Breast Cancer Understanding among University Students: A Rapid Review of Cross-Country Comparisons

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ARTICLE INFO

ABSTRACT

Background: In alignment with the World Health Organization's Global Breast Cancer Initiative objectives, this rapid review sought to determine the extent to which breast cancer understanding is being researched globally in undergraduate student populations, and review recent findings, to inform policy makers and practitioners on the baseline level of student understanding by world region.

Methods: Four academic databases were searched, and 114 studies meeting the search criteria were assessed based upon Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines and comprehensiveness of coverage for the factors of interest. Finally, 33 were selected as representing quality research from all world regions producing recent research of this topic. Their findings were narratively synthesized.

Results: The majority of recent research emanates from regions with accelerating breast cancer mortality rates, corresponding with lower economic resources, primarily within Africa and Asia. Most focus on breast cancer understanding in female participants, with little data available for males or minority gender groups. Disparity between medical and non-medical students' breast cancer understanding is widely reported, though breast cancer understanding is found to be inadequate for most students. Interventions to improve breast cancer understanding indicate promising results, though a lack of standardized measures, together with inadequate reporting of effect sizes, makes meta-analysis of prevailing data challenging.

Conclusion: Evidence suggests undergraduate students' breast cancer understanding globally is inadequate, showing the necessity of increased rigor in research design and reporting to facilitate reliable knowledge generation. Systematic reviews are recommended to widen the scope and depth of this rapid review in support of WHO targets.

INTRODUCTION

Worldwide Breast Cancer (BC) has become the leading cause of Cancer[1] and accounted for 2.3 million cases in 2021.[2] It is estimated that this figure will reach 11 million by 2030.[3] To address this major disease burden, the World Health Organization (WHO) launched The Global Breast Cancer Initiative in 2021, with health promotion for early detection prioritised.[4] Higher rates of survival and recovery

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have been associated with timely diagnosis and treatment[5], facilitated through BC understanding. This understanding is here conceptualized as BC awareness (BCA), which includes general awareness of the prevalence of the disease, and BC knowledge, including scientifically informed knowledge of heritable and environmental BC risk factors, symptoms, prevention through lifestyle choices and clinical screening, plus treatment options. Further, breast self-examination (BSE), although of limited efficacy at lowering BC mortality[6,7], is the primary screening technique for signs of BC and supports early detection in many economically developing countries.[8] A recent systematic review of the literature found that BC awareness and screening knowledge in women are lower in developing countries and further interventions are needed.[9] However, since BC understanding is expected to necessitate different types of focus across different age groups, it is important to gain insight into different age cohorts to adequately assess progress towards WHO targets. It is the objective of the present study to review recent findings to determine the extent to which BC understanding is being researched throughout the world in undergraduate student populations. Findings will inform policy makers and practitioners on the baseline level of student BC understanding by world region. Additionally, insights from this review will help progress BC understanding toward WHO targets, informing public health interventions well-targeted for this under-researched population in this area.

Undergraduate student populations are at lower risk of BC given average age,[10] so they are not commonly advised to attend clinical screening. However, they represent an important target for BC understanding, since their high lifetime risk can be effectively reduced through knowledge of risk factors[11,12], plus the advantage early detection through awareness of screening at an appropriate age can provide.[4] In addition, world regions have varying ages of BC diagnosis, with averages in some regions, such as Western Asia, up to ten years earlier than others[13], placing some undergraduate students at greater risk depending on location. Students' BC understanding has previously been shown to be very poor and variable by geographical region.[14,15] As the first cohort to benefit from the WHO's Global Breast Cancer Initiative, it is crucial to determine the baseline of prevailing BC understanding and behaviors in this population globally at this timepoint. By reviewing contemporary evidence of BC understanding in the undergraduate student population globally this study aims to provide much needed insight into the prevalence of recent research in this area for this well-defined population and provide baseline data to inform future assessment of

Global Breast Cancer Initiative progress. The present review additionally aims to document whether sex and course of study differences are reported in BC understanding, since these may highlight important areas for future research and intervention, and assess prevailing measures in use to determine BC understanding, to provide initial indication of the possibility of meta-analysis.

Summary of Research Aims

Existing reviews addressing some aspects of these research aims are either based upon data that is out of date considering recent dramatic societal changes, such as the fourth industrial revolution, and advances in knowledge of genetic risk for BC[14], focused exclusively on particular regions such as Asia, Africa and the Americas[15], or exclusively focused on female populations and not limited to undergraduate students.[9,16] In summary, the aims in the current study are not answered by existing reviews, and can be stated as four novel research questions with regard to BC understanding of undergraduate students:

1. In what regions are these factors being actively researched, with peer-reviewed findings published within the previous five years, and what might be contributing to between region differences?
2. To what extent are sex or gender differences reported?
3. How is inclusion of medical and non-medical students represented and what are the possible differences in findings between these groups?
4. Do the measures being used to assess these factors facilitate effective meta-analysis?

In answering these research questions, transferrable evidence-based good practices identified can inform future research, policy and interventions.

