



Musculoskeletal pain and working practices in the UK early childhood education workforce

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ABSTRACT

This research investigates role demands and musculoskeletal pain (MSP) in UK Early Childhood Education (ECE) workforce (N = 196). Associations between frequency of actions construing higher risk to musculoskeletal health, and MSP, need to take sickness absence and considering changing jobs are considered. Differences between practitioners and leaders are investigated. Evaluation of pain severity, frequency, are gathered, and for the first time in ECE staff, pain duration, onset and bothersomeness. 98 % of participants reported pain associated with carrying out work-related tasks, with lower back the most reported area (89 %). Average onset was reported as > 12 months, average frequency every 7–14 days, and average duration of experience 1–2 weeks. Regression analysis controlling for age, and other demographic factors indicated frequency of exposure to occupational MSK risk predicted pain frequency and pain onset. Greater participant age predicted the duration of pain events. Greater number of years working in ECE predicted a greater number of pain locations (independently of age). Sickness absence was predicted by pain intensity, and frequency of pain caused by carrying out high MSK risk actions (e.g. lifting, stooping, working at low heights, and floor level). Consideration of leaving ECE employment was predicted by pain frequency, bothersomeness, number of locations and perceived need for greater provision of musculoskeletal protective measures. Findings presented here show for the first time the significant burden of pain with chronic characteristics present in UK ECE workforce. Findings highlight the need for ECE workplaces to better protect and promote the physical health of their staff.

1. Introduction

Pain or impairments of the musculoskeletal system (commonly referred to as musculoskeletal disorders (MSDs) (Zhuang et al., 2022)) are the most widespread and burdensome form of impairment globally, with an estimated 1.71 billion people affected (Cieza et al., 2020). While symptoms such as stiffness or reduced mobility are associated with MSDs, they are characterised by the presence of their ‘primary symptom’, musculoskeletal pain (MSP) (National Academies of Sciences, 2020). Chronic MSP can be identified as both a primary condition or as secondary factor of another primary condition, with back pain alone identified as one of largest individual sources of disability and impairment globally (World Health Organisation, 2022) and in the UK (Wang et al., 2020, Institute for Health Metrics and Evaluation (IHME), 2019). In 2021–22 an estimated 7.3 million working days were lost in the UK

alone (Health and Safety Executive, 2022a), and individuals living with MSDs have significant reductions in years of healthy life expectancy (Vos et al., 2020), and increased risk of developing other chronic health conditions such as cancer, cardiovascular disease, and diabetes (Williams et al., 2018).

Evidence suggests that MSD incidence, progression, and recovery is influenced by social support and relationship factors, with findings indicating that greater access to support from a spouse or significant other (usually in the form of a long-term relationship) tends to yield improved outcomes (Kindt et al., 2016, Edwards et al., 2016). Current evidence indicates MSDs to be more common in females compared to males (Wijnhoven, De Vet, and Picavet, 2006), however not all findings are in support of this conclusion (see Erik and Smith 2013 for a review). In the absence of reliable objective tests to indicate MSP presence; diagnosis and assessment relies heavily on the use of self-report

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measures to gather an individual's experiences (Williams and Craig, 2016, Erick & Smith, 2011). While some formal clinical diagnosis processes may seek to incorporate other approaches such as testing or examination (Turk and Melzack, 2011), evidence shows it is still common for conditions to go undiagnosed despite these professional investigations (The Royal Osteoporosis Society, 2021). While some MSP research does opt to use formal diagnosis by a health professional as inclusion criterion (Converso et al., 2018), this approach has the potential to exclude important data from analyses for the reasons outlined, and most research opts for participant self-report measures as the sole form of evaluation. The present study aims to evaluate the nature of musculoskeletal (MSK) health and pain (MSP) in those working the UK early education (ECE) (0–8 years) sector. It will seek to understand potential relationships between working environments, role demands, MSP experiences, work absenteeism and workforce retention in the UK ECE sector.

Approximately 300,000 people are paid to work in early years and childcare positions in England (Department for Education, 2021b). Guidelines describe an optimal and 'enabling' ECE environment as delivering resources and activities to children at their own level in specialised low-height environments, with ECE practitioners facilitating development and progression by providing scaffolded and independent activities and experiences within these settings (Department for Education, 2021a).

Existing evidence demonstrates that certain role demands placed on people working in education are associated with increased risk of developing MSDs; these include lifting heavy loads, prolonged sitting or standing, working in awkward postures, bodily twisting movement, and provision of inappropriate furniture (Grant, Habes, and Tepper, (1995), Pillastrini et al., (2009), Erick and Smith (2011). ECE professionals are required to carry out many of the hazardous actions described above as routine aspects of their role alongside facing unique and additional factors. These include the added demands associated with working in a low-height environment, such as stooping, bending, crouching, kneeling or sitting for prolonged periods, as well as role demands such as, lifting, moving and carrying equipment and/or children, feeding and/or changing children. These tasks are commonly completed by the ECE workforce in the absence of adequate support and/or appropriate furniture (Erick and Smith, 2013). These physical demands are associated with increased risk of MSDs (Gallagher, 2005). Further support for this is provided by the UK HSE, which highlight 'manual-handling' and 'working in awkward/tiring positions' to be two of the most prominent risk factors contributing to MSDs (Health and Safety Executive, 2022b). It is reasonable therefore to conclude, that the role and environmental demands of individuals working in the ECE sector present a high potential risk to MSK health and the development of MSDs.

