Review*, *10*(3), 256–259. https://doi.org/10.1080/17437199.2016.1190292

Jose, K., & Hansen, E. (2013). Exploring the relationship between physical activity and leisure in the lives of young Australians. *Journal of Physical Activity & Health*, *10*(1), 54–61. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/23324488

Joshua, A.M., Samson-Akpan, P.E., Eyo, M.B. & Joshua, M. T. (2012). Determinants of Nigerian University Teachers' Participation in Physical Activities Towards Health Promotion. *Continental Journal of Nursing Science*, *4*(2), 1–10. https://doi.org/10.5707/cjnsci.2012.4.2.1.10

Kaczynski, A. T., & Glover, T. D. (2012). Talking the talk, walking the walk: Examining the effect of neighbourhood walkability and social connectedness on physical activity. *Journal of Public Health*, *34*(3), 382–389. https://doi.org/10.1093/pubmed/fds011

Kaewthummanukul, T., & Brown, K. C. (2006). Determinants of employee Participation in Physical Activity: Critical Review of the Literature. *American Association of Occupational Health Nurses*, *54*(6), 249–261. https://doi.org/10.1177/216507990605400602

Kamal, A.A. & Radzani, M. (2016). Motivation Influence Towards Physical Activity Level Among University Staff. *Movement, Health & Exercise*, *5*(1), 49–56.

Kaplan, D. H. (2015). Transportation sustainability on a university campus. *International Journal of Sustainability in Higher Education*, *16*(2), 173–186. https://doi.org/10.1108/14676371311312905

Kattelmann, K. K., Bredbenner, C. B., White, A. A., Greene, G. W., Hoerr, S. L., Kidd, T., … Morrell, J. S. (2014). The Effects of Young Adults Eating and Active for Health (YEAH): A Theory-Based Web-Delivered Intervention. *Journal of Nutrition Education and Behavior*, *46*(6), S27–S41. https://doi.org/10.1016/j.jneb.2014.08.007

Kay, M. C., Carroll, D. D., Carlson, S. A., & Fulton, J. E. (2014). Awareness and Knowledge of the 2008 Physical Activity Guidelines for Americans. *Journal of Physical Activity and Health*, *11*, 693–698. https://doi.org/10.1123/jpah.2012-0171

Kayani, S., Kiyani, T., Wang, J., Sánchez, M. L. Z., Kayani, S., & Qurban, H. (2018). Physical activity and academic performance: The mediating effect of self-esteem and depression. *Sustainability (Switzerland)*, *10*(10), 1–17. https://doi.org/10.3390/su10103633

Keating, X. D., Guan, J., Piñero, J. C., & Bridges, D. M. (2005). A Meta-Analysis of College Students' Physical Activity Behaviors. *Journal of American College Health*, *54*(2), 116–126. https://doi.org/10.3200/JACH.54.2.116-126

Keating, X. D., Zhou, K., Liu, X., Hodges, M., Liu, J., Guan, J., … Castro-Piñero, J. (2019). Reliability and concurrent validity of global physical activity questionnaire (GPAQ): A systematic review. *International Journal of Environmental Research and Public Health*, *16*(21). https://doi.org/10.3390/ijerph16214128

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care*, *15*(3), 261–266. https://doi.org/10.1093/intqhc/mzg031

Khera, R., & Sharma, R. (2012). Physical inactivity among college students is associated with living in hostels: a study from Delhi, India. *Global Journal of Medicine and Public Health*, *1*(5), 82–85.

King, N. (2012). Doing template analysis. In C. Symon, G. & Cassell (Ed.), *Qualitative organizational research* (pp. 426–450). London: Sage.

King, N., & Horrocks, C. (2010). *Interviews in Qualitative Research*. London: Sage.

King, A. C., Ahn, D. K., Oliveira, B. M., Atienza, A. A., Castro, M., & Gardner, C. D. (2008). Promoting physical activity through hand-held computer technology. *American Journal of Preventive Medicine*, *34*(2), 138–142. https://doi.org/10.1016/j.amepre.2007.09.025.Promoting

King, A. C., Hekler, E. B., Grieco, L. A., Winter, S. J., Sheats, J. L., Buman, M. P., … Cirimele, J. (2013). Harnessing Different Motivational Frames via Mobile Phones to Promote Daily Physical Activity and Reduce Sedentary Behavior in Aging Adults. *PLoS ONE*, *8*(4), 2–9. https://doi.org/10.1371/journal.pone.0062613

King, N. (2004). Using Templates in the thematic analysis of text. In C. Cassell & G. Symon (Ed.), *Essential guide to qualitative methods in organizational research* (pp. 256–270). London: Sage Publications.

Knight, J. A. (2012). Physical Inactivity: Associated Diseases and Disorders. *Annals of Clinical & Laboratory Science*, *42*(3), 320–337.

Knox, E. C. L., Esliger, D. W., Biddle, S. J. H., & Sherar, L. B. (2013). Lack of knowledge of physical activity guidelines : can physical activity promotion campaigns do better ? *British Medical Journal*, *3*, e003633. https://doi.org/10.1136/bmjopen-2013-003633

Knox, E. C. L., Musson, H., & Adams, E. J. (2015). Knowledge of physical activity recommendations in adults employed in England : associations with individual and workplace-related predictors. *International Journal of Behavioral Nutrition*, *12*, 69. https://doi.org/10.1186/s12966-015-0231-3

Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., … Wells, J. C. (2012). The pandemic of physical inactivity: Global action for public health. *The Lancet*, *380*(9838), 294–305. https://doi.org/10.1016/S0140-6736(12)60898-8

Kok, G., Schaalma, H., Ruiter, R. A. C., Van Empelen, P., & Brug, J. (2004). Intervention Mapping: A Protocol for Applying Health Psychology Theory to Prevention Programmes. *Journal of Health Psychology*, *9*(1), 85–98. https://doi.org/10.1177/1359105304038379

Kolehmainen, N., Francis, J. J., Ramsay, C. R., Owen, C., McKee, L., Ketelaar, M., & Rosenbaum, P. (2011). Participation in physical play and leisure : developing a theory- and evidence-based intervention for children with motor impairments. *BMC Pediatrics*, *11*, 100. https://doi.org/10.1186/1471-2431-11-100

Krippendorff, K. (2013). *Content Analysis: An Introduction to Its Methodology*. London: Sage.

Krueger, R. A. (1994). *Focus groups. A practical guide for applied research* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Kuehl, R. O. (2000). *Design of experiments: statistical principles in research design and analysis.* Pacific Grove, CA: Duxbury Press.

Kumar, R. (2017). Role of Physical Activity in Mental Well-Being. *The International Journal of Indian Psychology*, *4*(2), 92. Retrieved from http://www.ijip.in/Archive/v4i2/18.01.111.20170402.pdf

Kuper, A., Lingard, L., & Levinson, W. (2008). Qualitative Research : Critically Appraising Qualitative Research Stable URL : http://www.jstor.org/stable/20510884 Linked references are available on JSTOR for this article : Critically appraising qualitative research. *BMJ*, *337*(7671), 687–689. https://doi.org/10.1136/bmj.a1035

Kwak, L., Hagströmer, M., Jensen, I., Karlsson, M. L., Alipour, A., & Elinder, L. S. (2014). Promoting physical activity and healthy dietary behavior: The role of the occupational health services: A scoping review. *Journal of Occupational and Environmental Medicine*, *56*(1), 35–46. https://doi.org/10.1097/JOM.0000000000000012

Kwak, L., Kremers, S.P., van Baak, M.A., & Brug, J. (2007). Formation of Implementation Intentions Promotes Stair Use. *American Journal of Preventive Medicine*, *32*(3), 254–255. https://doi.org/10.1016/j.amepre.2006.11.005

Kwan, C. M. L., Chun, K. M., & Chesla, C. A. (2011). Cultural norms shaping research group interviews with Chinese American immigrants. *Asian American Journal of Psychology*, *2*(2), 115–127. https://doi.org/10.1037/a0024184

Kwasnicka, D., Dombrowski, S.U., White, M. & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychology Review*, *10*(3), 277–296. https://doi.org/10.1080/17437199.2016.1151372

Lacaille, L. J., Dauner, K. N., Krambeer, R. J., & Pedersen, J. (2011). Psychosocial and environmental determinants of eating behaviors, physical activity, and weight change among college students: A qualitative analysis. *Journal of American College Health*, *59*(6), 531–538. https://doi.org/10.1080/07448481.2010.523855

Laeremans, M., Dons, E., Avila-Palencia, I., Carrasco-Turigas, G., Orjuela, J. P., Anaya, E.,

… Int Panis, L. (2017). Physical activity and sedentary behaviour in daily life: A comparative analysis of the Global Physical Activity Questionnaire (GPAQ) and the SenseWear armband. *PLoS ONE*, *12*(5), 1–15. https://doi.org/10.1371/journal.pone.0177765

Lagersted-Olsen, J., Korshoj, M., Skotte, J., Carneiro, I. G., Sogaard, K., & Holtermann, A. (2014). Comparison of objectively measured and self-reported time spent sitting. *International Journal of Sports Medicine*, *35*(6), 534–540. https://doi.org/10.1055/s-0033-1358467

Laird, Y., Fawkner, S., & Niven, A. (2018). A grounded theory of how social support influences physical activity in adolescent girls. *International Journal of Qualitative Studies on Health and Well-Being*, *13*(1). https://doi.org/10.1080/17482631.2018.1435099

Landauer, J. & Rowlands, J. (2001). Importance of Philosophy. Retrieved February 21, 2018, from http://www.importanceofphilosophy.com/Epistemology_Main.html

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310

Latimer, A. E., Brawley, L. R., & Bassett, R. L. (2010). A systematic review of three approaches for constructing physical activity messages : What messages work and what improvements are needed ? *International Journal of Behavioral Nutrition and Physical Activity*, *7*, 36. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2885311/pdf/1479-5868-7-36.pdf

Laurence, E. (2018). Endorphins and Exercise: How intense does a workout have to be for the “High” to kick in? Retrieved January 8, 2020, from Well and Good website: https://www.wellandgood.com/good-sweat/endorphins-and-exercise/

LeCheminant, J. D., Smith, J. D., Covington, N. K., Hardin-Renschen, T., & Heden, T. (2011). Pedometer use in university freshmen: A randomized controlled pilot study. *American Journal of Health Behavior*, *35*(6), 777–784. https://doi.org/10.5993/AJHB.35.6.13

Lee, I.-M. (2003). Physical activity and cancer prevention--data from epidemiologic studies. *Med Sci Sport Exerc*, *35*(11), 1823–1827. https://doi.org/10.1249/01.MSS.0000093620.27893.23

Lee, C. Do, Folsom, A. R., & Blair, S. N. (2003). Physical activity and stroke risk: A meta-analysis. *Stroke*, *34*(10), 2475–2481. https://doi.org/10.1161/01.STR.0000091843.02517.9D

Lee, P. H., Macfarlane, D. J., Lam, T., & Stewart, S. M. (2011). Validity of the international physical activity questionnaire short form (IPAQ-SF): A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 115. https://doi.org/10.1186/1479-5868-8-115

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., … Wells, J. C. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9

Lee, I. P., & Walker, R. M. (2019). Does source credibility matter for point-of-decision prompts? A quasi-experimental field study to increase stair use. *PLoS ONE*, *14*(11), 1–19. https://doi.org/10.1371/journal.pone.0225520

Lee, P. H., Yu, Y. Y., Mcdowell, I., Leung, G. M., Lam, T. H., & Stewart, S. M. (2011). *Performance of the international physical activity questionnaire (short form) in subgroups of the Hong Kong chinese population*. *1998*, 1–10.

Leininger, L.J. & Adams, K. J. (2015). Differences in health promotion program participation, barriers and physical activity among faculty, staff and administration at a university worksite. *International Journal of Workplace Health Management*, *8*(4), 246–255. https://doi.org/10.1108/EL-01-2014-0022

Leung, L. (2015). Impact of Qualitative Research upon Primary Care. *Journal of Family Medicine and Primary Care*, *4*(3), 324–327. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4535087/#!po=5.00000

Lin, Y.-P., McCullagh, M. C., Kao, T.-S., & Larson, J. L. (2014). An Integrative Review: work environment factors associated with physical activity among white-collar workers. *Western Journal of Nursing Research*, *36*(2), 262–283. https://doi.org/10.1177/0193945913503417

Litman, T. (2019). Evaluating Active Transport Benefits and Costs: Guide to Valuing Walking and Cycling Improvements and Encouragement Programs. Retrieved from Victoria Transport Policy Institute website: https://www.vtpi.org/nmt-tdm.pdf

Liu, H., & Dai, X. (2017). Correlation between physical activity and self-efficacy in Chinese university students. *Journal of Sport Psychology*, *26*(4), 110–114. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=fua&AN=124557704&lang=es&site=ehost-live

Lobiondo-wood, G., Haber, J. & Signh, M. (2013). *Nursing research in Canada. Methods, critical appraisal, and utilization* (3rd ed.). Toronto: Elsevier.

Locke, E.A, & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *The American Psychologist*, *57*(9), 705–717. https://doi.org/10.1037/0003-066X.57.9.705

Long, T., & Johnson, M. (2000). Rigour, reliability and validity in qualitative research. *Clinical Effectiveness in Nursing*, *4*(1), 30–37. https://doi.org/10.1054/cein.2000.0106

Long, M. H., Johnston, V., & Bogossian, F. (2012). Work-related upper quadrant musculoskeletal disorders in midwives, nurses and physicians: A systematic review of risk factors and functional consequences. *Applied Ergonomics*, *43*(3), 455–467. https://doi.org/10.1016/j.apergo.2011.07.002

Loughlan, C. & Mutrie, N. (1997). An evaluation of the effectiveness of three interventions in promoting physical activity in a sedentary population. *Health Education Journal*, *56*, 154–165. https://doi.org/https://doi.org/10.1177/001789699705600206

Lu, C. C., Chu, P. Y., Hsia, S. M., Wu, C. H., Tung, Y. T., & Yen, G. C. (2017). Insulin induction instigates cell proliferation and metastasis in human colorectal cancer cells. *International Journal of Oncology*, *50*(2), 736–744. https://doi.org/10.3892/ijo.2017.3844

Luborsky, M.R. & Rubinstein, R. L. (1995). Sampling in Qualitative Research: Rationale, Issues, and Methods. *Research on Aging*, *17*(1), 89–113.

https://doi.org/10.1177/0164027595171005.Sampling

Lukka, K., & Modell, S. (2010). Validation in interpretive management accounting research. *Accounting, Organizations and Society*, *35*(4), 462–477. https://doi.org/10.1016/j.aos.2009.10.004

Ma, J. K., & Martin Ginis, K. A. (2018). A meta-analysis of physical activity interventions in people with physical disabilities: Content, characteristics, and effects on behaviour. *Psychology of Sport and Exercise*, *37*(July 2017), 262–273. https://doi.org/10.1016/j.psychsport.2018.01.006

Macdowall, W., Bonnell, C. & Davies, M. (2006). *Health promotion practice*. Maidenhead: McGraw-Hill Education.

Macmillian Cancer Support. (2014). Walking for health. In *Macmillian Cancer Support*. https://doi.org/10.1097/smj.0b013e3181583a09

Magoc, D., Tomaka, J., & Bridges-Arzaga, A. (2011). Using the web to increase physical activity in college students. *American Journal of Health Behavior*, *35*(2), 142–154. https://doi.org/10.5993/AJHB.35.2.2

Magoc, D., Tomaka, J., Shamaley, A.G. & Bridges, A. (2016). Gender Differences in Physical Activity and Related Beliefs Among Hispanic College Students. *Hispanic Journal of Behavioral Sciences*, *38*(2), 279–290. https://doi.org/10.1177/0739986316637355

Majid, M. A. A., Othman, M., Mohamad, S. F., Lim, S. A. H., & Yusof, A. (2017). Piloting for Interviews in Qualitative Research: Operationalization and Lessons Learnt. *International Journal of Academic Research in Business and Social Sciences*, *7*(4), 1073–1080. https://doi.org/10.6007/ijarbss/v7-i4/2916

Malina, M. A., Nørreklit, H. S. O., & Selto, F. H. (2011). Lessons learned: advantages and disadvantages of mixed method research. *Qualitative Research in Accounting & Management*, *8*(1), 59–71. https://doi.org/10.1108/11766091111124702

Mansell, I., Bennett, G., Northway, R., Mead, D. & Moseley, L. (2004). The learning curve: the advantages and disadvantages in the use of focus groups as a method of data collection. *Nurse Researcher*, *11*(4), 79–88. https://doi.org/10.7748/nr2004.07.11.4.79.c6217

Mansoubi, M., Pearson, N., Biddle, S.J.H. & Clemes, S. A. (2016). Using sit-to-stand workstations in offices : is there a compensation effect ? *Medicine and Science in Sports and Exercise*, *48*(4), 720–725.

Marshall, S. J., & Biddle, S. J. H. (2001). The transtheoretical model of behavior change: a meta-analysis of applications to physical activity and exercise. *Annals of Behavioral Medicine*, *23*(4), 229–246. https://doi.org/10.1207/S15324796ABM2304_2

Marteau, T., Hollands, G.J. & Kelly, M. (2015). Changing population behavior and reducing health disparities: Exploring the poten-tial of "choice architecture" interventions. In D. H. Kaplan, R.M., Spittel, M. & David (Ed.), *Emerging Behavioral and Social Science Perspectives on Population Health.* Rockville, MD: Agency for Healthcare Research and Quality and Office of Behavioral and Social Sciences Research.

Martens, M. P., Buscemi, J., Smith, A. E., & Murphy, J. G. (2012). The short-term efficacy of a brief motivational intervention designed to increase physical activity among college students. *Journal of Physical Activity and Health*, *9*(4), 525–532. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84861157214&partnerID=40&md5=1237b739a77537a451c6420c69983307

Martínez-Mesa, J., González-Chica, D. A., Bastos, J. L., Bonamigo, R. R., & Duquia, R. P. (2014). Sample size: How many participants do i need in my research? *Anais Brasileiros de Dermatologia*, *89*(4), 609–615. https://doi.org/10.1590/abd1806-4841.20143705

Martinez, Y. T. S., Harmon, B. E., Nigg, C. R., Bantum, E. O., & Strayhorn, S. (2016). Diet and Physical Activity Intervention Strategies for College Students. *Health Behavior and Policy Review*, *3*(4), 336–347. https://doi.org/10.14485/HBPR.3.4.5

Maselli, M., Ward, P. B., Gobbi, E., & Carraro, A. (2018). Promoting Physical Activity Among University Students: A Systematic Review of Controlled Trials. *American Journal of Health Promotion*, 089011711775379. https://doi.org/10.1177/0890117117753798

Mathew. V., Akkilagunta. S., Kumar. D., Lakshminarayana, S. & Kar, S. S. (2019). Effectiveness of pedometer-based walking program to improve physical activity of workers in a software industry: An experimental study. *International Journal of Preventive Medicine*, *10*(1), 49. https://doi.org/10.4103/2008-7802.257212

Matson-Koffman, D. M., Brownstein, J. N., Neiner, J. A., & Greaney, M. L. (2005). A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: What works? *American Journal of Health Promotion*, *19*(3), 167–193. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-12144270455&partnerID=40&md5=e897e835e351cc80cb309c7eab21a79d

Mattke, S., Liu, H., Caloyeras, J., Huang, C., Van Busum, K., Khodyakov, D., … Broderick, M. (2014). Do Workplace Wellness Programs Save Employers Money? In *RAND Corporation*. https://doi.org/10.7249/rb9744

Maureira, F. & Diaz, H. (2017). Physical Exercise and Academic Performance. *MOJ Sports Medicine*, *1*(4), 1–4. https://doi.org/10.15406/mojsm.2017.01.00021

Mazzetti, S., Kraemar, W.J., Volek, J.S., Duncan, N.D., Ratamess, N.A., Gomez, A.L., Newton, R.U., Hakkinen, K. & Fleck, S. J. (2000). The influence of direct supervision of resistance training on strength performance. *Medicine and Science in Sports and Excercise*, *32*(6), 1175–1184. https://doi.org/10.1097/00005768-200006000-00023

McAuley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise and Sport Sciences Reviews*, *28*(2), 85–88.

McAuley, E., Szabo, A., Gothe, N., & Olson, E. A. (2011). Functional Limitations in Older Adults. *American Journal of Lifestyle Medicine*, *5*(4), 1–15. https://doi.org/10.1177/1559827610392704.Self-efficacy

McCann, J., Ridgers, N. D., Carver, A., Thornton, L. E., & Teychenne, M. (2013). Effective recruitment and retention strategies in community health programs. *Health Promotion Journal of Australia*, *24*(2), 104–110. https://doi.org/10.1071/HE13042

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychology Review*, *5*(2), 97–144.

https://doi.org/10.1080/17437199.2010.521684

McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. (2016). Meta-Analysis of the Reasoned Action Approach (RAA) to Understanding Health Behaviors. *Annals of Behavioral Medicine*, *50*(4), 592–612. https://doi.org/10.1007/s12160-016-9798-4

Mcevoy, P., & Richards, D. (2006). A critical realist rationale for using a combination of quantitative and qualitative methods. *Journal of Research in Nursing*, *11*(1), 66–78. https://doi.org/10.1177/1744987106060192

McLeod, S. (2014). The interview Method. Retrieved from Simply Psychology website: https://www.simplypsychology.org/interviews.html

McNeill, L.H., Wyrwich, K.W., Brownson, R.C., Clark, E.M. & Kreuter, M. W. (2006). Individual, social environmental, and physical environmental influences on physical activity among black and white adults: a structural equation analysis. *Annals of Behavioural Medicine*, *31*(1), 34–44. https://doi.org/10.1207/s15324796abm3101_7

McParlin, C., Bell, R., Robson, S. C., Muirhead, C. R., & Araújo-Soares, V. (2017). What helps or hinders midwives to implement physical activity guidelines for obese pregnant women? A questionnaire survey using the Theoretical Domains Framework. *Midwifery*, *49*, 110–116. https://doi.org/10.1016/j.midw.2016.09.015

McSherry, L. a, Dombrowski, S. U., Francis, J. J., Murphy, J., Martin, C. M., O'Leary, J. J., … Group, A. (2012). "It's a can of worms": understanding primary care practitioners' behaviours in relation to HPV using the theoretical domains framework. *Implementation Science*, *7*(1), 73. https://doi.org/10.1186/1748-5908-7-73

Meyer, P., Kayser, B., Kossovsky, M.P., Sigaud, P., Carballo, D., Keller, P.F., Martin, X.E, Farpour-Lambert, N., Pichard, C. & Mach, F. (2010). Stairs instead of elevators at workplace: cardioprotective effects of a pragmatic intervention. *European Journal of Cardiovascular Prevention and Rehabilitation*, *17*(5), 569–575. https://doi.org/10.1097/HJR.0b013e328338a4dd

Michie, S. (2008). Designing and implementing behaviour change interventions to improve population health. *Health Services Research*, *13*(October), 64–70. https://doi.org/10.1258/jhsrp.2008.008014

Michie, S. & Abraham, C. (2004). Interventions to change health behaviours: evidence-based or evidence-inspired? *Psychology & Health*, *19*(1), 29–49. https://doi.org/10.1080/0887044031000141199

Michie, S., Abraham, C., Whittington, C., McAteer, J. & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology*, *28*(6), 690–701. https://doi.org/http://dx.doi.org/10.1037/a0016136

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. *Psychology & Health*, *26*(11), 1479–1498. https://doi.org/10.1080/08870446.2010.540664

Michie, S., Atkins, L. & West, R. (2014). *The behaviour change wheel: A guide to designing interventions.* London: Silverback Publishing.

Michie, S., Hyder, N., Walia, A. &, & West, R. (2011). Development of a taxonomy of behaviour change techniques used in individual behavioural support for smoking cessation. *Addictive Behaviors*, *36*(4), 315–319. https://doi.org/10.1016/j.addbeh.2010.11.016

Michie, S. & Johnston, M. (2013). Behavior Change Techniques. In J. R. Gellman, M. & Turner (Ed.), *Encyclopedia of Behavioral Medicine* (pp. 182–187). New York: Springer.

Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., & Walker, A. (2005). Making psychological theory useful for implementing evidence based practice: a consensus approach. *Quality & Safety in Health Care*, *14*(1), 26–33. https://doi.org/10.1136/qshc.2004.011155

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology: An International Review*, *57*(4), 660–680. Retrieved from http://aura.abdn.ac.uk/bitstream/handle/2164/302/Michie 2008.pdf?sequence=1&isAllowed=y

Michie, S. & Prestwich, A. (2010). Are interventions theory-based? Development of a theory coding scheme. *Health Psychology*, *29*(1), 1–8. https://doi.org/10.1037/a0016939

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M.P., Cane, J., & Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, *46*(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6

Michie, S., van Stralen, M.M., &, & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*(1), 42. https://doi.org/10.1186/1748-5908-6-42

Michie, S., West, R., Sheals, K., &, & Godinho, C. A. (2018). Evaluating the effectiveness of behavior change techniques in health-related behavior: A scoping review of methods used. *Translational Behavioral Medicine*, *8*(2), 212–224. https://doi.org/10.1093/tbm/ibx019

Michie, S., Whittington, C., Hamoudi, Z., Zarnani, F., Tober, G, & West, R. (2012). Identification of behaviour change techniques to reduce excessive alcohol consumption. *Addiction*, *107*(8), 1431–1440. https://doi.org/10.1111/j.1360-0443.2012.03845.x

Milne, S., Orbell, S., & Sheeran, P. (2002). Combining motivational and volitional interventions to promote exercise participation : Protection motivation theory and implementation intentions. *British Journal of Health Psychology*, *7*(2), 163–184. https://doi.org/10.1348/135910702169420

Mingers, J. (2004). Real-izing information systems: Critical realism as an underpinning philosophy for information systems. *Information and Organization*, *14*(2), 87–103. https://doi.org/10.1016/j.infoandorg.2003.06.001

Mirbaha, F., Shalviri, G., Yazdizadeh, B., Gholami, K., & Majdzadeh, R. (2015). Perceived barriers to reporting adverse drug events in hospitals: a qualitative study using theoretical domains framework approach. *Implementation Science*, *10*(1), 110. https://doi.org/10.1186/s13012-015-0302-5

Moayyeri, A. (2008). The Association Between Physical Activity and Osteoporotic Fractures:

A Review of the Evidence and Implications for Future Research. *Annals of Epidemiology*, *18*(11), 827–835. https://doi.org/10.1016/j.annepidem.2008.08.007

Mohammed, G., Salmiah, M. S., Ahmad Azuhairi, A., & Jusoff, K. (2014). Physical Inactivity and Its Associated Factors among University Students. *IOSR Journal of Dental and Medical Sciences*, *13*(10), 119–130. https://doi.org/10.9790/0853-13101119130

Moore, G. F., & Evans, R. E. (2017). What theory, for whom and in which context? Reflections on the application of theory in the development and evaluation of complex population health interventions. *SSM - Population Health*, *3*, 132–135. https://doi.org/10.1016/j.ssmph.2016.12.005

Moore, S. C., Patel, A. V., Matthews, C. E., Berrington de Gonzalez, A., Park, Y., Katki, H. A., … Lee, I. M. (2012). Leisure Time Physical Activity of Moderate to Vigorous Intensity and Mortality: A Large Pooled Cohort Analysis. *PLoS Medicine*, *9*(11), 1–14. https://doi.org/10.1371/journal.pmed.1001335

Moreira-Silva, I., Mota, J., Abreu, S., & Alves, S. (2017). The Effects of Workplace Physical Activity Programs in Musculoskeletal Pain : A Systematic review. *Medical Safety & Global Health*, *6*(2), 1–7. https://doi.org/10.4172/2574-0407/1000136

Moreira-Silva, I., Teixeira, P. M., Santos, R., Abreu, S., Moreira, C., & Mota, J. (2016). The effects of workplace physical activity programs on musculoskeletal pain: A systematic review and meta-analysis. *Workplace Health and Safety*, *64*(5), 210–222. https://doi.org/10.1177/2165079916629688

Morgan, D. L. (1997). *Focus groups as qualitative research Methods Series 16* (2nd ed.). Thousand Oaks, CA: Sage.

Morrish, L. (2019). Pressure Vessels: The epidemic of poor mental health among higher education staff. In *Higher Education Policy Institute*. Retrieved from https://www.hepi.ac.uk/wp-content/uploads/2019/05/HEPI-Pressure-Vessels-Occasional-Paper-20.pdf

Morrow, J. R., Krzewinski-Malone, J. A., Jackson, A. W., Bungum, T. J., & Fitzgerald, S. J. (2004). American Adults' Knowledge of Exercise Recommendations. *Research Quarterly for Exercise and Sport*, *75*(3), 231–237. https://doi.org/10.1080/02701367.2004.10609156

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification Strategies for Establishing Reliability and Validity in Qualitative Research. *International Journal of Qualitative Methods*, *1*(2), 13–22. https://doi.org/10.1177/160940690200100202

Motl, R. W., Dishman, R. K., Saunders, R. P., Dowda, M., & Pate, R. R. (2007). Perceptions of physical and social environment variables and self-efficacy as correlates of self-reported physical activity among adolescent girls. *Journal of Pediatric Psychology*, *32*(1), 6–12. https://doi.org/10.1093/jpepsy/jsl001

Mozaffarian, D., Afshin, A., Benowitz, N. L., Bittner, V., Daniels, S. R., Franch, H. A., … Zakai, N. A. (2012). Population approaches to improve diet, physical activity, and smoking habits: A scientific statement from the American heart association. *Circulation*, *126*(12), 1514–1563. https://doi.org/10.1161/CIR.0b013e318260a20b

Mumu, S.J., Ali, L., Barnett, A. & Merom, D. (2017). Validity of the global physical activity questionnaire (GPAQ) in Bangladesh. *BMC Public Health*, *17*, 650. https://doi.org/10.1186/s12889-017-4666-0

Munir, F., Biddle, S. J. H., Davies, M. J., Dunstan, D., Esliger, D., Gray, L. J., … Edwardson, C. L. (2018). Stand More at Work (SMArT Work): Using the behaviour change wheel to develop an intervention to reduce sitting time in the workplace. *BMC Public Health*, *18*(1), 1–15. https://doi.org/10.1186/s12889-018-5187-1

Murphy, M. H., Carlin, A., Woods, C., Nevill, A., MacDonncha, C., Ferguson, K., & Murphy, N. (2018). Active Students Are Healthier and Happier Than Their Inactive Peers: The Results of a Large Representative Cross-Sectional Study of University Students in Ireland. *Journal of Physical Activity and Health*, *15*(10), 737–746. https://doi.org/10.1123/jpah.2017-0432

Murphy, J. J., Murphy, M. H., MacDonncha, C., Murphy, N., Nevill, A. M., & Woods, C. B. (2017). Validity and Reliability of Three Self-Report Instruments for Assessing Attainment of Physical Activity Guidelines in University Students. *Measurement in Physical Education and Exercise Science*, *21*(3), 134–141. https://doi.org/10.1080/1091367X.2017.1297711

Murray, J. M., Brennan, S. F., French, D. P., Patterson, C. C., Kee, F., & Hunter, R. F. (2017). Effectiveness of physical activity interventions in achieving behaviour change maintenance in young and middle aged adults: A systematic review and meta-analysis. *Social Science and Medicine*, *192*, 125–133. https://doi.org/10.1016/j.socscimed.2017.09.021

Murray, T.C., Rodgers, W.M., & Fraser, S. N. (2009). Examining Implementation Intentions in an Exercise Intervention : The Effects on Adherence and Self-Efficacy in a Naturalistic Setting 1. *Journal of Applied Social Psychology*, *39*(10), 2303–2320.

Musharrafieh, U., Tamim, H. M., Rahi, A. C., El-Hajj, M. A., Al-Sahab, B., El-Asmar, K., & Tamim, H. M. (2008). Determinants of university students physical exercise: A study from Lebanon. *International Journal of Public Health*, *53*(4), 208–213. https://doi.org/10.1007/s00038-008-7037-x

Must, a, & Tybor, D. J. (2005). Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth. *International Journal of Obesity (2005)*, *29*(Suppl 2), S84–S96. https://doi.org/10.1038/sj.ijo.0803064

Mwangi, F. M., Rintaugu, E. G., Mwangi, F. M., & Rintaugu, E. G. (2017). Physical Activity and Health Related Physical Fitness Attributes of Staff Members in a Kenyan Public University. *International Journal of Sports Science*, *7*(2), 81–86. https://doi.org/10.5923/j.sports.20170702.09

Myers, J. (2003). Exercise and Cardiovascular Health. *Circulation*, *107*(1), 2e–5. https://doi.org/10.1161/01.CIR.0000048890.59383.8D

Nagle, B. & Williams, N. (2011). Methodology Brief : Introduction to Focus Groups. Retrieved July 31, 2017, from Center for Assessment, Planning & Accountability website: http://www.uncfsp.org/projects/userfiles/File/FocusGroupBrief.pdf

National Institute for Health and Care Execellence. (2014). *Behaviour change : individual approaches*. Retrieved from https://www.nice.org.uk/guidance/ph49/resources/behaviour-change-individual-approaches-1996366337989

NHS. (2019). CMO announces major new exercise guidelines. Retrieved December 3, 2019, from NHS website: http://www.sportandphysicalactivity.nhs.uk.iw-temp.co.uk/cmoguidelines.asp

NHS Digital. (2017). Health Survey for England, 2016. Retrieved January 16, 2018, from NHS Digital website: http://digital.nhs.uk/catalogue/PUB30169

NHS Digital. (2019). Statistics on Obesity, Physical Activity and Diet, England, 2019. Retrieved January 6, 2020, from NHS Digital website: https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity-physical-activity-and-diet/statistics-on-obesity-physical-activity-and-diet-england-2019/part-5-adult-physical-activity

Nisbett, R.E. & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Reports*, *84*(3), 231–259.

Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin*, *133*(4), 673–693. https://doi.org/10.1037/0033-2909.133.4.673

Noar, S. M., & Zimmerman, R. S. (2005). Health Behavior Theory and cumulative knowledge regarding health behaviors: Are we moving in the right direction? *Health Education Research*, *20*(3), 275–290. https://doi.org/10.1093/her/cyg113

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing*, *18*(2), 34–35. https://doi.org/10.1136/eb-2015-102054

Norton, L. H., Norton, K. I., Lewis, N., & Dollman, J. (2011). A comparison of two short-term intensive physical activity interventions: Methodological considerations. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 133. https://doi.org/10.1186/1479-5868-8-133

Nunnally J, B. L. (1994). *Psychometric theory*. New York: McGraw-Hill Higher, INC.

Nwana, O. C. (2007). *Textbook on Educational Measurement and Evaluation*. Owerri: Bomaway Publishers.

Office for National Statistics. (2017). *Statistics on Obesity, Physical Activity and Diet. England 2017*. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/613532/obes-phys-acti-diet-eng-2017-rep.pdf

Ogden, J. (2016). Celebrating variability and a call to limit systematisation: the example of the Behaviour Change Technique Taxonomy and the Behaviour Change Wheel. *Health Psychology Review*, *10*(3), 245–250. https://doi.org/10.1080/17437199.2016.1190291

Ojo, S. O., Bailey, D. P., Brierley, M. L., Hewson, D. J., & Chater, A. M. (2019). Breaking barriers: Using the behavior change wheel to develop a tailored intervention to overcome workplace inhibitors to breaking up sitting time. *BMC Public Health*, *19*(1), 1–17. https://doi.org/10.1186/s12889-019-7468-8

Okazaki, S., Lee, R. M., & Sue, S. (2007). Theoretical and conceptual models: Toward Asian Americanist psychology. In M. Leong, F.T.L., Inman, A., Ebreo, A., Yang, L., Kinoshita, L., & Fu (Ed.), *Handbook of Asian American psychology* (2nd ed, pp. 29–46). Thousand Oaks, CA: Sage.

Okazaki, K., Okano, S., Haga, S., Seki, A., Suzuki, H., & Takahashi, K. (2014). One-year outcome of an interactive internet-based physical activity intervention among university students. *International Journal of Medical Informatics*, *83*(5), 354–360. https://doi.org/10.1016/j.ijmedinf.2014.01.012

Olagbegi, O. M., Adegoke, B. O., Christie, C. J. A., Bolarinde, O. S., & Jegede, J. A. (2017). Effects of an Eight-Week Stepladder Exercise Protocol on Lower Limb Muscular Strength of Apparently Healthy Young Adults. *Human Movement*, *18*(3), 60–66. https://doi.org/10.1515/humo-2017-0026

Oliveira, A. J., Lopes, C. S., de Leon, A., Rostila, M., Griep, R. H., Werneck, G. L., & Faerstein, E. (2011). Social support and leisure-time physical activity: longitudinal evidence from the Brazilian Pró-Saúde cohort study. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 77. https://doi.org/10.1186/1479-5868-8-77

Olsen, W. (2002). Dialectical Triangulation and Empirical Research. *IACR Annual Conference*. Bradford: University of Bradford.

