REVIEW

Editorial Process: Submission:09/07/2024 Acceptance:03/12/2025

The Effect of Exercise on Quality of Life among Patients and Survivors of Breast Cancer: A Systematic Review and Meta-Analysis

Bhupesh Gupta[1], Kirtika Gupta[2]*, Kashish Narula[3], Prerna Sharma[4], Anshu Mittal[1]

Abstract

Introduction: The impact of physical activity on the quality of life in breast cancer patients and survivors is examined in this study by a comprehensive meta-analysis of randomized control trials. **Materials and procedures:** We searched databases like PubMed, Scopus, Embase, and Google Scholar for research publications published between 2005 and 2024, using the PRISMA guidelines. R software was utilised to perform the meta-analysis, and Cochrane's ROB 2.0 tool was employed to assess the quality of the studies. We utilised the I^2 statistics to evaluate heterogeneity. A funnel plot and Egger's regression test were used to determine publication bias. **Results:** The pooled effect of training on overall health-related quality of life (HRQOL) in survivors and patients of breast cancer was estimated to have been 0.70 (CI = 95%: 0.41–0.99) using a random effects model. HRQOL was calculated using Functional Assessment of Cancer Therapy-Breast (FACT-B) outcomes in breast cancer survivors and patients with cancer following giving them physical training and fitness intervention. The downward trend in the meta-regression study suggests that younger people benefited more from exercise in terms of quality of life than older patients. Participants in Asia [1.72 (CI = 95%: -0.60-4.05)], America [0.52 (CI = 95%: 0.30-0.74)], and Australia [0.43 (CI = 95%: 0.24-0.61)] had a stronger effect of the treatment compared to patients in Europe [0.51 (CI = 95%: -0.12-1.15)], according to sub-group analysis. **Conclusion:** Physical activity enhances breast cancer patients' and survivors' health-related quality of life.

Keywords: Physical Training- Breast Carcinoma- HRQOL- FACT-B

Asian Pac J Cancer Prev, **26 (3)**, 715-723

Introduction

Around 2.1 million additional cases of breast cancer are identified each year, making it the most common cancer among women globally and the primary cause of death for them [1]. Globally, 670,000 people died from breast cancer in 2022, out of 2.3 million diagnoses [2]. However, according to the kind and stage of breast cancer, advances in both technology and medical care have considerably raised 5-year survival rates by as much as 89% [3].

The declining rate of breast cancer death over time indicates that more and more women are surviving long after receiving their initial diagnosis and course of treatment, which means they are dealing with a variety of short-, mid-, and long-term adverse effects from their medical care. Thus, there is a great deal of clinical and public health concern about managing side effects associated with breast cancer [4].

The current recommendations for caring for breast cancer survivors involve providing advice on physical activity. Additionally, structured physical activity appears to have positive effects on various side effects [5–8]. The negative effects of cancer and its treatment, such as cognitive decline, persistent tiredness, increased body weight, sexual problems, and infertility, can all affect the quality of life for breast cancer patients and survivors. Numerous research projects have been carried out to enhance physical and mental health for breast cancer survivors, such as aquatic workouts [9-11], Pilates classes [12], yoga sessions [13-16], cognitive-behavioural therapy [17], compassion training based on cognition [18], as well as aerobic and strength training exercises [19], targeting issues related to patients' low quality of life. There is

*[1]Department of Community Medicine, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala), India. [2]Department of Otorhinolaryngology, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala), India. [3]Department of General Medicine, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, India. [4]Department of Anaesthesia, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala), India. *For Correspondence: bhupeshgupta1992@gmail.com*

a recommendation to research how different exercise programs can improve different aspects of the quality of life in cancer patients [19].

The present meta-analysis and systematic review aim to find out the effect of exercise on health-related quality of life among breast cancer patients and survivors.

Materials and Methods

The research was recorded in the International Prospective Register of Systematic Reviews PROSPERO (CRD42024539204). This research was conducted by PRISMA guidelines for systematic review and meta-analysis [20].