Increased incidence of MSDs and the demands of certain job roles is well established. The potential risks posed by sectors such as construction or agriculture are widely understood and routinely reported upon (Health and Safety Executive, 2022a). In line with earlier studies (Cheng et al., 2013), use of term 'MSP' in the current report will refer to 'work-related musculoskeletal pain' which is pain that occurs during working hours. Erick and Smith's, 2011 systematic review of MSDs among schoolteachers globally reports high incidence, with sources providing estimates ranging between 39 % and 95 % of their samples reporting some form of MSD. However, despite the equivalency of risk presented, the ECE sector does not attract similar levels of attention or consideration regarding the promotion and protection of physical health in its workforce. This is reflected by the current dearth of research on MSDs/MSP in UK ECE populations. The Labour Force Survey aims to measure and evaluate key factors in specific sectors of employment within the UK, with the most recent survey for the education sector (Health and Safety Executive, 2022b) reporting MSD incidence rate as 0.9 %. However, it must be highlighted that participants completing the survey are only required to report health problems which have caused them to take formal sick leave from work, rather than the actual status of their

physical or mental health (Office of National Statistics, 2022). This failure to include considerations of presenteeism obfuscate the actual nature and quality of physical health in this population.

The UK ECE sector is currently experiencing challenges related to attracting new staff and keeping those who are already there. A report from the Early Years Alliance (2021), highlights present and growing issues regarding recruitment and retention, with up to 84 % of settings reporting difficulties recruiting staff members. Retention of early childhood educators is also a concern, where greater rates of staff departure have been associated with back pain or other MSDs related to work factors (Lallukka et al., 2018). Despite this, a recent UK government report titled "The early years workforce: recruitment, retention, and business planning" (DfE, 2022), did not include considerations of practitioner health, or MSK risk as contributing factors. Similarly, the "Childcare and early years providers survey: 2021", which records and evaluates current UK ECE environments and settings (for example primary classrooms, kindergarten, preschools, private day nurseries, childminders, etc.) and employees (DfE, 2021b), omits practitioner health as a factor. Additionally, in a move that is likely to further increase the physical demand and strain placed on the ECE workforce, recent reports indicate the UK government is currently considering amending staff-child ratio guidelines for ECE settings to increase the number of children that one practitioner can legally supervise (Early Years Alliance, 2022). Changes such as these have the potential to exacerbate challenges in retention/recruitment by increasing demands placed on individual practitioners, thereby reducing the quality of provision provided to children (National Children's Bureau, 2022).

Greater efforts to reduce the threats posed to educators globally have previously been called for (Erick and Smith, 2013), with research showing that evidence-based interventions focused on improving individuals' moving and handling, and raising awareness of potential risk, can yield positive improvement, and reduce risk in the mobility practices of teachers and practitioners (Shuai et al., 2014, Pillastrini et al., 2009). However, Erick and Smith (2014) also note that intervention campaigns focused solely on behaviour change in educators are unlikely to be sufficient to enact the significant positive change required. Evidence infers, these approaches should be implemented in parallel with improvements to the ergonomic design of environments and consideration of specific role demands that have increased risk. Cheng et al., (2016) echo this, reporting that factors such as staff-student ratios, and the provision of enforced break times for staff help reduce musculoskeletal risk in education roles. Even though guidance exists requiring risk assessments for environment and furniture to be carried out in educational settings (Health and Safety Executive, 2011), high numbers of UK practitioners reporting MSDs linked to work-related demands (Taylor, 2011), indicates that these approaches may be ineffective (particularly regarding working safely at low heights, commonly found in ECE environments).

Both quality and quantity of ECE provision are known to be among the most important factors in determining good developmental outcomes for children, and so, failure to address the issues outlined intrinsically includes the potential for significant consequential impacts to children and families using these services. An absence of research in this area currently prevents meaningful progression towards addressing these factors, as well as preventing improvements in protecting the safety and health of ECE staff. Accordingly, this research will determine the prevalence and correlates of MSP in the UK ECE workforce, and will investigate:

1. Prevalence, onset, intensity, frequency, and duration of MSP.
2. Physical role demands on ECE workers and how they relate to MSP.
3. Environmental risks and protective factors and their relation to MSP.
4. Sickness absence related to MSP and workforce retention.
5. Differences between those working in practitioners' roles or in leadership/ management roles.

2. Method

2.1. Sample and procedure

This study was approved by the University of Derby ethics committee (ETH2021-0072). Participants were recruited online via social media and personal-professional networks, as well as via relevant member organisations for people working in the early education sector (in particular, Early Years Alliance with 14,000 members). Data were collected via an online survey hosted on <https://www.qualtrics.com>, with completion taking on average 20 min. The number of items on the survey was dynamic, offering branched options containing follow-up questions when participants answered ‘yes’ to specific items related to their pain experiences (outlined further below).

The survey was accessed 360 times, but on 148 occasions people did not progress to consent. Of the 212 participants who consented, 16 did not complete the survey. The remaining 196 participants completed the survey, with all participants either current, or recently retired ECE workforce working in England or Wales. Sociodemographic characteristics for the study sample can be found in [Table 1](#).

3. Exclusion criterion

Participants were asked to report any formal diagnoses for their reported musculoskeletal pain. In cases where a respondent indicated they did have a diagnosis, their further responses to questions regarding pain encountered while carrying out specific work-related roles were also reviewed. Responses would have been excluded in cases where an

Table 1
Sociodemographic characteristics of sample.