METHODS

To address the research questions in a timely manner, demanded by the need to baseline prevailing undergraduate student BC understanding and behavior, a rapid review methodology was chosen. Rapid review follows systematic review procedures omitting those criteria deemed appropriate to the research aims based upon time constraints and resources.[17] The research team, which included specialists in the fields of oncology, breast health behavior, and student wellbeing, formulated a rapid review protocol in accordance with prevailing Cochrane rapid review guidance[17] to answer the research questions. The protocol informed each step of the review process. Searches took place on September 10, 2022. Following Cochrane recommendations for rapid review[17] databases included in the search were Embase and MEDLINE to encompass the specialist health literature,

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PsycINFO to extend search to social science findings and Google Scholar to capture remaining studies from heterogenous academic disciplines. To account for synonymous terms[18], identified through a preliminary scoping exercise, iterations of the search included the terms 'breast cancer awareness students', 'breast cancer understanding students', 'breast cancer knowledge students', 'breast cancer awareness student', 'breast cancer understanding student', and 'breast cancer knowledge student'. Results were manually screened for duplicates and eligibility based on the study protocol, informed by Cochrane rapid review constraints:[17] full-text peer-reviewed English articles, published between January 1st 2017 and September 10th 2022, quantitatively investigating university students' BC understanding, BSE knowledge and behaviors, and BC screening attendance, were included. Screening details are reported in Figure 1.

To provide a representative sample of the full breadth of research in this area whilst ensuring coverage of all global regions returned in the search, the resultant set of studies (n=114) were assessed for quality based on Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines[19] and comprehensiveness of coverage for the factors of interest based on the research questions. All searching and screening underwent peer-review by the research team. Data extraction and quality assessment were assessed for inter-rater reliability between two researchers based upon a sample prior to commencing extraction and assessment against the entire set of studies included in the review. [20] The resultant 33 studies selected for narrative synthesis are detailed in Appendix A Table 1.
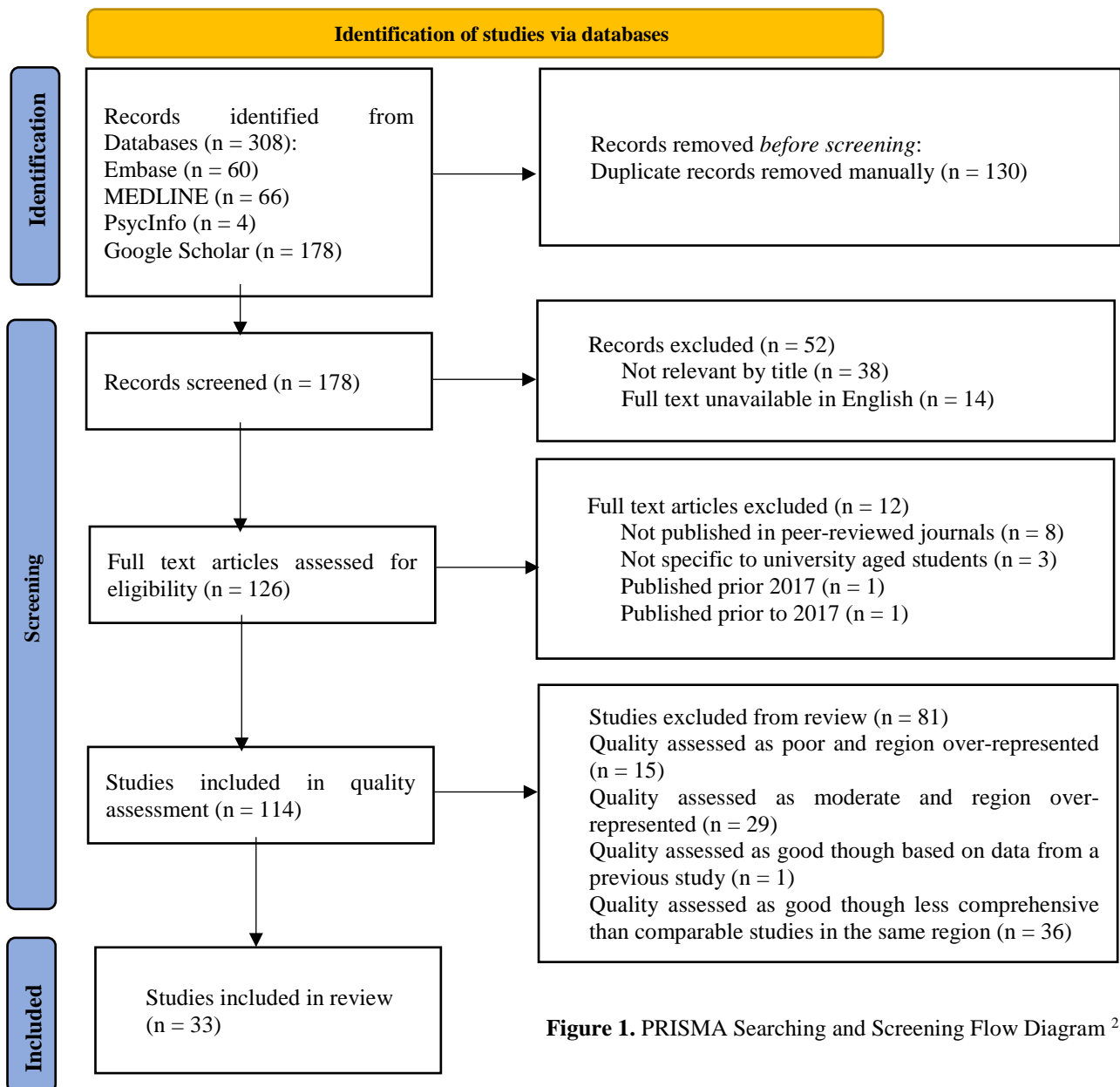

Figure 1. PRISMA Searching and Screening Flow Diagram [21]

RESULTS

Regions Actively Generating Research of Students' BC Understanding

The identified articles in Appendix A Table 1 present the regions generating empirical breast cancer research since 2017, originating from Western Asia (n=6), Eastern Asia (n=5), Southern Asia (n=5), South-Eastern Asia (n=5), Eastern Europe (n=3), South America (n=2), Northern Africa (n=2), Eastern Africa (n=1), Middle Africa (n=1), Northern America (n=1), Western Africa (n=1), and a multi-national collaboration (n=1) in which Turkish students demonstrated more BC understanding than Polish students. [22]

Of the 33 selected articles, there were 27 descriptive cross-sectional studies, characterizing the prevalence of breast cancer awareness, five quasi-experimental interventions estimating the causal impact of specific breast cancer interventions, and one BCA scale development study. [23] All of the studies explored breast cancer awareness and knowledge, 30 studies addressed BSE, and 6 studies focused on attitudes towards breast cancer awareness. Only two studies, each from Eastern Europe, reported BC screening attendance. Kryvoviaz et al.[24] reported 46.3% of female participants as regularly visiting a gynecologist and in Zuzak et al.[25] 69.01% of female participants reported having attended their first gynecologist visit.