Onken, L. S., Carroll, K. M., Shoham, V., Cuthbert, B. N., & Riddle, M. (2014). Reenvisioning Clinical Science: Unifying the Discipline to Improve the Public Health. *Clinical Psychological Science*, *2*(1), 22–34. https://doi.org/10.1177/2167702613497932

Onwuegbuzie, A.J. & Collins, K. M. (2007). A Mixed Methods Investigation of Mixed Methods Sampling Designs in Social and Health Science Research. *Journal of Mixed Methods Research*, *1*(3), 267–294. https://doi.org/10.1177/1558689807299526

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2007). Toward more rigor in focus group research: A new framework for collecting and analyzing focus group data. *Annual Meeting of the Southwest Educational Research Association*. San Antonio, TX: Southwest Educational Research Association.

Orbell, S., Hodgkins, S., & Sheeran, P. (1997). Implementation Intentions and the Theory of Planned Behavior. *Personality and Social Psychology Bulletin*, *23*(9), 945–954. https://doi.org/10.1177/0146167297239004

Orbell, S., & Sheeran, P. (1998). "Inclined abstainers": A problem for predicting health-related behaviour. *British Journal of Social Psychology*, *37*(2), 151–165.

Orozco, L.J., Buchleitner, A.M., Gimenez-Perez, G., Roqué I Figuls, M., Richter, B. & Mauricio, D. (2008). Exercise or exercise and diet for preventing type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews*, *16*(3), CD003054. https://doi.org/10.1002/14651858.CD003054.pub3.

Oxfordshire Sport and Physical Activity. (2016). Stats and Facts. Retrieved June 12, 2018, from Oxfordshire Sport and Physical Activity website: https://www.getoxfordshireactive.org/stats-and-facts

Oyeyemi, A. L., Oyeyemi, A. Y., Jidda, Z. A., & Babagana, F. (2013). Prevalence of Physical Activity Among Adults in a Metropolitan Nigerian City: A Cross-Sectional Study. *Journal of Epidemiology*, *23*(3), 169–177. https://doi.org/10.2188/jea.je20120116

Palinkas, L. A., Aarons, G. A., Horwitz, S., Chamberlain, P., Hurlburt, M., & Landsverk, J. (2011). Mixed method designs in implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, *38*(1), 44–53.

https://doi.org/10.1007/s10488-010-0314-z

Pallant, J. (2011). *A Step by Step Guide to Data Analysis Using the SPSS Program: Survival Manual*. Berkshire: McGraw-Hill.

Pan, X. R., Li, G. W., Hu, Y. H., Wang, J. X., Yang, W. Y., An, Z. X., … Howard, B. V. (1997). Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: The Da Qing IGT and diabetes study. *Diabetes Care*, *20*(4), 537–544. https://doi.org/10.2337/diacare.20.4.537

Papalia, Z., Wilson, O., Bopp, M., & Duffey, M. (2018). Technology-Based Physical Activity Self-Monitoring Among College Students. *International Journal of Exercise Science*, *11*(7), 1096–1104. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6179427/

Parrott, M. W., Keith, L., Olejnik, S., & Poudevigne, M. S. (2008). Theory of Planned Behavior : Implications for an email-based physical activity intervention. *Psychology of Sport and Exercise*, *9*, 511–526. https://doi.org/10.1016/j.psychsport.2007.07.002

Patey, A. M., Islam, R., Francis, J. J., Bryson, G. L., & Grimshaw, J. M. (2012). Anesthesiologists' and surgeons' perceptions about routine pre-operative testing in low-risk patients: application of the Theoretical Domains Framework (TDF) to identify factors that influence physicians' decisions to order pre-operative tests. *Implementation Science : IS*, *7*(1), 52. https://doi.org/10.1186/1748-5908-7-52

Patrick, R.P. & Ames, B. N. (2015). Vitamin D and the omega-3 fatty acids control serotonin synthesis and action, part 2: relevance for ADHD, bipolar disorder, schizophrenia, and impulsive behavior. *FASEB Journal*, *29*(6), 2207–2222.

Patton, M. Q. (2002). *Qualitative Evaluation Methods*. Thousand Oaks, CA: Sage Publications.

Pauline, J. S. (2013). Physical Activity Behaviors, Motivation, and Self-Efficacy among College Students. *College Student Journal*, *47*(1), 64–74.

Pedrelli, P., Nyer, M., Yeung, A., Zulauf, C., & Wilens, T. (2015). College Students: Mental Health Problems and Treatment Considerations. *Academic Psychiatry*, *39*(5), 503–511. https://doi.org/10.1007/s40596-014-0205-9.College

Pekmezi, D., Jennings, E. & Marcus, B. H. (2009). Evaluating and Enhancing Self-efficacy for Physical Activity. *ACSM'S Health and Fitness Journal*, *13*(2), 16–21. https://doi.org/10.1016/j.physbeh.2017.03.040

Pengpid, S., Peltzer, K., Kassean, H. K., Tsala Tsala, J. P., Sychareun, V., & Müller-Riemenschneider, F. (2015). Physical inactivity and associated factors among university students in 23 low-, middle- and high-income countries. *International Journal of Public Health*, *60*(5), 539–549. https://doi.org/10.1007/s00038-015-0680-0

Penn, L., Dombrowski, S. U., Sniehotta, F. F., & White, M. (2013). Participants' perspectives on making and maintaining behavioural changes in a lifestyle intervention for type 2 diabetes prevention: A qualitative study using the theory domain framework. *BMJ Open*, *3*(6). https://doi.org/10.1136/bmjopen-2013-002949

Perraton, L.G., Kumar, S. & Machotka, Z. (2010). Exercise parameters in the treatment of clinical depression: a systematic review of randomized controlled trials. *Journal of Evaluation in Clinical Practice*, *16*(3), 597–604. https://doi.org/0.1111/j.1365-

2753.2009.01188.x

Petruzzello, S. J., Landers, D. M., Hatfield, B. D., Kubitz, K. A., & Salazar, W. (1991). A Meta-Analysis on the Anxiety-Reducing Effects of Acute and Chronic Exercise: Outcomes and Mechanisms. *Sports Medicine*, *11*(3), 143–182. https://doi.org/10.2165/00007256-199111030-00002

Petty, R.E. & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (19th ed., pp. 123–205). New York: Academic Press.

Philip, L. J. (1998). Combining Quantitative and Qualitative Approaches to Social Research in Human Geography—An Impossible Mixture? *Environment and Planning A*, *30*(2), 261–276. https://doi.org/https://doi.org/10.1068/a300261

Physical Activity Intervention Research Laboratory. (2015). Relapse prevention. Retrieved November 6, 2020, from Kansas State University website: https://www.hhs.k-state.edu/kines/labs/Relapse prevention.pdf

Plotnikoff, R.C., Brunet, S., Courneya, K.S., Spence, J.C., Birkett, N.J., Marcus B. & Whiteley, J. (2007). The efficacy of stage-matched and standard public health materials for promoting physical activity in the workplace: the Physical Activity Workplace Study (PAWS). *American Journal of Health Promotion*, *21*(6), 501–509. https://doi.org/https://doi.org/10.4278/0890-1171-21.6.501

Plotnikoff, R. C., Costigan, S. A., Williams, R. L., Hutchesson, M. J., Kennedy, S. G., Robards, S. L., … Germov, J. (2015). Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 45. https://doi.org/10.1186/s12966-015-0203-7

Plotnikoff, R.C., Lipkke, S., Johnson, S.T. & Hugo, K. (2011). Awareness of Canada’s Physical Activity Guide to Healthy Active Living in a Large Community Sample. *American Journal of Health Promotion*, *25*(2), 294–297.

Plotnikoff, R. C., McCargar, L. J., Wilson, P. M., & Loucaides, C. A. (2005). Efficacy of an e-mail intervention for the promotion of physical activity and nutrition behavior in the workplace context. *American Journal of Health Promotion*, *19*(6), 422–429. https://doi.org/10.4278/0890-1171-19.6.422

Power, B. T., Kiezebrink, K., Allan, J. L., & Campbell, M. K. (2017). Understanding perceived determinants of nurses’ eating and physical activity behaviour: a theory-informed qualitative interview study. *BMC Obesity*, *4*, 1–12. https://doi.org/10.1186/s40608-017-0154-4

Pratschke, J. (2003). Realistic Models? Critical Realism and Statistical Models in the Social Sciences. *Philosophica*, *71*(January 2003), 13–38. Retrieved from https://www.academia.edu/21033541/Realistic_models_Critical_realism_and_statistical_models_in_the_social_sciences

Prestwich, A., Ayres, K., & Lawton, R. (2008). Social Science & Medicine Crossing two types of implementation intentions with a protection motivation intervention for the reduction of saturated fat intake : A randomized trial. *Social Science and Medicine Medicine*, *67*, 1550–1558. https://doi.org/10.1016/j.socscimed.2008.07.019

Prestwich, A., & Kellar, I. (2014). How can the impact of implementation intentions as a behaviour change intervention be improved ? *Revue Europeenne de Psychologie Appliquee*, *64*(1), 35–41. https://doi.org/10.1016/j.erap.2010.03.003

Prestwich, A., Lawton, R., & Conner, M. (2003). The use of implementation intentions and the decision balance sheet in promoting exercise behaviour. *Psychology and Health Health*, *18*(6), 707–721.

Prestwich, A., Sniehotta, F. F., Whittington, C., Dombrowski, S. U., Rogers, L., & Michie, S. (2014). Does theory influence the effectiveness of health behavior interventions? Meta-analysis. *Health Psychology*, *33*(5), 465–474. https://doi.org/10.1037/a0032853

Prince, S. A., Adamo, K. B., Hamel, M., Hardt, J., Gorber, S., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *5*(1), 56. https://doi.org/10.1186/1479-5868-5-56

Prochaska, J.O. & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Cilinical Psychology*, *51*(3), 390–395. https://doi.org/10.1037/0022-006X.51.3.390

Prochaska, J.O. & DiClemente, C. C. (1992). Stages of change in the modification of problem behaviors. *Progress in Behavior Modification*, *28*, 183–218.

Prochaska, J.O., Redding, C.A. & Evers, K. E. (1996). The transtheoretical model and stages of change. In B. Glanz, F.; Marcus Lewis, F.; Rimer (Ed.), *Health Behavior and Health Education: Theory, Research, and Practice* (pp. 60–84). San Francisco: Mossy-Bass.

Pronk, N. P. (2009). Physical activity promotion in business and industry: evidence, context, and recommendations for a national plan. *Journal of Physical Activity & Health*, *6 Suppl 2*(Suppl 2), S220-35. https://doi.org/10.1123/jpah.6.s2.s220

Proper, K., & Van Mechelen, W. (2007). Effectiveness and economic impact of worksite interventions to promote physical activity and healthy diet. In *World Health Organization*. Retrieved from https://www.who.int/dietphysicalactivity/Proper_K.pdf?ua=1

Public Health England. (2018). Why are musculoskeletal conditions the biggest contributor to morbidity? Retrieved September 4, 2020, from Public Health England website: https://publichealthmatters.blog.gov.uk/2019/03/11/why-are-musculoskeletal-conditions-the-biggest-contributor-to-morbidity/

Pugh, J.D., Cormack, K., Gelder, L., Williams, A.M., Twigg, D.E. & Blazevich, A. J. (2019). Exercise, fitness and musculoskeletal health of undergraduate nursing students: A cross-sectional study. *Journal of Advanced Nursing*, *7*(10). https://doi.org/https://doi.org/10.1111/jan.13990

Quigley, A., Baxter, L., Keeler, L., & MacKay-Lyons, M. (2019). Using the Theoretical Domains Framework to identify barriers and facilitators to exercise among older adults living with HIV. *AIDS Care-Psychological and Socio-Medical Aspects of AIDS/HIV*, *31*(2), 163–168. https://doi.org/10.1080/09540121.2018.1499860

Quintiliani, L. M., Campbell, M. K., Bowling, J. M., Steck, S., Haines, P. S., & Devellis, B. M. (2010). Results of a Randomized Trial Testing Messages Tailored to Participant-Selected Topics Among Female College Students : Physical Activity Outcomes. *Journal* *of Physical Activity and Health*, *7*, 517–526.

Rajappan, R., Selvaganapathy, K., & Liew, L. (2015). Physical Activity Level Among University Students: a Cross Sectional Survey. *International Journal of Physiotherapy and Research*, *3*(6), 1336–1343. https://doi.org/10.16965/ijpr.2015.202

Ramírez-Vélez, R., Tordecilla-Sanders, A., Laverde, D., Hernández-Novoa, J. G., Ríos, M., Rubio, F., … Martinez-Torres, J. (2014). The prevalence of barriers for Colombian college students engaging in physical activity. *Nutrición Hospitalaria*, *31*(2), 858–865. https://doi.org/10.3305/nh.2015.31.2.7737

Rebar, A. L., Rhodes, R. E., & Gardner, B. (2019). How we are misinterpreting physical activity intention - Behavior relations and what to do about it. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 1–13. https://doi.org/10.1186/s12966-019-0829-y

Regmi, S., Sharma, I., KC, A., & Mahato, P. (2016). Prevalence of Risk Factors for Cardiovascular Diseases among Employees of Academic Institutions in Pokhara Sub-Metropolitan, Nepal. *International Journal of Health Sciences & Research*, *2346*(5). Retrieved from http://www.ijhsr.org/IJHSR_Vol.6_Issue.5_May2016/35.pdf

Reiner, M., Niermann, C., Jekauc, D., & Woll, A. (2013). Long-term health benefits of physical activity--a systematic review of longitudinal studies. *BMC Public Health*, *13*(1), 813. https://doi.org/10.1186/1471-2458-13-813

Resnick, B., Orwig, D., Magaziner, J., & Wynne, C. (2002). The effect of social support on exercise behavior in older adults. *Clinical Nursing Research*, *11*(1), 52–70. https://doi.org/10.1177/105477380201100105

Rhodes, R. & Courneya, K. S. (2003). Investigating Multiple Components of Attitude, Subjective Norm, and Perceived Control: An Examination of the Theory of Planned Behaviour in the Exercise Domain. *British Journal of Social Psychology*, *42*(Pt 1), 129–146. https://doi.org/10.1348/014466603763276162

Rhodes, R.E. & Dickau, L. (2012). Experimental evidence for the intention-behavior relationship in the physical activity domain: a meta-analysis. *Health Psychology*, *31*(6), 724–727. https://doi.org/10.1037/a0027290

Riddell, N. S., Baskerville, R., & Castell, L. M. (2019). Physical Activity Behaviours in the Workplace and Home in a University College Population. *Physical Activity and Health*, *3*(1), 23–30. https://doi.org/10.5334/paah.30

Rimer, J., Dwan, K., Lawlor, D.A., Greig, C.A., McMurdo, M., Morley, W. & Mead, G. E. (2012). Exercise for depression. *Cochrane Database of Systematic Reviews*, *11*(7), CD004366. https://doi.org/10.1002/14651858.CD004366.pub5

Rissel, C., Mulley, C., & Ding, D. (2013). Travel mode and physical activity at Sydney University. *International Journal of Environmental Research and Public Health*, *10*(8), 3563–3577. https://doi.org/10.3390/ijerph10083563

Riviere, F., Widad, F.Z., Speyer, E., Erpelding, M.L., Escalon, H. & Vuillemin, A. (2016). Reliability and validity of the French version of the global physical activity questionnaire. *Journal of Sport and Health Science*, 1–7. Retrieved from background: The Global Physical Activity Questionnaire (GPAQ) has been used to measure physical activity (PA) and sedentary time in France,%0Abut no study has assessed its psychometric properties. This study aimed to compare the reliability as well as cri

Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. C. & R. Petty. (Ed.), *Social psychophysiology* (pp. 153–176). New York: Guilford Press.

Romaguera, D., Tauler, P., Bennasar, M., Pericas, J., Moreno, C., Martinez, S., & Aguilo, A. (2011). Determinants and patterns of physical activity practice among Spanish university students. *Journal of Sports Sciences*, *29*(9), 989–997. https://doi.org/10.1080/02640414.2011.578149

Rote, A. E., Klos, L. A., Brondino, M. J., Harley, A. E., & Swartz, A. M. (2015). The Efficacy of a Walking Intervention Using Social Media to Increase Physical Activity: A Randomized Trial. *Journal of Physical Activity and Health*, *12*(s1), S18–S25. https://doi.org/10.1123/jpah.2014-0279

Rothman, A. J. (2004). “Is there nothing more practical than a good theory?”: Why innovations and advances in health behavior change will arise if interventions are used to test and refine theory. *International Journal of Behavioral Nutrition and Physical Activity*, *1*(1), 11. https://doi.org/10.1186/1479-5868-1-11

Rothman, A. J. (2009). Capitalizing on Opportunities to Refine Health Behavior Theories. *Health Education & Behavior*, *36*(5_suppl), 150S–155S. https://doi.org/10.1177/1090198109340514

Roumen, C., Blaak, E.E. & Corpeleijn, E. (2009). Lifestyle intervention for prevention of diabetes: determinants of success for future implementation. *Nutrition Reviews, 67*(3), 132–146. https://doi.org/10.1111/j.1753-4887.2009.00181.x

Ruff, R. R., Rosenblum, R., Fischer, S., Meghani, H., Adamic, J., & Lee, K. K. (2014). Associations between building design, point-of-decision stair prompts, and stair use in urban worksites. *Preventive Medicine*, *60*, 60–64. https://doi.org/10.1016/j.ypmed.2013.12.006

Ruiz-Casado, A., Alejo, L.B., Santos-Lozano, A., Soria, A., Ortega, M.J., Pagola, I., Fiuza-Luces, C., Palomo, I., Garatachea, N., Cebolla, H. & Lucia, A. (2016). Validity of the Physical Activity Questionnaires IPAQ-SF and GPAQ for Cancer Survivors: Insights from a Spanish Cohort. *International Journal of Sports Medicine, 37*(12), 979–985.

Saadan, R., Jano, Z., Sidek, S., Bokhari, M., & Rosli, N. (2015). Perceived Barriers in Physical Activities. *Journal of Human Capital Development*, *8*(1), 39–45.

Sallis, J. F., Bull, F., Guthold, R., Heath, G. W., Inoue, S., Kelly, P., … Hallal, P. C. (2016). Progress in physical activity over the Olympic quadrennium. *The Lancet*, *388*(10051), 1325–1336. https://doi.org/10.1016/S0140-6736(16)30581-5

Sallis, J. F., Owen, N., & Fisher, E. B. (2008). Ecological models of health behavior. In K. Glanz, K., Rime,r B.K, & Viswanath (Ed.), *Health Behavior and Health Education: Theory, Research, and Practice* (4th ed., pp. 465–486). https://doi.org/10.7326/0003-4819-116-4-350_1

Salvo, G., Lashewicz, B. M., Doyle-Baker, P. K., & McCormack, G. R. (2018). A mixed methods study on the barriers and facilitators of physical activity associated with residential relocation. *Journal of Environmental and Public Health, 2018*. https://doi.org/10.1155/2018/1094812

Samdal, G. B., Eide, G. E., Barth, T., Williams, G., & Meland, E. (2017). Effective behaviour change techniques for physical activity and healthy eating in overweight and obese adults; systematic review and meta-regression analyses. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 1–14. https://doi.org/10.1186/s12966-017-0494-y

Sandelowski, M. (1993). Rigor or rigor mortis: The problem of rigor in qualitative research revisited. *Advances in Nursing Science*, *16*(2), 1–8. https://doi.org/10.1097/00012272-199312000-00002

Sandelowski, M. (1995). Sample size in qualitative research. *Research in Nursing & Health*, *18*(2), 179–183. https://doi.org/10.1002/nur.4770180211

Sattelmair, J., Pertman, J., Ding, E. L., Kohl, H. W., Haskell, W., & Lee, I. M. (2011). Dose response between physical activity and risk of coronary heart disease: A meta-analysis. *Circulation*, *124*(7), 789–795. https://doi.org/10.1161/CIRCULATIONAHA.110.010710

Saunders, M., Lewis, P., & Thornhill, A. (2009). Understanding research philosophy and approaches to theory development. Retrieved August 13, 2019, from ResearchGate website: file:///C:/Users/stf2408/Downloads/Research_Methods_for_Business_Students_C.pdf

Saunders, M., Lewis, P. & Thornhill, A. (2016). *Research methods for business students*. Munich: Pearson Education Limited.

Saunders, M.N.K., Lewis, P. & Thornhill, A. (2019). *Research Methods for Business Students* (8th ed.). Retrieved from file:///C:/Users/stf2408/Downloads/2019RMB8Chapter4-compressed.pdf

Schreier, M. (2012). *Qualitative Content Analysis in Practice*. London: Sage.

Schröer, S., Haupt, J., & Pieper, C. (2014). Evidence-based lifestyle interventions in the workplace-an overview. *Occupational Medicine*, *64*(1), 8–12. https://doi.org/10.1093/occmed/kqt136

Schwarzer, R. (1992). Self-Efficacy in the Adoption and Maintenance of Health Behaviors: Theoretical Approaches and a New Model. In R. Schwarzer (Ed.), *Self-Efficacy: Thought Control of Action* (pp. 217–243). Washington, DC: Hemisphere.

Schwarzer, R., Lippke, S., & Luszczynska, A. (2011). Mechanisms of Health Behavior Change in Persons With Chronic Illness or Disability: The Health Action Process Approach (HAPA). *Rehabilitation Psychology*, *56*(3), 161–170. https://doi.org/10.1037/a0024509

Scriven , A. & Hodgins, M. (2012). *Health Promotion Settings. Principles and Practice*. London: Sage.

Seun, L.J., Huang, H.M. & Lee, H. H. (2014). A comparison of convenience sampling and purposive sampling. *The Journal of Nursing*, *61*(3), 105–111. https://doi.org/10.6224/JN.61.3.105

Shah, H., Dhami, H., & Shah, T. (2016). Assessment of physical activity level in female students of residential college using global physical activity questionnaire: A cross sectional analysis. *International Journal of Current Research and Reviews*, *8*(13), 24–27.

Sharifzadeh, M. (2013). Does Fitness and Exercises Increase Productivity? Assessing Health, Fitness and Productivity Relationship. *American Journal of Management*, *13*(1), 32–52. Retrieved from http://www.na-businesspress.com/AJM/SharifzadehM_Web13_1_.pdf

Sharp, P. & Caperchione, C. (2016). The effects of a pedometer-based intervention on first-year university students: A randomized control trial. *Journal of American College Health*, *64*(8), 630–638.

Sheeran, P. (2002). Intention—Behavior Relations: A Conceptual and Empirical Review. *European Review of Social Psychology*, *12*(1), 1–36. https://doi.org/10.1080/14792772143000003

Sheeran, P. & Orbell, S. (1999). Implementation intentions and repeated behaviour: Augmenting the predictive validity of the theory of planned behavior. *European Journal of Social Psychology*, *29*(2–3), 349–369. https://doi.org/10.1002/(SICI)1099-0992(199903/05)29

Sheeran, P., & Silverman, M. (2003). Evaluation of three interventions to promote workplace health and safety: Evidence for the utility of implementation intentions. *Social Science and Medicine*, *56*(10), 2153–2163. https://doi.org/10.1016/S0277-9536(02)00220-4

Shilts, M. K., Horowitz, M., & Townsend, M. S. (2004). Goal setting as a strategy for dietary and physical activity behavior change: a review of the literature. *American Journal of Health Promotion : AJHP*, *19*(2), 81–93. https://doi.org/10.4278/0890-1171-19.2.81

Shuttleworth, M. (2015). Internal Consistency Reliability. Retrieved October 1, 2019, from Explorable website: https://explorable.com/node/495/discuss

Simons, D., Clarys, P., De Bourdeaudhuij, I., de Geus, B., Vandelanotte, C., & Deforche, B. (2014). Why do young adults choose different transport modes? A focus group study. *Transport Policy*, *36*, 151–159. https://doi.org/10.1016/j.tranpol.2014.08.009

Sims, S. R., Nelson, B., Lanza, K., Lozano, J., & Amonette, W. E. (2017). Physical Activity , Park , Nature Trail Usage among Students , Faculty and Staff at a Mid-sized University. *International Journal of Exercise Science*, *2*(9), 59.

Singer, E., & Ye, C. (2013). The Use and Effects of Incentives in Surveys. *Annals of the American Academy of Political and Social Science*, *645*(1), 112–141. https://doi.org/10.1177/0002716212458082

Sissons, A., Grant, A., Kirkland, A., & Currie, S. (2020). Using the theoretical domains framework to explore primary health care practitioner's perspectives and experiences of preconception physical activity guidance and promotion. *Psychology, Health and Medicine*, *25*(7), 844–854. https://doi.org/10.1080/13548506.2019.1679846

Skår, S., Sniehotta, F. F., Molloy, G. J., Prestwich, A., & Araújo-Soares, V. (2011). Do brief online planning interventions increase physical activity amongst university students? A randomised controlled trial. *Psychology and Health*, *26*(4), 399–417. https://doi.org/10.1080/08870440903456877

Slevin, E., & Sines, D. (2000). Enhancing the truthfulness, consistency and transferability of a qualitative study: utilising a manifold of approaches. *Nurse Researcher*, *7*(2), 79–98.

Small, M. & Morgan, N. (2014). Changes in Eating and Physical Activity Behaviors Across Seven Semesters of College: Living On or Off Campus Matters. *Health Education and Behavior*, *40*(4), 435–441. https://doi.org/10.1177/1090198112467801.Changes

Soler, R. E., Leeks, K. D., Buchanan, L. R., Brownson, R. C., Heath, G. W., & Hopkins, D. H. (2010). Point-of-Decision Prompts to Increase Stair Use. A Systematic Review Update. *American Journal of Preventive Medicine*, *38*(2 SUPPL.), S292–S300. https://doi.org/10.1016/j.amepre.2009.10.028

Spalek, B. (2021). The forgotten mental health crisis: pressures on staff. Retrieved June 26, 2021, from University World News website: https://www.universityworldnews.com/post.php?story=20210111140929866

Speake, H., Copeland, R. J., Till, S. H., Breckon, J. D., Haake, S., & Hart, O. (2016). Embedding Physical Activity in the Heart of the NHS: The Need for a Whole-System Approach. *Sports Medicine*, *46*(7), 939–946. https://doi.org/10.1007/s40279-016-0488-y

Spence, J.C., Blanchard, C.M., Clark, M., Plotnikoff, R.C., Storey, K.E. & McCargar, L. (2010). The role of self-efficacy in explaining gender differences in physical activity among adolescents: a multilevel analysis. *Journal of Physical Activity and Health*, *7*(2), 176–183. https://doi.org/10.1123/jpah.7.2.176

Sport England. (2017). Active Lives Survey 2015-16: Year 1 Report. Retrieved November 11, 2017, from Sport England website: https://www.sportengland.org/media/11498/active-lives-survey-yr-1-report.pdf

Sriramatr, S., Berry, T. R., & Spence, J. C. (2014). An internet-based intervention for promoting and maintaining physical activity: A randomized controlled trial. *American Journal of Health Behavior*, *38*(3), 430–439. https://doi.org/10.5993/AJHB.38.3.12

Steinmo, S. H., Michie, S., Fuller, C., Stanley, S., Stapleton, C., & Stone, S. P. (2015). Bridging the gap between pragmatic intervention design and theory: using behavioural science tools to modify an existing quality improvement programme to implement "Sepsis Six." *Implementation Science*, *11*(1), 14. https://doi.org/10.1186/s13012-016-0376-8

Stewart-Brown, S., Evans, J., Patterson, J., Petersen, S., Doll, H., Balding, J., & Regis, D. (2000). The health of students in institutes of higher education: An important and neglected public health problem? *Journal of Public Health Medicine*, *22*(4), 492–499. https://doi.org/10.1093/pubmed/22.4.492

Storer, T.W., Dolezal, B.A., Berenc, M.N., Timmins, J.E. & Cooper, C. B. (2014). Effect of supervised, periodized exercise training vs. self-directed training on lean body mass and other fitness variables in health club members. *Journal of Strength and Conditioning Research*, *28*(7), 1995–2006. https://doi.org/10.1519/JSC.0000000000000331

Strauss, A. & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (2nd ed.). Thousand Oaks: Sage.

Streiner, D. L. (2003). Starting at the beginning: An introduction to coefficient alpha and internal consistency. *Journal of Personality Assessment*, *80*(1), 99–103. https://doi.org/10.1207/S15327752JPA8001_18

Sultoni, J.K. & Suherman, A. (2017). Barriers to Physical Activity on University Student. *IOP Conference Series: Material Science & Engineer*, *180*. https://doi.org/10.1088/1742-6596/755/1/011001

Suminski, R. R., Petosa, R., Utter, A. C., & Zhang, J. J. (2002). Physical Activity Among Ethnically Diverse College Students. *Journal of American College Health*, *51*(2), 75–80.

https://doi.org/10.1080/07448480209596333

Suresh, K. P. (2011). An overview of randomization techniques: An unbiased assessment of outcome in clinical research. *Journal of Human Reproductive Science*, *4*(1), 8–11. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3136079/

Sutton, S. (2008). How does the Health Action Process Approach (HAPA) bridge the intention-behaviour gap? An examination of the model's causal structure. *Applied Psychology*, *57*(1), 66–74.

Swann, C., Rosenbaum, S., Lawrence, A., Vella, S. A., McEwan, D., & Ekkekakis, P. (2020). Updating goal-setting theory in physical activity promotion: a critical conceptual review. *Health Psychology Review*, 1–17. https://doi.org/10.1080/17437199.2019.1706616

Swartz, A. M., Rote, A. E., Welch, W. A., Maeda, H., Hart, T. L., Cho, Y. I., & Strath, S. J. (2014). Prompts to disrupt sitting time and increase physical activity at work, 2011-2012. *Preventing Chronic Disease*, *11*, E73. https://doi.org/10.5888/pcd11.130318

Tavender, E. J., Bosch, M., Gruen, R. L., Green, S. E., Knott, J., Francis, J. J., … O'Connor, D. A. (2014). Understanding practice: the factors that influence management of mild traumatic brain injury in the emergency department - a qualitative study using the Theoretical Domains Framework. *Implementation Science*, *9*(1), 8. https://doi.org/10.1186/1748-5908-9-8

Taylor, A. H. (2003). Physical activity, anxiety, and stress. In S. H. Biddle, S.J.H., Fox, K.R. & Boutcher (Ed.), *Physical activity and psychological well-being.* (pp. 10–45). London: Routledge.

Taylor, N., Conner, M., & Lawton, R. (2012). The impact of theory on the effectiveness of worksite physical activity interventions: a meta-analysis and meta-regression. *Health Psychology Review*, *6*(1), 33–73. https://doi.org/10.1080/17437199.2010.533441

Taylor, W. C., King, K. E., Shegog, R., Paxton, R. J., Evans-Hudnall, G. L., Rempel, D. M., … Yancey, A. K. (2013). Booster Breaks in the workplace: participants' perspectives on health-promoting work breaks. *Health Education Research*, *28*(3), 414–425. https://doi.org/10.1093/her/cyt001

Taylor, N., Lawton, R., & Conner, M. (2013). Development and initial validation of the determinants of physical activity questionnaire. *International Journal of Behavioral Nutrition and Physical Activity*, *10*(1), 74. https://doi.org/10.1186/1479-5868-10-74

Taylor, N., Lawton, R., Slater, B., & Foy, R. (2013). The demonstration of a theory-based approach to the design of localized patient safety interventions. *Implementation Science*, *8*(1), 123. https://doi.org/10.1186/1748-5908-8-123

Taylor, N., Parveen, S., Robins, V., Slater, B., & Lawton, R. (2013). Development and initial validation of the Influences on Patient Safety Behaviours Questionnaire. *Implementation Science*, *8*(1), 81. https://doi.org/10.1186/1748-5908-8-81

Teixeira, P. J. (2016). Health behavior change: a field just picking up speed. A comment on Ogden (2016). *Health Psychology Review*, *10*(3), 269–273. https://doi.org/10.1080/17437199.2016.1183507

Teixeira, P. J., Carraça, E. V, Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 78.

https://doi.org/10.1186/1479-5868-9-78

Teychenne, M., Ball, K., & Salmon, J. (2008). Physical activity and likelihood of depression in adults: A review. *Preventive Medicine*, *46*(5), 397–411. https://doi.org/10.1016/j.ypmed.2008.01.009

Thomas, S., & Mackintosh, S. (2014). Use of the Theoretical Domains Framework to Develop an Intervention to Improve Physical Therapist Management of the Risk of Falls After Discharge. *Physical Therapy*, *94*(11), 1660–1675. https://doi.org/10.2522/ptj.20130412

Thompson, L. M., Diaz-Artiga, A., Weinstein, J. R., & Handley, M. A. (2018). Designing a behavioral intervention using the COM-B model and the theoretical domains framework to promote gas stove use in rural Guatemala: A formative research study. *BMC Public Health*, *18*(1), 1–17. https://doi.org/10.1186/s12889-018-5138-x

Thomson, S. B. (2011). Qualitative Research: Validity. *Journal of Administration and Governance*, *6*(1), 77–82. https://doi.org/10.4135/9781412972024.n2090

Thorgersen-Ntoumani, C., Loughren, E. A., Taylor, I. M., Duda, J. L., & Fox, K. R. (2014). A step in the right direction? Change in mental well-being and self-reported work performance among physically inactive university employees during a walking intervention. *Mental Health and Physical Activity*, *7*(2), 89–94. https://doi.org/10.1016/j.mhpa.2014.06.004

To, Q. G., Chen, T. T. L., Magnussen, C. G., & To, K. G. (2013). Workplace physical activity interventions: A systematic review. *American Journal of Health Promotion*, *27*(6), 113–124. https://doi.org/10.4278/ajhp.120425-LIT-222

Tomczak, M., Tomczak, E., Kleka, P., & Lew, R. (2014). Using power analysis to estimate appropriate sample size. *Trends in Sport Sciences*, *4*(21), 195–206. Retrieved from https://www.academia.edu/11044470/Using_power_analysis_to_estimate_appropriate_sample_size?auto=download&campaign=weekly_digest

Torjesen, I. (2016). Global cost of physical inactivity is estimated at $67.5bn a year. *BMJ (Clinical Research Ed.)*, *354*, i4187. https://doi.org/10.1136/bmj.i4187

Townsend, N., Wickramasinghe, K., Williams, J., Bhatnagar, P. &, & Allender, S., Peto, V., Scarborough, P., Boxer, A. & Rayner, M. (2015). Physical activity statistics 2015. In *British Heart Foundation*. London.

Trifiletti, L. B., Gielen, A. C., Sleet, D. A., & Hopkins, K. (2005). Behavioral and social sciences theories and models: Are they used in unintentional injury prevention research? *Health Education Research*, *20*(3), 298–307. https://doi.org/10.1093/her/cyg126

Trochim, W. M. K. (2006). Deduction and Induction. Retrieved September 13, 2019, from Web Center fo Social Research Methods website: http://www.socialresearchmethods.net/kb/dedind.htm

Tsai, L. T., Lo, F. E., Yang, C. C., Keller, J. J., & Lyu, S. Y. (2015). Gender differences in recreational sports participation among Taiwanese adults. *International Journal of Environmental Research and Public Health*, *12*(1), 829–840. https://doi.org/10.3390/ijerph120100829

Tse, J. L. M., Flin, R., & Mearns, K. (2006). Bus driver well-being review: 50 years of research. *Transportation Research Part F: Traffic Psychology and Behaviour*, *9*(2), 89–

114. https://doi.org/10.1016/j.trf.2005.10.002

Tucker, P. & Gilliland, J. (2007). The effect of season and weather on physicalactivity: A systematic review. *Public Health*, *121*, 909–922. https://doi.org/10

Tucker, P., & Irwin, J. D. (2007). University Students' Perspectives on a Physical Activity Record-Keeping Log. *Health Promotion Practice*, *8*(2), 173–180. https://doi.org/10.1177/1524839906289584

Tully MA, H. R. (2015). Promoting physical activity: time for a major re-think. *Aspetar Sports Medicine Journal*, *4*, 258–263.