Sex	Count	Days worked per week	Count	%
Female	192	0	1	0.5
Male	3	2	1	0.5
Age		3	13	6.6
Mean (SD)	47.7 (10.6)	3.5	1	0.5
Relationship Status	count %	4	37	18.9
Unmarried	24 12.2	4.5	1	0.5
Married	117 59.7	5	127	64.8
In long term relationship	32 16.3	6	8	4.1
Separated	3 1.5	7	1	0.5
Divorced	17 8.7	Role	count %	
Widowed	3 1.5	Administrator	3	1.5
no response	32 16.3	Assistant	4	2
Is Parent	count %	Practitioner/Teacher	65	33.2
Yes	161 82.1	Manager/Leader	123	62.8
No	35 17.9	Years of Service	count %	
No. of children	count %	1 to 10 years	43	21.8
1	24 12.2	11 to 20 years	63	32.5
2	96 49	21 to 30 years	67	34.2
3	25 12.8	31 to 40 years	17	8.5
4	14 7.1	40 + Years	6	3
5	1 0.5	Practical % of role	count %	
Education Level	count %	0–20 %	21	10.7
GCSE	16 8.2	21–40 %	32	16.3
A-Level	15 7.7	41–60 %	47	23.9
College	53 27	61–80 %	54	27.6
Undergraduate	39 19.9	80–100 %	42	21.5
Postgraduate	73 37.2			
Hours worked	count %			
1 to 10 h	6 3			
11 to 20 h	16 8.1			
21 to 30 h	28 14.2			
31 to 40 h	55 28			
41 to 50 h	70 35.6			
51 to 60 h	17 8.6			
61 to 70 h	3 1.5			

individual reported a formal diagnosis, but no pain carrying out these tasks. There were no instances of this in the sample for the current study.

4. Measures

Participants answered demographic questions on sex, gender, relationship status, number of children, and education level. Other questions in this section included items on frequency of work, years of experience, and proportion of role which was practical in nature (balance between practical child-facing roles, and more desk based administrative duties). Initial drafting and development of questions for the current study was undertaken by the lead author and based on previous research from [Cheng et al. \(2016\)](#). These were then reviewed by and discussed with the other authors, with specialist physiotherapeutic knowledge and input from Lorna Taylor and pain and health psychology expertise from Prof. David Sheffield. These items were then subjected to pilot testing via the authors’ personal networks, allowing final updates to be made.

4.1. MSK pain experiences

To better understand the MSK health of the sample, participants were asked if they had experienced MSK pain in any of 11 different bodily locations (Neck, Shoulder(s), Upper Back, Lower Back, Elbow(s), Hand(s), Wrist(s), Hip(s), Knee(s), Foot/feet, Ankle(s)); if they responded ‘yes’ to any of these areas, they were then presented with four follow-up questions on their pain experiences in that location. Questions about pain intensity, time since initial pain onset, frequency of pain experiences in the specific location, and duration of pain experiences when they occur. All these questions were answered via 5-point Likert scale, except for the final item on duration which was a 6-point scale. Participants were also asked to score the ‘bothersomeness’ of their pain. Bothersomeness has been explored extensively in relation to conditions like sciatica and low back pain, and it is considered a valid measure of pain severity, particularly in the context of their impact on a person’s life ([Parsons et al., 2007](#)).

4.2. Consequences of pain experiences

Participants were asked if actions had taken place as a result of their pain experiences, specifically: if they had sought professional help for their pain (and if so, what the outcomes were); if they had reported it to a manager or leader at their place of work (and if so, what the outcomes were); if MSK pain had caused them to take sick leave from work, and; if MSK pain had made them consider changing jobs.

4.3. Work roles and environment

We also asked about the frequency of working in certain scenarios/environments and carrying out certain roles/actions which pose greater risk to MSK health (e.g. working at low sinks and low tables, sitting on floor and/or low chairs, changing nappies, lifting children, feeding children at mealtimes, moving furniture), these are referred to in the analyses as ‘MSK risk roles/actions’. If participants reported their role to include a specific MSK risk, follow up questions asked if this action ever resulted in pain and if so in what body location.

4.4. MSK protective factors

Finally, participants answered questions about the provision of equipment or information which can act in a protective capacity against potential MSK injury. Specifically, if settings provided; specialist furniture for working safely at low heights, moving and handling training, information about protective devices (e.g., lumbar supports), sufficient break/recovery time. In each of the mentioned examples, participants were also asked if they thought their setting should provide improved

access to the resource or information in question.

4.5. Analytic Approach

Checking of assumptions prior to execution of planned analyses found no concern regarding linearity, multicollinearity, outliers or leverage points in the data. Minor deviations from normality, and/or marginal heteroscedasticity were identified in each of the multiple regression models. In response to this, bootstrapping was applied in all these instances (n = 2000 samples). Also, non-parametric analysis was selected for comparison between groups due to this. All analyses reported here have been conducted using IBM SPSS 28.

Hierarchical multiple regression was used to establish if the predictors (average frequency of MSK risk role activities, and provision of MSK protective factors) significantly predict the composite scores generated from number of pain locations, and mean scores for pain, intensity, onset, frequency, and duration. Models cumulatively corrected for age, number of children, and education level [model 1], and additionally hours per week worked, days per week worked, years of service, and percentage of practical work in role [model 2].

In addition, hierarchical binomial logistic regression is applied to establish if mean frequency of MSK risk role activities, average frequency of pain caused by MSK risk roles, and provision of MSK protective factors predicted either likelihood of taking time off work due to MSK pain or likelihood of considering changing jobs. Models cumulatively corrected for age, number of children, education level [model 1], hours worked per week, days worked per week, years of service, percentage of practical work in role [model 2], and bothersomeness,

number of pain locations, average pain intensity, average time since onset, average pain frequency, and average pain duration [model 3].

Finally, Mann-Whitney U tests were used to evaluate differences between participants identifying as either leaders/managers, or practitioners/teachers on the measures of age, number of children, education level, hours worked per week, days worked per week, years of service, practical percentage of role, pain bothersomeness, number of pain locations, average pain intensity, average pain duration, average time since onset of pain, average pain frequency, average frequency of MSK risk roles, average pain caused by MSK risk roles, provision of MSK protective factors, and perceived need for greater provision of MSK protective factors.