Sample sizes of 100-800 were typical of the selected studies, yet three had above 1000 participants. [26-28] Studies cited average ages between 18 years and 24 years, with samples ranging from 17 years to 37 years.

Sex and Gender Representation in Recent Research of Student BC Understanding

The majority of the studies (n=21) included women only. There were only nine studies which included both women and men and three studies which included only men. There were no studies which recorded a wider spectrum of gender. In nine studies, which included men and women, the largest gender group were all reported as female. Moreover, seven of these did not make comparisons of BC knowledge between gendered groups. One study excluded questions from male participants in their data collection tool such as whether they had performed BSE.[25] The remaining three studies did make gender comparisons, but two reported no significant difference in BC knowledge.[29,30] Salim et al.[31] did report a significant difference in total knowledge of BC prevalence and detection, with females more knowledgeable. However, knowledge about tools for BC detection also showed no significant differences between sexes. Two of the three studies which included only male participants focused on BC in males only. Faria et al.[32] compared their knowledge to wider data which did not identify a significant difference. However, their study sample did report a lack of knowledge of BSE (69%) and BC signs and symptoms (77%) whereas Saritas et al.[33] reported a higher awareness of BC (83%) in their male sample. The remaining study, which only included men, reported poor knowledge of BC in women and worryingly it reported over half its sample believed BC was contagious (54%).[34]

Medical and Non-medical Discipline Representation in Recent Research of Students' BC Understanding

The university courses varied throughout the 33 identified articles and focused on a variety of medical and non-medical students. Nine articles included both medical and non-medical students and used cross-sectional studies to investigate BC. The consensus within seven of the articles was that there was greater knowledge about BC among the medical students compared to the non-medical students.[25,27,29,34-37] However, low rates of BSE were reported for both medical and non-medical students, with no significant difference between the groups for performing examinations.[27,29] Additionally, studies in Western Asia reported all the students had an overall weak to poor knowledge of the topic area.[31,38]

Seventeen of the identified articles investigated either medical or non-medical students. Twelve articles investigated medical students' knowledge, understanding and awareness of BC. There was a high (98%[39], 95%[24], 67.58%[40]) to low (22.5%[41]) spectrum of knowledge, awareness and understanding reported among the medical students.[42-45] Despite the reported range of BC knowledge, further studies found low BSE rates (83.7% not practicing BSE[33]) or incorrectly practicing breast self-examinations, for example, lack of frequency and appropriate time to practice (71.5%[41]) among the medical students. Two additional studies conducted effective interventions that increased BC knowledge among African (t=29.047, P=0.000)[46] and Southeastern Asian (92% improved BC knowledge)[47] medical students. Five of the articles focused on non-medical university students, the studies reported that more BC understanding was needed[26,48-50]). Four articles included interventions for non-medical students and all studies reported an increase in knowledge and awareness after the interventions.[51-54]

Measures in Use to Determine Student BC Understanding, BSE and BC Screening Attendance

Of the 33 studies selected for comprehensive coverage of the factors associated with the research

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aims, including quantitative measures of BCA, BSE and BC screening, all incorporated some measure of BCA. Standardized measures employed were the Breast Cancer Awareness Measure (BCAM)[55] (n=2), translated versions of BCAM (n=2), Champion's Health Belief Model Scale versions[56] (n=2), and the American College of Obstetricians and Gynecologists Updated Clinical Management Guidelines (n=1). The remainder of the studies employed novel scales, with only 13 reporting scale reliability and / or validity properties. Of the novel scales for which psychometric properties were reported, only five reported coefficients for the individual scales, with the remainder reporting coefficients for the aggregated scales. Cronbach's alpha for the novel scales ranged between 0.53 and 0.89. The majority, 30, included measures of BSE knowledge and 20 included measures of BSE practice, though not all reported on BSE practice levels. The two studies measuring BC screening attendance used single item non-standardized questionnaire items. The majority of studies did not report the outcome effect size.

DISCUSSION

Following search of four databases, of 114 studies meeting the search criteria 33 were selected as representing quality research from all world regions producing recent BC understanding research. Their findings were narratively synthesized. Results indicated the majority of recent research emanates primarily from Africa and Asia. The majority of studies focused on BC understanding in female participants, with little data available for males or minority gender groups. Disparity between medical and non-medical student breast cancer understanding was widely reported, though BC understanding was found to be inadequate for most students. Interventions to improve BC understanding indicated promising results. Different standardized measures were used in seven studies and the remainder deployed novel scales, not always reporting psychometric properties. Effect sizes were not reported for the majority of studies. These findings will now be discussed.