Tuomilehto J., Indstrom J., Eriksson J.G., Valle T.T., Hamalainine, H., Ilanne-Parikka, P., Keinanen-Kiukaanniemi, S., Laakso, M., Louheranta, A., Rastas, M., Salminen, V. & Uusitupa, M. (2001). Prevention of Type 2 Diabetes Mellitus By Changes in Lifestyle Among Subjects With Impaired Glucose Tolerance. *The New England Journal of Medicine*, *344*(18), 1343–1350. https://doi.org/10.1056/NEJM200105033441801

U.S. Department of Health and Human Services. (2020). Physical Activity: Overcoming Barriers to Physical Activity. Retrieved November 2, 2020, from Centers for Disease Control and Prevention website: https://www.cdc.gov/physicalactivity/basics/adding-pa/barriers.html

Uba, L. (2002). *A postmodern psychology of Asian Americans: Creating knowledge of a racial minority (vol. 202)*. Albany, NY: SUNY Press.

UKActive. (2014). Turning the tide of inactivity Acknowledgments. Retrieved October 28, 2016, from http://ukactive.com/downloads/managed/Turning_the_tide_of_inactivity.pdf

UKactive Research Institute. (2018). *British Active Students Survey: Further Education*. Retrieved from https://www.aocsport.co.uk/wp-content/uploads/2019/05/BASS-FEI-2018-2019-Report-FINAL.pdf

Universities UK. (2017). *Patterns and trends in UK Higher Education 2017*. Retrieved from http://www.universitiesuk.ac.uk/facts-and-stats/data-and-analysis/Documents/patterns-and-trends-2017.pdf

University of Derby. (2017a). Current Vacancies. Retrieved October 26, 2017, from University of Derby website: https://jobs.derby.ac.uk/vacancies.aspx

University of Derby. (2017b). Student statistics - 2015/16. Retrieved August 7, 2017, from University of Derby website: https://www.derby.ac.uk/about/organisation/student-statistics/

University of Derby. (2019). Research Ethics and Integrity. Retrieved October 2, 2019, from University of Derby website: Good Scientific Practice

Usher, W., & Curran, C. (2019). Predicting Australia's university students' mental health status. *Health Promotion International*, *34*(2), 312–322. https://doi.org/10.1093/heapro/dax091

Van Cauwenberg, J., Cerin, E., Timperio, A., Salmon, J., Deforche, B., & Veitch, J. (2015). Park proximity, quality and recreational physical activity among mid-older aged adults: Moderating effects of individual factors and area of residence. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 1–8. https://doi.org/10.1186/s12966-015-0205-5

Van Horn, P. S., Green, K. E., & Martinussen, M. (2009). Survey response rates and survey administration in counseling and clinical psychology: A meta-analysis. *Educational and Psychological Measurement*, *69*(3), 389–403.

van Nieuw-Amerongen, M. E., Kremers, S. P. J., de Vries, N. K., & Kok, G. (2011). The use of prompts, increased accessibility, visibility, and aesthetics of the stairwell to promote stair use in a university building. *Environment and Behavior*, *43*(1), 131–139. https://doi.org/10.1177/0013916509341242

van Poppel, M. N., Chinapaw, M. J., Mokkink, L. B., Van, M. W., & Terwee, C. B. (2010). Physical activity questionnaires for adults: a systematic review of measurement properties. *Sports Medicine*, *40*, 565–600. https://doi.org/10.2165/11531930-000000000-00000

Vaughan-Jones, H., & Barham, L. (2009). *Healthy Work Challenges and Opportunities to 2030*. Retrieved from http://www.unionsafety.eu/pdf_files/HealthyWorkChallenges2030.pdf

Verplanken, B. A. S., & Faes, S. (1999). Good intentions , bad habits , and effects of forming implementation intentions on healthy eating. *European Journal of Social Psychology*, *29*, 591–604.

Vos, T., Abajobir, A. A., Abbafati, C., Abbas, K. M., Abate, K. H., Abd-Allah, F., … Murray, C. J. L. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*, *390*(10100), 1211–1259. https://doi.org/10.1016/S0140-6736(17)32154-2

Wagner, A. L., Keusch, F., Yan, T., & Clarke, P. J. (2019). The impact of weather on summer and winter exercise behaviors. *Journal of Sport and Health Science*, Vol. 8, pp. 39–45. https://doi.org/10.1016/j.jshs.2016.07.007

Wang, S., Moss, J. R., & Hiller, J. E. (2006). Applicability and transferability of interventions in evidence-based public health. *Health Promotion International*, *21*(1), 76–83. https://doi.org/10.1093/heapro/dai025

Wanner, M., Hartmann, C., Pestoni, G., Martin, B. W., Siegrist, M., & Martin-Diener, E. (2017). Validation of the Global Physical Activity Questionnaire for self-administration in a European context. *BMJ Open Sport & Exercise Medicine*, *3*(1), e000206. https://doi.org/10.1136/bmjsem-2016-000206

Warburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal*, *174*(6), 801–809.

Watanabe, K., & Kawakami, N. (2017). Effects of a multicomponent workplace intervention programme with environmental changes on physical activity among Japanese white collar employees: A protocol for a cluster randomised controlled trial. *BMJ Open*, *7*(10), 1–10. https://doi.org/10.1136/bmjopen-2017-017688

Wattanapisit, A., Fungthongcharoen, K., Saengow, U., & Vijitpongjinda, S. (2016). Physical activity among medical students in Southern Thailand: A mixed methods study. *BMJ Open*, *6*(9), e013479. https://doi.org/10.1136/bmjopen-2016-013479

Weatherson, K. A., McKay, R., Gainforth, H. L., & Jung, M. E. (2017). Barriers and facilitators to the implementation of a school-based physical activity policy in Canada:

Application of the theoretical domains framework. *BMC Public Health*, *17*(1), 1–16. https://doi.org/10.1186/s12889-017-4846-y

Webb, J., Foster, J., & Poulter, E. (2016). Increasing the frequency of physical activity very brief advice for cancer patients. Development of an intervention using the behaviour change wheel. *Public Health*, *133*, 45–56. https://doi.org/10.1016/j.puhe.2015.12.009

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, *132*(2), 249–268. https://doi.org/10.1037/0033-2909.132.2.249

Webb, T. L., & Sheeran, P. (2008). Mechanisms of implementation intention effects: The role of goal intentions, self-efficacy, and accessibility of plan components. *British Journal of Social Psychology*, *47*(3), 373–395. https://doi.org/10.1348/014466607X267010

Webb, T. L., Sniehotta, F. F., & Michie, S. (2010). Using theories of behaviour change to inform interventions for addictive behaviours. *Addiction*, *105*(11), 1879–1892. https://doi.org/10.1111/j.1360-0443.2010.03028.x

Webster, R., & Bailey, J. V. (2013). Development of a theory-based interactive digital intervention to improve condom use in men in sexual health clinics: an application of qualitative methods using the behaviour change wheel. *The Lancet*, *382*, S102. https://doi.org/10.1016/s0140-6736(13)62527-1

Weinstock, J. (2010). A review of exercise as intervention for sedentary hazardous drinking college students: rationale and issues. *Journal of American College Health*, *58*(6), 539–544. https://doi.org/10.1080/07448481003686034

Wendel-Vos, W., Droomers, M., Kremers, S., Brug, J., & Van Lenthe, F. (2007). Potential environmental determinants of physical activity in adults: A systematic review. *Obesity Reviews*, *8*(5), 425–440. https://doi.org/10.1111/j.1467-789X.2007.00370.x

West, R. & Brown, J. (2013). *Theory of addiction* (2nd ed.). John Wiley and Sons Ltd.

Whitelaw, S., Baxendale, A., Bryce, C., MacHardy, L., Young, I., & Witney, E. (2001). “Settings” based health promotion: A review. *Health Promotion International*, *16*(4), 339–353. https://doi.org/10.1093/heapro/16.4.339

Wijndaele, K., Brage, S., Besson, H., Khaw, K. T., Sharp, S. J., Luben, R., … Ekelund, U. (2011). Television viewing time independently predicts all-cause and cardiovascular mortality: The EPIC Norfolk study. *International Journal of Epidemiology*, *40*(1), 150–159. https://doi.org/10.1093/ije/dyq105

Williams, S. L., & French, D. P. (2011). What are the most effective intervention techniques for changing physical activity self-efficacy and physical activity behaviour - And are they the same? *Health Education Research*, *26*(2), 308–322. https://doi.org/10.1093/her/cyr005

Wilson, D., Bopp, M., Coglan, J., Sims, D., Matthews, S., Rovniak, L., & Poole, E. (2016). A Social Media Campaign for Promoting Active Travel to a University Campus. *Journal of Healthcare Communications*, *1*(2), 1–6. https://doi.org/10.4172/2472-1654.100011

Wilson, O. W. A., Papalia, Z., Duffey, M., & Bopp, M. (2019). Differences in college students’ aerobic physical activity and muscle-strengthening activities based on gender, race, and sexual orientation. *Preventive Medicine Reports*, *16*, 0–2. https://doi.org/10.1016/j.pmedr.2019.100984

World Health Organisation. (1981). *Global Strategy for Health for All by the Year 2000.* Geneva: World Health Organisation.

World Health Organisation. (1986). The Ottawa Charter for Health Promotion. *First International Conference on Health Promotion*. Retrieved from http://www.who.int/healthpromotion/conferences/previous/ottawa/en/

World Health Organisation. (2004). Resolution WHA57.17. Global Strategy on Diet, Physical Activity and Health. *Fifty-Seventh World Health Assembly*, 1–18. Retrieved from http://apps.who.int/gb/ebwha/pdf_files/WHA57/A57_R17-en.pdf

World Health Organisation. (2008). The Global Burden of Disease: 2004 update. In *World Health Organisation*. https://doi.org/10.1038/npp.2011.85

World Health Organisation. (2009). Interventions on diet and physical activity: What works summary report. In *Geneva: Wold Health Organization*. https://doi.org/10.1017/CBO9781107415324.004

World Health Organisation. (2010a). *Global recommendations on physical activity for health*. Retrieved from http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf

World Health Organisation. (2010b). Global status report on noncommunicable diseases 2010. *World Health*, 176. https://doi.org/978 92 4 156422 9

World Health Organisation. (2012a). Global Physical Activity Questionnaire (GPAQ) Analysis Guide. In *World Health Organisation*. https://doi.org/10.1016/S0140-6736(12)60736-3.The

World Health Organisation. (2012b). *Health Education: Theoretical Concepts, Effective Strategies and Core Competencies*. Cairo, Eastern Mediterranean Region.

World Health Organisation. (2013a). Global action plan for the prevention and control of noncommunicable diseases 2013-2020. In *World Health Organization*. https://doi.org/978 92 4 1506236

World Health Organisation. (2013b). *Physical inactivity : meeting the 2025 global targets*. Retrieved from http://www.searo.who.int/entity/noncommunicable_diseases/events/ncd_workshop_2014_physical_inactivity.pdf

World Health Organisation. (2015). Global Strategy on Diet, Physical Activity and Health. Physical Inactivity: A Global Public Health Problem. Retrieved October 28, 2016, from World Health Organisation website: http://www.who.int/dietphysicalactivity/factsheet_inactivity/en/

World Health Organisation. (2017). Global Health Observatory (GHO) data: Prevalence of insufficient physical activity. Retrieved November 22, 2017, from World Health Organisation website: http://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/

World Health Organisation. (2018a). 10 key facts on physical activity in the WHO European Region. Retrieved June 11, 2018, from World Health Organisation website: http://www.euro.who.int/en/health-topics/disease-prevention/physical-activity/data-and-statistics/10-key-facts-on-physical-activity-in-the-who-european-region

World Health Organisation. (2018b). Global Strategy on Diet, Physical Activity and Health: Physical Activity. Retrieved June 11, 2018, from World Health Organisation website: http://www.who.int/dietphysicalactivity/pa/en/

World Health Organisation. (2018c). Healthy Setting: Types of Healthy Settings. Retrieved June 14, 2018, from World Health Organisation website: http://www.who.int/healthy_settings/types/en/

World Health Organisation. (2018d). Non-communicable diseases. Retrieved October 4, 2019, from World Health Organisation website: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

World Health Organisation. (2019a). Global Health Observatory (GHO) data: Disability-adjusted life years (DALYs). Retrieved October 4, 2019, from World Health Organisation website: https://www.who.int/gho/mortality_burden_disease/daly_rates/text/en/

World Health Organisation. (2019b). Global Health Observatory (GHO) data: Prevalence of insufficient physical activity. Retrieved October 3, 2019, from World Health Organisation website: https://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/

World Health Organisation. (2019c). Physical activity. Retrieved October 4, 2019, from World Health Organisation website: https://www.who.int/health-topics/physical-activity

Yamada, J., Potestio, M. L., Cave, A. J., Sharpe, H., Johnson, D. W., Patey, A. M., … Grimshaw, J. M. (2018). Using the theoretical domains framework to identify barriers and enablers to pediatric asthma management in primary care settings. *Journal of Asthma*, *55*(11), 1223–1236. https://doi.org/10.1080/02770903.2017.1408820

Yang, C. H., Maher, J. P., & Conroy, D. E. (2015). Implementation of behavior change techniques in mobile applications for physical activity. *American Journal of Preventive Medicine*, *48*(4), 452–455. https://doi.org/10.1016/j.amepre.2014.10.010

Yang, L., Panter, J., Griffin, S. J., & Ogilvie, D. (2012). Associations between active commuting and physical activity in working adults: Cross-sectional results from the Commuting and Health in Cambridge study. *Preventive Medicine*, *55*(5), 453–457. https://doi.org/10.1016/j.ypmed.2012.08.019

Young, S. J., Ross, C. M., & Barcelona, R. J. (2003). Perceived Constraints by College Students to Participation in Campus Recreational Sports Programs. *Recreational Sports Journal*, *27*(2), 47–62.

Zamani Sani, S. H., Fathirezaie, Z., Brand, S., Puhse, U., Holsboer-Trachsler, E., Gerber, M., & Talepasand, S. (2016). Physical activity and self-esteem: Testing direct and indirect relationships associated with psychological and physical mechanisms. *Neuropsychiatric Disease and Treatment*, *12*, 2617–2625. https://doi.org/10.2147/NDT.S116811

Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A.-R. (2015). Design and Implementation Content Validity Study: Development of an instrument for measuring Patient-Centered Communication. *Journal of Caring Sciences*, *4*(2), 165–178. https://doi.org/10.15171/jcs.2015.017

Zhu, W., Gutierrez, M., Toledo, M. J., Mullane, S., Stella, A. P., Diemar, R., … Buman, M. P. (2018). Long-term effects of sit-stand workstations on workplace sitting: A natural experiment. *Journal of Science and Medicine in Sport*, *21*(8), 811–816. https://doi.org/10.1016/j.jsams.2017.12.005

Appendices:

Appendix1: Ethical approval letter for study 1 (Group interviews)

Approval Letter: Human Sciences Research Ethics Committee

University of Derby

Date: 29th November 2017

Dr Edward Stupple
Chair, Human Sciences Research Ethics Committee, University of Derby

Dear Lawrence,

Ethics Ref No: 09-1717-LNs

Thank you for submitting this revised application to the Human Sciences Research Ethics Committee.

I have now reviewed the revised documents you sent following the feedback you received on your initial application, and I am satisfied that all of the issues raised have been dealt with. The application can now therefore be approved.

The following documents have now been re-reviewed:

1. Ethics application form
2. Responses to reviewer comments

If any changes to the study described in the application or supporting documentation is necessary, you must notify the committee and may be required to make a resubmission of the application.

Please note ethical approval for application 09-1717-LNs is valid for a period of 5 years i.e. November 2022.

Good luck with the study.

Yours sincerely

Dr Ed Stupple

Appendix 2: Group interview schedule for university staff and students for study 1

GROUP INTERVIEW SCHEDULE

Before the participants arrive

The recording equipment will be tested to ensure that it is properly working and that the sound is recording at an acceptable level.

All paperwork such as participant's consent form, debrief sheets, notes and name badges/tags will be checked to ensure they are at the venue before the participants arrive.

Preparing to start the discussion

As the participants arrive, some refreshments will be offered to them.

A map will be drawn to show where everyone is sitting. It will be ensured that everyone is comfortable and can see each other before the discussions start. The statement on confidentiality will then be read out:

Views and opinions expressed here today will be treated in confidence amongst the research team for the purpose of establishing an evidence base as to the determinants (barriers and facilitators) of physical activity in University of Derby staff and students. Even though we cannot assure your confidentiality because of the nature of this study, all responses will remain anonymous.

Then for ethical reasons, all participants will be expected to sign an informed consent form before the discussions commence. Additionally, the participants will be informed that the whole session will be audio recorded in order to have a written account of the discussions and asked if any of them have objections to this; then the audio recorder will be switched on.

Introduction to the session

The session will start off by reiterating the purpose of the study.

Good morning/good afternoon. My name is Lawrence Ndupu, a PhD research student from the College of Life and Natural Science. I am grateful to you for taking out time to attend this focus group discussion. The purpose of this focus group is to explore the capability, opportunity and motivation of University of Derby staff and students to engage in physical activity. This means that I will be seeking your views and opinions about the determinants (barriers and facilitators) of physical activity in staff/students. Are there any questions?

Any questions asked will be responded to and then the ground rules will be read out:

Let's go over some Ground Rules before we start the discussions.

- **First, please can we all turn off our cell phones or at least put them on silence, so we are not interrupted. If you must respond to a call, please do so as quietly as possible and re-join us as quickly as you can.**
- **Kindly minimise or eliminate side conversations**
- **One person will speak at a time. Please do not interrupt someone when they are taking.**
- **Don't criticise what others have to say.**
- **Treat everyone's idea with respect.**
- **You have the obligation to keep details of this focus group discussion private and not divulge any personal or sensitive information that may be discussed.**
- **In case the firm alarm goes off, the research will direct you to the nearest fire exit and muster point.**
- **If I ask you questions while you are talking, I'm not being rude; I'm just making sure everyone has a chance to talk and that we discuss all of the issues.**
- **Finally, there are no right or wrong opinions, only differing points of view. I would like you to feel comfortable saying what you really think and how you really feel.**

Are there other things you would like us to add to the ground rules before we start?

Just to get started, let's have everyone tell us your name and job role/level and mode of study at the University of Derby (the moderator will point at one of the participants to start). This group discussion will last between 60-90 minutes.

Areas to explore:

1. **What do you know about physical activity? (How might you define physical activity? Is anybody here aware about any recommended guidelines for physical activity? Thinking about what we have discussed, do you think you achieve the recommended physical activity level?).**

2. **Why are the physical activity recommendations to that level? (Overall, do you think staff/students engage in the recommended physical activity levels?)- If not, why not?**

3. **So, do people in the room do any form of physical activity? (What sorts of physical activity do you do? For those of you that do physical activity, why do you do it? Do you have any specific goals in mind when you are engaging in physical activity?)- What about those of you who don't do much physical activity, why don't you do it?**

4. **For those of you who don't engage, how confident are you that engaging in physical activity is something you could do? (Are there anything that prevent you from being more active?).**

5. **How do you know how much physical activity you've done?**

6. **Thinking about when you do/when you have done physical activity, how did/does it make you feel?**

7. **How difficult or easy is it for you to engage in physical activity? (If you wanted to engage in physical activity, do you have the skills to do it?).**

8. **Would anyone in the room like to do more physical activity? Do you want to do more of the same or different things? What types of things would you like to do? Why these things? What is currently preventing you from getting involved in them?**

9. **What do you think are the best ways for you to become physically active? (What do you think are the best forms of physical activity?). How would you go about increasing your activity?**

10. **What do you think are the best ways for you to become physically active? (What do you think are the best forms of physical activity?). How would you go about increasing your activity?**

11. **What do you think are those things that the University of Derby is doing to engage staff and students in physical activity? (Do you think there is enough opportunity for staff/students to do physical activity?).**

12. **What would you say are the main influences on your decision to engage in physical activity? (Do you engage in more or less physical activity when your family, friends or colleagues are with you?).**

13. **In your view, what are the incentives that would encourage or support you to engage in physical activity? (It could be either financial (money, gift vouchers) or non-financial (appreciation/praise, competition, knowledge of goal achievements, etc.)**

14. **Thinking about the university setting, are there any aspects of the university environment that would influence whether or not you engage in physical activity?**

15. **Of all the things we talked about, what is most important to you?**

16. **Are there other things related to physical activity at the University of Derby that I didn't ask you about this morning/afternoon that are important for me to know?** All questions will be responded to and debrief sheets will then be given to all the participants.

Would you want to be contacted to take part in the behaviour change interventions aimed at improving physical activity among students and staff of the University of Derby? If yes kindly provide your preferred mode of communication.

Thank you for participating in the focus group today. We are excited to learn about what you think.

Appendix 3: Invitation fosters/flyers for university staff and students for study 1

Enter a Draw for the chance to win a Star Prize of £50 Amazon Voucher

…. by taking part in a group interview about your views on factors that influence engagement of staff members and students of the University of Derby in physical activity.

We're looking for students (first year undergraduate, postgraduate taught (masters), postgraduate research (PhD) and international students) and staff members (academic, administrative, catering and cleaning staff) of the University of Derby to let us know what you think about the factors that influence your engagement in physical activity.

Your input is important- have your say!

Separate group interview sessions to be held for students and staff members

The venues to be announced shortly

Second Prize: £30 Amazon Voucher

Third Prize: £20 Amazon Voucher

Interested in taking Part? Email Lawrence Ndupu (principal Researcher) at 100312037@unimail.derby.ac.uk

Appendix 4: General group interview invitation email to all university staff and students for study 1

General group invitation email for university staff

Survey for University of Derby Staff Aged 18+

By taking part in this group interview discussion that aims to assess University of Derby staff member's views and opinions about the determinants (barriers and facilitators) of physical activity.

As part of the study, we are looking for volunteers from across the university to participate in a small Group Interview discussion (maximum of 6 in a group).

Each group discussion will last for a duration of 90 minutes.

We will also be holding a prize draw at the end of the study for everyone that volunteered, and you will be entitled to be entered even if you are consequently not chosen to take part in one of the Group Interviews.

In the prize draw, the first person will win a £50 Amazon voucher, the second a £30 Amazon voucher and the third a £20 Amazon voucher.

If you are interested in receiving further information about this research study and are available for any of the dates and times listed below, please email me as soon as possible.

Monday 5th November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Wednesday 8th November 2017	**10:00-11:30 am; 12:00-1:30 pm**
Friday 10th November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Wednesday 15th November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Friday 17th November 2017	**10:00-11:30 am; 12:00-1:30 pm**
Wednesday 22nd November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Thursday 23rd November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Friday 24th November 2017	**10:00-11:30 am; 12:00-1:30 pm**

Further information will be sent to those staff members who express an interest in the study. We are aiming to get a good representation of the staff members with different work roles (e.g. academic, administrative, catering and cleaning service staff), so there is a possibility that you may not be selected. However, every staff member that volunteers and are able to make one of the listed slots above will be entered into the prize draw.

If you have any queries, kindly email me on 100312037@unimail.derby.ac.uk

Thank you

General group interview invitation email to university students

UNIVERSITY of DERBY

Survey for University of Derby Students Aged 18+

By taking part in this group interview discussion that aims to assess University of Derby students' views and opinions about the determinants (barriers and facilitators) of physical activity.

As part of the study, we are looking for volunteers from across the university to participate in a small Group Interview discussion (maximum of 6 in a group).

Each group discussion will last for a duration of 90 minutes.

We will also be holding a prize draw at the end of the study for everyone that volunteered, and you will be entitled to be entered even if you are consequently not chosen to take part in one of the Group Interviews.

In the prize draw, the first person will win a £50 Amazon voucher, the second a £30 Amazon voucher and the third a £20 Amazon voucher.

If you are interested in receiving further information about this research study and are available for any of the dates and times listed below, please email me **as soon as possible.**

Monday 5th November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Wednesday 8th November 2017	**10:00-11:30 am; 12:00-1:30 pm**
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Wednesday 22nd November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Thursday 23rd November 2017	**10:00-11:30 am; 12:00-1:30 pm; 3:00-4:30 pm**
Friday 24th November 2017	**10:00-11:30 am; 12:00-1:30 pm**

Further information will be sent to those students who express an interest in the study. We are aiming to get a good representation of students across different levels and modes of study (e.g. undergraduate (BSc.), postgraduate (MSc.), postgraduate (PhD), and international students), so there is a possibility that you may not be selected. However, every student that volunteers and are able to make one of the listed slots above will be entered into the prize draw.

If you have any queries, kindly email me on 100312037@unimail.derby.ac.uk

Thank you

Appendix 5: Participants reply slip for university staff and students

Participants reply slip for university staff

UNIVERSITY of DERBY

PARTICIPANTS REPLY SLIP

Name: …………………………………………………………………………………….

Programme: …………………………………………………………………………...

1. Please indicate below, by ticking, all the dates and times that you are free to attend a Focus Group Discussion.

	Mon 5th Nov 2017	**Wed 8th Nov 2017**	**Fri 10th Nov 2017**	**Wed 15th Nov 2017**	**Fri 17th Nov 2017**	**Wed 22nd Nov 2017**	**Thurs 23rd Nov 2017**	**Fri 24th Nov 2017**
10:00-11:30 am								
12:00-1:30 pm								
3:00-4:00 pm								

2. Below is a list of the staff categories we would like to hold discussion with. Please tick the category that best fits your job role and would be happy to contribute to as part of a Focus Group discussion.

☐ **Academic Staff**

☐ **Administrative Staff**

☐ **Cleaning service staff**

☐ **Catering Staff**

Thank you for your assistance. Please complete this form and email back to l.ndupu@derby.ac.uk as soon as possible. On the other hand, you can copy the information into an email and return directly.

Participants reply slip for university students

PARTICIPANTS REPLY SLIP

Name: ………………………………………………………………………………………

Programme: …………………………………………………………………………..

1. Please indicate below, by ticking, all the dates and times that you are free to attend a Focus Group Discussion.

	Mon 5th Nov 2017	Wed 8th Nov 2017	Fri 10th Nov 2017	Wed 15th Nov 2017	Fri 17th Nov 2017	Wed 22nd Nov 2017	Thurs 23rd Nov 2017	Fri 24th Nov 2017
10:00-11:30 am								
12:00-1:30 pm								
3:00-4:00 pm								

2. Below is a list of the student groups we would like to hold discussion with. Please tick the group that you feel you have membership of and would be happy to contribute to as part of a Focus Group discussion.

☐ **Undergraduate First Year Students**

☐ **Postgraduate Taught (masters) Students**

☐ **Postgraduate Research (PhD) Student**

☐ **International Student**

Thank you for your assistance. Please complete this form and email back to l.ndupu@derby.ac.uk as soon as possible. On the other hand, you can copy the information into an email and return directly.

Appendix 6: Participants information sheet for staff and students

Participants' information sheet for staff

UNIVERSITY of DERBY

PARTICIPANTS INVITATION AND INFORMATION SHEET

Introduction

We would like to invite you to participate in a research study to assess the determinants (i.e. barriers and facilitators) of physical activity in staff members of the University of Derby. Prior to deciding to take part, it is important for you to understand why the research is being carried out and what it will involve. Please ensure you read the following information carefully prior to deciding whether you would participate.

Who is conducting the research?

This study is being carried out by Lawrence B.N. Ndupu, a PhD research student from the College of Life and Natural Sciences. This study has been approved by the Human Sciences Research Ethics Committee.

What is the purpose of this research study?

- This research study is being carried out to identify the determinants (barriers and facilitators) of physical activity in the University of Derby staff members.
- We hope the research study will help us to identify the barriers and facilitators that influence the University of Derby staff members from engaging in physical activity, with a view of designing bespoke university-focused interventions to address them.
- This research is being undertaken by Lawrence Ndupu, a PhD research candidate of the Faculty of Life and Natural Sciences, as a study in a series of studies in his programme of research (see contact details at the end of the sheet).
- Only the researcher and his supervisory team will have access to any data generated during this study. Pseudonyms will be used instead of any identifier such as names, post codes, addresses, etc., to protect the participants' identity when the data is transcribed.

Why have you been asked to take part?

You have been asked to participate in this group interview discussion because you are a staff member of the University of Derby and you are 18 years and above. We are inviting all staff members to participate in this study. We are hoping to recruit 24 staff members (4 group interviews with 6 participants in each). We are particularly interested in the following groups of staff members:

- Academic staff
- Administrative staff
- Cleaning service staff
- Catering staff

Staff members will be requested to identify the group they belong to.

What does participating in this research study involve?

Participating in this research study involves agreeing to participate in a group interview discussion with a small group of other people who share some common experience with you, that is they would belong to one of the same staff groups you identified with. The group interview is designed to examine the barriers and facilitators that each group of staff members identify as having influence on their engagement in physical activity.

What is a group interview?

A group interview is a form of in-depth interview accomplished in a group where individuals share their ideas, opinions and views about a specific subject matter.

What is the purpose of this group interview discussion study?

The purpose of this group interview discussion study is to investigate a range of issues associated with the determinants of physical activity in the university of Derby staff members.

Who will be hosting this group interview?

The group interview will be hosted by Lawrence Ndupu (principal researcher) and an assistant moderator.

How long will the group interview discussion last?

The group interview discussion is expected to last up to 90 minutes.

What will happen on the day of the group interview discussion?

Prior to the start of the group interview discussion, Lawrence and another research student will check to ensure that all participants have completed and signed an informed consent form to say that they have understood what the group interview is all about and how much information will be used. Assistance will be provided for any participant who has issues completing the form.

During the discussion, individuals will be asked to share their opinions and views about a range of barriers and facilitators that may influence physical activity in the university of Derby staff. Furthermore, you will be required to share your ideas about how the university can support staff engagement in physical activity.

The group interview discussion will be audio recorded. At the end of the discussion, each participant will be given the opportunity for any further comments.

Will other people know what I have said?

The other individuals in the group will not will know what you have said during the discussion, but everyone who participates in the group discussion has the obligation to keep all information that is shared in the group to themselves. This is one of the **"ground rules"** for participating in a group interview and these ground rules will be discussed prior to the commencement of the group interview. However, we cannot guarantee that the information you share will not be discussed later by other members of the group.

No one outside the group will have access to any information you have provided to the research team. Even if we do include specific quotes or experiences in our written reports, you will not be identified by name or any identifying information, for instance, pseudonyms will be used instead of your real name, and locations, etc. will be changed. A**ll information that you provide during the discussion will be kept confidential.**

What happens after the group interview?

At the end of the group interview discussion session you will be thanked for taking part in the study. You will also be given debriefing letter that will provide information on the purpose of the group interview, how the data you provide will the stored and handled, what the data will be used for, how your anonymity will be guaranteed, and counselling contacts if required. Additionally, you will be entered into a prize draw that all staff members who volunteered to participate in the study are being entered. You will have the chance to win the first prize of a £50 amazon voucher, second prize of a £30 amazon voucher or third prize of a £20 amazon voucher.

At the end of the group interview, the audio recording generated during the discussion will be transcribed by the researcher in order to have a written account of the discussion. The transcribed data will subsequently be analysed. This research will form part of the researcher's PhD thesis and may also be used in publications. The research team will not contact you again unless you have won one of the prizes in the draw. However, you can contact the research team after the discussion should you have any questions or want to provide some additional information.

What do I do if I am interested in participating in the group interview?

- If you intend to participate in the group interview, you will be required to ascertain that you are available for one of the group discussion slots, as detailed in the invitation email and on the reply slip. Please let us know all of the slots you could make so we can allocate individuals to slots more easily.
- You will also be required to read the copy of the informed consent sheet. You will be asked to complete and sign an informed consent form on the day of the group interview discussion should you be chosen to take part.
- If you are still willing to participate in the group interview after reading this information sheet and the copy of the consent form, please complete the response slip and return by **email to Lawrence Ndupu at** l.ndupu@derby.ac.uk **as soon as possible.**
- The principal researcher will then contact you to confirm your selection and provide details of which group discussion you have been allocated to.
- If you are not selected to participate in the group interview discussion, the principal researcher will contact you directly. You will still be entered into the prize draw to show our appreciation for your willingness to take part in this research study.

What happens if you change your mind?

- Even though your opinions and views will be invaluable, participation in this group interview study is entirely voluntary and should you decide you no longer want to participate, you are free to withdraw from the study without giving any reasons at any time, before, during or for a period of up to 1 week after the group interview discussion takes place.
- All staff members that volunteer to participate in the group interview will be entered in the prize draw. Additionally, staff members who withdraw before, during or after the group interview discussion will still be entered in the prize draw.

What happens if you decide not to participate?

- Participation is entirely voluntary and therefore your choice whether to participate in the research study. If you decide not to participate it will not affect the possibility of you taking part in future research. All students are being invited but no one outside of the research team will know who has participated.

What will happen to the information that you give?

- All information generated during this group interview study will be securely stored in a password protected personal computer accessible only to the research team. All generated transcripts and hardcopies will be securely stored indefinitely, while the tapes or digital recordings will be securely stored in the university for up to 6 years. The information will also be used in my thesis and publications.
- A report will be produced at the end of the study, but no information will be included which could identify who took part in the study. All the information you provide will be confidential; if we do you any extracts or quotes from the interviews, pseudonyms will be used so no information can be directly traced back to any individual participant or group of participants.

Are there any risks in participating?

There may be some risks involved in participating in this study such as the possibility of data leakage since confidentiality cannot be guaranteed. However, steps have been taken to minimise this. Consider carefully what type of information we might discuss and if there is any information you would not like to share before agreeing to take part.

Where can I get more Information about this research?

If you would like more information, please contact Lawrence Ndupu:

Room N302,
University of Derby
Kedleston Road
Derby, DE22 1GB
Tel: 01332592135
l.ndpu@derby.ac.uk

Questions and Complaints:

If you have any questions about this research please contact the principal researcher at l.ndupu@derby.ac.uk. This research is being supervised by Dr Chris Bussell (c.bussell@derby.ac.uk); Dr Mark Faghy (m.faghy@derby.ac.uk); Dr Vicki Staples (v.staples@derby.ac.uk) ; and Dr Sigrid Lipka (s.lipka@derby.ac.uk).

Participants' information sheet for students

PARTICIPANTS INVITATION AND INFORMATION SHEET

Introduction

We would like to invite you to participate in a research study to assess the determinants (i.e. barriers and facilitators) of physical activity in Students of the University of Derby. Prior to deciding to take part, it is important for you to understand why the research is being carried out and what it will involve. Please ensure you read the following information carefully prior to deciding whether you would participate.

Who is conducting the research?

This study is being carried out by Lawrence B.N. Ndupu, a PhD research student from the College of Life and Natural Sciences. This study has been approved by the Human Sciences Research Ethics Committee.

What is the purpose of this research study?

- This research study is being carried out to identify the determinants (barriers and facilitators) of physical activity in the University of Derby students
- We hope the research study will help us to identify the barriers and facilitators that influence the University of Derby students from engaging in physical activity, with a view of designing bespoke university-focused interventions to address them.
- This research is being undertaken by Lawrence Ndupu, a PhD research candidate of the Faculty of Life and Natural Sciences, as a study in a series of studies in his programme of research (see contact details at the end of the sheet).
- Only the researcher and his supervisory team will have access to any data generated during this study. Pseudonyms will be used instead of any identifier such as names, post codes, addresses, etc., to protect the participants' identity when the data is transcribed.

Why have you been asked to take part?

You have been asked to participate in this group interview discussion because you are a student at the University of Derby, and you are 18 years and above. We are inviting all students to participate in this study. We are hoping to recruit 24 students (4 group interviews with 6 students in each). We are particularly interested in the following groups of students:

- Undergraduate first year students
- Postgraduate taught (masters) students
- Postgraduate research (PhD) students
- International students

Some students might see themselves belonging to more than one of these groups, therefore they will be asked to identify the groups they consider themselves to be a member of or to which they would be happy to contribute to a discussion with. For instance, an international student might also belong to any of the other groups. We anticipate this overlap.

What does participating in this research study involve?

Participating in this research study involves agreeing to participate in a group interview discussion with a small group of other people who share some common experience with you, that is they would belong to one of the same student groups you identified with. The group interview is designed to examine the barriers and facilitators that each group of students identify as having influence on their engagement in physical activity.

What is a group interview?

A group interview is a form of in-depth interview accomplished in a group where individuals share their ideas, feelings, opinions and views about a specific subject matter.

What is the purpose of this group interview discussion study?

The purpose of this group interview discussion study is to investigate a range of issues associated with the determinants of physical activity in the university of Derby students.