5. Results

5.1. Descriptive Statistics

5.1.1. Pain Experiences

Three participants (1.5 %) in the sample reported having no pain in any of the body locations. Fifty three (27 %) reported between 1–3 locations, ninety-two (47 %) reported between 4–6 locations, thirty-nine (20 %) reported between 7–9 locations and the remaining 4.5 % (nine participants) reported 10 or 11 locations. Total sample N = 198 (see Table 2 for overview). Correlations between differing measures of pain experience were analysed to check for multicollinearity, which was not evident, see Table 3.

Table 2
Mean pain outcomes for all participants.

	count	percentage	Average severity (SD)	Time since onset (SD)	Average frequency (SD)	Average duration (SD)
Lower Back	172	89.1	3.15(0.88)	4.07(1.55)	3.80(1.52)	2.84 (1.87)
Neck	123	63.7	2.54(0.82)	4.14(1.36)	3.46(1.6)	2.24(1.71)
Knee(s)	122	63.2	2.74 (0.96)	4.25(1.31)	3.74(1.48)	2.64(1.93)
Shoulder(s)	114	59.1	2.62(0.85)	3.97(1.53)	3.71(1.50)	2.68(1.81)
Hip(s)	95	49.2	2.83(1.11)	4.16(1.4)	3.61(1.57)	2.67(1.9)
Foot/Feet	89	46.1	2.77 (0.96)	4.40(1.22)	3.88(1.51)	2.93(2.09)
hand(s)	80	41.5	2.34 (0.94)	3.85(1.57)	3.86(1.50)	2.67(2.12)
Upper Back	68	35.2	2.50(0.89)	4.26(1.36)	3.94(1.34)	2.47(1.94)
Wrist(s)	53	27.5	2.38 (0.77)	4.02(1.53)	3.13(1.57)	2.25(1.69)
Ankle(s)	35	18.1	2.43(0.78)	4.23(1.31)	3.89(1.49)	2.34(1.94)
Elbow(s)	33	17.1	2.42 (1.0)	4.12(1.43)	3.24(1.75)	2.30(1.57)

Values in this table represent the aggregate average of responses given on multiple items with responses ranging from 1-lowest to 5 – highest.

Severity.

- 1-Very low Pain
- 2-Mild Pain
- 3-Moderate Pain
- 4-Severe Pain
- 5-Unbearable Pain

Time since onset.

- 1–1 month or less.
- 2-Between 1 and 3 months.
- 3-Between 3 and 6 months.
- 4-Between 6 and 12 month.
- 5-More than 12 months .

Frequency.

- 5-Almost every day.
- 4-About once a week.
- 3-About once every 2 weeks.
- 2-About once a month.
- 1-Every few months.

duration

- 1-up to 48 h.
- 2-up-to 1 week.
- 3-between 1–3 weeks.
- 4-up-to a month.
- 5-up-to 3 months.
- 6-up-to 6 months.

Table 3
Correlations between differing measures of pain.

Spearman's rho	Average time since onset	Average Pain frequency	Average Pain Duration	Average frequency of Role MSK pain	Number of pain locations
Average time since onset	1	0.109	0.016	0.103	0.058
Average Pain frequency	0.109	1	0.264**	0.337**	0.311**
Average Pain Duration	0.016	0.264**	1	0.242**	0.244**
Average frequency of Role MSK pain	0.103	0.337**	0.242**	1	0.528**
Number of pain locations	0.058	0.311**	0.244**	0.528**	1

** Correlation is significant at the 0.01 level (2-tailed).

5.1.2. Pain locations and Experiences

Lower back was the most common pain location reported in 89 % of the sample. Other locations reported in more than 50 % of the sample included neck, knee, and shoulders. Lower back was also identified as having the highest average severity of all locations. However, other

locations were reported as the most frequently occurring on average (upper back), with ankles and feet being among the locations with the longest time since onset and longest pain experience durations, respectively (see Table 2). No significant differences were found for pain experiences between participants who were or were not in a relationship. More than half of the sample indicated they had reported their MSP to a health professional, of these N = 73 (37 %) had received a formal diagnosis. Taking sick leave due to MSP was reported by N = 56 (28 %) participants.

5.2. Regression analysis

5.2.1. Pain experiences

Hierarchical Multiple Regression modelling significantly predicted reported number of individual pain locations; $R^2 = 0.10$ F (9, 178) = 2.239, p = 0.022, adjusted $R^2 = 0.06$, with years of service, and education level as the two significant variables in the model. Duration of pain events was significantly predicted ($R^2 = 0.13$, F (9, 178) = 2.89, p = 0.004 adjusted $R^2 = 0.08$) by age in a separate model. The average frequency of MSK risk roles was a significant predictor of average time since first onset of pain ($R^2 = 0.14$, F (9, 178) = 3.13, p = 0.002; adjusted $R^2 = 0.09$), and pain frequency ($R^2 = 0.14$, F (9, 178) = 3.13, p = 0.002; adjusted $R^2 = 0.09$). The average frequency of MSK risk roles was also the significant predictor, along with education level, of average frequency of pain caused by MSK risk roles ($R^2 = 0.15$, F (9, 178) = 3.41, p = 0.001; adjusted $R^2 = 0.10$), see Table 4 for full details.