Eligibility criteria

Inclusion Criteria

The researchers incorporated trials into their study that met the following conditions: (a) they had to be either RCTs or controlled clinical studies in English language ; (b) the participants must have been adult cancer patients or survivors; (c) the study had to compare exercise interventions initiated post-cancer treatment with standard treatment or a non-exercise comparison intervention; and (d) they had to assess overall HRQOL or a specific realm of HRQOL as a result.

Exclusion Criteria: (a) Research focusing on individuals with end-stage diseases, hospice patients, or studies in which a majority of participants were undergoing treatment were not considered. (b) Articles older than twenty years of publication (before the year 2005) were also excluded. (c) Observational studies were eliminated.

Information sources

We searched databases like PubMed, Scopus, Embase, and Google Scholar for research publications published between 2005 and 2024, using the PRISMA guidelines.

Search strategy

Various search terms were used to search the English language articles between the year 2005 and 2024 in databases which included ‘‘breast cancer’’, “breast neoplasm”, ‘‘breast cancer survivors’’, ‘‘exercise’’, ‘‘physical exercise’’, ‘‘aerobic exercises’’, ‘‘physical activity”, ‘‘motor activity”, ‘‘quality of life”, and “health-related quality of life”. Furthermore, we also reviewed the bibliographies of relevant articles to locate additional papers.

Selection process

Each author (Gupta B, Gupta K, Narula K, Sharma P, Mittal A) independently evaluated the eligibility of each study individually, after they were located in the databases. If the writers had any discrepancies, they thoroughly discussed them to resolve them.

Data collection process

The eligibility of each study was determined using the titles and abstracts. Next, the authors reviewed complete trial texts that were deemed eligible or potentially eligible to confirm their eligibility (see Figure 1). Paired reviewers assessed the eligibility of each trial and gathered information on the trial’s characteristics and the impact of the intervention on outcomes. Disputes among reviewers were resolved through consensus or by bringing in a third reviewer. To obtain any needed details or clear up confusion, the authors reached out to the original trial author.

Data items

The first researcher’s name, publication year, research nation, continent, size of the sample, mean age, and key findings were extracted from the retrieved publications using a standardized form (Table 1).

Study risk of bias assessment

The Risk of Bias tool 2.0 created by Cochrane was employed for assessing the quality of randomized control trials. The quality is assessed using five areas: (1) Risk of Bias in Randomization Process; (2) Risk of Bias in Deviations from Intended Interventions; (3) Risk of Bias in Missing Outcome Data; (4) Risk of Bias in Measurement Process; and (5) Risk of Bias in Reporting Process.

Effect measures

Any physical activity that resulted in higher energy usage and demanded intentional, organized, and systematic body movements was viewed as exercise. Patient self-reported outcomes involved measuring overall health-related quality of life through FACT-B scores. I2 values were used to evaluate heterogeneity.

Synthesis methods

Trial data that showed no significant clinical differences were combined in a meta-analysis when appropriate. The authors combined all studies in a random-effects meta-analysis using R software version 4.3.0 to calculate the standardized mean difference (SMD) and 95% confidence interval (CI) of the intervention effect estimate. A meta-analysis was conducted for each type of measurement and every follow-up time frame, as the trial results were reported in the form of a change in score from baseline to follow-up or follow-up data.

Reporting bias assessment

Funnel plots were made to express publication bias.

Results

Study selection

After applying the keywords, a total of 2017 items were identified; out of these, 236 articles were removed due to being duplicates. Due to not being in English, 311 articles were removed. Of the 793 publications that did not meet the inclusion criteria, were eliminated. 123 studies did not have an abstract, while 430 studies were deemed old enough to be included in the research. Following thorough consideration and review, the authors selected twenty articles deemed appropriate for the meta-analysis. The detailed selection process is illustrated by the PRISMA flow diagram shown in Figure 1.