Addressing the first research question, research into BC understanding in students globally demonstrates correspondence between regions actively researching BC understanding with regional increase in BC mortality.[2] A significant proportion of nearly 24% of all BC cases occurs in regions of Asia, with the highest rates seen in China, Japan, and Indonesia, despite lower screening rates in these regions than those with the highest incidence, such as Europe and North America.[57] Similarly, accelerating BC rates, including high mortality to incidence ratio, are prevalent in the African and South Asian regions

producing recent BC understanding research.[2] Although economically developed countries have demonstrated consistently higher estimated BC incidence compared to developing countries over the last five years[2,58], in low- and middle-income countries, the mortality rates are rising due to a lack of screening and treatment resources.[59] These circumstances indicate why such regions may be producing recent empirical BC research and promoting BSE for this age group. Although BC mortality rates are falling in regions for which there is no active research into BC understanding, such as Northern and Western Europe, BC disease burden remains significant and a leading cause of female mortality in these regions[2], indicating the requirement for renewed research investment in BC understanding in these regions to accord with the WHO Global Breast Cancer Initiative.

In relation to BC understanding across genders, the majority of evidence does not consider comparing or measuring BC understanding of men, reflecting a trend in the general BC understanding literature, e.g. Anastasi & Lusher[11], Peacey et al.[14], Wang et al.[9], and older assessments of student BC understanding.[15] Only three studies of the total 33 made such comparisons[29-31] and findings are mixed, preventing meaningful interpretation. Whilst female sex is the strongest BC risk factor with approximately 0.5-1% of the total diagnosed occurring in men[60], it does present risk of male mortality[61], and it is still crucial to examine men's understanding of BC in women. This is because women diagnosed with BC also impact on the mental health and wellbeing of men, as family members and partners.[62,63] Additionally, a husband's BC knowledge has been identified as a significant factor to their wives' practices and attitudes towards BC.[64] Therefore, increasing men's knowledge of BC will, in turn, promote health preventative behaviors in women. It is also crucial for both women and men to have knowledge of male BC diagnosis. This is because culturally it is seen as a woman's disease and stigmatization in male BC patients is high.[65] The findings have also highlighted that research considering the needs of wider gender identities is insufficient. Trans women are also at an increased risk of BC during hormone treatment and therefore it is important for research to be inclusive of minority gender groups to ensure any resulting recommendations meet all gender needs.[66]

The findings suggest the medical students and non-medical students' knowledge, awareness and self-examination rates ranged from low to high. However, the non-medical students displayed less knowledge and awareness than the medical students; furthermore, a portion of the students had never heard of BC or BSE. Medical students are taught about

Cancer (and BC) and the associated risk factors within the course and curriculum [67], but non-medical students may not have any direct education about the topic. The interventions suggested that they were effective in increasing the knowledge and awareness of BC and would be a benefit to medical and non-medical students. Interventions to enhance students' BSE practice have preliminary support in regions for which BSE is recommended for this population.

Lastly, an assessment of BC understanding remains to be developed. The use of validated reliable psychometric scales is essential in ascertaining the levels of cancer awareness.[68] One established scale is the BCAM validated by Linsell *et al.*[55] Originally, this scale was considered reliable to evaluate BC understanding among UK women. Since its development, BCAM has been tested for its validity and reliability among different populations.[69-73] More recently, the African Women Awareness of CANcer (AWACAN) tool was developed[74], but the BCAM has been used more commonly across the globe including Africa. BCAM consists of eight questions with a total of 31 items assessing awareness and knowledge of BC risk factors, symptoms, BSE and clinical screening options. Indeed, the presence of one established scale helps researchers and practitioners to determine which tool to employ to assess the awareness of BC in their target population. However, the risk is if the scale does not fit or is unsure to fit to a context, the researchers and practitioners have no other way to assess. Moreover, as seen in mental health research[75,76], people's awareness can change over time. Developing a timely scale or updating an already-developed scale is important. However, to date, an investigation on tools to assess BC understanding remains to be conducted.

Lack of inclusion of BC screening attendance data to measure behavior in all but two studies may reflect regional and national differences in public health policy. For many regions, consensus exists that female BC screening should not commence until the 50th year of life, and thus it is outside the range of participants reported in the studies reviewed.

Limitations

Several limitations must be noted that may affect the generalizability of this review. English language articles only were chosen due to the standardization of English as the primary language scientific journals favor, but inclusion of articles available in all languages would broaden the evidence base. Risk of methodological and researcher bias was controlled as far as practicable but limitations of rapid review methodology may have influenced study selection. Therefore, it is an important recommendation of this review that future systematic reviews build upon the evidence presented here to deepen the knowledge in this area to best promote the reduction of BC mortality.

CONCLUSION

This review undertook a search of the literature in order to answer four research questions regarding BC understanding among student populations worldwide. It was found that research is almost exclusively being generated in economically developing world regions in which BC incidence is increasing and for which BC mortality is high. Prevailing evidence includes predominantly female samples though a good representation of medical and non-medical students. Although standardized instruments exist to measure BCA and BSE, they are seldom used in the regions generating research output in this area. In all these regions recent evidence suggests BC understanding is inadequate. Interventions to improve BCA and BSE indicate promising results and highlight the necessity of increased rigor in design and reporting to facilitate reliable knowledge generation.

Since the incidence of BC is rising globally, the lack of recent empirical studies into critical factors of risk reduction for student populations in economically developed nations is worrying. Although BC mortality rates are lower in these regions than those seen to be producing recent relevant output, there is still a compelling case for more knowledge to be created to ascertain the effectiveness of their public health campaigns, answering the WHO's Global Breast Cancer Initiative recommendations.

In regions for which incidence is increasing most rapidly, there are a wealth of descriptive studies, consistently finding low BC understanding, indicating well-designed RCT intervention studies are now required to determine effective means of improving BC understanding for all student groups, in a contextually appropriate manner depending on region.