Table 4
Hierarchical stepwise multiple regression of individual, working, and role/environmental factors for pain experience outcome measures.

variable	Average time since onset of pain					
	model 1		model 2		model 3	
	B	β	B	β	B	β
(constant)	2.959		3.502		2.702	
Age	0.029*	0.249	0.032*	0.274	0.031*	0.268
No of children	-0.1	-0.087	-0.125	-0.11	-0.119	-0.104
Education level	-0.038	-0.038	-0.003	-0.003	-0.017	-0.017
Hours per week			-0.021*	-0.18	-0.02	-0.17
Days per week			0.026	0.073	0.026	0.074
Years of service			-0.008	-0.061	-0.005	-0.043
Percentage of practical work in role					-0.003	-0.066
Average frequency of MSK role risk activities					0.077	0.052
Provision of MSK protective factors					0.357*	0.14
variable	Average freq. of pain					
	model 1		model 2		model 3	
	B	β	B	β	B	β
(constant)	2.858		3.395		1.179	
Age	0.015	0.139	0.01	0.094	0.023	0.209
No of children	-0.035	-0.033	-0.026	-0.025	0.069	0.064
Education level	-0.006	-0.007	0	0	0.001	0.001
Hours per week			-0.001	-0.009	0.001	0.013
Days per week			-0.087	-0.059	-0.091	-0.062
Years of service			0.005	0.044	0.001	0.008
Percentage of practical work in role					-0.002	-0.053
Average frequency of MSK role risk activities					0.546**	0.392
Provision of MSK protective Factors					0.003	0.001
variable	Average freq. of pain caused by MSK risk roles					
	model 1		model 2		model 3	
	B	β	B	β	B	β
(constant)	2.104		2.653		1.736	
Age	0.01*	0.185	0.006	0.107	0.008	0.162
No of children	-0.088*	-0.173	-0.079	-0.155	-0.045	-0.088
Education level	-0.073*	-0.165	-0.073*	-0.165	-0.076*	-0.172
Hours per week			0.002	0.047	0.004	0.077
Days per week			-0.114	-0.164	-0.122	-0.175
Years of service			0.004	0.07	0.004	0.072
Percentage of practical work in role					0	-0.006
Average frequency of MSK role risk activities					0.165*	0.249
Provision of MSK protective factors					0.11	0.097

5.3. Role differences

Comparisons between participants acting primarily in a leadership or management role were compared to those reporting their primary role as a practitioner or teacher. *Years of service* was significantly higher ($U = 4937, z = 2.65, p = 0.008$) in leaders (median = 22 years) than in practitioners (median = 18 years), as was access to MSK protective measures $U = 2639, z = -3.48, p = 0.001$ (Leader's median = 2.00, Practitioners median = 2.25). In contrast, mean *percentage of role which is practical* was significantly higher ($U = 1582, z = -6.85, p < 0.001$) in practitioners (77 %) (mean rank = 131.66) than for leaders (51 %) (mean rank = 74.86), as was *perceived need for greater MSK protective factors* $U = 2621, z = -3.85, p < 0.001$ (practitioners median = 3.75; leaders median = 3.00). Over the 11 pain locations surveyed, only two were found to be significantly different and moderately strong, with managers more likely to report elbow pain, $\chi^2(2) = 8.08, p = 0.02$, Cramer's $V = 0.18$, and practitioners more likely to report ankle pain, $\chi^2(2) = 6.06, p = 0.05$, Cramer's $V = 0.48$; the association was moderately strong, (Cohen, 1988).

5.4. Time off work and career change

Hierarchical binomial logistic regression significantly predicted the likelihood that a participant needed to take leave from work due to problems caused by factors related to MSK health, $\chi^2(4) = 43.976, p < 0.001$, explaining 29.7 % of the variance (Nagelkerke R^2). 77.1 % of cases were correctly classified; sensitivity and specificity were 91.0 % and 43.6 % respectively and the positive predictive value was 79.6 %

Table 5

Hierarchical stepwise binary logistic regression of individual, working, and role/environmental factors for employment measures.

Variables in the Equation	B	S.E.	Considered Changing job due to MSK health					
			Wald	df	Exp(B)	95 % C.I. for EXP(B)		Sig.
						Lower	Upper	
Age	0.01	0.03	0.13	1	1.01	0.95	1.08	0.72
No of children	-0.05	0.26	0.03	1	0.96	0.57	1.60	0.86
Education level	-0.11	0.19	0.34	1	0.90	0.62	1.29	0.56
Hours per week	0.02	0.03	0.49	1	1.02	0.97	1.07	0.49
Days per week	-0.16	0.32	0.23	1	0.86	0.46	1.61	0.63
Years of service	-0.02	0.03	0.50	1	0.98	0.93	1.04	0.48
Percentage of practical work in role	0.00	0.01	0.23	1	1.00	0.99	1.02	0.63
Bothersomeness	-0.87	0.29	9.24	1	0.42	0.24	0.73	0.002**
Sick leave due to MSK	0.36	0.47	0.60	1	1.43	0.58	3.57	0.44
Number of pain locations	-0.25	0.11	5.06	1	0.78	0.63	0.97	0.024*
Average pain intensity	0.23	0.46	0.25	1	1.26	0.51	3.11	0.62
Average time since onset	-0.09	0.19	0.21	1	0.92	0.63	1.33	0.64
Average Pain frequency	-0.52	0.24	4.55	1	0.60	0.37	0.96	0.03*
Average Pain Duration	-0.08	0.18	0.20	1	0.92	0.64	1.32	0.66
Average frequency of MSK role risk activities	-0.09	0.33	0.07	1	0.92	0.48	1.74	0.80
Average frequency of Role MSK pain	-0.74	0.49	2.31	1	0.48	0.19	1.24	0.13
Provision of MSK protective Factors	0.82	0.55	2.22	1	2.26	0.77	6.59	0.14
Average perceived need for more setting MSK protective factors	-1.04	0.31	11.57	1	0.35	0.20	0.64	0.001**
Constant	10.37	2.98	12.12	1	31958.03			0
Taken sick leave due to MSK health problems								
Age	0.02	0.03	0.64	1	1.02	0.97	1.08	0.42
No of children	-0.03	0.22	0.03	1	0.97	0.63	1.48	0.88
Education level	-0.06	0.16	0.17	1	0.94	0.69	1.27	0.68
Hours per week	-0.01	0.02	0.07	1	0.99	0.95	1.04	0.79
Days per week	-0.08	0.28	0.08	1	0.92	0.53	1.60	0.77
Years of service	-0.03	0.03	1.20	1	0.97	0.93	1.02	0.27
Percentage of practical work in role	0.00	0.01	0.01	1	1.00	0.99	1.02	0.93
Bothersomeness	-0.31	0.24	1.66	1	0.74	0.46	1.17	0.20
Number of pain locations	-0.12	0.10	1.66	1	0.88	0.73	1.07	0.20
Average pain intensity	-0.94	0.43	4.72	1	0.39	0.17	0.91	0.03*
Average time since onset	-0.04	0.17	0.06	1	0.96	0.68	1.35	0.82
Average Pain frequency	0.23	0.21	1.24	1	1.26	0.84	1.88	0.27
Average Pain Duration	-0.08	0.17	0.24	1	0.92	0.67	1.28	0.62
Average frequency of MSK role risk activities	0.86	0.31	7.82	1	2.36	1.29	4.32	0.005**
Average frequency of Role MSK pain	-0.93	0.46	4.13	1	0.39	0.16	0.97	0.04*
Provision of MSK protective factors	-0.48	0.42	1.29	1	0.62	0.27	1.41	0.26
Constant	5.61	2.36	5.67	1	274.07			0.017