Who will be hosting this group interview?

The group interview will be hosted by Lawrence Ndupu (principal researcher) and an assistant moderator.

How long will the group interview discussion last?

The group interview discussion is expected to last about 60 to 90 minutes.

What will happen on the day of the Group interview discussion?

Prior to the start of the group interview discussion, Lawrence and Shan will check to ensure that all participants have completed and signed an informed consent form to say that they have understood what the group interview is all about and how much information will be used. Assistance will be provided for any participant who has issues completing the form.

During the discussion, individuals will be asked to share their opinions and views about a range of barriers and facilitators that may influence physical activity in the university of Derby students. Furthermore, you will be required to share your ideas about how the university can support student's engagement in physical activity.

The group discussion will be audio recorded. At the end of the discussion, each participant will be given the opportunity for any further comments.

Will other people know what I have said?

The other individuals in the group will not will know what you have said during the discussion, but everyone who participates in the group interview discussion has the obligation to keep all information that is shared in the group to themselves. This is one of the **"ground rules"** for participating in a group interview and these ground rules will be discussed prior to the commencement of the group interview. However, we cannot guarantee that the information you share will not be discussed later by other members of the group.

No one outside the group will have access to any information you have provided to the research team. Even if do include specific quotes or experiences in our written reports, you will not be identified by name or any identifying information, for instance, pseudonyms will be used instead of your real name, and locations, etc. will be changed. A**ll information that you provide during the discussion will be kept confidential.**

What happens after the group interview?

At the end of the group interview discussion session you will be thanked for taking part in the study. You will also be given debriefing letter that will provide information on the purpose of the group interview, how the data you provide will the stored and handled, what the data will be used for, how your anonymity will be guaranteed, and counselling contacts if required. Additionally, you will be entered into a prize draw that all students who volunteered to participate in the study are being entered. You will have the chance to win the first prize of £50 amazon voucher, second prize of £30 amazon voucher or third prize of £20 amazon voucher.

At the end of the group interview, the audio recording generated during the discussion will be transcribed by the researcher in order to have a written account of the discussion. The transcribed data will subsequently be analysed. This research will form part of the researcher's PhD thesis and may also be used in publications. The research team will not contact you again unless you have won one of the prizes in the draw. However, you can contact the research team after the discussion should you have any questions or want to provide some additional information.

What do I do if I am interested in participating in the group interview?

- If you intend to participate in the group interview, you will be required to ascertain that you are available for one of the group discussion slots, as detailed in the invitation email and on the reply slip. Please let us know all of the slots you could make so we can allocate individuals to slots more easily.
- You will also be required to read the copy of the informed consent sheet. You will be asked to complete and sign an informed consent form on the day of the group interview discussion should you be chosen to take part.
- If you are still willing to participate in the group interview after reading this information sheet and the copy of the consent form, please complete the response slip and return by **email to Lawrence Ndupu at** l.ndupu@derby.ac.uk **as soon as possible.**
- The principal researcher will then contact you to confirm your selection and provide details of which group discussion you have been allocated to.
- If you are not selected to participate in the group interview discussion, the principal researcher will contact you directly. You will still be entered into the prize draw to show our appreciation for your willingness to take part in this research study.

What happens if you change your mind?

- Even though your opinions and views will be invaluable, participation in this group interview study is entirely voluntary and should you decide you no longer want to participate, you are free to withdraw from the study without giving any reasons at any time, before, during or for a period of up to 1 week after the group interview discussion takes place.
- All students that volunteer to participate in the group interview will be entered in the prize draw. Additionally, students who withdraw before, during or after the group interview discussion will still be entered in the prize draw.

What happens if you decide not to participate?

- Participation is entirely voluntary and therefore your choice whether to participate in the research study. If you decide not to participate it will not affect the possibility of you taking part in future research. All students are being invited but no one outside of the research team will know who has participated.

What will happen to the information that you give?

- All information generated during this group interview study will be securely stored in a password protected personal computer accessible only to the research team. All generated transcripts and hardcopies will be securely stored indefinitely, while the tapes or digital recordings will be securely stored in the university for up to 6 years. The information will also be used in my thesis and publications.
- A report will be produced at the end of the study, but no information will be included which could identify who took part in the study. All the information you provide will be confidential; if we do you any extracts or quotes from the interviews, pseudonyms will be used so no information can be directly traced back to any individual participant or group of participants.

Are there any risks in participating?

There may be some risks involved in participating in this study such as the possibility of data leakage since confidentiality cannot be guaranteed. However, steps have been taken to minimise this. Consider carefully what type of information we might discuss and if there is any information you would not like to share before agreeing to take part.

Where can I get more Information about this research?

If you would like more information, please contact Lawrence Ndupu:

Room N302,

University of Derby
Kedleston Road
Derby, DE22 1GB
Tel: 01332592135
l.ndpu@derby.ac.uk

Questions and Complaints:

If you have any questions about this research please contact the principal researcher at l.ndupu@derby.ac.uk. This research is being supervised by Dr Chris Bussell (c.bussell@derby.ac.uk); Dr Mark Faghy (m.faghy@derby.ac.uk); Dr Vicki Staples (v.staples@derby.ac.uk) ; and Dr Sigrid Lipka (s.lipka@derby.ac.uk).

Appendix 7: Informed consent forms for university staff and students for study 1

Participant Informed Consent Form

Please, kindly tick the box to show you have read and understood the statement before signing this informed consent form.

I…………………………………………………………………………………… **[PRINT NAME]**

Hereby give my consent to participate in the Group Interview study investigating the determinants of physical activity in University of Derby staff and students conducted by Mr Lawrence Ndupu, a research student at the University of Derby, United Kingdom.

☐ I have carefully read the participants information sheet and fully understand the nature of this study and any risk involved and wish to participate.

☐ I understand that my participation is entirely voluntary, and that am free to withdraw at any time I wish to without giving any reason or explanations for doing so.

☐ I understand that I am free to withdraw from the study before, during, and up to 1 week of completing the group interview session by contacting the researcher, after which I will not be able to withdraw my data.

☐ I understand that the whole session will be audio recorded and data generated will be securely stored on a password protected computer, accessible only to the research team, to protect my identity.

☐ I understand that the data generated from this group interview will be used for research purpose and may be published in conference proceedings or scientific journals, and also used in the researcher's PhD thesis and seen by external examiners.

☐ I understand my obligation to keep the details of the group interview discussion private and agree not to divulge any personal or sensitive information that may be discussed.

☐ I have read and understood the above and agree to participate in this study.

Participant's Name: ……………………………………………………………………………..

Participant's signature: ………………………………………………………………

Date: …………………………………………………………………………

Appendix 8: Ground Rules for the Focus Group Discussions for Staff and Students

UNIVERSITY of DERBY

GROUND RULES

Ground rules are suggestions that will help guide the discussion and communicated to the participants before the group interview commences: They include:

- Minimise or eliminate side conversations.
- One person will speak at a time.
- Don't criticise what others have to say.
- Treat everyone's ideas with respect.
- Kindly switch off all mobile phones or put them on silence.
- You have the obligation to keep details of the group interview discussion private and not divulge any personal or sensitive information that may be discussed.
- In case the fire alarm goes off, the researcher will direct you to the nearest fire exit and muster point.

Appendix 9: Debrief sheet for staff and students

Debrief sheet for staff

UNIVERSITY of DERBY

DEBRIEF SHEET

Thank you for participating in today's group interview study. Your participation is much appreciated.

The aim of this study is to investigate the barriers and facilitators of physical activity in the University of Derby staff members. We hope the research study will inform the development of bespoke behaviour change interventions to encourage more staff members to engage in physical activity.

We hope you found the discussion interesting and enjoyed participating in the group interview discussion.

As we discussed before the group discussion, everyone who participated in the group interview has an obligation to keep the information that has been shared within the group to themselves. Please do not discuss the details of the group discussion with anyone outside of the group.

If any aspect of the group discussion has raised issues for you of has caused any upset, please you can contact the **Health Assured** a counselling Service at **08000305182** for counselling (request free call if using a mobile) or you can contact your usual care provider or GP for medical issues.

If you think of any further information that you think would be useful to the researcher or that you did not want to discuss in front of the group you are very welcome to contact Lawrence Ndupu directly on 01332592135 or l.ndupu@derby.ac.uk. Kindly see below details of some physical activity websites you may wish to visit.

General Information about Some Physical Activity Websites:

- NHS Change 4 Life initiative at: https://www.nhs.uk/change4life-beta/cards#Vk5MdQHasVbTolHF.97
- Department of Health Start Active, Stay Active at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf
- Derby City Council Livewell Programme at: https://www.livewellderby.co.uk/
- University of Derby Sports and exercise facilities available for staff at the Sport Centre at: https://www.derby.ac.uk/campus/sport/fitness-suite/

Thank you once again for your participation in this research study

Debrief sheet for students

UNIVERSITY of DERBY

DEBRIEF SHEET

Thank you for participating in today's group interview study. Your participation is much appreciated.

The aim of this study is to investigate the barriers and facilitators of physical activity in the University of Derby students. We hope the research study will inform the development of bespoke behaviour change interventions to encourage more students to engage in physical activity.

We hope you found the discussion interesting and enjoyed participating in the group interview discussion.

As we discussed before the group discussion, everyone who participated in the group interview has an obligation to keep the information that has been shared within the group to themselves. Please do not discuss the details of the group discussion with anyone outside of the group.

If any aspect of the group discussion has raised issues for you or has caused any upset, please you can contact the **student wellbeing service** at **01332593000** or email to **studentwellbeing@derby.ac.uk** for counselling or you can contact your usual care provider or GP.

If you think of any further information that you think would be useful to the researcher or that you did not want to discuss in front of the group you are very welcome to contact Lawrence Ndupu directly on 01332592135 or l.ndupu@derby.ac.uk. Kindly see below details of some physical activity websites you may wish to visit.

General Information about Some Physical Activity Websites:

- NHS Change 4 Life initiative at: https://www.nhs.uk/change4life-beta/cards#Vk5MdQHasVbTolHF.97
- Department of Health Start Active, Stay Active at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf
- Derby City Council Livewell Programme at: https://www.livewellderby.co.uk/
- University of Derby Sports and exercise facilities available for students at the Sport Centre at: https://www.derby.ac.uk/campus/sport/fitness-suite/

Thank you once again for your participation in this research study

Appendix 10: SPSS output for Cohen's Kappa inter-reliability test

Table 1: Crosstabulation for coder 1 and coder 2

			Coder 2		Total
			.00	1.00	
Coder 1	Disagree	Count	3	0	2
		Expected Count	2	2.8	3.0
	Agree	Count	2	69	71
		Expected Count	4.8	66.2	71.0
Total		Count	5	69	74
		Expected Count	5.0	69.0	74.0

Table 2: Symmetric measures

	value	Asymptomatic Standard Error[a]	Approximate T[b]	Approximate Significance
Measure of Kappa Agreement	.737	.177	6.569	.000
N of Valid Cases	74			

a. Not assuming the null hypothesis
b. Using the asymptomatic standard error assuming the null hypothesis

Appendix 11: Enablers and barriers to physical activity among university staff and students

Table 1: Enablers to physical activity among university staff and students

TDF domains (a priori themes)	Subthemes	Participants		Sample quote
		Staff	**PhD students**	
Knowledge (a perception of the actuality of something)	• Awareness of the recommended physical activity guidelines	√	√	*Yeah, with, erm, because, erm, at work, we do Health Psychology Masters, so I've actually looked it up before and it's something like 150 minutes of mild to moderate per week…with two sessions per week of stretching and then there's something else as well. Oh yeah, like, weight, or… Something like weights (Martha- Master's student).* *Um… so, current recommendations are 30 minutes 5 times a week moderate intensity exercise (Mark- Academic staff).*
	• Awareness of available sports/exercise facilities	-	√	*Erm, I think knowledge would be an incentive in regards to the…if something was…if more information was provided on, say, the easily accessible nature of something, you know, more information, if there was a lot of information provided about a particular sport event or something like that, that's an incentive for me, because, I think, it's… it's that knowledge of it's easy to do, I can do this, it's okay (Michelle- master's student).*
	• Awareness of the benefits of physical activity	√	-	*The main influences I suppose are just my knowledge that it is good for me. That's my…that's what influences me the most, just my knowledge to do something that I ought to do (Jane- Administrative staff)*

Social influences (those relational processes that could make people to change their opinions, emotional state and conducts)	• Acknowledged support from family, friends and colleagues	√	√	*Yes, definitely yes, with the social influence I mean, colleagues, family, I do more stuff (Joseph- Academic staff).* *Yeah, so friends, family um… that's what I found with myself, so there's a lot of encouragement between each other, and you can enjoy it more if you're with people that you enjoy being around (Andrew- PhD student).*
Reinforcement (Raising the likelihood of a reaction by organising a dependent association, or exigency, between the reaction and a specified inducement)	• Financial incentives: ➢ Free/cheaper exercise classes	√	√	*It's like most of us finish at…well, most of the cleaners finish at nine o'clock now if they had an incentive where if you went to the gym from nine till half past ten say… then you could have it for a quarter of the price or for free. People would, even though they've got other jobs, they… they could make, you know, alterations to their life to be able to put that in their goal and go and do the other job (Kate- cleaning staff).*
	➢ Gift voucher	-	√	*Yeah. I mean, just if it was, not even like a financial incentive, just it was free or the transport there was free or something that would be enough than a financial incentive, and if it was something that was more, like I said, it isn't really expected in my family, if it was something that was more expected and it was a bit, why aren't you doing that, then I think that might change it (Martha- Master's student).* *Yeah, I think, erm, the first option, yeah, the financial factor or, erm, maybe a gift, like voucher and a voucher is given to me to go and do a physical activity for free. Yeah, why not?* (Audrey-Master's student).
	➢ Money	√	√	*Um… I would definitely do it if someone was paying me a fiver, definitely! Um… the competition bit for me, only when I am there. It wouldn't get me there, but once I am there* (Jane-Administrative staff).

				It's um… so I would rather go for tangible rewards, maybe financial (Ali- International student).
	➢ Pay as you go ➢	√	-	*Pay as you go, yeah, pay as you go* (Kate- Cleaning staff).
	• Non-financial incentives ➢ Appreciation and praise	√	√	*I think to me, it's kind of strange. Financial reward might not encourage me, you know, sometimes you say that you would go and do this if you are given money. I might not even do it. I think mine would be kind of appreciation. Ah, you're looking good, you know, like those kind of things* (Titilayo- International student).
	➢ Recognition	√	-	*I think it's um… self-satisfaction really. It's what you've done and then when people sort of like think, Oh, say to you, Oh, you look good and that, and you're… you're doing something, yeah, exercise* (Aby- Cleaning staff). *Um… so yeah, some recognition I think could be a good… could be a good incentive for me as well* (Anita- Administrative staff).
	➢ Health benefits	√	√	*Well, I guess health and I want to be more fit than I am now, because I'm not* (Joseph- Academic staff). *…my medical assessment like if medically I know that am gaining this thing medically and my doctor says that, okay you've lost so much weight, your heart is good because you're doing more exercise, that would encourage me than financial aspect of it* (Titilayo- International student).

	➢ Competition	√	√	*I think um… I think myself, competition I think is a good incentive as in you know, not doing a sport competitively but I like um… yeah, I like competition so, you know, like for example, I know we do these tower challenges or something, you know, I would, you know… I think I'd like to be the one who does it in less time* (Anita- Administrative staff) *Yeah, even I agree with them, I don't think the money is the main purpose for that kind of thing, but the competition, when you find someone that um… just the competition, this is going, let's say, the waiting to go and increase your skills in this kind of stuff, so the motivation for that, competition in my opinion is the point* (Elvis- PhD student).
	➢ Goal achievement	√	√	*Um… the only thing I can think of is to the incentive I suppose is that you get a result that you… you want if you work at it, it might be lose your weight* (Laura- Cleaning staff) *Um, for me I'd say competition and goal achievement* (Hillary- first year undergraduate student). Um… the only thing I can think of is to the incentive I suppose is that you get a result that you… you want if you work at it, it might be lose your weight (Laura)
	➢ Intrinsic motivation	√	-	*They're all internal motivators, I wouldn't be motivated by a gift or financial, it's what I want to do when I want to do it* (Mark- Academic staff).
	➢ Social factors	√	√	*Yeah, I don't think money would encourage me either. I think sort of social things encourage me more, like if you are doing*

				something together with friends, aiming to get fit together (Wendy- Administrative staff) *It should always come from within really and be like a, you know, motivation, or um… assistance from friends, or maybe like a support group, or maybe a group of people who are interested in wanting to do more exercise and they don't know how to, could get together and support each other to do that* (Andrew- PhD student).
Emotion (An intricate response pattern, comprising experiential, behavioural, and mental components, through which the person tries to cope with an individually important issue or occurrence)	• Feel happy	√	√	*Oh, start with me. Well it produces happy hormones doesn't it? So, you do feel better for it... your physical wellbeing* (Diana- Cleaning staff). *Um… I feel um… very light after doing physical activity and um… obviously it makes you feel good that you have done something, and so obviously, yes, I feel happy after it*. (Eric- PhD students).
	• Relieves stress	√	-	*Yeah, I think in the gym I don't enjoy it at all um… and um… but I try and use it to work off any angst or stress. Um… it's, it's quite a good psychological processing tool really. Um… and… and I get… and afterwards I think…not immediately afterwards, because afterwards you are hot and sweaty and actually feel really uncomfortable um… but you get a bit of an adrenaline rush and feel… feel quite um… alive really afterwards* (Peter- administrative staff).
	• Fear of death	-	√	*For me whenever I hear about any incident. Mayor's death brought a massive change for me. Um… a young guy died back home with a heart attack couple of days ago that… with these*

				kind of things, I… I usually start thinking about… I got to be more active, I shouldn't drink alcohol, I should do this, I should go to gym on every day, I should make myself more accessible, available to get engaged in this (Ali- International student).
Intentions (A cognisant resolution to carry out a behaviour or a decide to behave in a specific manner)	• Plans to engage in more physical activity • Plans to engage more of the same or different types of activities	√ √	√ √	*Of course, I would like to do more physical activities* (Mohammed- International student). *Of course, I would, I'd love to do more physical activity. Yes, most* definitely (Jennifer- Catering staff). *Yes, some different activities, why not, experience something new* (Joseph- Academic staff) *…erm, and do, yeah, do different things. Like I'd like to do more, erm, weight things …erm, and then, yeah, I'd also like to get back into competitive sport because I used to always do team sports …erm, but then since going to University, left all those teams, so then, it's like having to find a new team to join or whatever. Erm, so I would like to do that, and, yeah, different, different things* (Jacqueline- Master's student). *Well, I'm happy doing what I am doing now. I would like to do more, but with my health and everything I might not able to* (Jessica- Cleaning staff). *I want to do more of the same thing, referring to the gym aspect getting back to my workout routine five days a week, I want to get back to that and I want, we're leaving out the food bit, so yes, I do want to get back in the gym and get back on that routine. As far as anything else, um, I don't see myself doing anything else right now* (Barak- First year undergraduate student).

	• Intrinsic motivation	√	-	*They're all internal motivators, I wouldn't be motivated by a gift or financial, it's what I want to do when I want to do it* (Mark- Academic staff).
Skills (a competence or capability developed via practice)	• Have the skills to engage in physical activity	√	√	Yeah, I think I have all the skills I need to go for the sports I want. I was a competent horse rider, hockey player, tennis, squash, badminton, table tennis, so… swimming, so all the sports I enjoy doing I can already do because I did them because I was really, really um… sporty when I was younger (Monica- Academic staff). Yes, I think I do have skills because, my point is when I was in my twenties I used to play semi-professional cricket, so I think obviously I do have the skill to do any sort of physical activity (Eric- PhD student). I have the skills, as I say, I love playing squash, and I'm very good at it (Bill- Master's student).
Behavioural Regulation (anything focused on dealing with or altering objectively monitored or evaluated activities)	• Monitoring of physical activity done ➢ Use of Phone apps	√	√	…and sometimes because with iPhone when… if I go to gym and I put my iPhone very close to me, sometimes I put it… I attach it to myself. At the end of it it's going to come up with… because I have this thing on my iPhone that will tell you how many calories I have, you know, I have burnt. So, with my iPhone I keep tracks on how many, you know, how um… the progress of my physical activities (Titilayo- International student). *Um… my step counter on the phone (Laura- Cleaning staff).*

	➢ Use of Fitbit	√	√	*Yeah, so I know how much I walk a week, the distance and how long it takes to get to and from work. I have got a little Fit Bit thing and it kind of emails you and tells you what you have done and.... (James- Administrative staff)* *…but I personally have a Fitbit, so that um… tracks what I've done, so um… it's a… it's… it's not a great measure but you can sort of compare it to different days to see if you've been more active on certain days and you can sometimes the encouragement of competition with members of your family or friends that have it can increase your fitness (Andrew- PhD students).*
	➢ Use of Self-assessment	√	√	*Similar things. I know roughly how long the walk to school takes and I do that five times a week, and I know how long the cycle takes to work and I just base it on that. I don't have a Fit Bit or anything like that. I just take it from that (Wendy- Administrative staff).* *The same, you feel it, for example, after just biking 30 or 40 minutes you can already feel it that you're biking since quite a long time, and if you're going climbing after 2 hours, you're feeling every muscle in your arm and your hands, so definitely you just feel it (Frank- PhD student).*
	➢ Setting of targets	√	-	*Because I set a certain amount of – with regards to exercise, I have a target and when I've achieved it, then I'm pretty satisfied (Joe- Cleaning staff).*
	➢ Use of training diary	√	-	*Eh… I keep a training diary, so for that aspect I would know how much I've done or need to do (Mark- Academic staff).*

Goals (mental depictions of consequences or final outcomes that an individual's wish to accomplish)	• Weight loss	√	√	*Mine has always been to lose weight. If I… when I do my exercises it is always to lose weight* (Jennifer- Catering Staff). *Yes, to reduce my belly fat. Um… to reduce [laughs] my weight in general, yea, and most importantly just because it gives me very good feeling* (Ali- International student)).
	• Health and fitness	√	√	*Um… I think I have a broad goal of quality of life and um… and that involves keeping as fit as possible within the parameters of, my parameters, and, and staying healthy, um… because my concern is that, you know, our health service isn't going to be able to help me, so I have to help myself* (Lynda- Academic staff). *Erm, well, I used to be really fit and then when I…in my first of University, I stopped doing any sort of sport, so my fitness went right down, so now, it's trying to get fitter again …erm, and me and my family are doing the Coast to Coast cycle ride …erm, at the end of July, so I'm aiming towards being at a good enough level to be able to complete that. Erm, yeah* (Jacqueline- Master's student).
	• Personal improvement	√	-	*I guess, most of mine are fairly intrinsic around performing in my sport. Eh… some of that, there's kind of an underlying thing of, I work with quite a lot of high-level athletes that there is a sense that I want to be able to competently demonstrate things, but also that I want to be seen as someone that could be, eh… I guess, practice what you preach sort of thing* (Mark- Academic staff).
	• Target achievement	√	√	*I've setup my daily step target for 9,000 steps a day, so that's my kind of aim I want to achieve* (Oliver- International student).

				Um… I think with…when I run, there is a little bit of competitiveness in that bit as well because I do want to increase the time that I do each time. So I have a goal of trying to…you know I am not happy if I don't do it below a certain time. Well not… not happy but I just want it (Jane-Administrative staff).
Beliefs about Consequences (Acknowledgment of the accuracy, actuality, or authenticity about effects of a behaviour in a specified circumstance)	• Health benefits	√	√	*Well it is about raising your heart… your heart beat, um… and um… and that helps to um…I mean that will get your heart working, it burns off the calories um… so you are fitter* (Peter-Administrative staff). *So, I think it's important for, you know, your overall organs, your heart, your muscles and er things like that* (Barak- First year student).
	• Economic implications	√	-	*…but it's also about um… the economics of it because um… it costs the country a lot of money to deal with folks who have um… heart disease and generally poor physical health* (Peter-Administrative staff). *…and minimise um… costs on the NHS for things like heart disease or obesity* (Wendy- Administrative staff)
	• Relieves stress	√	-	*Yeah, I think in the gym I don't enjoy it at all um… and um… but I try and use it to work off any angst or stress. Um… it's, it's quite a good psychological processing tool really. Um… and… and I get… and afterwards I think…not immediately afterwards, because afterwards you are hot and sweaty and actually feel really uncomfortable um… but you get a bit of an adrenaline rush and feel… feel quite um… alive really afterwards (Peter- Administrative staff).*

	• Improvement of sleep quality	√	√	*…and you get a better sleep too. I get a real good sleep* (Barak- First year student). *Yeah, I feel more able to focus, as I said before, um… or I can also feel more able to rest, so to sleep better if I've engaged, which is quite good* (Lynda- Academic staff).
	• Feel happy, better and good	√	√	*So, you feel good, you feel… you're happy that you've been able to do something, so for me I'm like okay at least that walk is for a week at least I have done something now in one week* (Oluchi- International student) *Well it is good ain't it to be active, I think you feel better when you're healthier. You definitely, it definitely gives you a feel-good factor about yourself* (Amy- Catering staff)
	• Feel more powerful, refreshed, focused and relaxed	√	√	*Erm, I feel refreshed, um, relaxed* (Hillary- First year undergraduate). *Yeah, more focussed, more powerful, because I want mostly to play table tennis, so I want it to be yes, back in the game, yeah* (Joseph- Academic staff).
	• Boosts confidence	-	√	*But psychologically, you kind of um… feel confident if you go to gym on time or if you try to do physical activities on time, especially for women. For me it boosts my confidence* (Titilayo- International student).
Beliefs about Capabilities (Acknowledgement of the	• Self-efficacy to engage in physical activity	√	√	I think, yeah, I think if I put my mind to it I could do it. I could do because I've not got anything wrong with me you know what

accuracy, actuality or authenticity about the proficiency, ability or capability that an individual can put to productive use)				I mean like, I'm fit enough, she says, um… no I'm fit enough I think for my age, so it is like yeah I could do anything I set my mind to it or wanted to (Anne- Academic staff). Erm, yeah, I think it's easy because I do have the time, like I don't work as much as other people. Erm, I live next to a really good, like, bus links, or my gym's like a ten minute run away …erm, so I have like all the resources and time. Erm and I know that it makes me feel good, so I have the motivation, so that's, I think that's why it's easy (Jacqueline- Master's student).
Environmental Context and Resources (Any situation of a person's condition or surroundings that inhibits or promotes the enhancement of competences and capabilities, autonomy, adaptive behaviours and social skill).	• Aspects of the university environment that encourage physical activity: ➢ Provision of the sports centre. ➢ High-rise buildings and location of campuses	√ √	- √	*Well yeah, I think having the sport centre in terms of our estate I think is great. A great facility in terms of location of the environment (Anita- Administrative staff)* *Erm, I think the location, because the …it's very much, obviously I know it's literally everything's high, it's not flat, all these buildings are high, so it's a fact of, you know, I'll always use the stairs instead of using the lift (Michelle- Master's student).* *So that kind of does make me think well there's no point in…sometimes I deliberately set it up so that…because I see students over at other sites, so that I can have a walk in between from here to Britannia Mill, and that's…I really enjoy doing that but it's just fitting it in (Jane- Administrative staff).*

	➢ Proximity of university to shops and park	√	-	*I think if we were…if there were more things around the University that would get me out of the office and I know a lot of people go to park farm for lunch, kind of walk to the shops and back (Anita- Administrative staff)* *It's pretty good that the park is quite near if you did want to go for a wonder walk, again, only if you can fit it in around you (James- Administrative staff)*
	➢ Changing facilities and secure bike sheds	√	-	*Um… I think it's quite good that it's got, you know, places to lock your bikes and there's the changing facilities in the gym (Wendy-Administrative staff).*
	➢ Motivational posters by the lifts	√	√	*I think the lift one, because I remember there was a time when I wanted to… I think we were having that teaching… that teaching something that we were doing and I was running late or... I wanted to climb the… [Laughs], I wanted to go inside the lift then I saw that noticeboard that you could encourage yourself by climbing and I ended up climbing [laughs], so I think that one is good (Titilayo- International student).* *I don't know if this makes sense, you know the lifts where they have those labels on, that says, "Don't use the lifts, use the stairs,"? That could be a bit of an encouragement, couldn't it? (Hillary- First year undergraduate student)*
	➢ Advertisements in university buses	-	√	*That's a good… and the advertisements in the bus as well, because sometimes when you look at the distance, especially during new session and they advertise that if you're a student, if you register at so, so time, so when you look at it you will start to think what if I do this in the uni, you know, it will pay off because I will be in uni after school, after my lecture or after*

	• Opportunities to do physical activity in the university: ➢ Physical activity initiatives	√	√	*everything you go back and do the exercise and go back home. I think that advert is good as well (Titilayo- International student).* *I think this kind of um… even yesterday we were sitting in our office, there is… two girls come to our office just to give us some brochures that… to encourage us to go to gym with some details inside I think. Um… this kind of thing arranged by the university, yeah, these kinds of things that maybe motivate us or are good things to go to, to do more and more now, like more training or more physical activities (Elvis- PhD student).* *No, a few…sometimes they do um… running up the towers don't they? They have all the people who want to do it, you can run up every single tower in the university, and the first one who completes it gets a gym pass. They do it and they get a gym pass free for a month. So that gets not a lot, I don't know how many people actually do it, but… but quite a lot of people do it and whoever wins does get something for it and the gym (Aby- Cleaning staff).*
Professional/Social Role and Identity (a rational set of behaviours and exhibited individual characteristics of a person in a societal or working contexts)	• Importance of physical activity in participants course/job role	√	√	*As a cleaning staff, our daily work involves lots of physical activity and I think it is essentially necessary to be physically active to perform well as a cleaner. I mean cleaners are expected to be physically active, aint we? (Joe- Cleaning staff).* *I was encouraged to start doing physical activity when I joined the university. They had this fair in the atrium with different clubs and societies for students to join. So I strongly believe that the university sees being physically active as important for*

				students and this has influenced me to active (Donald- First year undergraduate student).
	• Opportunities to be physically active	√	-	*As I said earlier, our job involves lots of physical activity and therefore demands us to be physically active. Although, I cannot say that all my colleagues meet the recommended physical activity guidelines, taking up physical activity opportunities with my colleagues to be active is an important part of my identity as a cleaning staff (Joe- Cleaning staff).*
Optimism (the self-assurance that things will occur for the best or that objectives yearned for will be accomplished)	• Confidence of the inactive to engage in physical activity	√	√	*Yes, I think obviously, I have the confidence to engage in physical activity (Eric- PhD student).* *Well I could do it yeah. I could, I'm really confident I could do it yeah. It wouldn't hold me back (Anne- Catering staff).*

√= mentioned by at least one administrative staff or students
-= not mentioned by any administrative staff or student

Table 2: Barriers to physical activity among university staff and PhD students

TDF domains (a priori themes)	Subthemes	Participants		Sample quote
		Staff	PhD students	
Knowledge (a perception of the actuality of something)	• Lack awareness of recommended physical activity guidelines	√	√	*I think its 3 hours a week of intensive activity. There is also for moderate activity, which should be longer, probably 1 hour a day (Richard- international student).* *Um… I think I read as well or heard 20 minutes a day (Sophie- catering staff).*
Social influences (those relational processes that could make people to change their opinions, emotional state and conducts)	• Family commitments	√	√	*…my research and time for family, so there is no time left (Christophe- PhD student).* *So, add that on to my working day, then add on going home, picking up my child, um… cooking dinner, getting her to bed, that leaves me, if I'm lucky, half an hour (Monica- Academic staff)*
Emotion (An intricate response pattern, comprising experiential, behavioural, and mental components, through which the person tries to cope with an individually important issue or occurrence)	• Confusion about recommended physical activity guidelines	√	-	*Yeah you do read different things, though don't you? One month they're telling you one thing and then another month they're telling you something else in magazines and stuff. Or don't they?* (Amy- Catering staff). *We're supposed to do it and they keep changing the things about how much you're meant to do and, you know, there was all this thing about, oh, you're meant to do 20 minutes a day, and then there was this so many hours a week, and there was this thing where, oh, 5 minutes a day is actually enough so long as it's really intense 5 minutes. So, they keep changing, they can't*

				make their minds up, I don't think they know what they're talking about half the time (Catherine- Academic staff).
	• Fear factor	-	√	*…but the interesting thing about that is, erm, because of how fit you have to be to play squash, because I haven't played for so many months now, there's a fear factor as well (Bill- Master's student).* *"I don't know, because I just, I don't like the feeling of it, I don't like the, the moving and the breathlessness, because I think I panic, because I assume it's the asthma" (Martha- Master's student).*
Intentions (A cognisant resolution to carry out a behaviour or a decide to behave in a specific manner)	• No plans to engage in physical activity	√	√	*I don't really, I don't really do anything. I used to go out on my pushbike a lot but I'm going to in summer because I haven't got a dog now. My life has changed quite a bit since I lost the dog really because I used to go out a lot more when I got the dog* (Amy- Catering staff). *I'm the odd one out. I'm not engaging in any physical activity and am not doing anything. It's just once a while that I do the trekking to, you know, city centre and back. I'm supposed to be going out every day to do like 30 minutes of… but I don't* (Oluchi- International student)
	• Do not plan to do more physical activity	-	√	*Erm, well I know that I should do more and I do think about doing more. Erm, in terms of trying different things, well I don't do anything, so everything's different* (Martha- Master's student)

				I don't know, because I just, I don't like the feeling of it, I don't like the, the moving and the breathlessness , because I think I panic, because I assume it's the asthma (Martha- Master's student).
Skills (a competence or capability developed via practice)	• Lack the skills to engage in physical activity	√	√	*I love swimming, but I don't have the skill so… and am really afraid that I don't want to start swimming without being trained, and I have tried my best to get myself trained like going to the council and they said they are fully booked up; I am number 65 on the waiting list (Titilayo- International student).* *Mhmm… I don't have the skill, and I don't even know what to engage in (Oluchi- International student)* *It is me because not that interested in... been…. Oh no, well I'm, I cannot swim, so I don't go swimming and kayaking would just terrify me. Canoeing and all that you know like I don't like heights. So no sorry but I'm quite happy to sit in the house (Anne- Catering staff).*
Memory, Attention and Decision Process (the capability to recall information, concentrate selectively on parts of the surroundings and select amongst two or more options)	• Difficulty in justifying time for physical activity	√	√	*…so I think there are things the university can, you know, not necessarily the sports centre I think it's also a matter of culture around staff wellbeing and it's true, the social timetable…I was interested in one and it just was like at 4 o'clock and I am at work at 4 so I couldn't do it (Anita- Administrative staff).* *I have so much going on at work and at home which makes it hard for me to engage in any form of Physical activity. The truth is that there is no time to actually do all the activities I would love to do, if that makes sense (Anne- Academic staff)* *Um, I don't really, um, I've not really done much while I've been at Uni, like, I keep meaning to join the gym here, I want to join,*

	• Forget planned physical activity	√	√	*like, and do my sports while I'm here, but I just haven't got round to doing it, I'm too busy (Donald- First year undergraduate student).* *I am working part-time and schooling at the same time, so it is about prioritising my time to do some form of physical activity. However, it is very difficult to justify time for physical activity. I really want to engage in some form of physical activity, but it is hard to find the time (Ali- PhD student).*
	• Difficulty in deciding physical activity to engage in	√	√	*On several occasions, I have planned to engage in physical activity, but due to my lab work and other study related commitments, I just forget to engage in it. I always feel bad afterwards, but this is a major barrier that prevents me from being active (Elvis-PhD student).* *Seriously, school work could be very challenging that you can genuinely forget to do physical activity that you had earlier planned to do. This has happened to me several times, especially when I have assignment deadlines to meet. You are just so busy and every other thing is secondary (Bill- Master student).* *Sometimes I had planned to go to the sports centre to play social badminton, but forget to go because am too busy working or attending one meeting or the other. The university does not encourage us the admin staff to engage in physical activity. That is the truth (Wendy- Administrative staff)*