When investigating BC knowledge, further research is needed to understand the needs of all gender groups irrespective of BC diagnosed in men or women. This will ensure all needs are understood in terms of the promotion of health preventative behaviors and shared recommendations for wider families and communities.

The low level of detail of scale properties and outcome effect sizes in the majority of studies reviewed challenges the possibility of reliable meta-analysis of extant findings. To accurately gauge BCA, BSE practice, and efficacy of interventions, more rigorous reporting is recommended, including the development and adoption of culturally sensitive standardized measures.

To address the limitations of rapid review, further systematic reviews are recommended to provide comprehensive coverage of the literature in support of WHO targets.

REFERENCES
1. Moslemi M, Moradi Y, Dehghanbanadaki H, Afkhami H, Khaledi M, Sedighimehr N, et al. The association between ATM variants and risk of breast cancer: a systematic review and meta-analysis. *BMC Cancer*. 2021;21(1):27. doi: 10.1186/s12885-020-07749-6.
2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin*. 2021;71(3):209-49. doi: 10.3322/caac.21660.
3. Benson JR, Jatoi I. The global breast cancer burden. *Future Oncol*. 2012;8(6):697-702. doi: 10.2217/fon.12.61.
4. World Health Organization. The Global Breast Cancer Initiative (GBCI): World Health Organization; 2022. Available from: https://www.who.int/publications/m/item/the-global-breast-cancer-initiative-gbci.
5. Ginsburg O, Rositch AF, Conteh L, Mutebi M, Paskett ED, Subramanian S. Breast Cancer Disparities Among Women in Low- and Middle-Income Countries. *Current Breast Cancer Reports*. 2018;10(3):179-86. doi: 10.1007/s12609-018-0286-7.
6. Hackshaw AK, Paul EA. Breast self-examination and death from breast cancer: a meta-analysis. *Br J Cancer*. 2003;88(7):1047-53. doi: 10.1038/sj.bjc.6600847.
7. Weiss NS. Breast Cancer Mortality in Relation to Clinical Breast Examination and Breast Self-Examination. *The Breast Journal*. 2003;9(s2):S86-S9. doi: 10.1046/j.1524-4741.9.s2.9.x.
8. Albeshan SM, Hossain SZ, Mackey MG, Brennan PC. Can Breast Self-examination and Clinical Breast Examination Along With Increasing Breast Awareness Facilitate Earlier Detection of Breast Cancer in Populations With Advanced Stages at Diagnosis? *Clinical Breast Cancer*. 2020;20(3):194-200. doi: 10.1016/j.clbc.2020.02.001.
9. Wang YJ, Wang F, Yu LX, Xiang YJ, Zhou F, Huang SY, et al. Worldwide review with meta-analysis of women's awareness about breast cancer. *Patient Education and Counseling*. 2022;105(7):1818-27. doi: 10.1016/j.pec.2021.12.012.
10. Hosseini MS, Arab M, Nemati Honar B, Noghabaei G, Safaei N, Ghasemi T, et al. Age - specific incidence rate change at breast Cancer and its different histopathologic subtypes in Iran and Western countries. *Pak J Med Sci*. 2013;29(6):1354-7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3905388/
11. Anastasi N, Lusher J. The impact of breast cancer awareness interventions on breast screening uptake among women in the United Kingdom: A systematic review. *Journal of Health Psychology*. 2019;24(1):113-24. doi: 10.1177/1359105317697812.
12. Britt KL, Cuzick J, Phillips K-A. Key steps for effective breast cancer prevention. *Nature Reviews Cancer*. 2020;20(8):417-36. doi: 10.1038/s41568-020-0266-x.
13. Naja F, Nasreddine L, Awada S, El Sayed Ahmad R, Hwalla N. Nutrition in the Prevention of Breast Cancer: A Middle Eastern Perspective. *Frontiers in Public Health*. 2019;7. doi: 10.3389/fpubh.2019.00316.
14. Peacey V, Steptoe A, Davídsdóttir S, Baban A, Wardle J. Low levels of breast cancer risk awareness in young women: An international survey. *European Journal of Cancer*. 2006;42(15):2585-9. doi: 10.1016/j.ejca.2006.03.017.
15. Peltzer K, Pengpid S. Awareness of breast cancer risk among female university students from 24 low, middle income and emerging economy countries. *Asian Pac J Cancer Prev*. 2014;15(18):7875-8. doi: 10.7314/apjcp.2014.15.18.7875.
16. Almutairi AH, Tamrin SBBM, Wirza R, Ahmad NB. Systematic Review on Knowledge and Awareness of Breast Cancer and Risk Factors Among Young Women. *Advances in Bioscience and Clinical Medicine*. 2019;7(1):7. doi: 10.7575/aiac.abcmed.v.7n.1p.41.
17. Garritty C, Gartlehner G, Nussbaumer-Streit B, King VJ, Hamel C, Kamel C, et al. Cochrane Rapid Reviews Methods Group offers evidence-informed guidance to conduct rapid reviews. *J Clin Epidemiol*. 2021;130:13-22. doi: 10.1016/j.jclinepi.2020.10.007.
18. Kotera Y, Lyons M, Vione KC, Norton B. Effect of Nature Walks on Depression and Anxiety: A Systematic Review. *Sustainability*. 2021;13(7):4015. doi: 10.3390/su13074015.
19. Elm Ev, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ*. 2007;335(7624):806-8. doi: 10.1136/bmj.39335.541782.AD.
20. Kotera Y, Van Gordon W. Effects of Self-Compassion Training on Work-Related Well-Being: A Systematic

Review. *Frontiers in Psychology*. 2021;12. doi: 10.3389/fpsyg.2021.630798.

21. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi: 10.1136/bmj.n71.

22. Rızalar S, Avcı İ A, Żołądkiewicz P, Altay B, Moraczewska I. University Students' Awareness of Breast and Cervical Cancers: A Comparison of Two Countries and Two Different Cultures. *J Breast Health*. 2017;13(2):77-82. doi: 10.5152/tjbh.2017.3117.

23. Akhtari-Zavare M, Aliyan-Fini F, Ghanbari-Baghestan A, Mohd-Sidik S. Development and Validation of Breast Cancer Knowledge and Beliefs Questionnaire for Malaysian Student Population. *Pertanika Journal of Social Sciences & Humanities*. 2018;26(4). Available from: http://www.pertanika2.upm.edu.my/resources/files/Pertanika%20PAPERS/JSSH%20Vol.%2026%20(4)%20Dec.%202018/23%20JSSH(S)-0899-2018.pdf

24. Kryvoviaz OV, Shcherba IK, Tomashevska YO, Kudria VV. Students' awareness of breast cancer risk factors (results of a sociological study). *Farmatsevtychnyi zhurnal*. 2019;0(6):14-21. doi: 10.32352/10.32352/0367-3057.6.19.02.

25. Zuzak TZ, Hałgas M, Kowalska K, Gospodarczyk M, Wdowiak-Filip A, Filip M, et al. Breast cancer–the level of knowledge about epidemiology and prophylaxis among polish medical universities students. *EJMT*. 2018;1:18. Available from: http://ww.medical-technologies.eu/upload/6_breast_cancer-_zuziak.pdf

26. Khraiwesh A, Shakarna A, Solimia S. Knowledge, beliefs and attitudes of female university students in Palestine toward breast cancer and breast self-examination. *Hebron University Research Journal*-A (Natural Sciences)-(مجلة جامعة الخليل للبحوث-أ (العلوم الطبيعيه. 2020;9(1):3. Available from: https://digitalcommons.aaru.edu.jo/hujr_a/vol9/iss1/3

27. Zhang S, Zhu W, Chen B, Tang T, Tao Z, Li X, et al. Relationship between demographic factors, health education, breast cancer-related knowledge, attitudes, and breast self-examination behavior among Chinese female college student: A structural equation analysis. *Journal of Obstetrics and Gynaecology Research*. 2021;47(12):4440-9. doi: 10.1111/jog.15064.

28. Zhang QN, Lu HX. Knowledge, attitude, practice and factors that influence the awareness of college students with regards to breast cancer. *World J Clin Cases*. 2022;10(2):538-46. doi: 10.12998/wjcc.v10.i2.538.

29. Onwusah DO, Eboigbe MU, Arute JE, Mgbahurike AA. Knowledge and Awareness of Breast Cancer among University Students In South-South Nigeria. *Scholars Academic Journal of Pharmacy*. 2017;6(1):4-15. doi: 10.21276/sajp.2017.6.2.

30. Ismail H, Shibani M, Zahrawi HW, Slitin AF, Alzabibi MA, Mohsen F, et al. Knowledge of breast cancer among medical students in Syrian Private University, Syria: a cross-sectional study. *BMC Medical Education*. 2021;21(1):251. doi: 10.1186/s12909-021-02673-0.

31. Salim KS, Al Attar WM, Jassim RA, Abdullaa NT. Knowledge and awareness about breast cancer among male and female students in Al-Bayan University in Iraq. *Annals of Tropical Medicine and Public Health*. 2020;23:23-103. doi: 10.36295/ASRO.2020.23103.

32. Faria EH, Kim D, Sisconetto RM, Cucio VFM, Dos Reis Ferreira PPG, Alves BSR, et al. Analysis of Knowledge About Male Breast Cancer Among Higher Education Male Students. *Eur J Breast Health*. 2021;17(4):333-40. doi: 10.4274/ejbh.galenos.2021.2021-4-6.

33. Saritas S, Aslan Dogan B, Gul E. Knowledge and attitudes of male nursing students towards male breast cancer and breast self-examination: An example from Turkish society. *Annals of Medical Research*. 2021;27(10):2592-8. doi: 10.5455/annalsmedres.2020.06.570.

34. Ghazi HF, Elnajeh M, Azri A, AbdalQader MA, Baobaid MF, Al-abed A-aAA. Knowledge and beliefs on female breast cancer among male students in a private university, Malaysia. *Malaysian Journal of Public Health Medicine*. 2017;17(1):8-13. Available from: https://www.mjphm.org.my/mjphm/index.php?option=com_content&view=article&id=774:knowledge-and-beliefs-on-female-breast-cancer-among-male-students-in-a-private-university-malaysia&catid=113:2017-volume-17-1&Itemid=128

35. Terui-Kohbata H, Egawa M, Yura K, Yoshida M. Knowledge and attitude of hereditary breast cancer among Japanese university female students. *Journal of Human Genetics*. 2020;65(7):591-9. doi: 10.1038/s10038-020-0743-9.

36. Xie T, Sun W, Chen D, Liu N, Wang X, Zhang W. Self-efficacy and its influencing factors of breast cancer screening for female college students in China. *J Obstet Gynaecol Res*. 2019;45(5):1026-34. doi: 10.1111/jog.13931.

37. Raji Lahiji M, Dehdari T, Shokouhi Shoormasti R, Hosseini AF, Navaei M, Zarrati M. Nutrition knowledge, attitudes, and practice towards breast cancer prevention among the female population of Iran University of medical science students. *Nutrition and Cancer*. 2019;71(8):1355-64. doi: 10.1080/01635581.2019.1607410.