and negative predictive value was 66.6 %. Variables significantly contributing to the model were *average pain intensity*, *average frequency of MSK risk roles*, and *average pain caused by MSK risk roles*. The area under the ROC curve was 0.78, 95 % CI [0.71, 0.85], which according to Hosmer et al. (2013), is an excellent level of discrimination.

Further hierarchical binomial logistic regression also significantly predicted the likelihood that a participant had considered changing job due to MSK pain, $\chi^2(4) = 92.47, p < 0.001$. Significant factors in the model were *years of service*, *bothersomeness*, *average pain frequency*; *number of pain locations*, and *mean perceived need for provision of more MSK factors in setting*. The model explained 53.0 % (Nagelkerke R^2) of the variance in the dependent variable and correctly classified 81.4 % of cases. Sensitivity was 67.6 % and specificity was 89.20 %; positive predictive value was 82.94 % and negative predictive value was 77.96 %. The area under the ROC curve was 0.88, 95 % CI [0.83, 0.93], which is an excellent level of discrimination according to Hosmer et al. (2013); see Table 5 for full details.

6. Discussion

This study examined relationships between workplace practices in the UK's early childhood education (ECE) sector and their impact on musculoskeletal health, specifically focusing on pain experiences, work absenteeism due to musculoskeletal issues, and the potential shift of employees to other sectors due to musculoskeletal pain. Differences between participants acting in leadership or management roles, and those working in practitioner roles were also investigated. Data was gathered from a broad range of settings, roles and backgrounds and

provide valuable new insights into the MSK health of people working in this sector and factors associated with differences in MSK outcomes. Almost all (98.5 %) participants reported pain in at least one body location, with 72 % of the sample reporting experiencing pain in at least four locations. In line with previous findings (WHO, 2022a), lower back was the location where most people reported experiencing pain (89 %). Findings reported in the current study provide the first evaluations of pain duration and onset in the ECE workforce, and the first statistical analyses of the relationships between the frequency of exposure to actions associated with MSK risk and pain experiences.

Estimates of MSP prevalence in the current study are amongst the highest found for ECE populations, with earlier investigations reporting a range of values: Pillastrini et al., 2009 (Italy) – Lower Back Pain (LBP) 86 %, Neck, 46 %, Kwon et al., (US) 2021 – 66 % MSD, Ono et al., 2002 (Japan) – 35 % Neck, 17 % arm, Tsuboi et al., 2002 (Japan) – 20 % LBP. Comparison between our findings and those of these studies are appropriate, in all cases these investigations used have self-report questionnaires and have not excluded people with prior injury. A majority of the sample indicated they had reported their MSP to a health professional; however, this had only resulted in a formal diagnosis in around half of cases, evidencing the significant burden of pain that people live with which may be overlooked by official figures and measures. This notion is supported by the comparatively low rate of recorded absence taken due to MSP, with nearly all the sample reporting some form of pain, but only around a quarter saying they had taken time off as a result. As suspected, the earlier value of 0.9 % MSD prevalence for the education sector (ONS, 2022) conceals a large proportion of under-reported strain and presenteeism in the workforce, with the potential to exacerbate and compound problems further (Karanika-Murray & Biron, 2020).

Current findings may indicate a relatively higher role demand and/or lower level of protection for the UK ECE workforce in comparison to international ECE sectors. While Ono et al. (2002) asked participants about lifting children, Grant et al., (1995) described observations of ergonomic activities, and Kwon et al. (2021), asked about general physical effort, no earlier studies of ECE employees have assessed the frequency or nature of specific role or environmental demands on workers. The current study's measurement and statistical evaluation of associations between exposure to MSK risk (frequency of working on the floor, sitting on small chairs) and pain experiences is novel in the literature to date, making comparisons of role or environmental demands with earlier studies in ECE populations unobtainable. The importance of evaluating MSK risk roles when investigating MSP is evidenced by the frequent contributions this variable made in the regression analyses, significantly predicting; average pain onset, average frequency of pain, and the average frequency of pain experienced while carrying out MSK risk roles/actions.