				They have so many sports and exercise classes going on in the sports centre that makes it difficult for me to choose the ones to do (Joe- Cleaning staff) *The other day, I went with some of my co-workers to the sports centre to see exercise sessions we could go together, but they had so many which made it difficult for us decide on the exercise classes to join. If they had a swimming pool it would have been an easy choice for us because we all love swimming, don't we? (Anne- Catering staff)* *I went to the sports centre the other day to look for an activity to start doing, but was overwhelmed by many options of sports and exercises that I can do and up till now am still trying to decide which activity to do (Martha- Master's student).* *Me that is very lazy. Um… one of my friends and I went to the sport centre to sign up for an exercise class and it was difficult making up our minds on which ones to do, because they had so many different types of exercise classes. We ended up trying to decide and ended up not doing any. This may inhibit people from engaging in physical activity (Mohammed- International student)*
Beliefs about Capabilities (Acknowledgement of the accuracy, actuality or authenticity about the proficiency, ability or capability that an individual can put to productive use)	• Lack of the self-efficacy to engage in physical activity	√	√	*I can't do everything I want to do anymore because my lower joints won't let me (Catherine- Academic staff).* *Um… to me I think number one, it's difficult. Why? Initially there used to be gym very close to my house at Moorways and they closed that place. Now which means I have to come to town, you know, and from my house to town will be about 30 minutes or 40 minutes to town. So when I think about the time I*

				have to walk or take the bus, and if I decide to stay back at uni, I don't normally come to uni every day, so as much as I would have loved to go to gym maybe two times in the week or three times, the distance to my house that's number one (Titilayo-International student).
Environmental Context and Resources (Any situation of a Person's condition or surroundings that inhibits or promotes the enhancement of competences and capabilities, autonomy, adaptive behaviours and social skill).	• Barriers to physical activity opportunities in the university: • ➢ Time constraints and timing	√	√	*Um… I don't know, I guess like there are some sort of ventures, you know, if you wanted to go outside for a walk at lunchtime but like you say, they haven't got much time to go far (Wendy-Administrative staff).* *…it was 7.30 so of course people are being free, but most of the students are away so they're not enjoying that, you could just watch or just try, so they are doing something but not at a good timing, so because of the timing… (Frank- PhD student)*
	➢ Financial constraints	√	√	*..but I've been down and it's too expensive. I think they ought to give like a, I don't know six weeks free or something or a month free just to encourage you. And then after that then you can decide whether it is worth the money what they're asking. Because they do have a lot of classes down there I think don't they? Because it is a big facility ain't it? (Amy- Catering staff).* *I wouldn't be able to join a gym because I can't afford gym membership and transport to a gym, I'd have to walk, like, an hour to get to the gym and then I've walked an hour, I'm not doing exercise on top of that (Martha- Master's student).*

		➢ Work commitments	√	√	*I think you know, when you have a full time job…I don't have kids so…but still it feels like there is just always too many things to do in a day (Anita- Administrative staff)* *Um… secondly I'm… sometimes am heavily loaded with work and I'll really want to go, like my colleagues usually go um… sometimes I want to go but I cannot because either am teaching or either I have to do something to meet some kind of deadlines (Ali- International student).*
		➢ Study commitments	-	√	*Like sometimes I'm in the uni till 10pm, 9pm, depending on the intensity of the work with deadlines for some publication and stuff like that. It takes so much time (Christopher- PhD students)* *I think it's similar to what you've said, like, the workload's just probably stopped me a little bit (Donald- First year undergraduate student).*
		➢ Family commitments	√	√	*Yeah, you know, yeah when you've got… Jennifer has got children and when you've got children, kids always come first, don't they? You're canoeing is on the back burner ain't it? (Anne- Catering staff).* *…my research and time for family, so there is no time left (Christopher- PhD student).*
		➢ Weather	√	√	*And I think, I don't know it is just, I think it is harder in winter to be healthier than in summer. I think you feel more like doing you know activities outside in summer. So, winter is a bad time but um… yeah, I think, I think everybody should do it (Amy- Catering staff)*

				The reason is this, back home in Nigeria, I used to trek from my house to the bus stop before getting a vehicle to work and then when I get to my bus stop to my workplace I will trek again to my house… to the um… office. So, for me that was the form of exercise that I was engaging in, but when I got here the weather is so cold, so because the weather is cold I'm not interested in going out. I just want curl up in bed (Oluchi- International student).
	➢ Inaccessibility to certain sports facilities.	√	√	*Um… If they had a swimming pool that would make a difference, perhaps um… that was a real missed opportunity in my opinion. Um… otherwise, I don't know, I think it would… it would be great to think that the university cared at all about our wellbeing, but I'm not holding my breath (Catherine- Academic staff).* *They don't have like a way of having sports for all people, just for a few people, as Eric said, maybe 20 or 25% maximum students. If they want to increase they have to think about completely again to what kind of facility they have and to access and, yeah (Frank- PhD students).*
	➢ Lack of advertisement	-	√	*I don't know, erm, maybe, like, where the lecture is will depend on how many stairs I climb. And, I suppose they could have more posters about what's available there, but I'm only at University two days a week and then the rest of it is me at home, so I don't think it really impacts that much (Martha- Master's student).*

	➢ High-rise buildings and location of university campuses	-	√	*Yeah, I think she's pretty right, I mean, you know, for me for example, I don't even take my lectures here, I take it at Friars Gate, which is just one long building, so it's a matter of getting to the building, jump in the lift, get to where you're going, come down, so there's really no room for that at all in Friars Gate (Bill- Master's student).* *But I think, again, when you look at the whole, er, University as a whole itself, I, I don't really think so and that's nothing to do with the University of Derby, it's just the way it is, because I go to University of Nottingham a lot to use their library and because everything is just on one big, er, er, land mass, it's just you do a lot of walking and they've got these really beautiful footpaths and all that, so you see students doing a lot of walking, you know, from their Halls to classes, to the library, you know, erm, you do a lot of that, but obviously the University of Derby is scattered all over the place, so you have to jump on the bus, you have to, so I don't think the whole University of Derby take the way it is really, I'm not sure that's, er… yeah (Bill- Master's student).*
	➢ Social timetabling at the sport centre	√	-	*…as well and I think some of the sports…social timetables and things don't quite fit well for staff, they are a better fit for the students. And yeah it's kind of geared a bit more for students than staff (James- Administrative staff).*
	➢ Free bus scheme	-	√	*Firstly, I don't think the university encouraging me for doing sport activity or just physical activity, but for another point of view, I noticed that Derby also does a free bus for students, it doesn't encourage them to walk, so they're just lazy (Frank- PhD student).*

Professional/Social Role and Identity (a rational set of behaviours and exhibited individual characteristics of a person in a societal or working contexts)	• Difficulty in taking up opportunities to do physical activity	√	√	*There are so many opportunities in the university for us as administrative staff to be physically activity, but I guess the university authorities do not belief that it is important for us to be active. I feel they should have a timetable of activities at the sport centre that fit with our work routines. They focus more of students, which may be a major reason why most administrative staff are inactive (Peter- Administrative staff).*
	• Laziness to engage in physical activity	√	√	*I do not know about other academic staff, but am very lazy when it comes to doing any form of physical activity. I guess most staff are too, with the ever increasing workloads you barely have time for physical activity. You just want to get home and sleep (Monica- Academic staff).* *I think like most administrative staff, I am very lazy with regards to engaging in physical activity. We are sat in front of our computers all day, so yes am pretty lazy when it comes to physical activity (Anita- Administrative staff)* *Um… as I said before, I am very lazy when it comes to physical activity. I cannot say for other students, but I believe that students are generally lazy when it comes to engaging in physical activity (Oluchi- International student).* *Yeah, I guess we are all lazy when it comes to physical activity. I mean the PhD students, including me. This may be due to our huge workloads, so at the end of the day we just want to hit our beds (Frank- PhD student).*

	• Physical activity not seen as an important attribute for university staff	√	-	*The university authority is not interested in encouraging the academic staff to be physically active. They just increase our workload almost on daily basis and do not really care if we engage in any form of physical activity. Since physical activity has been associated with many health benefits, as well as reduction in absenteeism from work, we should be given time to engage in some form of physical activity. However, this is not the case, as the university authority do not believe physical activity is important for us. That's my own opinion (Lynda- Academic staff).*
	• More focus on undergraduates	-	√	*The university only cares about the undergraduate students. I remember them having sports fairs in the atrium for the undergraduates to encourage them to be physically active. For us, the university does not care if we are active or not. I guess that is why most of us are inactive. There is no encouragement from the university to make PhD students physically active (Christopher- PhD students).*
Optimism (the self-assurance that things will occur for the best or that objectives yearned for will be accomplished)	• Lack of confidence of the inactive to engage in physical activity	-	√	*I'm not very confident when it comes to swimming in deep sea and last time I experienced this, I lost my um… all confidence and I started to get panicked (Ali) , so when I came back I realised that I should do that, but again they are fully booked and there is no such trainers and we do not have much um… opportunities here. I mean… I find it really funny that council in Derby that they control all the swimming pools. That doesn't make sense to me, so I would like to have this set of skills (Ali- International student).*

√= mentioned by at least one administrative staff or students
-= not mentioned by any administrative staff or student

Appendix 12: Ethical approval letter for study 2 (Survey study)

Approval Letter: Human Sciences Research Ethics Committee

University of Derby

Date: 19th March 2018

Dr Christopher Barnes

Deputy-Chair, Human Sciences Research Ethics Committee, University of Derby

Dear Lawrence,

Ethics Ref No: 19-1718-LNs

Thank you for submitting this revised application to the Human Sciences Research Ethics Committee.

I have now reviewed the revised documents you sent following the feedback you received on your initial application, and I am satisfied that all of the issues raised have been dealt with. The application can now therefore be approved.

The following documents have been re-reviewed:

1. Ethics application form

If any changes to the study described in the application or supporting documentation is necessary, you must notify the committee and may be required to make a resubmission of the application.

Please note ethical approval for application 19-1718-LNs is valid for a period of 5 years i.e. 19th March 2023.

Good luck with the study.

Yours sincerely,

Chris Barnes

Appendix 13: SPSS output for the reliability tests conducted on the four items to measure the ‘reinforcement’ domain of the TDF

Administrative staff:

Table 1: Reliability Statistics

Cronbach’s Alpha	N of items
.937	4

Table 2: Item-Total Statistics:

	Scale Mean if Item Deleted	Scale variance if Item Deleted	Corrected Item-Total Correlation	Cronbach’s Alpha if Item Deleted
Reinforcement 1	14.67	14.02	.827	.930
Reinforcement 2	15.25	11.16	.914	.897
Reinforcement 3	15.36	10.91	.901	.904
Reinforcement 4	14.55	13.58	.806	.932

PhD students

Table 1: Reliability statistics:

Cronbach's Alpha	N of items
.950	4

Table 2: Item-Total Statistics:

	Scale Mean if Item Deleted	Scale variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Reinforcement 1	15.05	15.80	.856	.944
Reinforcement 2	15.55	13.31	.950	.913
Reinforcement 3	15.59	13.09	.934	.920
Reinforcement 4	14.89	16.33	.808	.957

Appendix 14: SPSS output for the reliability tests conducted on the six items developed to measure the 'memory, attention and decision processes' and the 'social/professional role and identity' domains of the TDF

Administrative staff:

Table 1: Reliability statistics:

Cronbach's Alpha	**N of Items**
.754	6

Table 2: Item Statistics:

	Mean	**Std. Deviation**	**N**
Memory, Attention and Decision Processes 1	3.80	1.671	121
Memory, Attention and Decision Processes 2	3.91	1.653	121
Memory, Attention and Decision Processes 3	2.25	1.598	121
Social/Professional Role and Identity 1	1.26	.780	121
Social/Professional Role and Identity 2	1.90	1.660	121
Social/Professional Role and Identity 3	1.17	.587	121

Table 3: Item-Total statistics:

	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Memory, Attention and Decision Processes 1	10.49	18.82	.698	.652
Memory, Attention and Decision Processes 2	10.38	19.72	.632	.676
Memory, Attention and Decision Processes 3	12.04	21.73	.497	.720
Social/Professional Role and Identity 1	13.03	29.23	.225	.772
Social/Professional Role and Identity 2	12.39	19.64	.635	.675
Social/Professional Role and Identity 3	13.12	29.57	.286	.766

PhD students

Table 1: Reliability statistics:

Cronbach's Alpha	N of Items
.812	6

Table 2: Item Statistics:

	Mean	Std. Deviation	N
Memory, Attention and Decision Processes 1	3.84	1.665	114
Memory, Attention and Decision Processes 2	4.03	1.643	114
Memory, Attention and Decision Processes 3	2.21	1.701	114
Social/Professional Role and Identity 1	1.26	.893	114
Social/Professional Role and Identity 2	1.95	1.818	114
Social/Professional Role and Identity 3	1.22	.849	114

Table 3: Item-Total Statistics:

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Memory, Attention and Decision Processes 1	10.67	25.18	.769	.733
Memory, Attention and Decision Processes 2	10.48	28.34	.558	.787
Memory, Attention and Decision Processes 3	12.30	26.28	.667	.760
Social/Professional Role and Identity 1	13.25	36.74	.302	.828
Social/Professional Role and Identity 2	12.56	24.00	.757	.735
Social/Professional Role and Identity 3	13.29	35.85	.415	.815

Appendix 15: Invitation posters/flyers for university staff and students for preliminary study 2

Appendix 16 Invitation emails for university staff and students for preliminary study 2

Invitation email for university staff

UNIVERSITY of DERBY

Complete this 10 minutes survey, and you will be entered into a prize draw with the chance to win the star prize of £50 amazon voucher!

Dear Staff,

Are you 18 years and above and able to spare 10 minutes to take part in this research survey that seeks to assess the physical activity levels of University of Derby staff.

To take our survey for a chance to **win a £50, a £30 or a £20** Amazon voucher visit this link: https://derby.qualtrics.com/staff-survey

This survey is entirely voluntary and be rest assured that your responses will kept confidential and only be used to inform the development of interventions that will help you engage more in physical activity. All generated data will be anonymised (using your unique identification code that will be generated at the start of the survey), password protected online and only accessible to the research team.

You are under no obligation to participate in this survey and are therefore, free to withdraw anytime by exiting the page before submitting the survey, or by contacting the researcher or his supervisor with your unique identification code up to 14 days after the survey closes.

If you have any concerns or queries, please feel free to contact me at 100312037@unimail.derby.ac.uk, my Director of Studies, Dr Chris Bussell at c.bussell@derby.ac.uk or my supervisor, Dr Vicki Staples at v.staples@derby.ac.uk.

Prize draw to be conducted at the end of the study and the lucky winners contacted to claim their prizes. Thank you in advance for your participation. We appreciate your time and look forward to receiving your responses.
Kind Regards,

Lawrence Ndupu (PhD Research Student)

Invitation email for university students

UNIVERSITY of DERBY

Complete this 10 minutes survey, and you will be entered into a prize draw with the chance to win the star prize of £50 amazon voucher!

To take our survey for a chance to **win a £50, a £30 or a £20** Amazon voucher visit this link: https://derby.qualtrics.com/students-survey

Dear Students,

Are you 18 years and above and able to spare 10 minutes to take part in this research survey that seeks to assess the physical activity levels of University of Derby students.

This survey is entirely voluntary and be rest assured that your responses will kept confidential and only be used to inform the development of interventions that will help you engage more in physical activity. All generated data will be anonymised (using your unique identification code that will be generated at the start of the survey), password protected online and only accessible to the research team.

You are under no obligation to participate in this survey and are therefore, free to withdraw anytime by exiting the page before submitting the survey, or by contacting the researcher or his supervisor with your unique identification code up to 14 days after the survey closes.

If you have any concerns or queries, please feel free to contact me at 100312037@unimail.derby.ac.uk, my Director of Studies, Dr Chris Bussell at c.bussell@derby.ac.uk or my supervisor, Dr Vicki Staples at v.staples@derby.ac.uk.

Prize draw to be conducted at the end of the study and the lucky winners contacted to claim their prizes. Thank you in advance for your participation. We appreciate your time and look forward to receiving your responses.
Kind Regards,

Lawrence Ndupu (PhD Research Student)

Appendix 17: Invitation emails for university administrative staff and PhD students for main survey study 2

Invitation e-mail for university

Dear Administrative Staff,

DETERMINANTS OF PHYSICAL ACTIVITY SURVEY FOR ADMINISTRATIVE STAFF

An earlier survey conducted in May 2018 revealed that the University of Derby administrative staff were the most physically inactive group in comparison with staff in other job roles. Therefore, this current survey aims to assess the physical activity levels, as well as the barriers and facilitators to physical activity among the University of Derby administrative staff. This survey is important, as the findings will inform the development of interventions that will encourage you to engage more in physical activity. It will take about 25 minutes to complete.

The purpose of the survey, your rights as respondents, how your data will be protected and how your data will be used is as detailed in the participant information page in the survey.

In order to show appreciation, all respondents that provide their email addresses at the end of the survey will be eligible to participate in a prize draw, with the chance to win a £50, a £30 or a £20 Amazon vouchers.

If you are interested in participating, please access the survey by clicking the link below or copying and pasting the link in your web browser:

Survey link: https://derby.qualtrics.com/jfe/form/SV_bda496ECm2kAVuZ

Please feel free to contact me at 100312037@unimail.derby.ac.uk or 01332592135 if you have any questions.

Thank you in advance for your participation.

Kind Regards,

Lawrence Ndupu

PhD Research Student

College of Life and Natural Sciences

Invitation e-mail for university PhD students

Dear Colleagues,

DETERMINANTS OF PHYSICAL ACTIVITY SURVEY FOR PHD RESEARCH STUDENTS

An earlier survey conducted in May 2018 revealed that the University of Derby PhD research students were the most physically inactive group in comparison with students in other levels of study. Therefore, this current survey aims to assess the physical activity levels, as well as the barriers and facilitators to physical activity among the University of Derby PhD students. This survey is important, as the findings will inform the development of interventions that will encourage you to engage more in physical activity. It will take about 25 minutes to complete.

The purpose of the survey, your rights as respondents, how your data will be protected and how your data will be used is as detailed in the participant information page in the survey.

In order to show appreciation, all respondents that provide their email addresses at the end of the survey will be eligible to participate in a prize draw, with the chance to win a £50, a £30 or a £20 Amazon vouchers.

If you are interested in participating, please access the survey by clicking the link below or copying and pasting the link in your web browser:

Survey link: https://derby.qualtrics.com/jfe/form/SV_cBjfYgcK5E9OXDD

Please feel free to contact me at 100312037@unimail.derby.ac.uk or 01332592135 if you have any questions.

Thank you in advance for your participation.

Kind Regards,

Lawrence Ndupu
PhD Research Student
College of Life and Natural Sciences

Appendix 18: Surveys for university administrative staff and PhD students for main survey study 2

University administrative staff survey

DETERMINANTS OF PHYSICAL ACTIVITY SURVEY- STAFF

INFORMATION FOR PARTICIPANTS

Are you a current administrative staff at the University of Derby and are able to spare 25 minutes to take part in a research survey about the determinants (barriers and facilitators) of physical activity? This study is being conducted by Lawrence Ndupu, a PhD research student from the Faculty of Life and Natural Sciences in the University of Derby. This will help us assess your views and opinions about the determinants of physical activity, in order to develop behaviour change interventions that will engage university staff in physical activity.
This research study will involve an online survey consisting of 71 questions, which will ask few basic questions about your demographic characteristics and about what you think are the barriers and facilitators of physical activity. This survey will take about 25 minutes maximum to complete.
All data generated from this survey will be securely stored in a password protected computer and all paper-based documents will be securely locked in a cabinet. The data will only be accessible to me and the research supervisory team. The findings from this research will be used in my thesis and might be published in academic journals and conference proceedings. There are no trick questions, nor right or wrong answers in this survey and you can choose not to answer any questions if you so wish.
Participation in this research study is entirely voluntary, and you are therefore under no obligation to take part. You are free to withdraw any time you wish to by exiting the page before submitting the questionnaire, or by contacting the researcher with your unique identification number up to 14 days after the survey closes. All data will be securely stored on a password protected personal computer for a minimum of 6 years and be rest assured that your responses will be stored on a secure dedicated web server (Qualtrics) for a duration of 6 months.

If you have any queries or problems, please feel free to contact **Lawrence Ndupu** (100312037@unimail.derby.ac.uk or 01332592135) or any of my supervisors: **Dr Chris Busse**ll (c.bussell@derby.ac.uk or 01322593063); **Dr Mark Faghy** (m.faghy@derby.ac.uk or 01332592109); **Dr Vicki Staples** (v.staples@derby.ac.uk or 01332593059) or **Dr Sigrid Lipka** (s.lipka@derby.ac.uk or 01332593052)

I have read the above information and agree to take part in this research study

- ○ Yes
- ○ No

Generate your unique identification number by using first 3 digits of your date of birth and last 3 digits of your mobile phone number. For example, if your date of birth is **02-12-1960** and mobile number is **075xxxxx419** then your unique identification number will be **021419.**

Do you consent to being contacted by the research team about future physical activity and sporting opportunities provided by the university?

- ○ Yes
- ○ No

Section 1: About You (Demographic Details)

Please, kindly try to answer the questions as it will be only used for research purpose.

How old are you (years and months?

____

What is your current gender identity? (check all that apply)

- ○ Male
- ○ Female
- ○ Trans male/ Trans man
- ○ Trans female/Trans woman
- ○ Genderqueer/Gender non-conforming
- ○ Different identity (Please state): ________________________________
- ○ Prefer not to say

What best describes your ethnic group?

- ○ White
- ○ Mixed/multiple ethnic groups
- ○ Asian/Asian British
- ○ Black/African/Caribbean/Black British
- ○ Other ethnic group (please describe) ________________________________

Are you a full or part-time worker?

- ○ Full-time
- ○ Part-time

Which site are you primarily based in?

- ○ Kedleston Road Campus
- ○ Markeaton Campus
- ○ Britannia Mills Campus
- ○ Chesterfield Campus
- ○ Buxton Campus
- ○ Friar Gate Campus
- ○ Leek Campus

Section 2: The General Physical Activity Questionnaire (GPAQ)

Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, teaching, researching, and activities associated with your job role. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Activity at Work:

Does your work involve vigorous-intensity activity that causes large increases in

breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do vigorous-intensity activities as part of your work?

○ Number of days ____

How much time do you spend doing vigorous-intensity activities as part of your work on a typical day?

○ Hours: minutes ____

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do moderate-intensity activities as part of your work?

○ Number of days ____

How much time do you spend doing moderate-intensity activities at work on a typical day?

○ Hours: minutes ____

Travel to and from places:

The next questions exclude the physical activities at work that you have already mentioned. Now, I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship.

Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

○ Yes

○ No

In a typical week, on how many days do you walk of bicycle for at least 10 minutes continuously to get to and from places?

○ Number of days ____

How much time do you spend walking or bicycling for travel on a typical day

○ Hours: minutes ____

Recreational activities The next questions exclude the work and transport activities that you have already mentioned. Now, I would like to ask you about sports, fitness and recreational activities (leisure).

Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

○ Number of days ____

How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

○ Hours: minutes ____

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

○ Number of days ____

How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

○ Hours: minutes ____

Sedentary behaviour:

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in a car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

How much time do you usually spend sitting or reclining on a typical day?

○ Hours: minutes ____

Section 3: Determinants of Physical Activity

We are interested in finding out about staff's views and opinions about the determinants of physical activity. The questions will assess your outlook to physical activity. Please select the response that most closely matches your own, remembering that there are no right or wrong answers.

Please read each statement and decide how much you agree or disagree by ticking the appropriate boxes.

I know what the recommended levels of physical activity are

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Somewhat disagree
- ☐ Neither agree nor disagree
- ☐ Somewhat agree
- ☐ Agree
- ☐ Strongly agree

I do not know the reason why I should be meeting the nationally recommended physical activity guidelines

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I have not previously read information about the current nationally recommended physical activity guidelines

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I want to do physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I cannot be bothered to do physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I feel motivated to do physical activity

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I can do physical activity to a good enough standard

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I've never really had sports skills, so I don’t do physical activity

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I don’t seem to have the skills to keep going in physical activity sessions

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I would not be prepared to give up work ambitions to do physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I would be prepared to give up things I usually do in my leisure time for physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I would not be prepared to give up spending time with my friends for physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

Facilities are available to help me to do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

There is nowhere to do physical activity near me

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

My local area is not very attractive, and this puts me off doing physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

My friends don’t support or encourage my physical activity

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

The people I spend my free time with don’t do physical activity

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I don't have anyone to do physical activity with

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

Daily life is too stressful for physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I have too many negative emotions which prevent me from doing physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

When I think about doing physical activity, I start to worry

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I do not feel confident when doing physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

Doing physical activity makes me feel embarrassed

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I find it hard to do physical activity when I see others doing well at physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

If I do physical activity, it will benefit me in the short term (e.g. burn calories, sleep better, etc.)

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

If I do physical activity, it will benefit me in the long term (e.g. live longer, lose weight, etc.)

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I think physical activity will change my life for the better

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I tend to plan where my physical activity will happen (e.g. at the Park, Leisure Centre, etc.)

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I do not tend to plan when my physical activity will happen (e.g. Monday at 6pm, Etc.)

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I tend to plan how my physical activity will happen (e.g. how to get there, kit needed, etc.)

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I do not tend to plan what type of physical activity I will do (e.g. aerobics class, walking to work, session at gym, etc.)

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I know what to do in difficult situations in order to make sure I do the physical activity I have planned

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I get easily distracted from the physical activity I have planned

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I always work around obstacles to physical activity; nothing really stops me

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

Please read each sentence and decide how TRUE about you is each sentence by selecting the appropriate answers.

I try, or would try, to be physically active regularly…

because it is interesting to see my own improvement

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

because I enjoy physical activity

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

because it's fun

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

because it is a challenge to accomplish my goal

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

I maintain positive attitude towards physical activity

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

I maintain negative attitude towards physical activity

- ○ Not at all true
- ○ Not true
- ○ Somewhat not true
- ○ Neither true or false
- ○ Somewhat true
- ○ True
- ○ Very true

Please read each sentence and rate how you agree with the following questions

With all my competing priorities, it is difficult to justify time for physical activity

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Sometimes I just forget I had planned to do physical activity, because am busy doing something else

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

The University offers so many options of physical activity that I can't decide which one(s) to do

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Being physically active is seen to be an important attribute for someone in my job role

- ◯ Strongly agree
- ◯ Agree
- ◯ Somewhat agree
- ◯ Neither agree nor disagree
- ◯ Somewhat disagree
- ◯ Disagree
- ◯ Strongly disagree

Like most staff, I am pretty lazy when it comes to physical activity

- ◯ Strongly agree
- ◯ Agree
- ◯ Somewhat agree
- ◯ Neither agree nor disagree
- ◯ Somewhat disagree
- ◯ Disagree
- ◯ Strongly disagree

Taking up opportunities to be physically active with colleagues is an important part of my staff identity

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Debrief Statement:

Thank you for participating in this survey study. Your participation is much appreciated. The aim of this study is to explore the determinants of physical activity among administrative staff and PhD students of the University of Derby using COM-B behaviour model and the Theoretical Domains Framework- informed questionnaire survey.

Strong evidence suggests that physical inactivity is the fourth leading cause of disease and disability in the UK, with 19% of men and 26% of women reported to be inactive. Despite the widespread health improvement efforts by the UK government, estimates suggest that only 62% (63% of males and 59% of females) of adults in the UK meet the recommended physical activity guidelines. Therefore, action is urgently required in diverse settings, including university campuses to counter this scale of inactivity. Furthermore, several studies worldwide have established the prevalence of physical inactivity among staff and students in the university setting, with a significant proportion of them not achieving the recommended physical activity levels of at least 30 minutes of moderate intensity physical activity at least 5 days a week. Therefore, university staff and students appear to be prime candidates for interventions to reduce physical inactivity.

Importantly, the university setting provides an ideal environment for physical activity promotion programmes due to the available social support, captive audience, and the number of waking hours people spend in the university environment. Encouraging routine physical activity among these university staff and students is very vital because evidence suggests that regular physical activity is positively associated with beneficial health factors, such as reduced risk of heart disease, weight control, lower incidence of illness, psychological wellbeing, reduction in sickness-related absenteeism, and increase in productivity. However, even with these inherent prospects in the university and health benefits of physical activity, university staff and students have remained progressively sedentary over the years. Therefore, it is now important to develop behaviour change interventions supported by psychological theories that target physical activity increases as a primary outcome in the university setting. Evidence suggest that interventions which are underpinned with overarching psychological models are more likely to be successful than those that are not, because theoretical approaches provide better understanding and explanation of how and why implementation succeeds or fails, thereby increasing the chances of implementing more effective interventions. Based on this, the COM-B (i.e. Capability, Opportunity, Motivation- Behaviour) model of behavior and the Theoretical Domains Framework were chosen as frameworks to support this study.

The COM-B behavior model considers the connections and all the continuous interactions between a person's capability (psychological and physical abilities to engage in a behaviour); opportunity (physical and social environment that will encourage the behaviour); and motivation (reflective and automatic processes that will prompt the behavior), in order for the target behaviour (in this case physical activity) to occur. Additionally, the Theoretical Domains Framework (TDF), which contains 14 domains of behaviour, was developed in 2008 to further describe these six components of the COM-B behaviour model. We want to understand what university staff and students perceive as the determinants of physical activity (i.e. barriers and facilitators, which will inform the development of bespoke behaviour change interventions that will engage staff and students in physical activity.

Your confidentiality and anonymity are guaranteed, which means that all the information you provide will not be linked back to you. All data generated will be securely stored in a password protected personal computer accessible only to the research team. The data will also be used for the researcher's PhD and subsequent publications. All data will be kept for a minimum of 6 years, as stipulated in the University of Derby's research guidelines. You will be allowed to withdraw your data at least 14 days after the survey closes, after which you will no longer be able to withdraw your data.

If any aspect of the group survey study has raised issues for you of has caused any upset, please you can contact the **Health Assured,** a counselling Service, at **08000305182** for counselling (request free call if using a mobile) or you can contact your usual care provider or GP for medical issues.
Kindly see below, details of some physical activity websites you may wish to visit:

General Information about Some Physical Activity Websites:

- NHS Change 4 Life initiative at: https://www.nhs.uk/change4life-beta/cards#Vk5MdQHasVbTolHF.97
- Department of Health Start Active, Stay Active at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf
- Derby City Council Livewell Programme at: https://www.livewellderby.co.uk/
- University of Derby Sports and exercise facilities available for students at the Sport Centre at: https://www.derby.ac.uk/campus/sport/fitness-suite/

If you have any questions or concerns about any aspect of this survey please feel free to contact any of the under listed:

- Lawrence Ndupu (PhD student) at 100312037@unimail.derby.ac.uk or 01332592135
- Dr. Chris Bussell (Director of Studies) at c.bussell@derby.ac.uk or 01332593036
- Dr. Vicki Staples (Supervisor) at v.staples@derby.ac.uk or 01332593059

Personal details:

Please, provide your e-mail address if you wish to be entered into a prize draw, with the chance to win a £50, a £30 or a £20 Amazon voucher.

○ Email: ____

University PhD students Survey

DETERMINANTS OF PHYSICAL ACTIVITY SURVEY- STUDENTS

INFORMATION FOR PARTICIPANTS

Are you a current PhD student at the University of Derby and are able to spare 25 minutes to take part in a research survey about the determinants (barriers and facilitators) of physical activity? This study is being conducted by Lawrence Ndupu, a PhD research student from the Faculty of Life and Natural Sciences in the University of Derby. This will help us assess your views and opinions about the determinants of physical activity, in order to develop behaviour change interventions that will engage university students in physical activity. This research study will involve an online survey consisting of 75 questions, which will ask few basic questions about your demographic characteristics and about what you think are the barriers and facilitators of physical activity. This survey will take about 25 minutes maximum to complete.

All data generated from this survey will be securely stored in a password protected computer and all paper-based documents will be securely locked in a cabinet. The data will only be accessible to me and the research supervisory team. The findings from this research will be used in my thesis and might be published in academic journals and conference proceedings. There are no trick questions, nor right or wrong answers in this survey and you can choose not to answer any questions if you so wish.

Participation in this research study is entirely voluntary, and you are therefore under no obligation to take part. You are free to withdraw any time you wish to by exiting the page before submitting the questionnaire, or by contacting the researcher with your unique identification number up to 14 days after the survey closes. All data will be securely stored on a password protected personal computer for a minimum of 6 years and be rest assured that your responses will be stored on a secure dedicated web server (Qualtrics) for a duration of 6 months.

If you have any queries or problems, please feel free to contact **Mr Lawrence Ndupu** (100312037@unimail.derby.ac.uk or 01332592135) or any of my supervisors: **Dr Chris Bussell** (c.bussell@derby.ac.uk or 01322593063); **Dr Mark Faghy** (m.faghy@derby.ac.uk or 01332592109); **Dr Vicki Staples** (v.staples@derby.ac.uk or 01332593059) or **Dr Sigrid Lipka** (s.lipka@derby.ac.uk or 01332593052)

I have read the above information and agree to take part in this research study

○ Yes

○ No

Generate your unique identification number by using first 3 digits of your date of birth and last 3 digits of your mobile phone number. For example, if your date of birth is **02-12-1960** and mobile number is **075xxxxx419** then your unique identification number will be **021419.**

____

Do you consent to being contacted by the research team about future physical activity and sporting opportunities provided by the university?

○ Yes

○ No

Section 1: About You (Demographic Details)

Please, kindly try to answer the questions as it will be only used for research purpose.

How old are you (years and months)?

____

What is your current gender identity? (check all that apply)

- ○ Male
- ○ Female
- ○ Trans male/ Trans man
- ○ Trans female/Trans woman
- ○ Genderqueer/Gender non-conforming
- ○ Different identity (Please state):

____

- ○ Prefer not to say

What best describes your ethnic group?

- ○ White
- ○ Mixed/multiple ethnic groups
- ○ Asian/Asian British
- ○ Black/African/Caribbean/Black British
- ○ Other ethnic group (please describe)

____

Is your study full or part-time?

- ○ Full-time
- ○ Part-time

Which site is this subject based?

- ○ Kedleston road campus
- ○ Markeaton campus
- ○ Britannia Mills campus
- ○ Chesterfield campus
- ○ Buxton campus
- ○ Friar Gate campus
- ○ Leek campus

Section 2: The General Physical Activity Questionnaire (GPAQ)

Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study related activities or training in the university and household chores, . In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Activity at Work:

Does your work involve vigorous-intensity activity that causes large increases in

breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do vigorous-intensity activities as part of your work?

○ Number of days ____

How much time do you spend doing vigorous-intensity activities as part of your work on a typical day?

○ Hours: minutes ____

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do moderate-intensity activities as part of your work?

○ Number of days ____

How much time do you spend doing moderate-intensity activities at work on a typical day?

○ Hours: minutes ____

Travel to and from places:

The next questions exclude the physical activities at work that you have already

mentioned. Now, I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship.

Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

- ○ Yes
- ○ No

In a typical week, on how many days do you walk of bicycle for at least 10 minutes continuously to get to and from places?

- ○ Number of days ______________________________

How much time do you spend walking or bicycling for travel on a typical day

- ○ Hours: minutes ______________________________

Recreational activities:

The next questions exclude the work and transport activities that you have already mentioned. Now, I would like to ask you about sports, fitness and recreational activities (leisure).

Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

- ○ Yes
- ○ No

In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

- ○ Number of days ______________________________

How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

- ○ Hours: minutes ______________________________

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?

○ Yes

○ No

In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

○ Number of days ____

How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

○ Hours: minutes ____

Sedentary behaviour:

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in a car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

How much time do you usually spend sitting or reclining on a typical day?

○ Hours: minutes ____

Section 3: Determinants of Physical Activity

We are interested in finding out about staff's views and opinions about the determinants of physical activity. The questions will assess your outlook to physical activity. Please select the response that most closely matches your own, remembering that there are no right or wrong answers.

Please read each statement and decide how much you agree or disagree by ticking the appropriate boxes.

I know what the recommended levels of physical activity are

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I do not know the reason why I should be meeting the nationally recommended physical activity guidelines

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I have not previously read information about the current nationally recommended physical activity guidelines

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I want to do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I cannot be bothered to do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I feel motivated to do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I can do physical activity to a good enough standard

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I've never really had sports skills, so I don’t do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I don’t seem to have the skills to keep going in physical activity sessions

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I would not be prepared to give up work ambitions to do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I would be prepared to give up things I usually do in my leisure time for physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I would not be prepared to give up spending time with my friends for physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

Facilities are available to help me to do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

There is nowhere to do physical activity near me

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

My local area is not very attractive, and this puts me off doing physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

My friends don’t support or encourage my physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

The people I spend my free time with don't do physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I don't have anyone to do physical activity with

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

Daily life is too stressful for physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I have too many negative emotions which prevent me from doing physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

When I think about doing physical activity, I start to worry

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I do not feel confident when doing physical activity

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

Doing physical activity makes me feel embarrassed

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I find it hard to do physical activity when I see others doing well at physical activity

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

If I do physical activity, it will benefit me in the short term (e.g. burn calories, sleep better, etc.)