38. Balakrishnan P, Kodamanchili SPDR, Kumar AA, Raju K, Gabunia L. Breast Cancer Awareness among Medical Students in Georgia. *International Journal of Progressive Sciences and Technologies*. 2022;33(1):58-73. doi: 10.52155/ijpsat.v33.1.4399.

39. Zainul Azlan N, Azhar AA, Abd. Jalil MA. Knowledge Level on Breast Cancer and Breast Self-Examination (BSE) Practice Among Female University Students. *International journal of care scholars*. 2022;5(2):46-57. doi: 10.31436/ijcs.v5i2.249.

40. Cichomska J, Sak-Dankosky N, Czarkowska-Pączek B. Knowledge of nursing students about breast cancer prevention. *Pielegniarstwo XXI wieku / Nursing in the*

21st Century. 2020;19(2):102-9. doi: 10.2478/pielxxiw-2020-0012.

41. Elzahaf R, Mekraz E, Arhaim S, Almansouri M. Knowledge, attitude, and practice regarding breast cancer among female students at college of medical technology/Derna. *Libyan Journal of Medical Sciences.* 2018;2(4):142-6. doi: 10.4103/ljms.Ljms_21_18.

42. Gebresillassie BM, Gebreyohannes EA, Belachew SA, Emiru YK. Evaluation of Knowledge, Perception, and Risk Awareness About Breast Cancer and Its Treatment Outcome Among University of Gondar Students, Northwest Ethiopia. *Frontiers in Oncology.* 2018;8. doi: 10.3389/fonc.2018.00501.

43. Qasim S, Tayyab H, Zulqadar K, Masood S, Qasim TB, Zubair Z. Breast Cancer knowledge and perceived barriers to help seeking among pre-clinical and clinical female medical students of King Edward Medical University, Lahore: a cross-sectional study. *BMC Medical Education.* 2020;20(1):222. doi: 10.1186/s12909-020-02132-2.

44. Delgado-Díaz N H-TM, Ramos-Becerra A, Samillán-Jara L, Sánchez-Carranza M, Iglesias-Osores S, Arce-Gil Z. Level of knowledge on risk factors and preventive measures for breast cancer in health science students. *Rev Fac Med Hum July.* 2020;20(3):412-8. doi: 10.25176/RFMH.v20i3.2900.

45. Yang S, Li P, Yu L, Liu N, Wang J, Guo P, et al. Breast Cancer Awareness Based on Health Information Literacy and Influential Factors among Female Nursing Students in China. *Journal of Cancer Education.* 2022;37(3):546-54. doi: 10.1007/s13187-020-01844-9.

46. Mahmoud MH, Sayed SH, Ibrahim HA-F, Abd-Elhakam EM. Effect of Health Belief Model-Based Educational Intervention About Breast Cancer on Nursing Students' Knowledge, Health Beliefs and Breast Self-Examination Practice. *International Journal of Studies in Nursing.* 2018;3(3):77. doi: 10.20849/ijsn.v3i3.503.

47. Rezano A, Utama MS, Wiraswati HL, Ekawardhani S, Adha MJ, Patahuddin NM, et al. Knowledge Level towards Breast Cancer and Breast Self-Examination among Medical Students of Indonesia. *Global Medical and Health Communication.* 2022;10(1):35-42. doi: 10.29313/gmhc.v10i1.8942.

48. Carlson-Babila S, Bonaventure D, Jules K, Cyril J, Ekabe, Brice V, Naomi L, Abua, et al. Awareness of breast cancer and breast self-examination among female undergraduate students in a higher teachers training college in Cameroon. *Pan African Medical Journal.* 2017;28. doi: 10.11604/pamj.2017.28.91.10986.

49. Justice MF, King KA, Vidourek RA, Merianos AL. Breast Cancer Knowledge Among College Students: Influencing Factors and Resultant Behaviors. *American Journal of Health Education.* 2018;49(2):86-93. doi: 10.1080/19325037.2017.1414645

50. Nimbannavar SM, Mane VP. Breast cancer: knowledge, attitude and practices among undergraduate female students at a government college in Koppal, Karnataka. *International Journal of Community Medicine and Public Health.* 2019;6(7):2944. doi: 10.18203/2394-6040.ijcmph20192830.

51. Elsayed AA, Mohammed H. Prevention of breast cancer: Effects of early education on knowledge and practice of university students in Saudi Arabia. *IOSR JNHS.* 2019;8(5):1-9. doi: 10.9790/1959-0805090109.

52. Sarker R, Islam MS, Moonajilin MS, Rahman M, Gesesew HA, Ward PR. Effectiveness of educational intervention on breast cancer knowledge and breast self-examination among female university students in Bangladesh: a pre-post quasi-experimental study. *BMC Cancer.* 2022;22(1):199. doi: 10.1186/s12885-022-09311-y.

53. Vasishta S, Ramesh S, Babu P S, Ramakrishnegowda AS. Awareness about breast cancer and outcome of teaching on breast self examination in female degree college students. *Indian Journal of Medical Specialities.* 2018;9(2):56-9. doi: 10.1016/j.injms.2018.03.002.

54. Islam T, Su TT, Musthaffa S, Din NA, Rahman Z, Mohamed KN, et al. Improving Breast Health Literacy Through an Innovative Breast Cancer Awareness Campaign Using the Know Your Lemons (KYL) Materials in Malaysia. *Journal of Global Oncology.* 2018;4(Supplement 2):36s-s. doi: 10.1200/jgo.18.59400.