Table 1. Characteristics of the Studies Included

S. No.	Author, and Year of Publication	Country and sample size	Mean age (years)	Continent	Major Findingsz
1.	Alberto et al. [4]	Spain, 64	52.6±8.8	Europe	The research discovered a rise in HRQOL following the resistance training regimen.
2.	Wei X et al. [21]	China, 70	55±4.5	Asia	This preliminary research showed the advantages and detailed the mediating mechanism of how Baduanjin exercise affects the subjective cognition and health-related quality of life of Chinese breast cancer patients undergoing chemotherapy.
3.	Heiman J et al. [22]	Sweden, 278	62±6	Europe	A pre-and post-surgery physical activity intervention without supervision for breast cancer did not impact quality of life (QoL) in the short or long term when compared to the control group.
4.	Lee et al. [23]	USA, 30	46.9± 9.8	America	High-intensity interval Training could be a useful method to enhance physical function and potentially sustain quality of life in individuals with breast cancer.
5.	C. Basoglu et al. [24]	Turkey, 38	53.4±8.3	Asia	At the 1st-month follow-up, there was a notable increase in FACT-B scores found in the group receiving Comprehensive Decongestive Therapy with exercises, when compared within groups
6.	Rossen et al. [25]	Denmark, 112	55.4±13.4	Europe	Overall, patients experienced a notable and important improvement in HRQoL.
7.	Kim M et al. [26]	South Korea, 68	47.69±8.9	Asia	Starting rehabilitation for Breast Cancer Survivors with Inflatable Ball Exercise is better, while Conventional Self Exercise is more effective once pain has lessened
8.	De Jesus et al. [27]	Canada, 37	53.1±8.43	America	The overall well-being (FACT-B) score changed from 92.7 to 98.3 ($p = 0.05$).
9.	C. Desbiens et al. [28]	Canada, 20	70.7±11	America	Physical activity has been shown to improve the quality of life of cancer survivors
10.	Phillips et al. [29]	USA, 716	56.4±9	America	Objectively measured Moderate to Vigorous Physical Activity was positively associated with many HRQOL indicators.
11.	Stan DL et al. [30]	USA, 32	62.1±8.1	America	Both DVD-based yoga and strength training programs catered to cancer survivors can be effective choices to combat fatigue in breast cancer survivors. Both are widely accepted, easy to use, and can be repeated, and they might reduce tiredness and enhance the well-being of breast cancer patients with fatigue within the initial year after diagnosis.
12.	Swisher et al. [31]	USA, 31	53.8±8	America	Physical activity and nutritional guidance resulted in decreased body fat and enhanced quality of life for individuals who are survivors of triple-negative breast cancer.
13.	Leach HJ et al. [32]	Canada, 126	50.5 ± 8.7	America	Extending the exercise program to 24 weeks instead of 12 revealed more advantages, indicating that a longer duration of physical activity post breast cancer treatments could be essential for enhancing fitness and mental well-being.
14.	Alexander et al. [33]	USA, 42	48±8	America	Team triathlon training for breast cancer survivors can enhance aerobic capacity and enhance quality of life, potentially leading to healthier post-cancer lifestyles.
15.	Nock et al. [34]	USA, 38	56.5 ± 11	America	Our findings indicate that lifestyle interventions within the community, such as engaging in physical activity, could enhance the quality of life and lessen depression in African American breast cancer survivors, providing valuable suggestions for enhancing upcoming initiatives.
16.	Murtezani et al. [35]	Kosovo, 60	52±11	Europe	It was determined that a 10-week moderate-intensity aerobic exercise regimen greatly enhances quality of life and physical abilities in women who have survived breast cancer.
17.	Anderson et al. [36]	USA, 104	53.6±10	America	Through this timely exercise program implemented following a breast cancer diagnosis, the individual experienced notable enhancements in physical ability, without any negative impact on their quality of life or arm size.
18.	Scott et al. [37]	United Kingdom, 94	55.7±9.7	Europe	The results indicate that tailored physical activity and a low-calorie nutritious diet can have a beneficial effect on health results that affect the long-term outlook of obese women recovering from early-stage breast cancer.
19.	H. M. Milne et al. [38]	Australia, 558	59.0±11.2	Australia	Physically active and healthy-weight breast cancer survivors have better quality of life than inactive and obese survivors right after finishing adjuvant therapy.
20.	Sandel et al. [39]	Philadelphia, 38	61±9.8	America	A physical and emotional support program for women after breast cancer treatment greatly enhanced their breast cancer-specific needs through dance movement.