The assessment of pain experiences in the current study is also novel in the field, offering a greater level of definition and detail than has been found in earlier investigations. Whilst Cardoso et al., (2009), and Tsuboi et al., (2002), measured pain frequency, and Pillastrini et al., (2009), assessed pain severity, all other studies have asked purely about the presence or absence of pain in specific bodily locations (e.g. Kwon et al., 2021, Coledam, et al., 2019). The current study is the first to report differences in experiences and nature of pain in different bodily locations, average values for frequency, onset, severity, and duration indicates that the current sample experience mild to moderate pain that occurs weekly, lasts between 1–2 weeks, and first occurred over 12 months ago. Lower back had highest average reported pain severity, upper back pain was most frequently occurring, and pain occurring the feet and ankles found to have the longest time since initial onset and the longest duration of pain event (see Table 2). These findings represent an exceedingly high burden of pain in the UK ECE workforce that could be described as chronic in nature (Katz et al., 2015).

Level of education significantly predicted outcomes for mean frequency of pain caused by MSK risk roles, and number of pain locations.

This finding reflects earlier investigations from Cardoso et al. (2009), who also showed associations between lower levels of education and poorer pain outcomes. It is likely that in these cases, level of education is acting a proxy measurement for socioeconomic status (Janković et al., 2014), and may reflect important differences in earlier life demands or opportunities within the sample. It should however be noted that, with 37 % and 20 % (see Table 1) of the sample reporting either having postgraduate or undergraduate qualification respectively, the overall level of education reported was relatively high for a sector which does not require higher qualifications for many roles. Alongside education level, years of service also significantly contributed to predicting number of pain locations (independently of age or other sociodemographic factors). This reflects earlier findings from Cardoso et al. (2009), Ono et al. (2002), and Coledam, et al. (2019), who also reported that those who have worked longer in the ECE roles reported significantly higher rates of MSD that those with fewer years of service (age of participants is controlled for in these analyses). The implication from these data is that working in ECE roles exacts a cumulative strain on individuals that accrues over time and is associated with a greater degree of MSP that cannot be attributed to the age of participants. Regression analysis did show that age significantly predicted the duration of pain events in the current sample, with older participants experiencing longer pain experiences. This finding is in line with general expectations about MSP that show age is a strong predictor of MSP development across the lifespan (Guido et al., 2020), it was however surprising to the current authors that age did not feature significantly in more of the models. Earlier studies have provided conflicting findings, with some indicating age to be a significant factor associated with MSD prevalence in ECE populations (Cardoso et al., 2009) and others reporting the contrary (Coledam et al., 2019). It seems reasonable to suggest that while age can play a role in MSP, the overshadowing of this relationship in current and previous investigation by factors such as role and working environment is revealing of the relatively greater role these have on MSP in the ECE workplace. The varied nature of pain experiences outlined here indicate a need for future studies to take a more discrete approach to understanding pain in different bodily locations.

An individual's need to take leave from work due to MSP was significantly predicted by average pain intensity, average frequency of MSK risk roles, and average pain caused by MSK risk roles. We see again here that it is not merely the presence or absence of pain that it important for understanding the relationship between MSP and wider employment outcomes. Instead, understanding nuanced changes in the way pain is experienced and the demands that are placed on individuals enable greater insight into how these factors adjust the needs or decisions of ECE workforce. The likelihood that a participant had considered changing job due to MSP was significantly predicted by a selection of factors including years of service, bothersomeness of pain, average pain frequency, number of pain locations, and higher perceived need for provision of MSK protective. Years of service and painful experiences are perhaps understandable push factors and are supported by earlier findings which evidence this relationship in multiple employment sectors (Lallukka et al., 2018). Perceived need for greater protection is a less expected finding and suggests that individuals working in the ECE who feel themselves under supported with respect to MSK risk are more motivated to leave by this perception. It was notable that perceptions of need were significantly greater in practitioners compared to leader/managers, and further to this that leaders/managers reported being significantly more aware of protection measures that were already present. Thus, the needs identified by practitioners may not be being adequately addressed by leaders and managers. This may be due to several factors including; leaders consider these needs have been addressed, practitioners not being aware of resources addressing these needs, organisational structures or work roles inhibiting awareness of the use of resources (cf. Coledam et al., 2019).

With the ECE sector already facing significant challenges related to recruitment and retention (Bonetti, 2019), the current findings show

MSP and provision of protective factors can significantly predict sickness absence and considering leaving ECE; this reflects previous findings showing MSK health to be a strong predictor of the length of employment in the ECE sector (Coledam, et al., 2019). While there were no significant differences between leaders and practitioners regarding the reported frequency with which they had to carry out MSK risk related activities, at 77 % vs. 51 % respectively, unsurprisingly the average total percentage of practical work of practitioners was significantly higher than leaders. However, findings also showed leaders to have significantly more years of service, a factor associated with greater number of pain locations, and tendency to consider leaving the sector. Leaders reported more elbow pain and less ankle pain than practitioners which may reflect differences in desk based and floor-level working. However, no other significant differences between reported pain locations were found, despite differences between the groups on proportion of practical work in their role, provision of and/or perceived need for MSK protective factors, and years of service.