55. Linsell L, Forbes LJ, Burgess C, Kapari M, Thurnham A, Ramirez AJ. Validation of a measurement tool to assess awareness of breast cancer. Eur J Cancer. 2010;46(8):1374-81. doi: 10.1016/j.ejca.2010.02.034.

56. Champion VL. Instrument refinement for breast cancer screening behaviors. *Nurs Res.* 1993;42(3):139-43. doi: 10.1097/00006199-199305000-00003.

57. Youlden DR, Cramb SM, Yip CH, Baade PD. Incidence and mortality of female breast cancer in the Asia-Pacific region. *Cancer Biol Med.* 2014;11(2):101-15. doi: 10.7497/j.issn.2095-3941.2014.02.005.

58. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2018;68(6):394-424. doi: 10.3322/caac.21492.

59. Francies FZ, Hull R, Khanyile R, Dlamini Z. Breast cancer in low-middle income countries: abnormality in splicing and lack of targeted treatment options. *Am J Cancer Res.* 2020;10(5):1568-91. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7269781/

60. World Health Organization. Breast cancer 2021. Available from: https://www.who.int/news-room/fact-sheets/detail/breast-cancer.

61. Konduri S, Singh M, Bobustuc G, Rovin R, Kassam A. Epidemiology of male breast cancer. *Breast.* 2020;54:8-14. doi: 10.1016/j.breast.2020.08.010.

62. Hilton BA, Crawford JA, Tarko MA. Men's perspectives on individual and family coping with their wives' breast cancer and chemotherapy. *West J*

Nurs Res. 2000;22(4):438-59. doi: 10.1177/019394590002200405.

63. Harrow A, Wells M, Barbour RS, Cable S. Ambiguity and uncertainty: The ongoing concerns of male partners of women treated for breast cancer. *European Journal of Oncology Nursing*. 2008;12(4):349-56. doi: 10.1016/j.ejon.2008.04.009.

64. Al-Musa HM, Awadalla NJ, Mahfouz AA. Male Partners' Knowledge, Attitudes, and Perception of Women's Breast Cancer in Abha, Southwestern Saudi Arabia. *Int J Environ Res Public Health*. 2019;16(17). doi: 10.3390/ijerph16173089.

65. Midding E, Halbach SM, Kowalski C, Weber R, Würstlein R, Ernstmann N. Men With a "Woman's Disease": Stigmatization of Male Breast Cancer Patients—A Mixed Methods Analysis. *American Journal of Men's Health.* 2018;12(6):2194-207. doi: 10.1177/1557988318799025.

66. de Blok CJM, Wiepjes CM, Nota NM, van Engelen K, Adank MA, Dreijerink KMA, et al. Breast cancer risk in transgender people receiving hormone treatment: nationwide cohort study in the Netherlands. *BMJ*. 2019;365:l1652. doi: 10.1136/bmj.l1652.

67. Amgad M, Shash E, Gaafar R. Cancer education for medical students in developing countries: where do we stand and how to improve? *Crit Rev Oncol Hematol.* 2012;84(1):122-9. doi: 10.1016/j.critrevonc.2012.01.003.

68. Stubbings S, Robb K, Waller J, Ramirez A, Austoker J, Macleod U, et al. Development of a measurement tool to assess public awareness of cancer. *British Journal of Cancer.* 2009;101(2):S13-S7. doi: 10.1038/sj.bjc.6605385.

69. Momayyezi M, Fallahzadeh H. Construction and Validation of Breast Cancer Awareness Scale in *Iranian Women. J Caring Sci.* 2020;9(3):140-7. doi: 10.34172/jcs.2020.021.

70. Al-Khasawneh EM, Leocadio M, Seshan V, Siddiqui ST, Khan AN, Al-Manaseer MM. Transcultural adaptation of the Breast Cancer Awareness Measure. *International Nursing Review*. 2016;63(3):445-54. doi: 10.1111/inr.12265.

71. Heidari Z, Feizi A. Transcultural adaptation and validation of the Persian version of the breast cancer awareness measure (BCAM) questionnaire. *Cancer Medicine*. 2018;7(10):5237-51. doi: 10.1002/cam4.1740.

72. Wachira J, Busakhala A, Chite F, Naanyu V, Kisuya J, Otieno G, et al. Refining a questionnaire to assess breast cancer knowledge and barriers to screening in Kenya: Psychometric assessment of the BCAM. *BMC Health Services Research.* 2017;17(1):110. doi: 10.1186/s12913-017-2058-x.

73. Liu N, Li P, Wang J, Chen D-d, Sun W-j, Guo P-p, et al. Psychometric properties of the Breast Cancer Awareness Measurement among Chinese women: a cross-sectional study. *BMJ Open*. 2020;10(3):e035911. doi: 10.1136/bmjopen-2019-035911.

74. Moodley J, Scott SE, Mwaka AD, Constant D, Githaiga JN, Stewart TS, et al. Development and validation of the African Women Awareness of CANcer (AWACAN) tool for breast and cervical cancer. *Plos one.* 2019;14(8):e0220545. doi: 10.1371/journal.pone.0220545.

75. Kotera Y, Ozaki A, Miyatake H, Tsunetoshi C, Nishikawa Y, Kosaka M, et al. Qualitative Investigation into the Mental Health of Healthcare Workers in Japan during the COVID-19 Pandemic. *Int J Environ Res Public Health.* 2022;19(1). doi: 10.3390/ijerph19010568.

76. Kotera Y, Kaluzeviciute G, Lloyd C, Edwards AM, Ozaki A. Qualitative Investigation into Therapists' Experiences of Online Therapy: Implications for Working Clients. *Int J Environ Res Public Health.* 2021;18(19). doi: 10.3390/ijerph181910295.