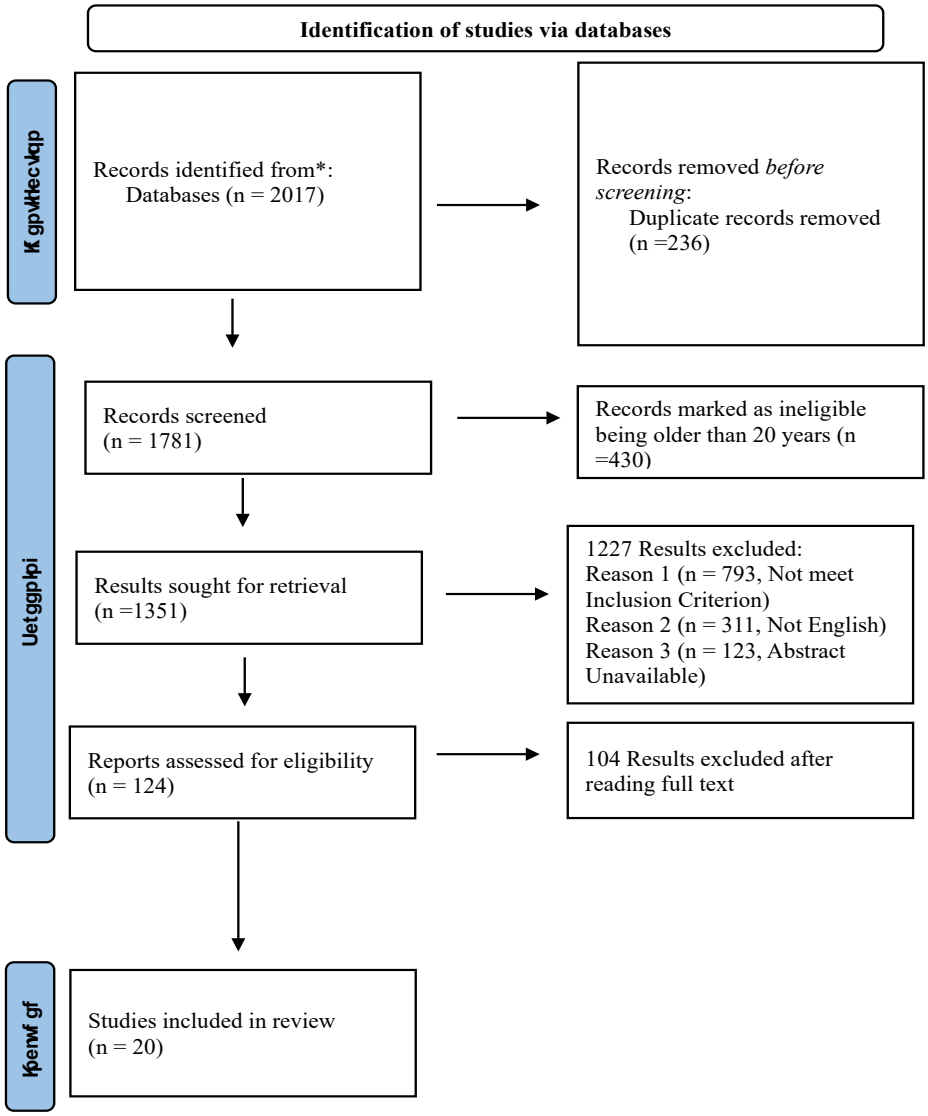

Figure 1. PRISMA Flow Diagram

Study characteristics

In the meta-analyses, 2556 individuals diagnosed with breast cancer were evaluated in twenty randomized control trials. The majority of the studies were carried out in the United States of America (n=7) and Canada (n=3). On the other hand, the remaining studies took place in Spain, China, Sweden, Turkey, Denmark, South Korea, Kosovo, the United Kingdom, Australia, and Philadelphia. The papers from 2005 and 2024 were the oldest and newest, respectively. The quality of all papers was assessed following Cochrane's ROB 2.0 guidelines, with papers being categorized as either "Low", "Medium" or "High" quality. Table 1 provides the details of the studies that are included in the list.