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

If I do physical activity, it will benefit me in the long term (e.g. live longer, lose weight, etc.)

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I think physical activity will change my life for the better

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I tend to plan where my physical activity will happen (e.g. at the park, leisure centre, etc.)

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I do not tend to plan when my physical activity will happen (e.g., Monday at 6pm, Etc.)

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I tend to plan how my physical activity will happen (e.g., how to get there, kit needed, etc.)

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Somewhat disagree
- ◯ Neither agree nor disagree
- ◯ Somewhat agree
- ◯ Agree
- ◯ Strongly agree

I do not tend to plan what type of physical activity I will do (e.g., aerobics class, walking to work, session at gym, etc.)

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I know what to do in difficult situations in order to make sure I do the physical activity I have planned

- ○ Strongly disagree
- ○ Disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Agree
- ○ Strongly agree

I get easily distracted from the physical activity I have planned

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

I always work around obstacles to physical activity; nothing really stops me

- Strongly disagree
- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Strongly agree

Please read each sentence and decide how TRUE about you is each sentence by selecting the appropriate answers.

I try, or would try, to be physically active regularly…

because it is interesting to see my own improvement

- ○ Not at all true
- ○ Not true
- ○ Somewhat not true
- ○ Neither true or false
- ○ Somewhat true
- ○ True
- ○ Very true

because I enjoy physical activity

- ○ Not at all true
- ○ Not true
- ○ Somewhat not true
- ○ Neither true or false
- ○ Somewhat true
- ○ True
- ○ Very true

because it's fun

- ○ Not at all true
- ○ Not true
- ○ Somewhat not true
- ○ Neither true or false
- ○ Somewhat true
- ○ True
- ○ Very true

because it is a challenge to accomplish my goal

- ○ Not at all true
- ○ Not true
- ○ Somewhat not true
- ○ Neither true or false
- ○ Somewhat true
- ○ True
- ○ Very true

I maintain positive attitude towards physical activity

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

I maintain negative attitude towards physical activity

- Not at all true
- Not true
- Somewhat not true
- Neither true or false
- Somewhat true
- True
- Very true

Please read each sentence and rate how you agree with the following questions

With all my competing priorities, it is difficult to justify time with physical activity

- ◯ Strongly agree
- ◯ Agree
- ◯ Somewhat agree
- ◯ Neither agree nor disagree
- ◯ Somewhat disagree
- ◯ Disagree
- ◯ Strongly disagree

Sometimes I just forget I had planned to do physical activity, because am busy doing something else

- ◯ Strongly agree
- ◯ Agree
- ◯ Somewhat agree
- ◯ Neither agree nor disagree
- ◯ Somewhat disagree
- ◯ Disagree
- ◯ Strongly disagree

The University offers so many options for physical activity that I can’t decide which one(s) to do

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Being physically active is seen to be important for people in my course

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Like most students, I am pretty lazy when it comes to physical activity

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Debrief Statement:

Thank you for participating in this survey study. Your participation is much appreciated. The aim of this study is to explore the determinants of physical activity among administrative staff and PhD students of the University of Derby using COM-B behaviour model and the Theoretical Domains Framework- informed questionnaire survey.

Strong evidence suggests that physical inactivity is the fourth leading cause of disease and disability in the UK, with 19% of men and 26% of women reported to be inactive. Despite the widespread health improvement efforts by the UK government, estimates suggest that only 62% (63% of males and 59% of females) of adults in the UK meet the recommended physical activity guidelines. Therefore, action is urgently required in diverse settings, including university campuses to counter this scale of inactivity. Furthermore, several studies worldwide have established the prevalence of physical inactivity among staff and students in the university setting, with a significant proportion of them not achieving the recommended physical activity levels of at least 30 minutes of moderate intensity physical activity at least 5 days a week. Therefore, university staff and students appear to be prime candidates for interventions to reduce physical inactivity.

Importantly, the university setting provides an ideal environment for physical activity promotion programmes due to the available social support, captive audience, and the number of waking hours people spend in the university environment. Encouraging routine physical activity among these university staff and students is very vital because evidence suggests that regular physical activity is positively associated with beneficial health factors, such as reduced risk of heart disease, weight control, lower incidence of illness, psychological wellbeing, reduction in sickness-related absenteeism, and increase in productivity. However, even with these inherent prospects in the university and health benefits of physical activity, university staff and students have remained progressively sedentary over the years. Therefore, it is now important to develop behaviour change interventions supported by psychological theories that target physical activity increases as a primary outcome in the university setting. Evidence suggests that interventions which are underpinned with overarching psychological models are more likely to be successful than those that are not, because theoretical approaches provide better understanding and explanation of how and why implementation succeeds or fails, thereby increasing the chances of implementing more effective interventions. Based on this, the COM-B (i.e. Capability, Opportunity, Motivation- Behaviour) model of behavior and the Theoretical Domains Framework were chosen as frameworks to support this study.

The COM-B behavior model considers the connections and all the continuous interactions between a person’s capability (psychological and physical abilities to engage in a behaviour); opportunity (physical and social environment that will encourage the behaviour); and motivation (reflective and automatic processes that will prompt the behavior), in order for the target behaviour (in this case physical activity) to occur. Additionally, the Theoretical Domains Framework (TDF), which contains 14 domains of behaviour, was developed in 2008 to further describe these six components of the COM-B behaviour model. We want to understand what university staff and students perceive as the determinants of physical activity (i.e. barriers and facilitators, which will inform the development of bespoke behaviour change interventions that will engage staff and students in physical activity.

Your confidentiality and anonymity are guaranteed, which means that all the information you provide will not be linked back to you. All data generated will be securely stored in a password protected personal computer accessible only to the research team. The data will also be used for the researcher's PhD and subsequent publications. All data will be kept for a minimum of 6 years, as stipulated in the University of Derby's research guidelines. You will be allowed to withdraw your data up to 14 days after the survey closes, after which you will no longer be able to withdraw your data.
If any aspect of the group discussion has raised issues for you or has caused any upset, please you can contact the **student wellbeing service** at **01332593000** or email to **studentwellbeing@derby.ac.uk** for counselling or you can contact your usual care provider or GP.

Kindly see below details of some physical activity websites you may wish to visit:

General Information about Some Physical Activity Websites:

- NHS Change 4 Life initiative at: https://www.nhs.uk/change4life-beta/cards#Vk5MdQHasVbTolHF.97 ·
- Department of Health Start Active, Stay Active at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf
- Derby City Council Livewell Programme at: https://www.livewellderby.co.uk/
- University of Derby Sports and exercise facilities available for students at the Sport Centre at: https://www.derby.ac.uk/campus/sport/fitness-suite/

If you have any questions or concerns about any aspect of this survey please feel free to contact any of the under listed:

- Lawrence Ndupu (PhD student) at 100312037@unimail.derby.ac.uk or 01332592135
- Dr Chris Bussell (Director of Studies) at c.bussell@derby.ac.uk or 01332593036
- Dr Vicki staples (Supervisor) at v.staples@derby.ac.uk or 01332593059.

Personal details:

Please, provide your e-mail address if you wish to be entered into a prize draw, with the chance to win a £50, a £30 or a £20 Amazon voucher.

○ Email: ____

Appendix 19: Ethical approval letter for studies 3 (intervention studies)

University of Derby

Dear Lawrence

Thank you for submitting your application to the College of Life and Natural Sciences Research Ethics Committee, which has now been reviewed and considered.

The outcome of your application is: approved.

If any changes to the study described in the application are necessary, you must notify the Committee and may be required to make a resubmission of the application.

Please note that ethical approval for this application is valid for 5 years.

On behalf of the Committee, we wish you the best of luck with your study.

Yours sincerely

Stuart Wain

Ethics ETH1819-0099: Mr Lawrence Ndupu

Appendix 18: Definition and examples of the BCT Taxonomy (v1) of 93 hierarchically clustered techniques (Michie et al., 2013)

Grouping and BCTs	Grouping and BCTs	Grouping and BCTs
1. Goals and Planning	6. **Comparison of behaviour**	**12. Antecedents**
1.1 Goal setting (behaviour) 1.2 Problem solving 1.3 Goal setting (outcome) 1.4 Action planning 1.5 Review behaviour goal(s) 1.6 Discrepancy between current behaviour and goal 1.7 Review outcome goal(s) 1.8 Behavioural contract 1.9 Commitment	6.1 Demonstration of behaviour 6.2 Social comparison 6.3 Information about others' approval	12.1 Restructuring the physical environment 12.2 Restructuring the social environment 12.3 Avoidance/reducing exposure to cues for the behaviour 12.4 Distraction 12.5 Adding objects to the environment 12.6 Body changes
		13. Identity
	7. **Associations**	13.1 identification of self as role model 13.2 Framing/reframing 13.3 Incompatible beliefs 13.4 Valued self-identity 13.5 identity associated with changed behaviour
2. Feedback and monitoring	7.1 Prompts/cues 7.2. Cue signalling reward 7.3 Reduce prompts/cues 7.4 Remove access to reward 7.5 Remove aversive stimulus 7.6 Satiation 7.7 Exposure 7.8 Associative learning	
2.1 Monitoring of behaviour by others without feedback 2.2 Feedback on behaviour 2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour 2.5 Monitoring of outcome(s) of behaviour without feedback 2.6 Biofeedback 2.7 Feedback on outcome(s) of behaviour		**14. Scheduled consequences**
	8. Repetition and substitution	14.1 Behaviour cost 14.2 Punishment 14.3 Remove reward 14.4 Reward approximation 14.5 Reward completion 14.6 Situation-specific reward 14.7 Reward incompatible behaviour 14.8 Reward alternative behaviour 14.9 Reduce reward frequency 14.10 Remove punishment
3. Social support	8.1 Behavioural practice/rehearsal 8.2 Behaviour substitution 8.3 Habit formation 8.4 Habit reversal 8.5 Overcorrection 8.6 Generalisation of target behaviour 8.7 Graded tasks	
3.1 Social support (unspecified) 3.2 Social support (practical) 3.3 Social support (emotional)		**15. Self-belief**
	9. Comparison of outcomes	15.1 Verbal persuasion about capability 15.2 Mental rehearsal of successful performance 15.3 Focus on past success 15.4 Self-talk
4. Shaping Knowledge	9.1 Credible source 9.2 Pros and cons 9.3 Comparative imagining of future outcomes	
4.1 Instruction on how to perform the behaviour 4.2 Information about Antecedents 4.3 Re-attribution		**16. Covert learning**
	10 Reward and threat	16.1 Imaginary punishment 16.2 Imaginary reward

4.4 Behavioural experiments	10.1 Material incentive (behaviour) 10.2 Material reward (behaviour) 10.3 Non-specific reward 10.4 Social reward 10.5 Social incentive 10.6 Non-specific incentive 10.7 Self-incentive 10.8 Incentive (outcome) 10.9 Self-reward 10.10 Reward (outcome) 10.11 Future punishment	16.3 Vicarious consequences
5. Natural consequences	**11. Regulation**	
5.1 Information about health consequences 5.2 Salience of consequences 5.3 Information about social and environmental consequences 5.4 Monitoring of emotional consequences 5.5 Anticipated regret 5.6 Information about emotional consequences	11.1 Pharmacological support 11.2 reduce negative emotions 11.3 Conserving mental resources 11.4 Paradoxical instruction	

Appendix 19: Linking the intervention functions to Behaviour Change Techniques (BCTs)

Intervention function	Individual BCTs
Education	**Most frequently used BCTs:** • **Information about social and environmental consequences** • **Information about health consequences** • **Feedback on behaviour** • **Feedback on outcome(s) of behaviour** • **Prompts/cues** • **Self-monitoring of behaviour** Less frequently used BCTs: • Biofeedback • Self-monitoring of outcome(s) of behaviour • Cue signalling reward • Satiation • Information about antecedents • Information about emotional consequences • Information about other' approval
Persuasion	**Most frequently used BCTs:** • **Credible source** • **Information about social and environmental consequences** • **Information about health consequence** • **Feedback on behaviour** • **Feedback on outcome(s) of behaviour** Less frequently used BCTs: • Biofeedback • Re-attribution • Focus on past success • Verbal persuasion about capability • Framing/reframing • Identity associated with change behaviour • Identification of self as a role model • Information about emotional consequences • Salience consequences • Information about other' approval • Social comparison
Incentivisation	**Most frequently used BCTs:** • **Feedback on behaviour** • **Feedback on outcome(s) of behaviour** • **Monitoring of behaviour by others without evidence of feedback** • **Monitoring outcome of behaviour by others without evidence of feedback** • **Self-monitoring of behaviour** Less frequently used BCTs: • Paradoxical instructions • Biofeedback • Self-monitoring of outcome(s) of behaviour

	• Cue signalling reward • Remove aversive stimulus • Reward approximation • Rewarding completion • Situation-specify reward • Reward incompatible behaviour • Reduce reward frequency • Reward alternate behaviour • Remove punishment • Social reward • Material reward • Material reward (outcome) • Self-reward • Non-specific reward • Incentive • Behavioural context • Commitment • Discrepancy between current behaviour and goal • Imaginary reward
Coercion	**Most frequently used BCTs:** • **Feedback on behaviour** • **Feedback on outcome(s) of behaviour** • **Monitoring of behaviour by others without evidence of feedback** • **Monitoring outcome of behaviour by others without evidence of feedback** • **Self-monitoring of behaviour** Less frequently used BCTs: • Biofeedback • Self-monitoring of outcome(s) of behaviour • Remove access to reward • Punishment • Behaviour cost • Remove reward • Future punishment • Behavioural contract • Commitment • Discrepancy between current behaviour and goal • Incompatible beliefs • Anticipated regrets • Imaginary punishment
Training	**Most frequently used BCTs:** • **Demonstration of the behaviour** • **Instruction on how to perform a behaviour** • **Feedback on the behaviour** • **Feedback on outcome(s) of behaviour** • **Self-monitoring of behaviour** • **Behavioural practice/rehearsal** Less frequently used BCTs: • Biofeedback • Self-monitoring of outcome(s) of behaviour

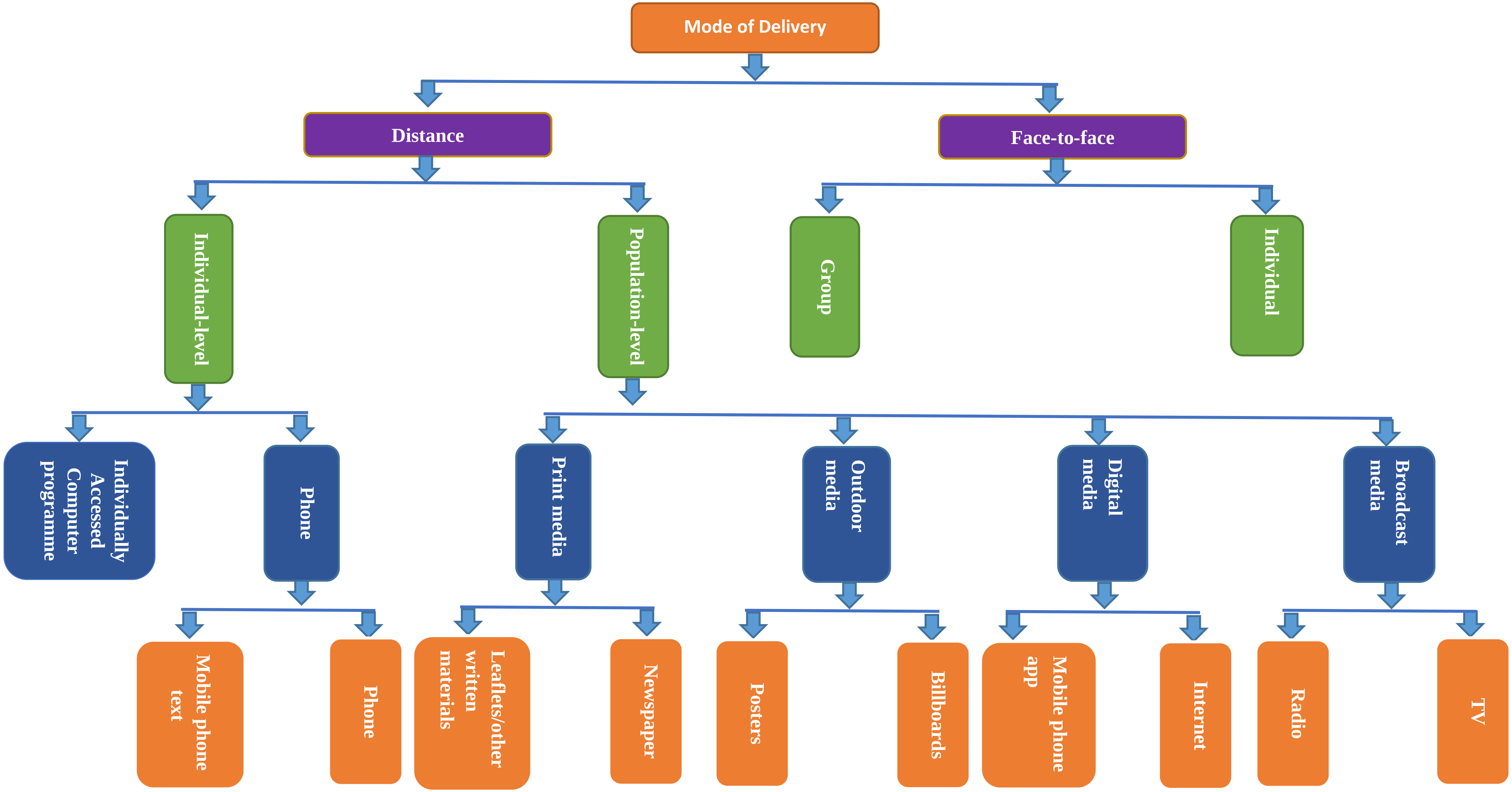
	• Habit formation • Habit reversal • Graded tasks • Behavioural experiments • Mental rehearsal of successful performance • Self-talk • Self-reward
Restriction	No BCTs are associated with this intervention function, as they are focused on changing the way that individual think, feel and react rather than the way the external environment limits their behaviour
Environmental restructuring	**Most frequently used BCTs:** • **Adding objectives to the environment** • **Prompts/cues** • **Restructuring the physical environment** Less frequently used BCTs: • Cue signalling reward • Remove access to the reward • Remove aversive stimulus • Satiation • Exposure • Associative learning • Reduce prompts/cue • Restructuring the social environment
Modelling	**Most frequently used BCTs:** • **Demonstration of the behaviour**
Enablement	**Most frequently used BCTs:** • **Social support (unspecified)** • **Social support (practical)** • **Goal setting (behaviour)** • **Goal setting (outcome)** • **Adding objects to the environment** • **Problem solving** • **Action planning** • **Self-monitoring of behaviour** • **Restructuring the physical environment** • **Review behaviour goal(s)** • **Review outcome goal(s)** Less frequently used BCTs: • Social support (emotional) • Reduce negative emotions • Conserve mental resources • Pharmacological support • Self-monitoring of outcome(s) of behaviour • Behaviour substitution • Overcorrection • Generalisation of target behaviour • Graded tasks • Avoidance/reducing exposure to cues for the behaviour

	• Restructuring the social environment • Distraction • Body changes • Behavioural experiments • Mental rehearsal of successful performance • Focus on past success • Self-talk • Verbal persuasion about capability • Self-reward • Behavioural contract • Commitment • Discrepancy between current behaviour and goal • Pros and cons • Comparative imagining of future outcomes • Valued self-identity • Framing/reframing • Incompatible beliefs • Identity associated with changed behaviour • Identification of self as a role model • Salience of consequences • Monitoring of emotional consequences • Anticipated regret • Imaginary punishment • Imaginary reward • Vicarious consequences

Appendix 20: The label, definition and examples of the BCTs selected to guide the intervention aimed at improving physical activity among University of Derby administrative staff

S/N	Label	Definition	Examples
1	Prompt/cues	Instruction on use of cues to help prompt individuals to perform a behaviour.	Encouraging exercisers to use frequently occurring routine events like a specific time of the day or mobile phone alerts to prompt them to start their physical activity routine.
2	Self-monitoring of behaviour	The individual is requested to keep a detailed record of their activity and use as a means of changing or modifying behaviour	This could the form of a questionnaire or diary focusing on duration, time, and circumstances in which the physical activity was tried or accomplished. Give the individual an accelerometer and a form for recording daily total number of steps.
3	Monitoring of behaviour by others without evidence of feedback	Observe or record outcomes of behaviours with the individual's knowledge as part of behaviour change strategy.	Record blood glucose, blood pressure, weight loss, or physical fitness.
4	Demonstration of the behaviour	Showing an individual how to execute an activity, through physical or visual ways.	A gym trainer might give a client a demonstration of a specific exercise or show them how to use a part of equipment, like a treadmill.
5	Instruction on how to perform a behaviour	Advice or agree on how to perform the behaviour (include skills training). Instructing an individual precisely how to successfully perform a behaviour.	Advice on techniques in the gym, or instruction on accurate frequency or extent of cycling to work.
6	Behavioural practice/rehearsal	Prompting the individual to rehearse and repeat the behaviour or conditions that led to the behaviour. This aids in strengthening the activity and making it more automated or habitual so that it becomes part of an individual's day-to-day routine.	Providing individuals with ways to rehearse when they are going to perform their exercise routine.
7	Use of follow-up prompts	Use of prompts provided after an individual has begun a behaviour modification routine in order to help remind them to continue. Eventually, as the individual becomes better at performing the behaviour, cues and prompts are reduced.	Providing individuals with a personal alarm, text messages, e-mail, or other reminders to help them remember their physical activity or aim.

Appendix 21: Categorisation of modes of delivery for physical activity intervention functions



Appendix 22: Invitation posters/flyers for administrative staff and PhD students

UNIVERSITY OF DERBY

Are you a Current Administrative Staff or a PhD student at the University of Derby and 18 years+

Then you are invited to participate in a 4-week behaviour change intervention programme aimed at increasing your physical activity during working days. If interested, please follow the **links** below or scan the **QR codes** to complete a 5-minute screening questionnaire to check your eligibility. If eligible you will be contacted via e-mail provided.

Content removed due to copyright reasons

Screening questionnaire links and QR codes:

For administrative staff: https://www.physical-activity-admin-staff

For PhD students: https://www.physical-activity-phd-students

For further information please contact Lawrence Ndupu at 100312037@unimail.derby.ac.uk or 013322593135

Appendix 23: Invitation e-mail for administrative staff

INTERVENTION TO INCREASE PHYSICAL ACTIVITY AMONG UNIVERSITY OF DERBY ADMINISTRATIVE STAFF

Dear Administrative staff,

Thank you for showing interest to take part in this study. As a pilot for university workplace wellness programme, I am looking to conduct a 4-week behaviour change intervention to encourage the administrative staff of the University of Derby to engage more in physical activity. This study would include the development of your physical skills to engage in physical activity. The people that show interest will be allocated to two groups: intervention group and control group. The people in the intervention group would be invited to come to the sports centre at least once every week (Mondays: 5-6 pm or Fridays: 1-2 pm) to learn how to play supervised badminton, while the people in the control group will just be asked to continue with their usual physical activity. During this intervention, weekly emails would also be sent to you to remind you to participate in the intervention. Additionally, you will also be provided with activity log sheets to record the types, intensity and minutes you have spent participating in physical activity every week.

This study is absolutely voluntary and you are therefore free to withdraw at any time during the intervention by simply contacting the researcher. All information provided during this study will be confidential and will only be seen by the primary investigator and his supervisory team.

If you are interested in participating, please access the screening questionnaire that includes the participant information sheet, demographic characteristics, Global physical activity questionnaire (GPAQ) to measure your physical activity level and consent form through this link: https://derby.qualtrics.physicalactivity-staff/survey

The participant information sheet provides you the details of all you need to know about this study. If you are still willing to participate in this study after reading this information, please sign the consent form and return to me. You will also be required to provide your preferred email address, with which we can contact you throughout the intervention period. You will no longer receive any information from me once the intervention is over. Please note that only those who are physically inactive as measured by the Global Physical Activity Questionnaire will be eligible to participate in this study and will thus be contacted. You will be allowed to withdraw your data if you so wish up to 14 days post-intervention after which you will not be allowed to withdraw your data.

If you have questions at any time about the study or the procedures, you may contact the researcher, Lawrence Ndupu, at 100312037@unimail.derby.ac.uk or 01332592135. If you have further concerns about participating, you can contact my Director of Studies, Dr Chris Bussell, at c.bussell@derby.ac.uk or 01332593063 or any of my supervisors: **Dr Mark Faghy**, at m.faghy@derby.ac.uk or 01332592109; **Dr Vicki Staples**, at v.staples@derby.ac.uk or 01332593059; or **Dr Sigrid Lipka**, at s.lipka@derby.ac.uk or 01332593052).

Thank you in advance for your participation.

Kind Regards,

Lawrence

Lawrence Ndupu CLANS PhD student

Appendix 24: Screening questionnaires for administrative staff

INFORMATION FOR PARTICIPANTS

This study aims at encouraging physical activity participation among the administrative staff. This study is being conducted by Lawrence, a PhD research candidate from the College of Life and Natural Sciences at the University of Derby. This will help us assess if certain psychological models are effective at increasing physical activity engagement among the inactive administrative staff in a university setting.

This questionnaire is comprised of four sections and should take about 10 minutes to complete. These include the information agreement, demographic characteristics, Global Physical Activity Questionnaire (GPAQ) and Health Screening Questionnaire. Please try to answer all questions in all sections of this questionnaire as much as possible as there are no right or wrong answers.

Participation in this research study is absolutely voluntary, and you are therefore under no obligation to take part. You are free to withdraw any time by contacting the researcher with your unique identification number up to 14 days after completing the questionnaire.

Researchers will be collecting data from your participation in this study. We need these data to understand the effectiveness of theory informed bespoke interventions at increasing physical activity levels among inactive administrative staff, and also in the public interest of enhancing academic research. This is the legal basis on which we are collecting your data and while this allows us to use your data, it also means we have obligations towards you to:

- not seek more information from you than what is essential and necessary for the study.
- make sure that you are not identified by the data by anonymising it using ID codes;
- use your anonymised data only for the purposes of this study and for any relevant publications that arise from it
- store data safely in password-protected databases to which only the named researchers have access
- not keep your information for longer than is necessary (usually for seven years);
- safely destroy your data by shredding or permanently deleting them The University of Derby will act as the Data Controller for this study. This means that the University is responsible for looking after your information and using it properly. Student researchers on the project with access to the data are supervised by highly qualified and experienced researchers and have been very careful to ensure the security of your data. The study was approved for its ethical standards by The University of Derby College of Life and Natural Sciences Research Ethics Committee. However, in the unlikely event that you feel you need to make a complaint regarding the use of your information, you can contact the Data Protection Officer at the University of Derby: James Eaglesfield (01332) 591762 or the Information Commissioners Office 0303 123 1113.

Further information about the project can be obtained from the researcher, **Lawrence**

Ndupu (100312037@unimail.derby.ac.uk or 01332592135) or any of my supervisors: **Dr Chris Bussell** (c.bussell@derby.ac.uk or 01332593063); **Dr Mark Faghy** (m.faghy@derby.ac.uk or 01332592109); **Dr Vicki Staples** (v.staples@derby.ac.uk or 01332593059); or **Dr Sigrid Lipka** (s.lipka@derby.ac.uk or 01332593052) at the University of Derby, Kedleston Road, Derby, DE22 1GB.

I have read the participant's information sheet and agree to take part in this research study

◯ Yes (1)

◯ No (2)

Skip To: End of Survey If I have read the participant's information sheet and agree to take part in this research study = No

Participant's unique identification number:

Please generate your unique identification number by using the first 3 digits of your date of birth and last 3 digits of your mobile phone number. For example, if your date of birth is 04-11-1965 and mobile number is 075xxxxx687 then your unique identification number will be 041687.

____

E-mail address:

Please kindly provide an e-mail address that would be used to contact you during the 4-week intervention period.

As detailed in the participant's information sheet, your email is required so that the researcher can send messages to remind you to participate in physical activity and also as a means of sending the intervention materials across to you during the intervention period.

____

DEMOGRAPHIC INFORMATION Please, kindly try to answer all the questions as it will be only used for research purpose. **How old are you (years and months)?**

____

What is your current gender identity? (please check the one that applies)

- ○ Male (1)
- ○ Female (2)
- ○ Trans male/Trans man (3)
- ○ Trans female/Trans woman (4)
- ○ Genderqueer/Gender non-conforming (5)
- ○ Different identity (Please state) (6) ____
- ○ prefer not to say (7)

What best describes your ethnic group?

- ○ White (1)
- ○ Mixed/multiple ethnic groups (2)
- ○ Asian/Asian British (3)
- ○ Black/Africa/ Caribbean/Black British (4)
- ○ Other ethnic group (please describe): (5) ____

Which site are you primarily based in?

- ◯ Kedleston Road Campus (1)
- ◯ Markeaton Campus (2)
- ◯ Britannia Mills Campus (3)
- ◯ Chesterfield Campus (4)
- ◯ Buxton Campus (5)
- ◯ Friar Gate Campus (6)
- ◯ Leek Campus (7)

Are you a full or part-time worker?

- ◯ Full-time (1)
- ◯ Part-time (2)

GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ)

Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, teaching, researching, and activities associated with your job role. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Activity at Work:

Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?

○ Yes (1)

○ No (2)

Skip To: Q14 If = No

In a typical week, on how many days do you do vigorous-intensity activities as part of your work? Number of days:

○ Number of days: (1) ____

How much time do you spend doing vigorous-intensity activities as part of your work on a typical day?

○ Hours: minutes: (1) ____

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

○ Yes (1)

○ No (2)

Skip To: Q17 If Does your work involve moderate-intensity activity that causes small increases in breathing or he... = No

In a typical week, on how many days do you do moderate-intensity activities as part of your work?

○ Number of days: (1) ____

How much time do you spend doing moderate-intensity activities at work on a typical day?

○ Hours: minutes: (1) ____

Travel to and from Places:

The next questions exclude the physical activities at work that you have already mentioned. Now, I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship. Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

○ Yes (1)

○ No (2)

Skip To: Q20 If Travel to and from Places: The next questions exclude the physical activities at work that you... = No

---

In a typical week, on how many days do you walk of bicycle for at least 10 minutes continuously to get to and from places?

○ Number of days: (1) ____

How much time do you spend walking or bicycling for travel on a typical day?

○ Hours: minutes: (1) ____

Recreational Activities:

The next questions exclude the work and transport activities that you have already mentioned. Now, I would like to ask you about sports, fitness and recreational activities (leisure).

Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

- ◯ Yes (1)
- ◯ No (2)

Skip To: Q23 If Recreational Activities: The next questions exclude the work and transport activities that you... = No

---

In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

- ◯ Number of days: (1) ____

How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

- ◯ Hours: minutes: (1) ____

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?

- ◯ Yes (1)
- ◯ No (2)

Skip To: Q26 If Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes... = No

In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

○ Number of days: (1) ____

How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

○ Hours: minutes: (1) ____

Sedentary Behaviour:

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in a car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

How much time do you usually spend sitting or reclining on a typical day?

○ Hours: minutes: (1) ____

HEALTH SCREENING QUESTIONNAIRE

As a volunteer participating in a physical activity, it is important that you are currently in good health and have had no significant medical problems in the past. This form is to (i) ensure your own continuing well-being and (ii) to avoid the possibility of individual health issues confounding session outcomes. If you are required to produce blood samples please ensure that you complete the Blood Analysis- Participant Consent Form.

Please complete this brief questionnaire to confirm your fitness to participate:

At present, do you have any health problem for which you are:

on medication, prescribed or otherwise

○ Yes (1)

○ No (2)

attending your general practitioner

○ Yes (1)

○ No (2)

on a waiting list

○ Yes (1)

○ No (2)

End of Block: SECTION 3: HEALTH SCREENING QUESTIONNAIRE

Start of Block: Block 5

In the past two years, have you had any illness which required you to:

consult your GP

○ Yes (1)

○ No (2)

attend a hospital outpatient department

- Yes (1)
- No (2)

be admitted to hospital

- Yes (1)
- No (2)

End of Block: Block 5

Start of Block: Block 6

Have you ever had any of the following:

Convulsion/epilepsy

- Yes (1)
- No (2)

Asthma

- Yes (1)
- No (2)

Eczema

- ◯ Yes (1)
- ◯ No (2)

Diabetes

- ◯ Yes (1)
- ◯ No (2)

A blood disorder

- ◯ Yes (1)
- ◯ No (2)

Head injury

- ◯ Yes (1)
- ◯ No (2)

Digestive problems

- ◯ Yes (1)
- ◯ No (2)

Heart problems

- ○ Yes (1)
- ○ No (2)

Problems with bones and joints

- ○ Yes (1)
- ○ No (2)

Disturbances of balance/coordination

- ○ Yes (1)
- ○ No (2)

Numbness in hands and feet

- ○ Yes (1)
- ○ No (2)

Disturbance of vision

- ○ Yes (1)
- ○ No (2)

Ear/hearing problems

- ◯ Yes (1)
- ◯ No (2)

Thyroid problems

- ◯ Yes (1)
- ◯ No (2)

Kidney or liver problems

- ◯ Yes (1)
- ◯ No (2)

Allergy to nuts

- ◯ Yes (1)
- ◯ No (2)

Severe dizziness and fainting

- ◯ Yes (1)
- ◯ No (2)

High blood pressure

◯ Yes (1)

◯ No (2)

Communicable disease

◯ Yes (1)

◯ No (2)

If you have answered <u>YES</u> to any of the question, please describe briefly (e.g. to confirm problem was/is short-lived, insignificant or well controlled.)

____

____

____

____

____

End of Block: Block 6

Appendix 25: Baseline questionnaire for administrative staff

BASELINE QUESTIONNAIRE FOR ADMINISTRATIVE STAFF (WEEK 0)

Participant's unique identification number Please generate your unique identification number by using the first 3 digits of your date of birth and last 3 digits of your mobile phone number. For example, if your date of birth is **04-11-1965** and mobile number is **075xxxxx687** then your unique identification number will be **041687**. Kindly use the unique identification number you generated during the screening phase of this study.

____

We are interested in finding out about the administrative staff's views and opinions about their physical skills to engage in physical activity/sports. Please select the response that most closely matches your own, remembering that there are no right and wrong answers.

Please read each statement and decide how much you agree or disagree by ticking the appropriate boxes.

I can do physical activity to a good enough standard

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Somewhat disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Somewhat agree (5)
- ○ Agree (6)
- ○ Strongly agree (7)

I’ve never had sports skills, so I don’t do physical activity

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

I don’t seem to have the skills to keep going in physical activity sessions

- Strongly disagree (1)
- Disagree (2)
- Somewhat disagree (3)
- Neither agree nor disagree (4)
- Somewhat agree (5)
- Agree (6)
- Strongly agree (7)

Appendix 26: Email invitation to administrative staff in the experimental group to learn how to play badminton

Come and learn how to play badminton

Content removed due to copyright reasons

Venue: University of Derby Sports Centre

Days: Mondays (5:00-6:00 pm) and Fridays (1:00-2:00 pm)

NB: All sessions will be supervised in a conducive environment

For further information please contact Lawrence Ndupu at 100312037@unimail.derby.ac.uk or 013322593135

Appendix 27: E-mail to the administrative staff in the control group

Dear Colleagues,

I want to thank you for taking part in this 4-week study aimed at increasing your physical activity levels.

In this study you are expected to just continue with your normal routine.

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Appendix 28: Screening questionnaire

UNIVERSITY OF DERBY

School of Human Sciences

Health Screen Questionnaire for Physical Activity Sessions

As a volunteer participating in a physical activity, it is important that you are currently in good health and have had no significant medical problems in the past. This is form is to (i) ensure your own continuing well-being and (ii) to avoid the possibility of individual health issues confounding session outcomes. If you are required to produce blood samples please ensure that you complete the Blood Analysis – Participant Consent Form.