When considering the findings of the current study, there are a number of limitations and factors which should be taken into context. The significant absence of male participants in the current study limits these findings to female UK ECE workers, however it should be noted that this imbalance reflects the general composition of the UK ECE workforce (Wilkinson & Warin, 2021), with recent findings indicating the population to be 97 % female (DfE, 2022). While it was the case that recruitment for the current study was inclusive and invited participation from all ECE workers, it is impossible to completely exclude the potential for self-selection bias (Babbie, 2020). While self-selection might suggest a potential for bias, it does not inherently compromise the representativeness of the sample (Fowler, 2009). Our findings, consistent with extant literature on MSK pain prevalence, further validate the integrity and relevance of our results. We acknowledge the limitations inherent in survey research, including potential self-selection bias, and suggest that future studies employ varied recruitment strategies to complement and extend our findings (Johnson & Onwuegbuzie, 2004). While it was valuable to be able to provide contrasts between practitioners and leaders, in some cases it may be too simplistic to separate participants in this way as some (particularly the self-employed) may be acting in both roles concurrently. Also, as it is reasonable to assume that a number of those in the leaders' group were also practitioners in previous years, recruitment of a robust control group would be a desirable improvement. While this was considered for the current study, difficulty in recruiting a large enough sample from the same environments which would not also have a reasonable degree of exposure to the risk factors studied impeded this. In furtherment to the approach taken in the current study, it would be beneficial to supplement the quantitative data presented here with some qualitative data and analysis; this would provide fuller insight into the lived experience of those working in ECE and facing some of the challenges outlined in this study. Future studies in the current area may also seek to include greater consideration of how ergonomic differences may be associated different MSP outcomes. Grant et al. (1995) provides some example of the kinds of details with respect to working height or the weight of children which might affect different outcomes. Related to this, it may also be of value to stratify ECE practitioner by age of children they work with. Findings from Grant et al (1995), and Ono et al (2002), both report higher rates of MSP for practitioners working with the very youngest ECE children (0–2 years) compared to those working with slightly older groups. A greater proportion of working at floor level and need for children to be carried at this age may explain these differences. Finally, while not considered a limitation as such, the decision not to require formal diagnosis of MSP for inclusion (such as is found in Converso et al., 2018) or to exclude people with previous injuries should be noted when considering these findings. Such approaches are likely to exclude a significant portion of the population who live with undiagnosed pain (The Royal Osteoporosis Society, 2021), but are methodological alternatives that future research may consider.

7. Conclusion

This study conducts the first statistical analyses investigating MSP and specific role demands for the ECE workforce, evidencing the significant risks to MSK health faced by this population. It includes the first measures of pain duration and onset, revealing significant amounts of pain with chronic characteristics. The ability to predict sickness absence or consideration of leaving ECE based on these measures and other factors is demonstrated, alongside some key differences between those in leadership and practitioner roles. A greater duration of employment is also associated with a greater number of pain locations. The improved understanding and insight provided by these findings is an important first step in moving towards safer and healthier working practices and reducing the risks faced by individuals working in ECE. To have a reasonable chance of effecting change, interventions and measures need to be multipronged, combining behavioural, environmental/ergonomic, and role-related actions to meaningfully reduce MSK risk, as noted by Erick and Smith (2014) and Cheng et al. (2016). The provision of appropriate environmental and behavioural interventions has already been established to be effective in reducing incidence and risk (Shuai et al., 2014, Pillastrini et al., 2009). However, in the present study no significant relationship was found between greater provision of MSK protective measures and improved outcomes, this may be due to lack of awareness by practitioners, and/or insufficient provision by leaders. Future investigation should aim to understand what type or combination and level of intervention might be effective in achieving these aims. Improvements in the protection and promotion of physical health and workplace safety in the ECE sector will not only serve to improve the quality of professional and personal lives of the workforce, but also enable a higher quality of care and education to be delivered to children in addition to helping address the significant staffing challenges faced by this sector.

CRedit authorship contribution statement

Alistair J. Turvill: Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **David Sheffield:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Formal analysis, Conceptualization. **Lorna Taylor:** Writing – review & editing, Resources, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Glossary of Abbreviations

- DfE:** Department for Education. The Department for Education is responsible for children's services and education, including early years, schools, higher and further education policy, apprenticeships and wider skills in England. DfE is a ministerial department of the Government of the UK
- ECE:** Early Childhood Education. Early childhood education (ECE) includes the formative years of teaching children (formally and informally) from birth up to the age of eight.
- MSD(s):** Musculoskeletal disorder(s). Musculoskeletal disorders affect joints, bones, muscles, tendons, ligaments and sometimes associated tissues such as nerves. MSDs can range from minor injuries to long-term conditions, leading to limitations in functioning and participation. They can develop quickly or build up over time. Workers can have different kinds of MSDs at the same time.
- MSK health:** Musculoskeletal health. Musculoskeletal health refers to the performance of the locomotor system, comprising efficient use of muscles, bones, joints and adjacent connective tissues. Musculoskeletal health is important across the life course – from childhood to older age.
- MSK risks:** Musculoskeletal risk. MSK risk factors causing Musculoskeletal disorders are present in many workplaces. They include physical actions: bending, crouching or stooping, lifting heavy loads. Poorly designed working environments and/or work organisation, a recent or existing injury and/or health condition and certain groups of workers are also at increased risk of MSDs (for example young people, disabled workers, pregnant/returning from pregnancy and those new to job role. Stress and other psychosocial factors can also be contributory MSK risk factors.
- MSP:** Musculoskeletal Pain. Musculoskeletal pain affects the joints, bones, muscles, tendons, ligaments and sometimes associated tissues. It is the primary symptom of musculoskeletal disorders and can be felt in one localised body part or the entire body. Musculoskeletal pain can be mild or severe, sudden (acute) or long term (chronic). It often affects people's ability to work, socialise and exercise.

WHO: World Health Organisation
IMHE: Institute for Health Metrics and Evaluation
HSE: Health and Safety Executive
UK: United Kingdom

ONS: Office for National Statistics
Prof.: Professor
IBM SPSS 28: International Business Machines Statistical Package for the Social Sciences
ROC: Receiver operating characteristic curve