Risk of bias in studies

Fifteen studies were determined to have a low risk of bias in the majority of cases. A few studies had a moderate risk of bias (n=3) and a couple had a high risk of bias (n=2) as illustrated in Figure 2 and Figure 3. There was a low level of bias overall.

Results of syntheses and individual studies

The studies showed substantial variability, demonstrated by an I2 value of 83% for the impact of physical activity on the quality of life of cancer patients. Because of this, the data was analyzed using the Random Effects model (Figure 4). Utilizing the random effect model, the combined findings from various publications were utilized to calculate the overall impact of physical exercise on the well-being of cancer patients, estimated to be 0.70 (CI = 95%: 0.41–0.99) in terms of standardised mean difference. In each analysis, the standardized mean difference is shown as the black square, with the 95% confidence interval denoted by the overall length of the line across it. The rhombus sign (Figure 4) demonstrates the beneficial impact of physical activity on quality of life in breast cancer patients

The link between the publication year (Figure 5), sample size (Supplementary Figure 6), and mean patient age (Supplementary Figure 7) on the impact of physical activity was analyzed through meta-regression. It was found that depression prevalence decreased as the year of publication, sample size, and patient age increased (P

Table 2. Sub-Group Analysis to Estimate the Effect of Physical Exercise on the HRQOL Index

Subgroup		Number of Studies	Point Estimate	95%CI	I^2 (%)	tau	p (subgroup)
Risk of Bias	Low	14	0.69	0.28-1.1	86.9	0.65	0.71
	Medium	4	0.68	0.11-1.36	71.7	0.33	
	High	2	0.83	-2.44	0	0	
Continents	Europe	5	0.51	-1.27	82.6	0.45	0.12
	Asia	3	1.72	-4.65	87.5	0.87	
	America	11	0.52	0.30-0.74	56.2	0.24	
	Australia	1	0.43	0.24-0.61	-	-	