Please complete this brief questionnaire to confirm your fitness to participate:

1. At present, do you have any health problem for which you are:

(a)	on medication, prescribed or otherwise	Yes	☐	No	☐
(b)	attending your general practitioner	Yes	☐	No	☐
(c)	on a hospital waiting list	Yes	☐	No	☐

2. In the past two years, have you had any illness which required you to:

(a)	consult your GP	Yes	☐	No	☐
(b)	attend a hospital outpatient department..................	Yes	☐	No	☐
(c)	be admitted to hospital	Yes	☐	No	☐

3. Have you ever had any of the following:

(a)	Convulsions/epilepsy	Yes	☐	No	☐
(b)	Asthma	Yes	☐	No	☐
(c)	Eczema	Yes	☐	No	☐
(d)	Diabetes	Yes	☐	No	☐
(e)	A blood disorder	Yes	☐	No	☐
(f)	Head injury	Yes	☐	No	☐
(g)	Digestive problems	Yes	☐	No	☐
(h)	Heart problems	Yes	☐	No	☐
(i)	Problems with bones or joints	Yes	☐	No	☐
(j)	Disturbance of balance/coordination	Yes	☐	No	☐
(k)	Numbness in hands or feet	Yes	☐	No	☐
(l)	Disturbance of vision	Yes	☐	No	☐
(m)	Ear / hearing problems	Yes	☐	No	☐
(n)	Thyroid problems	Yes	☐	No	☐
(o)	Kidney or liver problems	Yes	☐	No	☐
(p)	Allergy to nuts	Yes	☐	No	☐
(q)	Severe dizziness and fainting..........................	Yes	☐	No	☐
(r)	High blood pressure......................................	Yes	☐	No	☐
(s)	Communicable disease..................................	Yes	☐	No	☐

If you have answered <u>YES</u> to any question, please describe briefly (e.g. to confirm problem was/is short-lived, insignificant or well controlled.)

....

....

....

Sensitivity: Internal

April 2018

4. Has any, otherwise healthy, member of your family under the age of 35 died suddenly during or soon after exercise?

Yes ☐ No ☐

5. In the last 3 months have you had an injury to any of the following areas:

(a)	Spine/Back..	Yes ☐	No ☐
(b)	Hip, Knee, or Ankle joint................................	Yes ☐	No ☐
(c)	Leg muscles..	Yes ☐	No ☐

If you answered yes to question 5 please explain the current status of your injury (i.e., does it still persist, or has your doctor/physiotherapist stated that it is ok for you to return to full physical activity?).

....

....

6. Females only:

A.	Are your periods regular?	Yes ☐	No ☐
B.	Are you currently taking oral contraception?	Yes ☐	No ☐
C.	Is there a chance that you could you be pregnant?	Yes ☐	No ☐

7. Have you eaten/drunk sufficiently prior to this session (unless otherwise specific requirements have been communicated by the session leader).

Yes ☐ No ☐

8. Please provide contact details of a suitable person for us to contact in the event of any incident or emergency.

Name:..

Telephone Number:... Work ☐ Home ☐ Mobile ☐

Relationship to Participant:...

Privacy Notice:
The information that you supply on this form will be held and processed in line with the Data Protection Act 1998, GDPR and subsequent legislation.
Information will be used by the UoD (as Data Controller) for Health and Safety purposes to identify your suitability to take part in physical activity.
We retain this data for one year, after such time it will be securely destroyed.
Our lawful basis for processing this data is your consent.
I give my explicit consent for my details to be used as stipulated Yes No
As a data subject you can request withdrawal of consent at any time by contacting gdpr@derby.ac.uk.
The DPO for the University can be contacted via GDPR@derby.ac.uk Further information on how we handle your information and details of our DPO can be found on our webpage https://www.derby.ac.uk/its/datagov/privnotice/

Consent for participation:

Participant Signature:............................... **Print Name:**............................... **Date:**..........

Witness Signature:................................... **Print Name:**............................... **Date:**..........

Session Leader Signature:.........................**Print Name:**............................... **Date:**.......

Sensitivity: Internal

Appendix 29: Activity log for administrative staff

Behaviour Change Intervention Physical Activity Log

Participant's Unique Identity number: ______________________________ **Week starting: _________**

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
Morning	Yoga/moderate/ 30 mins at Pure gym 1 2 3 4	No activity 1 2 3 4	Walking/light/20 mins in Markeaton park 1 2 3 4	**No activity** 1 2 3 4	Badminton/moderate /45mins at the sport centre 1 2 3 4	Swimming/high/60 mins at Lloyds club 1 2 3 4	Gardening/moderate/ 60 mins at home 1 2 3 4	**215 minutes**
Afternoon	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	
Evening	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	

NB: Please, record the type of physical activity engaged in, the intensity (high, moderate or light), time (minutes) and place spent engaging in the activity. How did you feel over all? (Please circle the expression that best described how you felt)

Enjoyed

1

Was Okay

2

Did not enjoy

3

Hated it

4

Appendix 30: Weekly reminder email for administrative staff (Experimental group)

Dear Colleagues,

I want to thank you for taking part in this study aimed at developing your physical skills to play badminton.

This is just to remind you to attend at least one badminton training session this week on Monday (5-6 pm) and/or on Friday (1-2 pm) at the University of Derby Sports Centre.

It is going to be very exciting and hope to see you.

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Appendix 31: Weekly reminder email for administrative staff (Control group)

Dear Colleagues,

I want to thank you for taking part in this study aimed at increasing your physical activity levels.

This is just to remind you to just continue with your usual routine.

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Appendix 32: Post-intervention survey for administrative staff

POST-INTERVENTION QUESTIONNAIRE FOR ADMINISTRATIVE STAFF

We want to thank you for taking part in this 4-week intervention aimed at improving your physical skills to engage in physical activity through learning a form of sport.

This questionnaire is comprised of two sections and should take about 10 minutes to complete. This includes the Global Physical Activity Questionnaire (GPAQ), and the Physical Skills sub-scale of the Determinants of Physical Activity Questionnaire (DPAQ).

Please try to answer all questions in all sections of this questionnaire as much as possible as there are no right or wrong answers.

Participant's unique identification number:

Please use the same unique identification number that you generated during the screening process of this intervention.

____

SECTION 1: GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ)

Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, teaching, researching, and activities associated with your job role. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are

activities that require moderate physical effort and cause small increases in breathing or heart rate.

Activity at Work:

Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?

◯ Yes (1)

◯ No (2)

Skip To: Q4 If = No

In a typical week, on how many days do you do vigorous-intensity activities as part of your work? Number of days:

◯ Number of days: (1) ____

How much time do you spend doing vigorous-intensity activities as part of your work on a typical day?

◯ Hours: minutes: (1) ____

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

◯ Yes (1)

◯ No (2)

Skip To: Q7 If Does your work involve moderate-intensity activity that causes small increases in breathing or he... = No

---

In a typical week, on how many days do you do moderate-intensity activities as part of your work?

○ Number of days: (1) ____

How much time do you spend doing moderate-intensity activities at work on a typical day?

○ Hours: minutes: (1) ____

Travel to and from Places:

The next questions exclude the physical activities at work that you have already mentioned. Now, I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship.

Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

○ Yes (1)

○ No (2)

Skip To: Q10 If Travel to and from Places: The next questions exclude the physical activities at work that you... = No

---

In a typical week, on how many days do you walk of bicycle for at least 10 minutes continuously to get to and from places?

○ Number of days: (1) ____

How much time do you spend walking or bicycling for travel on a typical day?

○ Hours: minutes: (1) ____

Recreational Activities:

The next questions exclude the work and transport activities that you have already mentioned. Now, I would like to ask you about sports, fitness and recreational activities (leisure).

Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

- ◯ Yes (1)
- ◯ No (2)

Skip To: Q13 If Recreational Activities: The next questions exclude the work and transport activities that you... = No

In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

- ◯ Number of days: (1) ____

How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

- ◯ Hours: minutes: (1) ____

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?

- ◯ Yes (1)
- ◯ No (2)

Skip To: Q16 If Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes... = No

In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

◯ Number of days: (1) ____

How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

◯ Hours: minutes: (1) ____

Sedentary Behaviour:

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in a car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

How much time do you usually spend sitting or reclining on a typical day?

◯ Hours: minutes: (1) ____

SECTION 2: PHYSICAL SKILLS QUESTIONNAIRE

We are interested in finding out about the administrative staff's views and opinions about their physical skills to engage in physical activity/sports. Please select the response that most closely matches your own, remembering that there are no right and wrong answers.

Please read each statement and decide how much you agree or disagree by ticking the appropriate boxes.

I can do physical activity to a good enough standard

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Somewhat disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Somewhat agree (5)
- ○ Agree (6)
- ○ Strongly agree (7)

I've never had sports skills, so I don't do physical activity

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Somewhat disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Somewhat agree (5)
- ○ Agree (6)
- ○ Strongly agree (7)

I don’t seem to have the skills to keep going in physical activity sessions

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Somewhat disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Somewhat agree (5)
- ○ Agree (6)
- ○ Strongly agree (7)

DEBRIEF STATEMENT

Thank you for participating in this study. Your participation is much appreciated.

The aim of this study was to increase the physical skills of the inactive university administrative staff to engage in sports, with a specific aim of increasing their physical activity levels. Several studies worldwide have established the prevalence of physical inactivity among staff in the university setting, especially the administrative staff, with a significant proportion of them not achieving the recommended physical activity levels of at least 150 minutes of moderate intensity physical activity or 75 minutes of vigorous intensity physical activity or a combination of both per week. Therefore, due to the nature of their work, the university administrative staff appear to be prime candidates for interventions to reduce physical inactivity.

Importantly, the university setting provides an ideal environment for physical activity promotion programmes due to the available social support, captive audience, and the number of waking hours people spend in the university environment. Encouraging routine physical activity among these university administrative staff is very vital because evidence suggests that regular physical activity is positively associated with beneficial health factors, such as reduced risk of heart disease, weight control, lower incidence of illness, psychological wellbeing, reduction in sickness-related absenteeism, and increase in productivity. However, even with these inherent prospects in the university and health benefits of physical activity, university staff have remained progressively sedentary over the years. Therefore, it is now important to develop behaviour change interventions supported by psychological theories that target physical activity increases as a primary outcome in the university setting.

The 4-week pre-post intervention involved going to the sports centre to learn how to play badminton at least once a week, either on Mondays, Wednesdays or Fridays. Weekly e-mail messages were also sent to all the participants to remind them to participate in physical activity. The participants were screened using the Global Physical Activity Questionnaire (GPAQ) and had to be physically inactive (i.e., score below 600 MET-min/week of moderate intensity physical activity) to be eligible to participate in this study. The participants were requested to complete some questionnaires at baseline (week 0) prior to the commencement of the intervention and again at week 5 at the end of the intervention, in order to evaluate if the intervention had any significant effect. This questionnaire requested for some basic demographic information, physical activity levels and physical skills scores employing validated psychometric measures.

Your confidentiality and anonymity are guaranteed, which means that all the information you provide will not be linked back to you. All data generated will be securely stored in a password protected personal computer accessible only to the research team. The data will also be used for the researcher's PhD and subsequent publications. All data will be kept for a minimum of 6 years, as stipulated in the University of Derby's research guidelines. You will be allowed to withdraw your data at least 14 days after data collection, after which you will no longer be able to withdraw your data.

If any aspect of the study has raised issues for you of has caused any upset, please you can contact the **Health Assured,** a counselling Service, at: https://staff.derby.ac.uk/sites/hr/Health Safety/Organisational-

Safety/Pages/EmployeeCare.aspx or **08000305182** for counselling (request free call if using a mobile) or you can contact your usual care provider or GP for medical issues.

Kindly see below, details of some physical activity websites you may wish to visit:

General Information about Some Physical Activity Websites:

- NHS Change 4 Life initiative
- Department of Health Start Active, Stay Active
- Derby City Council Livewell Programme
- University of Derby Sports and exercise facilities available for staff at the Sport Centre

If you have any questions or concerns about any aspect of this study please feel free to contact any of the under listed:

- Lawrence Ndupu (PhD Research student) at 100312037@unimail.derby.ac.uk or 01332592135
- Dr. Chris Bussell (Director of Studies) at c.bussell@derby.ac.uk or 01332593036

- Dr. Mark Faghy (Supervisor) at m.faghy@derby.ac.uk or 103312592109
- Dr. Vicki Staples (Supervisor) at v.staples@derby.ac.uk or 01332593059
- Dr. Sigrid Lipka (Supervisor) at s.lipka@derby.ac.uk or 01332593052

Appendix 33: SPSS output for the Reliability test of the physical skills subscale conducted among university administrative staff

Table 1: Reliability statistics

Cronbach's Alpha	N of Items
.946	3

Table 2: Item-Total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I've never had sports skills, so I don't do physical activity	8.6	19.31	.817	.973
I don't seem to have the skills to keep going in physical activity sessions	7.9	18.62	.930	.890
I can do physical activity to a good enough standard	8.0	17.26	.920	.896

Appendix 34: Descriptive statistics showing the mean physical skills scores and total physical activity levels for administrative staff

Variables	Pre-intervention		Post-intervention	
	N	Mean (SD)	N	Mean (SD)
Total physical activity (MET-minutes/week)				
Experimental group Male Female	 4 5	 500.0 ± 76.59 428.0 ± 71.55	 4 5	 1790.0 ± 1010.54 1708.0 ± 1588.68
Total	9	460.0 ± 78.74	9	1744.4 ± 1283.27
Control group Male Female	 4 8	 320.0 ± 141.42 337.5 ± 182.50	 4 8	 400.0 ± 172.82 600.0 ± 538.36
Total	12	331.7 ± 163.48	12	533.3 ± 449.75
Treatment groups total Male Female	 8 13	 410.0 ± 142.63 372.3 ± 152.43		 1095.0 ± 1001.24 1026.2 ± 1151.16
Total	21	386.7 ± 146.33		1052.4 ± 1071.05
Mean Physical skills scores (minutes/week)				
Experimental group Male Female	4 5	4.8 ± 2.60 3.7 ± 1.33	4 5	6.2 ± 0.88 5.1 ± 1.22
Total	9	4.1 ± 1.94	9	5.6 ± 1.15
Control group Male Female	 4 8	 2.3 ± 1.50 3.1 ± 1.84	 4 8	 2.9 ± 1.52 4.1 ± 2.17
Total	12	2.8 ± 1.71	12	3.7 ± 1.99
Treatment groups total Male Female	 8 13	 3.5 ± 2.38 3.3 ± 1.63		 4.5 ± 2.09 4.5 ± 1.87
Total	21	3.4 ± 1.89		4.5 ± 1.90

Appendix 35: Descriptive statistics showing the mean time spent in physical activity weekly among administrative staff

Treatment Groups	N	Time spent in physical activity weekly (minutes/week) (mean (SD))			
		Week 1	**Week 2**	**Week 3**	**Week 4**
Experimental group					
Male Female	4 5	155.0 ± 61.78 171.0 ± 76.68	215.0 ± 55.24 258.0 ± 60.17	265.0 ± 89.72 243.0 ± 45.78	268.8 ± 78.14 249.0 ± 85.03
Total	9	163.9 ± 66.65	238.9 ± 58.88	252.8 ± 64.81	257.8 ± 77.54
Control group					
Male Female	4 8	113.8 ± 38.16 131.3 ± 108.85	102.5 ± 31.22 147.5 ± 70.71	90.0 ± 38.30 135.6 ± 93.86	106.3 ± 45.71 170.0 ± 127.39
Total	12	125.4 ± 89.51	132.5 ± 62.76	120.4 ± 80.69	148.8 ± 109.01
Treatment Groups Total					
Male Female	8 13	134.4 ± 52.40 146.5 ± 96.32	158.8 ± 73.08 190.0 ± 85.17	177.5 ± 113.26 176.9 ± 93.78	187.5 ± 105.15 200.4 ± 116.09
Total	21	141.9 ± 81.02	178.1 ± 80.40	177.1 ± 98.83	195.5 ± 109.53

Appendix 36: The label, definition and examples of BCTs selected to guide the PhD student's intervention

S/N	Label	Definition	Examples
1	Action planning	Thorough plans are made including when (frequency) and where (in what situation) to act. It is essential that there is a distinct connection between plans and behavioural responses to define situational cues. Such plans are frequently stated in 'If-Then' format	A business executive may plan this 'If it is 5pm and everybody is beginning to leave the office, then I will pick up my gym bag and go to the fitness centre'.
2	Information about health consequences	Provide information (e.g., verbal, visual, and written) about health consequences of performing the behaviour.	Explain to the individual that sustained physical inactivity can increase susceptibility to obesity, diabetes, cardiovascular diseases, and other chronic diseases.
5	Prompt/cues	Instruction on use of cues to help prompt individuals to perform a behaviour.	Encouraging exercisers to use frequently occurring routine events like a specific time of the day or mobile phone alerts to prompt them to start their physical activity routine.
6	Self-monitoring of behaviour	The individual is requested to keep a detailed record of their activity and use as a means of changing or modifying behaviour	This could the form of a questionnaire or diary focusing on duration, time, and circumstances in which the physical activity was tried or accomplished. Give the individual an accelerometer and a form for recording daily total number of steps.
7	Credible source	Present visual or verbal communication from a credible source in favour of or against the behaviour.	Present a speech or poster given by a high-status professional to emphasise the importance of staying active.
8	Goal setting (behaviour)	Set or agree a goal defined in terms of behaviour to be achieved. Encouragement to begin or maintain behaviour change. It does not involve precise planning for the behaviour sequence or performance.	A goal may be to engage in more exercise next week.
9	Review behaviour goal(s)	A chance for the person to evaluate the successful completion of earlier set goals. Contingencies and	Not being able to exercise five times weekly because of other obligations, so reorganising allocated times

		additional plans can be made for occasions in which goals were missed.	to exercise at more suitable times or fitting it into a work timetable (e.g., walking to work).
10	Relapse prevention	The individual is enthused to make plans to sustain behaviour that has been changed. The individual is encouraged to focus on circumstances or occurrences in which the changed behaviour may relapse, and then create ways to increase the likelihood of success.	An individual engaged in jogging routine may accentuate bad weather as a likely barrier to sustaining their exercise, so they might be encouraged to use a treadmill in the gym on cold rainy days.
11	Use of follow-up prompts	Use of prompts provided after an individual has begun a behaviour modification routine in order to help remind them to continue. Eventually, as the individual becomes better at performing the behaviour, cues and prompts are reduced.	Providing individuals with a personal alarm, text messages, e-mail, or other reminders to help them remember their physical activity or aim.
12	Identifying barriers/problems resolution	After the development of a clear plan, people are tasked with detecting potential barriers to performance and answers to the potential problems. Barriers may be cognitive, emotional, physical and/or social.	An individual may feel too tired to exercise on Fridays, and therefore resolve to go to sleep earlier on Thursday nights.

Appendix 37: Invitation e-mail to PhD students

INTERVENTION TO INCREASE PHYSICAL ACTIVITY AMONG UNIVERSITY OF DERBY PHD STUDENTS

Dear Colleagues,

Thank you for showing interest to take part in this study. As a pilot for university wellness programme, I am looking to conduct a 4-week behaviour change intervention to encourage the PhD students at the University of Derby to engage more in physical activity. This study would include educational and/or intentions interventions, which are expected to improve your knowledge about physical activity as well as increase your intentions to engage in physical activity. The eligible participants would be allocated to any of these four groups: education only group, intentions only group, education & intentions group, and control group (no intervention). During this intervention, weekly emails would also be sent to you to remind you to participate in the intervention. Additionally, you will also be provided with activity log sheets to record the types, intensity and minutes you have spent participating in physical activity every week.

This study is absolutely voluntary, and you are therefore free to withdraw at any time during the intervention by simply contacting the researcher. All information provided during this study will be confidential and will only be seen by the primary investigator and his supervisory team. If you are interested in participating, please access the screening questionnaire that includes the participant information sheet, demographic characteristics, Global physical activity questionnaire (GPAQ) to measure your physical activity level and consent form through this link: https://derby.qualtrics.com/jfe/form/SV_9tNWnjcQR4cp1cN

The participant information sheet provides you the details of all you need to know about this study. If you are still willing to participate in this study after reading this information, please sign the consent form and return to me. You will also be required to provide your preferred email address, with which we can contact you throughout the intervention period. You will no longer receive any information from me once the intervention is over. Please note that only those who are physically inactive as measured by the Global Physical Activity Questionnaire will be eligible to participate in this study and will thus be contacted. You will be allowed to withdraw your data if you so wish up to 14 days post-intervention after which you will not be allowed to withdraw your data.

If you have questions at any time about the study or the procedures, you may contact the researcher, Lawrence Ndupu, at 100312037@unimail.derby.ac.uk, or 01332592135. If you have further concerns about participating, you can contact my Director of Studies, Dr Chris Bussell, at c.bussell@derby.ac.uk, or 01332593063 or any of my supervisors: **Dr Mark Faghy**, at m.faghy@derby.ac.uk or 01332592109; **Dr Vicki Staples**, at v.staples@derby.ac.uk, or 01332593059; or **Dr Sigrid Lipka**, at s.lipka@derby.ac.uk, or 01332593052).

Thank you in advance for your participation.

Kind Regards,

Lawrence

Lawrence Ndupu CLANS PhD student

Appendix 38: Screening questionnaire for PhD students

INFORMATION FOR PARTICIPANTS

This study aims at encouraging physical activity participation among the postgraduate PhD research students. This study is being conducted by Lawrence, a PhD research candidate from the College of Life and Natural Sciences at the University of Derby. This will help us assess if certain psychological models are effective at increasing physical activity engagement among the inactive PhD students in a university setting.

This questionnaire is comprised of four sections and should take about 10 minutes to complete. These include the information agreement, demographic characteristics, Global Physical Activity Questionnaire (GPAQ) and Health Screening Questionnaire. Please try to answer all questions in all sections of this questionnaire as much as possible as there are no right or wrong answers.

Participation in this research study is absolutely voluntary, and you are therefore under no obligation to take part. You are free to withdraw any time by contacting the researcher with your unique identification number up to 14 days after completing the questionnaire.

Researchers will be collecting data from your participation in this study. We need these data to understand the effectiveness of theory informed bespoke interventions at increasing physical activity levels among inactive PhD students, and also in the public interest of enhancing academic research. This is the legal basis on which we are collecting your data and while this allows us to use your data, it also means we have obligations towards you to:

- not seek more information from you than what is essential and necessary for the study.
- make sure that you are not identified by the data by anonymising it using ID codes;
- use your anonymised data only for the purposes of this study and for any relevant publications that arise from it
- store data safely in password-protected databases to which only the named researchers have access
- not keep your information for longer than is necessary (usually for seven years);
- safely destroy your data by shredding or permanently deleting them

The University of Derby will act as the Data Controller for this study. This means that the University is responsible for looking after your information and using it properly. Student researchers on the project with access to the data are supervised by highly qualified and experienced researchers and have been very careful to ensure the security of your data. The study was approved for its ethical standards by The University of Derby College of Life and Natural Sciences Research Ethics Committee. However, in the unlikely event that you feel you need to make a complaint regarding the use of your information, you can contact the Data Protection Officer at the University of Derby: James Eaglesfield (01332) 591762 or the Information Commissioners Office 0303 123 1113.

Further information about the project can be obtained from the researcher, **Lawrence Ndupu** (100312037@unimail.derby.ac.uk or 01332592135) or any of my supervisors: **Dr Chris**

Bussell (c.bussell@derby.ac.uk or 01332593063); **Dr Mark Faghy** (m.faghy@derby.ac.uk or 01332592109); **Dr Vicki Staples** (v.staples@derby.ac.uk or 01332593059); or **Dr Sigrid Lipka** (s.lipka@derby.ac.uk or 01332593052) at the University of Derby, Kedleston Road, Derby, DE22 1GB.

I have read the participant's information sheet and agree to take part in this research study

- ◯ Yes (1)
- ◯ No (2)

Skip To: End of Survey If I have read the participant's information sheet and agree to take part in this research study = No

---

Participant's unique identification number:

Please generate your unique identification number by using the first 3 digits of your date of birth and last 3 digits of your mobile phone number. For example, if your date of birth is 04-11-1965 and mobile number is 075xxxxx687 then your unique identification number will be 041687.

____

E-mail address:

Please kindly provide an e-mail address that would be used to contact you during the 4-week intervention period.

As detailed in the participant's information sheet, your email is required so that the researcher can send messages to remind you to participate in physical activity and also as a means of sending the intervention materials across to you during the intervention period.

____

DEMOGRAPHIC INFORMATION

Please, kindly try to answer all the questions as it will be only used for research purpose. How old are you (years and months)?

____

What is your current gender identity? (please check the one that applies)

○ Male (1)

○ Female (2)

○ Trans male/Trans man (3)

○ Trans female/Trans woman (4)

○ Genderqueer/Gender non-conforming (5)

○ Different identity (Please state) (6)

____

○ prefer not to say (7)

What best describes your ethnic group?

○ White (1)

○ Mixed/multiple ethnic groups (2)

○ Asian/Asian British (3)

○ Black/Africa/ Caribbean/Black British (4)

○ Other ethnic group (please describe): (5)

____

Which site are you primarily based in?

- ◯ Kedleston Road Campus (1)
- ◯ Markeaton Campus (2)
- ◯ Britannia Mills Campus (3)
- ◯ Chesterfield Campus (4)
- ◯ Buxton Campus (5)
- ◯ Friar Gate Campus (6)
- ◯ Leek Campus (7)

Are you a full or part-time student?

- ◯ Full-time (1)
- ◯ Part-time (2)

GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ)
Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, teaching, researching, and activities associated with your job role. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Activity at Work:

Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?

○ Yes (1)

○ No (2)

Skip To: Q14 If = No

In a typical week, on how many days do you do vigorous-intensity activities as part of your work? Number of days:

○ Number of days: (1) ____

How much time do you spend doing vigorous-intensity activities as part of your work on a typical day?

○ Hours: minutes: (1) ____

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

○ Yes (1)

○ No (2)

Skip To: Q17 If Does your work involve moderate-intensity activity that causes small increases in breathing or he... = No

---

In a typical week, on how many days do you do moderate-intensity activities as part of your work?

○ Number of days: (1) ____

How much time do you spend doing moderate-intensity activities at work on a typical day?

○ Hours: minutes: (1) ____

Travel to and from Places:

The next questions exclude the physical activities at work that you have already mentioned. Now, I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship. Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

○ Yes (1)

○ No (2)

Skip To: Q20 If Travel to and from Places: The next questions exclude the physical activities at work that you... = No

In a typical week, on how many days do you walk of bicycle for at least 10 minutes continuously to get to and from places?

○ Number of days: (1) ____

How much time do you spend walking or bicycling for travel on a typical day?

○ Hours: minutes: (1) ____

Recreational Activities:

The next questions exclude the work and transport activities that you have already mentioned. Now, I would like to ask you about sports, fitness and recreational activities (leisure). Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

◯ Yes (1)

◯ No (2)

Skip To: Q23 If Recreational Activities: The next questions exclude the work and transport activities that you... = No

In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

◯ Number of days: (1) ____

How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

◯ Hours: minutes (1) ____

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?

◯ Yes (1)

◯ No (2)

Skip To: Q26 If Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes... = No

In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

○ Number of days:(1) ____

How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

○ Hours: minutes: (1) ____

Sedentary Behaviour:

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in a car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

How much time do you usually spend sitting or reclining on a typical day?

○ Hours: minutes: (1) ____

HEALTH SCREENING QUESTIONNAIRE

As a volunteer participating in a physical activity, it is important that you are currently in good health and have had no significant medical problems in the past. This form is to (i) ensure your own continuing well-being and (ii) to avoid the possibility of individual health issues confounding session outcomes. If you are required to produce blood samples, please ensure that you complete the Blood Analysis- Participant Consent Form.

Please complete this brief questionnaire to confirm your fitness to participate:

At present, do you have any health problem for which you are:

on medication, prescribed or otherwise:

◯ Yes (1)

◯ No (2)

attending your general practitioner

◯ Yes (1)

◯ No (2)

on a hospital waiting list

◯ Yes (1)

◯ No (2)

In the past two years, have you had any illness which required you to:

consult your GP

◯ Yes (1)

◯ No (2)

attend a hospital outpatient department

◯ Yes (1)

◯ No (2)

be admitted to hospital

○ Yes (1)

○ No (2)

End of Block: Block 5

Start of Block: Block 6

Have you ever had any of the following?

Convulsion/epilepsy

○ Yes (1)

○ No (2)

Asthma

○ Yes (1)

○ No (2)

Eczema

○ Yes (1)

○ No (2)

Diabetes

- ○ Yes (1)
- ○ No (2)

A blood disorder

- ○ Yes (1)
- ○ No (2)

Head injury

- ○ Yes (1)
- ○ No (2)

Digestive problems

- ○ Yes (1)
- ○ No (2)

Heart problems

- ○ Yes (1)
- ○ No (2)

Problems with bones and joints

- Yes (1)
- No (2)

Disturbances of balance/coordination

- Yes (1)
- No (2)

Numbness in hands and feet

- Yes (1)
- No (2)

Disturbance of vision

- Yes (1)
- No (2)

Ear/hearing problems

- Yes (1)
- No (2)

Thyroid problems

- Yes (1)
- No (2)

Kidney or liver problems

- Yes (1)
- No (2)

Allergy to nuts

- Yes (1)
- No (2)

Severe dizziness and fainting

- Yes (1)
- No (2)

High blood pressure

- Yes (1)
- No (2)

Communicable disease

○ Yes (1)

○ No (2)

If you have answered YES to any of the question, please describe briefly (e.g., to confirm problem was/is short-lived, insignificant or well controlled.)

____

____

____

____

____

End of Block: Block 6

Appendix 39: Baseline questionnaire for PhD students

BASELINE QUESTIONNAIRE FOR PHD STUDENTS (WEEK 0)

Participant's unique identification number
Please generate your unique identification number by using the first 3 digits of your date of birth and last 3 digits of your mobile phone number. For example, if your date of birth is 04-11-1965 and mobile number is 075xxxxx687 then your unique identification number will be 041687. Kindly use the same unique identification number you used during the screening phase of this intervention.

____

Please select the response you think applies: **To the best of your knowledge, how much physical activity is sufficient to achieve HEALTH BENEFITS in adults? Do you think it is… [SELECT ONE RESPONSE ONLY]**

- ○ 30 minutes of physical activity every day (1)
- ○ 30 minutes of moderate intensity physical activity on 5 or more days a week (2)
- ○ 30 minutes of vigorous intensity physical activity on 5 or more days a week (3)
- ○ 30 minutes of vigorous intensity physical activity on at least 2 days a week (4)
- ○ I don't know (5)

Please rate your agreement with the following statement: I believe that I am doing enough physical activity to achieve health benefits.[SELECT ONE RESPONSE ONLY]

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither disagree nor agree (3)
- ○ Agree (4)
- ○ Strongly agree (5)
- ○ I don't know (6)

In your opinion, is participating in REGULAR PHYSICAL ACTIVITY beneficial for people's health? Would you say that it is…[SELECT ONE RESPONSE ONLY]

- Very beneficial (1)
- Somewhat beneficial (2)
- Neither (3)
- Not very beneficial (4)
- Not beneficial at all (5)
- I don't know (6)

In your opinion, is NOT participating in REGULAR PHYSICAL ACTIVITY harmful to people's health? Would you say that it is…[SELECT ONE RESPONSE ONLY]

- Very harmful (1)
- Somewhat harmful (2)
- Neither (3)
- Not very harmful (4)
- Not harmful at all (5)
- I don't know (6)

To the best of your knowledge, which health conditions are related to a lack of physical activity?[SELECT ALL RESPONSES YOU THINK APPLY]

☐ 1. Cardiovascular diseases (e.g., heart attack, stroke) (1)

☐ 2. Fatty liver disease (2)

☐ 3. Depression (3)

☐ 4. Lung cancer (4)

☐ 5. Type 2 diabetes (5)

☐ 6. Type 1diabetes (6)

☐ 7. Skin cancer (7)

☐ 8. Cervical cancer (8)

☐ 9. Breast cancer (9)

☐ 10. Colon cancer (10)

☐ 11. Overweight and obesity (11)

☐ 12. Asthma (12)

☐ 13. Osteoporosis (13)

☐ 14. High blood pressure (14)

☐ 15. Metabolic syndrome (15)

☐ 16. Flu (16)

☐ 17. Anxiety (17)

☐ 18. Stress (18)

☐ 19. Elevated cholesterol (19)

☐ 20. Poor sleep (20)

☐ 21. Malaria (21)

☐ 22. Arthritis (22)

☐ 23. Functional status (23)

☐ 24. Risk of falls and fractures (24)

☐ 25. I don't know. (25)

End of Block: SECTION 1: LEVELS OF KNOWLEDGE OF PHYSICAL ACTIVITY FOR HEALTH QUESTIONNAIRE

Start of Block: Block 3

Please choose the one that you think is most appropriate:

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing cardiovascular disease (e.g. heart attack, stroke) at some point during YOUR lifetime?

○ Yes, a very high increase in risk (1)

○ Yes, a high increase in risk (2)

○ Yes, a moderate increase in risk (3)

○ Yes, a slight increase in risk (4)

○ No increased risk (5)

○ I don't know (6)

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing type 2 diabetes at some point during YOUR lifetime? SELECT ONE RESPONSE ONLY

- ◯ Yes, a very high increase in risk (1)
- ◯ Yes, a high increase in risk (2)
- ◯ Yes, a moderate increase in risk (3)
- ◯ Yes, a slight increase in risk (4)
- ◯ No increased risk (5)
- ◯ I don’t know (6)

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing colon cancer at some point during YOUR lifetime? SELECT ONE RESPONSE ONLY

- ◯ Yes, a very high increase in risk (1)
- ◯ Yes, a high increase in risk (2)
- ◯ Yes, a moderate increase in risk (3)
- ◯ Yes, a slight increase in risk (4)
- ◯ No increased risk (5)
- ◯ I don’t know (6)

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing depression at some point during YOUR lifetime?

- ○ Yes, a very high increase in risk (1)
- ○ Yes, a high increase in risk (2)
- ○ Yes, a moderate increase in risk (3)
- ○ Yes, a slight increase in risk (4)
- ○ No increased risk (5)
- ○ I don’t know (6)

Please select the most appropriate:

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person’s risk of developing cardiovascular disease (e.g. heart attack, stroke)?

- ○ 0% (1)
- ○ 10% (2)
- ○ 20% (3)
- ○ 30% (4)
- ○ 40% (5)
- ○ 50% (6)
- ○ 60% (7)
- ○ 70% (8)
- ○ 80% (9)
- ○ 90% (10)
- ○ 100% (11)
- ○ I don't know (12)

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person's risk of developing type 2 diabetes?

- ○ 0% (1)
- ○ 10% (2)
- ○ 20% (3)
- ○ 30% (4)
- ○ 40% (5)
- ○ 50% (6)
- ○ 60% (7)
- ○ 70% (8)
- ○ 80% (9)
- ○ 90% (10)
- ○ 100% (11)
- ○ I don't know (12)

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person's risk of developing colon cancer?

- ○ 0% (1)
- ○ 10% (2)
- ○ 20% (3)
- ○ 30% (4)
- ○ 40% (5)
- ○ 50% (6)
- ○ 60% (7)
- ○ 70% (8)
- ○ 80% (9)
- ○ 90% (10)
- ○ 100% (11)
- ○ I don't know (12)

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person's risk of developing depression?

- ◯ 0% (1)
- ◯ 10% (2)
- ◯ 20% (3)
- ◯ 30% (4)
- ◯ 40% (5)
- ◯ 50% (6)
- ◯ 60% (7)
- ◯ 70% (8)
- ◯ 80% (9)
- ◯ 90% (10)
- ◯ 100% (11)
- ◯ I don't know (12)

Do you know what the national recommendations are for taking part in physical activity, in terms of minutes per week of moderate intensity physical activity?

- ◯ Yes (1)
- ◯ No (2)

Skip To: Q20 If Do you know what the national recommendations are for taking part in physical activity, in terms... = Yes

Skip To: Q21 If Do you know what the national recommendations are for taking part in physical activity, in terms... = No

What are the national recommendations for taking part in physical activity, in terms of minutes per week of moderate intensity physical activity?

____

SECTION 3: BEHAVIOURAL INTENTIONS QUESTIONNAIRE

I intend to engage in physical activity __________ times during the next 4 weeks.

____

I intend to engage in physical activity during the next 4 weeks with the following regularity.

- ○ Not at all (1)
- ○ Rarely (2)
- ○ Occasionally (3)
- ○ Sometimes (4)
- ○ Frequently (5)
- ○ Usually (6)
- ○ Every day (7)

Please choose the one that you think is most appropriate:

I do/do not intend to engage in physical activity at least 12 times during the next 4 weeks

- ○ I do (1)
- ○ I do not (2)

I intend to engage in physical activity at least 12 times during the next 4 weeks.

- ○ Definitely (1)
- ○ Very probably (2)
- ○ Probably (3)
- ○ Neither (4)
- ○ Possibly (5)
- ○ Probably not (6)
- ○ Definitely not (7)

Appendix 40: Educational information for PhD students

Benefits of being physically active

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Did you know that?

- Physical activity can reduce your risk of developing major chronic disease, such as heart disease, type 2 diabetes, stroke and cancer by up to 50%.
- Can lower your risk of early death by up to 30%.
- Physical activity can lower your risk of developing osteoarthritis by 83%, risk of colon cancer by 50%, risk of breast cancer by 20%.
- Physical activity can also boost your self-esteem, mood, sleep quality and energy, as well as reduce your risk of stress, depression, dementia and Alzheimer's disease.
- Whatever your age, there's strong scientific evidence that being physically active can help you lead a healthier and happier life.

Please follow this link for further information on physical activity: https://www.nhs.uk/live-well/exercise/exercise-health-benefits/

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For more enquiries please contact **Lawrence Ndupu** at:

100312037@unimail.derby.ac.uk or 01332592135

Consequences of being physically inactive

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Did you know that?

- Physical inactivity is as deadly as smoking, with physical inactivity being linked to 6% of coronary heart disease, 7% of type 2 diabetes, 10 % of breast cancer, 10% of colon cancer, and 9% of premature deaths globally.
- Circulatory and heart disease causes almost 160,000 deaths in the UK annually- an average of 435 people daily or one death every 3 minutes.
- Approximately 42,000 of people below the age of 75 years in the UK die from circulatory disease.
- In the UK, physical inactivity is attributed to about one out of 10 deaths from heart disease and one out of six deaths due to any cause.
- Physical inactivity may be responsible for about one in 10 cases of heart disease (10.5%), almost one in five cases of colon cancer (18.7%), 13% of type 2 diabetes and 17.9% of breast cancer in the UK.

Please follow this link for further information on physical inactivity:
https://www.nhs.uk/news/lifestyle-and-exercise/lack-of-exercise-as-deadly-as-smoking/

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For more enquiries please contact **Lawrence Ndupu** at:
100312037@unimail.derby.ac.uk or 01332592135

Recommended physical activity guidelines for adults

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How much physical activity do adults aged 19 to 64 years old need to do to stay healthy?

To stay healthy, adults aged 19 to 64 should try to be active daily and should do:

- at least 150 minutes of moderate aerobic activity such as cycling or brisk walking every week **and**
- strength exercises on 2 or more days a week that work all the major muscles (legs, hips, back, abdomen, chest, shoulders and arms) Or:
- 75 minutes of vigorous aerobic activity such as running or a game of singles tennis every week **and**
- strength exercises on 2 or more days a week that work all the major muscles (legs, hips, back, abdomen, chest, shoulders and arms) Or:
- a mix of moderate and vigorous aerobic activity every week – for example, 2 x 30-minute runs plus 30 minutes of brisk walking equates to 150 minutes of moderate aerobic activity **and**
- strength exercises on 2 or more days a week that work all the major muscles (legs, hips, back, abdomen, chest, shoulders and arms)
- One way to do your recommended 150 minutes of weekly physical activity is to do 30 minutes on 5 days every week.

Please follow this link for further information on physical inactivity: https://www.nhs.uk/live-well/exercise/

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For more enquiries please contact **Lawrence Ndupu** at:

100312037@unimail.derby.ac.uk or 01332592135

How to achieve the physical activity guidelines

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What counts as moderate aerobic activity?

- Examples of activities that require moderate effort for most people include: brisk walking, water aerobics, riding a bike on level ground or with few hills, doubles tennis, pushing a lawn mower, hiking, skateboarding, rollerblading and volleyball, basketball.
- One way to tell if you're working at a moderate level is if you can still talk, but you can't sing the words to a song.

What counts as vigorous activity?

- Examples of activities that require vigorous effort for most people include jogging or running, swimming fast, riding a bike fast or on hills, singles tennis, football, rugby, skipping rope, hockey, aerobics, gymnastics, and martial arts.
- Vigorous activity makes you breathe hard and fast. If you're working at this level, you won't be able to say more than a few words without pausing for breath.

What activities strengthen muscles?

- There are many ways you can strengthen your muscles, whether it's at home or in the gym.
- Examples of muscle-strengthening activities for most people include: lifting weights; working with resistance bands; doing exercises that use your own body weight, such as push-ups and sit-ups; heavy gardening, such as digging and shovelling; yoga; and Pilates.
- You can do activities that strengthen your muscles on the same day or on different days as your aerobic activity – whatever's best for you.

Please follow this link for further information on physical inactivity: https://www.nhs.uk/live-well/exercise/

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For more enquiries please contact **Lawrence Ndupu** at:

100312037@unimail.derby.ac.uk or 0133259213

Appendix 41: Implementation intention template for PhD students:

Implementation Intentions

Many people find that they intend to take at least one 20-minute session of moderate exercise but then forget or 'never get around to it'. It has been found that if you form a definite plan of exactly when and where you will carry out an intended behaviour you are more likely to actually do so and less likely to forget or find you don't get round to doing it. It would be useful for you to plan when and where you will exercise in the next week.

Please complete the following statements:

During next week I will partake in at least 20 minutes of moderate exercise on (day or days)________________ at ________________(time of day) at/or in (place)________________.

For example: During the next week I will partake in at least 20 minutes of moderate exercise on (day or days) <u>Wednesday and Friday</u> at <u>5:30 pm</u> at/or in (place) <u>the University of Derby sports centre.</u>

Appendix 42: The If-Then template for PhD students

Instructions on how to complete the If-Then Template

Participant's unique identification number: Please, if you completed the previous determinants of physical activity survey, kindly use the same unique identification number. However, for new participants, you can generate your unique identification number by using first 3 digits of your date of birth and last 3 digits of your mobile number. For example, if your date of birth is **02-12-1960** and mobile number is **075xxxxx419**, then your unique identification number will be **021419**.

The following is an example of how to complete the If-Then Template. Please carefully think about all the possible obstacles/barriers that may prevent you from achieving your objective and plan how to overcome them.

For example,

Objective: Exercise more

Action: Walk home from the university campus 3 days a week

If-Then: IF… its 5pm on a Monday, Wednesday or Friday, THEN… I will walk home from the university campus.

Overcoming the obstacle: IF… the weather is bad, THEN… I will use the stairs instead of the lifts on these days in the university campus.

If-Then Planning Template

Unique Identification Number: ________________________

Week 1 (Week starting: ____________________________)

Objective	
Action	
If-Then	**If it's…**
	Then…
Overcoming the obstacle	**If it's…**
	Then…

Week 2 (Week starting: ______________________________)

Objective	
Action	
If-Then	**If it's…**
	Then…
Overcoming the obstacle	**If it's…**
	Then…

Week 3 (Week starting: ____________________________)

Objective	
Action	
If-Then	**If it's…**
	Then…
Overcoming the obstacle	**If it's…**
	Then…

Week 4 (Week starting: ______________________________)

Objective	
Action	
If-Then	**If it's…**
	Then…
Overcoming the obstacle	**If it's…**
	Then…

Appendix 43: Weekly e-mail reminder for PhD students in different treatment groups

Education and intentions group

Dear Colleagues,

Education and Intentions Intervention

I want to thank you for agreeing to take part in this study aimed at increasing your knowledge about physical activity and your intentions to engage in physical activity.

Some educational materials with useful websites were sent to you at the start of this intervention. Additionally, implementation intentions and If-Then templates have been sent to you so that you can plan where, when and how you would engage in physical activity and how you would plan to overcome any barriers. Examples have been provided on how to complete these templates.

Please try to make out time to read the educational materials and complete these templates every week, as your knowledge about physical activity will be assessed, as well as your ability to follow your weekly plans to engage in physical activity at the end of the 4-week intervention period.

If you have any queries, please feel free to contact me. My contact details are below:

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Education only group

Dear Colleagues,

Education Intervention

I want to thank you for agreeing to take part in this study aimed at increasing your knowledge about physical activity.

Some educational materials and useful websites were sent to you at the start of this intervention. Please try to make out time to read them, as your knowledge about physical activity will be assessed at the end of the 4-week intervention period.

If you have any queries, please feel free to contact me. My contact details are as below:

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Intentions only group

Dear colleagues,

Intentions Intervention

I want to thank you for agreeing to take part in this study aimed at increasing your intentions to engage in physical activity.

The implementation intentions and If-Then templates have been sent to you, so that you can plan where, when and how you would engage in physical activity and how you would plan to overcome any barriers. Examples have been provided on how to complete these templates.

Please ensure you complete these templates every week, as you will be assessed at the end of the of the 4-week intervention period to determine if you carried out the physical activity you planned to engage in.

If you have any queries, please feel free to contact me. My contact details are below:

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Control group

Dear Colleagues,

Control group

I want to thank you for agreeing to take part in this 4-week intervention aimed at increasing your physical activity levels.

This is just to remind you to continue with your usual daily routine.

If you have any queries, please feel free to contact me. My contact details are below:

Kind Regards,

Lawrence Ndupu

PhD Research Student

Email: 100312037@unimail.derby.ac.uk

Phone: 01332593135

Appendix 44: Post-intervention questionnaire for PhD students

POST-INTERVENTION QUESTIONNAIRE FOR PHD STUDENTS

We want to thank you for taking part in this 4-week intervention aimed at improving your knowledge about physical activity and/or intentions to engage in physical activity.
This questionnaire is comprised of three sections and should take about 10 minutes to complete. This includes the Global Physical Activity Questionnaire (GPAQ), the Levels of Knowledge of Physical Activity for Health Questionnaire (LKPAHQ) and the Past Behaviour Questionnaire (PBQ).
Please try to answer all questions in all sections of this questionnaire as much as possible as there are no right or wrong answers.

Participant's unique identification number:

Please use the same unique identification number that you generated during the screening process of this intervention.

____

SECTION 1: GLOBAL PHYSICAL ACTIVITY QUESTIONNAIRE (GPAQ)

Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, teaching, researching, and activities associated with your job role. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Activity at Work: Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?

- ○ Yes (1)
- ○ No (2)

Skip To: Q4 If = No

In a typical week, on how many days do you do vigorous-intensity activities as part of your work? Number of days:

- ○ Number of days: (1) ____

How much time do you spend doing vigorous-intensity activities as part of your work on a typical day?

- ○ Hours: minutes: (1) ____

Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?

- ○ Yes (1)
- ○ No (2)

Skip To: Q7 If Does your work involve moderate-intensity activity that causes small increases in breathing or he... = No

---

In a typical week, on how many days do you do moderate-intensity activities as part of your work?

○ Number of days: (1) ____

How much time do you spend doing moderate-intensity activities at work on a typical day?

○ Hours: minutes: (1) ____

Travel to and from Places:

The next questions exclude the physical activities at work that you have already mentioned. Now, I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship.

Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

○ Yes (1)

○ No (2)

Skip To: Q10 If Travel to and from Places: The next questions exclude the physical activities at work that you... = No

---

In a typical week, on how many days do you walk of bicycle for at least 10 minutes continuously to get to and from places?

○ Number of days: (1) ____

How much time do you spend walking or bicycling for travel on a typical day?

○ Hours: minutes: (1) ____

Recreational Activities:

The next questions exclude the work and transport activities that you have already mentioned. Now, I would like to ask you about sports, fitness and recreational activities (leisure).

Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like running or football, for at least 10 minutes continuously?

○ Yes (1)

○ No (2)

Skip To: Q13 If Recreational Activities: The next questions exclude the work and transport activities that you... = No

In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?

○ Number of days: (1) ____

How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

○ Hours: minutes: (1) ____

Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?

○ Yes (1)

○ No (2)

Skip To: Q16 If Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes... = No

In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?

○ Number of days: (1) ____

How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

○ Hours: minutes: (1) ____

Sedentary Behaviour:

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in a car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

How much time do you usually spend sitting or reclining on a typical day?

○ Hours: minutes: (1) ____

SECTION 2: LEVELS OF KNOWLEDGE OF PHYSICAL ACTIVITY FOR HEALTH QUESTIONNAIRE (LKPAHQ)
Please select the response you think applies:

To the best of your knowledge, how much physical activity is sufficient to achieve HEALTH BENEFITS in adults?

Do you think it is… [SELECT ONE RESPONSE ONLY]?

- ○ 30 minutes of physical activity every day (1)
- ○ 30 minutes of moderate intensity physical activity on 5 or more days a week (2)
- ○ 30 minutes of vigorous intensity physical activity on 5 or more days a week (3)
- ○ 30 minutes of vigorous intensity physical activity on at least 2 days a week (4)
- ○ I don’t know (5)

Please rate your agreement with the following statement:

I believe that I am doing enough physical activity to achieve health benefits. [SELECT ONE RESPONSE ONLY]

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither disagree nor agree (3)
- ○ Agree (4)
- ○ Strongly agree (5)
- ○ I don't know (6)

In your opinion, is participating in REGULAR PHYSICAL ACTIVITY beneficial for people's health?

Would you say that it is… [SELECT ONE RESPONSE ONLY]?

- ○ Very beneficial (1)
- ○ Somewhat beneficial (2)
- ○ Neither (3)
- ○ Not very beneficial (4)
- ○ Not beneficial at all (5)
- ○ I don't know (6)

In your opinion, is NOT participating in REGULAR PHYSICAL ACTIVITY harmful to people's health?

Would you say that it is… [SELECT ONE RESPONSE ONLY]?

- ○ Very harmful (1)
- ○ Somewhat harmful (2)
- ○ Neither (3)
- ○ Not very harmful (4)
- ○ Not harmful at all (5)
- ○ I don't know (6)

To the best of your knowledge, which health conditions are related to a lack of physical activity? [SELECT ALL RESPONSES YOU THINK APPLY]

- ☐ 1. Cardiovascular diseases (e.g. heart attack, stroke) (1)
- ☐ 2. Fatty liver disease (2)
- ☐ 3. Depression (3)
- ☐ 4. Lung cancer (4)

- ☐ 5. Type 2 diabetes (5)
- ☐ 6. Type 1diabetes (6)
- ☐ 7. Skin cancer (7)
- ☐ 8. Cervical cancer (8)
- ☐ 9. Breast cancer (9)
- ☐ 10. Colon cancer (10)
- ☐ 11. Overweight and obesity (11)
- ☐ 12. Asthma (12)
- ☐ 13. Osteoporosis (13)
- ☐ 14. High blood pressure (14)
- ☐ 15. Metabolic syndrome (15)
- ☐ 16. Flu (16)
- ☐ 17. Anxiety (17)
- ☐ 18. Stress (18)
- ☐ 19. Elevated cholesterol (19)
- ☐ 20. Poor sleep (20)
- ☐ 21. Malaria (21)
- ☐ 22. Arthritis (22)
- ☐ 23. Functional status (23)

☐ 24. Risk of falls and fractures (24)

☐ 25. I don't know (25)

Please choose the one that you think is most appropriate:

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing cardiovascular disease (e.g., heart attack, stroke) at some point during YOUR lifetime?

○ Yes, a very high increase in risk (1)

○ Yes, a high increase in risk (2)

○ Yes, a moderate increase in risk (3)

○ Yes, a slight increase in risk (4)

○ No increased risk (5)

○ I don't know (6)

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing type 2 diabetes at some point during YOUR lifetime? SELECT ONE RESPONSE ONLY

○ Yes, a very high increase in risk (1)

○ Yes, a high increase in risk (2)

○ Yes, a moderate increase in risk (3)

○ Yes, a slight increase in risk (4)

○ No increased risk (5)

○ I don't know (6)

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing colon cancer at some point during YOUR lifetime? SELECT ONE RESPONSE ONLY

- ◯ Yes, a very high increase in risk (1)
- ◯ Yes, a high increase in risk (2)
- ◯ Yes, a moderate increase in risk (3)
- ◯ Yes, a slight increase in risk (4)
- ◯ No increased risk (5)
- ◯ I don’t know (6)

In your opinion, would NOT participating in REGULAR PHYSICAL ACTIVITY increase YOUR risk of developing depression at some point during YOUR lifetime?

- ◯ Yes, a very high increase in risk (1)
- ◯ Yes, a high increase in risk (2)
- ◯ Yes, a moderate increase in risk (3)
- ◯ Yes, a slight increase in risk (4)
- ◯ No increased risk (5)
- ◯ I don’t know (6)

Please select the most appropriate:

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person's risk of developing cardiovascular disease (e.g., heart attack, stroke)?

- ○ 0% (1)
- ○ 10% (2)
- ○ 20% (3)
- ○ 30% (4)
- ○ 40% (5)
- ○ 50% (6)
- ○ 60% (7)
- ○ 70% (8)
- ○ 80% (9)
- ○ 90% (10)
- ○ 100% (11)
- ○ I don't know (12)

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person’s risk of developing type 2 diabetes?

- ◯ 0% (1)
- ◯ 10% (2)
- ◯ 20% (3)
- ◯ 30% (4)
- ◯ 40% (5)
- ◯ 50% (6)
- ◯ 60% (7)
- ◯ 70% (8)
- ◯ 80% (9)
- ◯ 90% (10)
- ◯ 100% (11)
- ◯ I don't know (12)

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person's risk of developing colon cancer?

- ○ 0% (1)
- ○ 10% (2)
- ○ 20% (3)
- ○ 30% (4)
- ○ 40% (5)
- ○ 50% (6)
- ○ 60% (7)
- ○ 70% (8)
- ○ 80% (9)
- ○ 90% (10)
- ○ 100% (11)
- ○ I don't know (12)

On a range of 0-100%, by what percentage do you think participating in REGULAR PHYSICAL ACTIVITY would REDUCE a person's risk of developing depression?

○ 0% (1)

○ 10% (2)

○ 20% (3)

○ 30% (4)

○ 40% (5)

○ 50% (6)

○ 60% (7)

○ 70% (8)

○ 80% (9)

○ 90% (10)

○ 100% (11)

○ I don't know (12)

SECTION 3: PAST BEHAVIOUR QUESTIONNAIRE

I engaged in physical activity______ times during the past 4 weeks.

○ Please enter how many times you engaged in physical activity during the past 4 weeks (1) ____

I engaged in physical activity during the past 4 weeks with the following regularity.

- ○ Not at all (1)
- ○ Rarely (2)
- ○ Occasionally (3)
- ○ Sometimes (4)
- ○ Frequently (5)
- ○ Usually (6)
- ○ Every day (7)

I did_____did not____ engage in physical activity at least 12 times during the past 4 weeks. Please select the one that mostly apply.

- ○ I did (1)
- ○ I did not (2)

I engaged in physical activity at least 12 times during the past 4 weeks

- ○ Definitely (1)
- ○ Very probably (2)
- ○ Probably (3)
- ○ Neither (4)
- ○ Possibly (5)
- ○ Probably not (6)
- ○ Definitely not (7)

DEBRIEF STATEMENT

Thank you for participating in this study. Your participation is much appreciated.

The aim of this study was to increase the PhD students' knowledge about physical activity and/or intentions to engage in physical activity, with a specific aim of increasing their physical activity levels. Strong evidence suggests that physical inactivity is the fourth leading cause of disease and disability in the UK, with 19% of men and 26% of women reported to be inactive. Despite the widespread health improvement efforts by the UK government, estimates suggest that only 61% (63% of males and 59% of females) of adults in the UK meet the recommended physical activity guidelines. Therefore, action is urgently required in diverse settings, including university campuses to counter this scale of inactivity. Furthermore, several studies worldwide have established the prevalence of physical inactivity among students in the university setting, with significant proportion of them not achieving the recommended physical activity level of at least 30 minutes of moderate intensity physical activity at least 5 days a week. Therefore, university students appear to be prime candidates for interventions to reduce physical inactivity.

Importantly, the university setting provides an ideal environment for physical activity promotion programmes due to the available social support, captive audience, and the number of waking hours spent in the university environment. Encouraging routine physical activity among these university students is very vital because evidence suggests that regular physical activity is positively associated with beneficial health factors, such as reduced risks of heart disease, diabetes and obesity, some types of cancers, stroke, depression and anxiety and reduction in sickness-related absenteeism. However, even with these inherent prospects in the university and health benefits of physical activity, university students remained progressively inactive over the years. Therefore, it is now important to develop behaviour change interventions supported by psychological theories to target physical activity increases as primary outcome in the university setting.

The 4-week pre-post intervention involved participants receiving educational intervention only, intentions intervention only, educational and intentions interventions and no intervention (i.e., control group, in order to assess if knowledge about physical activity and/or intentions to engage in physical activity will increase physical activity level among university PhD students. Weekly e-mail messages were also sent to all the participants to remind them to engage in the interventions. The participants were screened using the Global Physical Activity Questionnaire (GPAQ) and had to be physically inactive (i.e., score below 600 MET-min/week of moderate intensity physical activity) to be eligible to participate in this study. The participants were requested to complete some questionnaires at baseline (week 0) prior to the commencement of the intervention and again at week 5 at the end of the intervention, in order to evaluate if the intervention had any significant effect. This questionnaire requested for some basic demographic information, physical activity levels, level of knowledge of physical activity for health, knowledge about the recommended physical activity levels, behavioural intentions scores, and past behaviour scores employing validated psychometric measures.

Your confidentiality and anonymity are guaranteed, which means that all the information you provide will not be linked back to you. All data generated will be securely stored in a password protected personal computer accessible only to the research team. The data will also be used for the researcher's PhD and subsequent publications. All data will be kept for a minimum of 6 years, as stipulated in the University of Derby's research guidelines. You will be allowed to withdraw your data at least 14 days after data collection, after which you will no longer be able to withdraw your data.

If any aspect of this study has raised issues for you of has caused any upset, please you can contact the **student wellbeing** at **01332593000** or email to **studentwellbeing@derby.ac.uk** for counselling or you can contact your usual care provider or GP.

Kindly see below, details of some physical activity websites you may wish to visit:

General Information about Some Physical Activity Websites:

- NHS Change 4 Life initiative
- Department of Health Start Active, Stay Active
- Derby City Council Livewell
- University of Derby Sports and exercise facilities available at the Sport Centre

If you have any questions or concerns about any aspect of this study, please feel free to contact any of the under listed:

- Lawrence Ndupu (PhD Research student) at 100312037@unimail.derby.ac.uk or 01332592135
- Dr. Chris Bussell (Director of Studies) at c.bussell@derby.ac.uk or 01332593036
- Dr. Mark Faghy (Supervisor) at m.faghy@derby.ac.uk or 103312592109
- Dr. Vicki Staples (Supervisor) at v.staples@derby.ac.uk or 01332593059
- Dr. Sigrid Lipka (Supervisor) at s.lipka@derby.ac.uk or 01332593052

Appendix 45: Descriptive statistics showing the mean total physical activity levels for PhD students

Treatment groups	Pre-intervention		Post-intervention	
	N	Mean (SD)	N	Mean (SD)
Education and Intentions Group				
Male Female Total	9 8 17	335.6 ± 148.59 384.0 ± 128.78 358.4 ± 137.54	9 8 17	1733.3 ± 669.93 1817.5 ± 1090.82 1771.9 ± 864.20
Education Only Group				
Male Female Total	9 9 18	373.3 ± 97.98 328.9 ± 91.17 351.1 ± 94.61	9 9 18	1666.7 ± 454.75 1128.9 ± 670.46 1397.8± 620.81
Intentions Only Group				
Male Female Total	5 11 16	400.0 ± 113.14 349.1 ± 107.82 365.0 ± 108.44	5 11 16	1556.0 ± 464.84 1850.9 ± 2441.79 1758.8 ± 2013.1
Control Group				
Male Female Total	8 8 16	377.5 ± 104.44 437.5 ± 100.53 407.5 ± 103.76	8 8 16	680.0 ± 298.57 440.0 ± 218.04 560.0 ± 281.33
Treatment Groups Total				
Male Female	31 36	367.7 ± 114.97 371.4 ± 110.53	31 36	1413.5 ± 649.01 1349.4 ± 1544.16
Total	67	369.7 ± 111.76	67	1379.1 ± 1207.05

Appendix 46: Descriptive statistics showing the mean time spent in physical activity weekly among PhD students

Treatment Groups	N	Time spent in physical activity weekly (minutes/week) (mean (SD))			
		Week 1	Week 2	Week 3	Week 4
Education and Intentions Group					
Male Female Total	9 8 17	143.3 ± 29.58 172.5 ± 56.25 157.06 ± 45.24	170.0 ± 30.82 197.5 ± 50.36 182.9 ± 42.24	205.6 ± 32.83 222.5 ± 65.63 213.5 ± 49.99	238.9 ± 39.82 208.8 ± 59.63 224.7 ± 50.88
Education Only Group					
Male Female Total	9 9 18	128.9 ± 28.92 139.4 ± 21.86 134.2 ± 25.45	170.0 ± 26.93 160.0 ± 26.93 165.0 ± 26.62	214.4 ± 33.58 170.6 ± 24.55 192.5 ± 36.39	232.2 ± 28.19 182.8 ± 27.28 207.5± 37.03
Intentions Only Group					
Male Female Total	5 11 16	146.0 ± 24.08 123.6 ± 44.11 130.6 ± 39.58	184.0 ± 21.91 155.0 ± 22.69 164.1 ± 25.77	214.0 ± 23.02 179.5 ± 20.55 190.3 ± 26.36	248.0 ± 19.24 188.6 ± 24.91 207.2 ± 36.33
Control Group					
Male Female Total	8 8 16	111.9 ± 35.25 90.0 ± 23.90 100.9 ± 31.21	132.5 ± 31.05 105.0 ± 20.00 118.8 ± 28.95	165.6 ± 27.70 118.1 ± 29.02 141.9 ± 36.78	189.4 ± 47.39 135.6± 20.60 162.5 ± 44.91
Treatment Groups Total					
Male Female	31 36	131.5 ± 31.71 131.0 ± 47.17	162.6 ± 32.96 154.6 ± 43.48	199.2 ± 33.45 173.2 ± 50.51	225.6 ± 41.33 179.9 ± 42.52
Total	67	131.2 ± 40.46	158.3 ± 38.89	185.2 ± 45.77	201.0 ± 47.58

Appendix 47: Levels of knowledge about physical activity among PhD students (descriptive statistics)

Variables		**Pre-intervention**			**Post-intervention**		
		Male (N=31)	**Female (N=36)**	**All (N=67)**	**Male (N=31)**	**Female (N=36)**	**All (N=67)**
Level 1, N (%)							
	1, Very beneficial	29 (93.5%)	35 (97.2%)	64 (95.5%)	30 (96.8%)	34 (94.4%)	64 (95.5%)
	2, Somewhat beneficial	2 (6.5%)	1 (2.8%)	3 (4.5%)	1 (3.2%)	1 (2.8%)	2 (3.0%)
	3, Neither	-	-	-	-	1 (2.8%)	1 (1.5%)
	4, Not very beneficial	-	-	-	-	-	-
	5, Not beneficial at all	-	-	-	-	-	-
	1, Very harmful	23 (74.2%)	26 (72.2%)	49 (73.1%)	28 (90.3%)	31 (86.1%)	59 (88.1%)
	2, Somewhat harmful	6 (19.4%)	9(25.0%)	15 (22.4%)	3 (9.7%)	4 (11.1%)	7 (10.4%)
	3, Neither	-	-	-	-	1 (2.8%)	1 (1.5%)
	4, Not very harmful	2 (6.4%)	1(2.8%)	3 (4.5%)	-	-	-
	5, Not harmful at all	-	-	-	-	-	-
Level 2, Mean (SD)		11.9 ± 4.63	12.4 ± 5.37	12.2 ± 5.01	16.8 ± 2.70	15.6 ± 3.86	16.1 ± 3.41
Level 3a, N (%)							
	Correct	5 (16.1%)	9 (25.0%)	14 (20.9%)	19 (61.3%)	19 (52.8%)	38 (56.7%)
	Incorrect	26 (83.9%)	27 (75.0%)	53 (79.1)	12 (38.7%)	17 (47.2%)	29 (43.3%)
Level 3b, N (%)							
	Don't know	-	-	-	-	-	-
	Underestimated	6 (19.4%)	2 (5.6%)	8 (11.9%)	4 (12.9%)	5 (13.9%)	9 (13.4%)
	Correct	13 (41.9%)	21 (58.3%)	34 (50.7%)	18 (58.1%)	16 (44.4%)	34 (50.7%)
	overestimated	12 (38.7%)	13 (36.1%)	25 (37.3%)	9 (29.0%)	15 (41.7%)	24 (35.8%)
Level 4 Mean (SD)		2.4 ± 1.35	2.2 ± 1.32	2.3 ± 1.32	1.4 ± 0.89	1.7 ± 1.18	1.5 ± 1.06

Appendix 48: Descriptive statistics showing total physical activity levels and level 2 knowledge among PhD students

Variables	Treatment Groups	Pre-intervention		Post-intervention	
		n	Mean (SD)	n	Mean (SD)
Total physical activity levels (MET-minutes/week)	Education and Intentions Group	17	358.35 ± 137.54	17	1772.9 ± 864.20
	Education Only Group	18	351.1 ± 94.61	18	1397.8 ± 620.81
	Intentions Only Group	16	365.0 ± 108.44	16	1758.8 ± 2013.07
	Control Group	16	407.5 ± 103.76	16	560.0 ± 281.33
	Total	**67**	**369.7 ± 111.76**	**67**	**1379.1 ± 1207.05**
Total Level 2 knowledge	Education and Intentions Group	17	12.0 ± 4.49	17	17.3 ± 3.46
	Education Only Group	18	13.2 ± 4.57	18	17.2 ± 3.81
	Intentions Only Group	16	10.7 ± 6.38	16	15.1 ± 3.12
	Control Group	16	12.8 ± 4.55	16	14.8 ± 2.51
	Total	**67**	**12.2 ± 5.01**	**67**	**16.1 ± 3.41**

Appendix 49: Descriptive statistics showing level 3b knowledge and time spent in physical activity weekly according to treatment groups among PhD students

Treatment groups	Mean level 3b knowledge	n	Time spent in physical activity weekly (minutes/week)			
			Week 1	Week 2	Week 3	Week 4
Education and intentions group						
	Underestimated	3	156.7 ± 35.12	193.3 ± 41.63	203.3 ± 40.41	256.7 ± 25.17
	Correct	7	161.4 ± 24.10	177.1 ± 28.70	234.3 ± 48.94	228.6 ± 56.10
	Overestimated	7	152.9 ± 66.51	184.3 ± 57.11	197.1 ± 53.45	207.1 ± 51.55
	Total	17	157.1 ± 45.24	182.9 ± 42.24	213.5 ± 49.99	224.7 ± 50.88
Education only group						
	Underestimated	2	145.0 ± 7.07	175.0 ± 7.07	172.5 ± 53.03	187.5 ± 3.54
	Correct	9	138.3 ± 20.31	175.6 ± 26.51	194.4 ± 36.44	201.1 ± 41.37
	Overestimated	7	125.7 ± 33.59	148.6 ± 23.40	195.7 ± 36.90	221.4 ± 34.36
	Total	18	134.2 ± 25.45	165.0 ± 26.62	192.5 ± 36.39	207.5 ± 37.03
Intentions only group						
	Underestimated	2	120.0 ± 0.00	155.0 ± 7.07	180.0 ± 14.14	220.0 ± 84.85
	Correct	10	134.0 ± 47.67	169.5 ± 28.33	196.5 ± 26.25	212.5 ± 31.56
	Overestimated	4	127.5 ± 29.86	155.0 ± 25.17	180.0 ± 31.62	187.5 ± 22.17
	Total	16	130.6 ± 39.58	164.1 ± 25.77	190.3 ± 26.36	207.2 ± 36.33
Control group						
	Underestimated	1	130.0	140.0	160.0	190.0
	Correct	8	96.3 ± 29.73	107.5 ± 27.12	129.4 ± 38.03	155.6 ± 45.31
	Overestimated	7	102.1 ± 35.10	128.6 ± 29.68	153.6 ± 35.67	166.4 ± 49.39
	Total	16	100.9 ± 31.21	1118.6 ± 28.95	141.88 ± 36.78	162.5 ± 44.91

Appendix 50: Descriptive statistics showing level 4 knowledge and total physical activity levels according to treatment groups among PhD students

Variables	Treatment Groups	n	Pre-intervention Mean (SD)	Post-intervention Mean (SD)
Total physical activity (MET-minutes/week)				
	Education and Intentions Group	17	358.4 ± 137.54	1772.9 ± 864.20
	Education Only Group	18	351.1 ± 94.61	1397.8 ± 620.81
	Intentions Only Group	16	365.0 ± 108.44	1758.8 ± 2013.07
	Control Group	16	407.5 ± 103.76	560.0 ± 281.33
	Total	67	369.7 ± 111.76	1379.1 ± 1207.05
Level 4 knowledge				
	Education and Intentions Group	17	2.8 ± 1.36	1.8 ± 1.37
	Education Only Group	18	2.0 ± 1.10	1.7 ± 1.16
	Intentions Only Group	16	2.3 ± 1.49	1.4 ± 0.83
	Control Group	16	2.2 ± 1.35	1.4 ± 0.73
	Total	67	2.3 ± 1.33	1.6 ± 1.06

Appendix 51: Descriptive statistics of intentions to engage in physical activity (intentions 1)

Number of times participants intend to engage in physical activity during the next 4 weeks	Pre-intervention (n=67)	Post-intervention (n=67)
	Frequency (n (%))	Frequency (n (%))
2	1 (1.5%)	-
3	3 (4.5%	2 (3,0%)
4	3 (4.5%)	1 (1.5%)
5	4 (6.0%)	3 (4.5%)
6	5 (7.5%)	3 (4.5%)
7	1 (1.5%)	-
8	8 (11.9%)	4 (6.0%)
10	4 (6.0%)	8 (11.9%)
12	11 (16.4%)	14 (20.9%)
13	2 (3.0%)	2 (3.0%)
14	8 (11.9%)	11 (16.4%)
15	3 (4.5%)	4 (6.0%)
16	5 (7.5%)	6 (9.0%)
18	3 (4.5%)	-
20	3 (4.5%)	3 (4.5%)
24	2 (3.0%)	4 (6.0%)
35	1 (1.5%)	1 (1.5%)
48	-	1 (1.5%)

Appendix 52: Descriptive statistics of intentions 1 to engage in physical activity among PhD students

Treatment Groups	n	Pre-intervention Mean (SD)	Post-intervention Mean (SD)
		Intentions 1 (I intend to engage in physical activity_____times during the next 4 weeks)	Intentions 1 (I engaged in physical activity ____ times during the past 4 weeks)
Education and Intentions Group	17	8.5 ± 4.57	11.0 ± 5.29
Education Only Group	18	12.3 ± 6.06	14.1 ± 6.23
Intentions Only Group	16	15.7 ± 6.18	16.4 ± 9.55
Control Group	16	9.9 ± 4.54	11.6 ± 2.61
	67	11.6 ± 5.94	13.3 ± 6.61

Appendix 53: Descriptive statistics of intentions to engage in physical activity (intentions 2 to 4)

Pre-Intervention		Post-intervention	
variables		**Variables**	
	Frequency n (%)		**Frequency n (%)**
Intentions 2 (frequency)			
1-4 5-8 9-12 13-16 17-20 20+	5 (7.5%) 15 (22.4%) 18 (26.9%) 19 (28.4%) 4 (6.0%) 6 (9.0%)	1-4 5-8 9-12 13-16 17-20 20+	2 (3.0%) 9 (13.4%) 23 (34.3%) 24 (35.8%) 3 (4.5%) 6 (9.0%)
Intentions 3 (regularity)			
Rarely Occasionally Sometimes Frequently Usually Everyday	1 (1.5%) 14 (20.9%) 11 (16.4%) 26 (38.8%) 13 (19.4%) 2 (3.0%)	Rarely Occasionally Sometimes Frequently Usually Everyday	1 (1.5%) 12 (17.9%) 12 (17.9%) 30 (44.8%) 11 (16.4%) 1 (1.5%)
Intentions 4 (commitment)			
I do I do not	48 (71.6%) 19 (28.4%)	I did I did not	53 (79.1%) 14 (20.9%)
Intentions 5 (certainty)			
Definitely Very probably Probably Possibly Probably not Definitely not	23 (34.3%) 16 (23.9%) 8 (11.9%) 4 (6.0%) 8 (11.9%) 8 (11.9%)	Definitely Very probably Probably Possibly Probably not Definitely not	31 (46.3%) 12 (17.9%) 10 (14.9%) 3 (4.5%) 7 (10.4%) 4 (6.0%)
Total	**67**		**67**