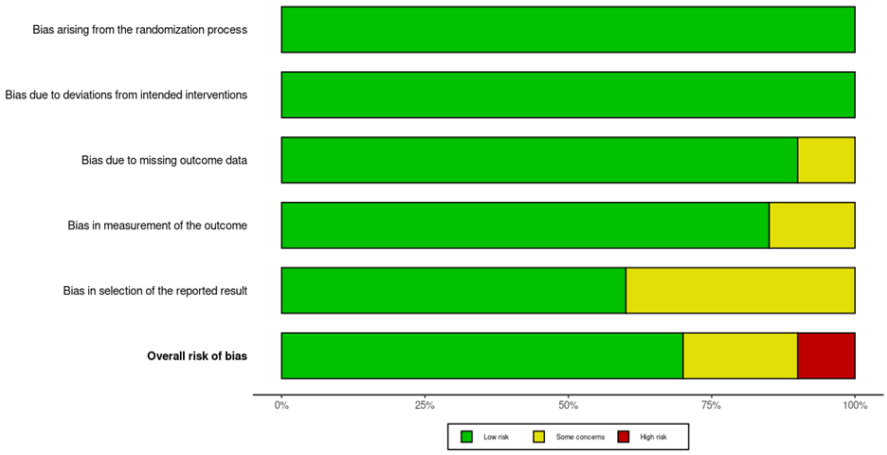

Figure 2. Summary Plot of Risk of Bias in Included Studies

Figure 3. Traffic Plot of Risk of Bias in Included Studies

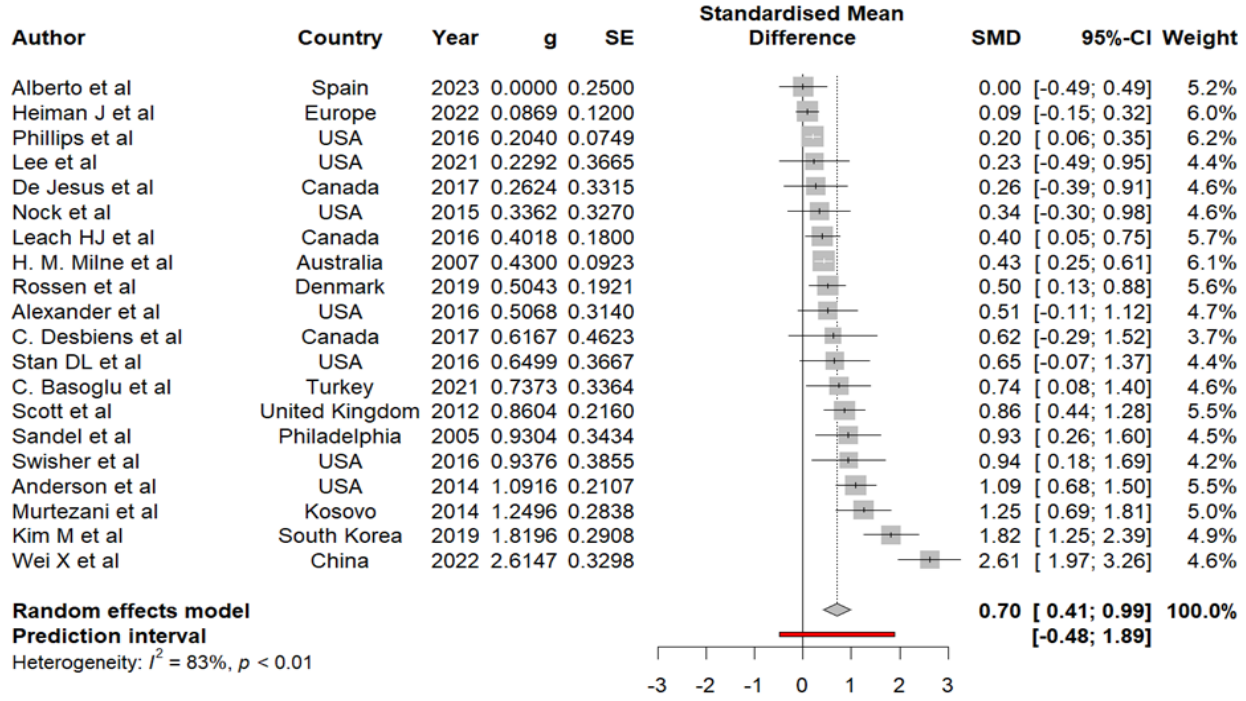

Figure 4. Forest Plot Showing the Effect of Physical Exercise on HRQOL index FACT-B Score of Breast Cancer Patients

< 0.01).

In light of the significant heterogeneity in the research, a subgroup analysis was done considering bias risk and continents. The most significant impact on patients was seen in trials with a high risk of bias (0.83 [CI: 95%; -0.39-2.05]), followed by those with a low risk of bias (0.69[CI: 95%;0.28-1.1]) and a moderate risk of bias (0.68[CI: 95%;0.11-1.36]). The subgroup analysis showed that exercise intervention had a greater impact on the quality of life of breast cancer patients in Asian countries (1.72 [CI: 95%;-0.60-4.05]) compared to America (0.52 [CI: 95%;0.30-0.74]), Europe (0.51 [CI: 95%;-0.12-1.15]), and Australia (0.43[CI: 95%;0.24-0.61]). (Table 2) remains unchanged.

Reporting biases and certainty of evidence

The funnel plot as shown in Supplementary Figure 8 was found to be symmetrical which indicates the absence of any publication bias.

The sensitivity analysis examined the potential influence of one study on overall results, potentially influencing future research in the following two scenarios. If one study is eliminated, it will greatly change the results. Merging studies excluded from the evaluation without impacting the outcome may result in unstable and fragile combined findings. Furthermore, the conclusion is precise and the data show consistency and responsiveness.

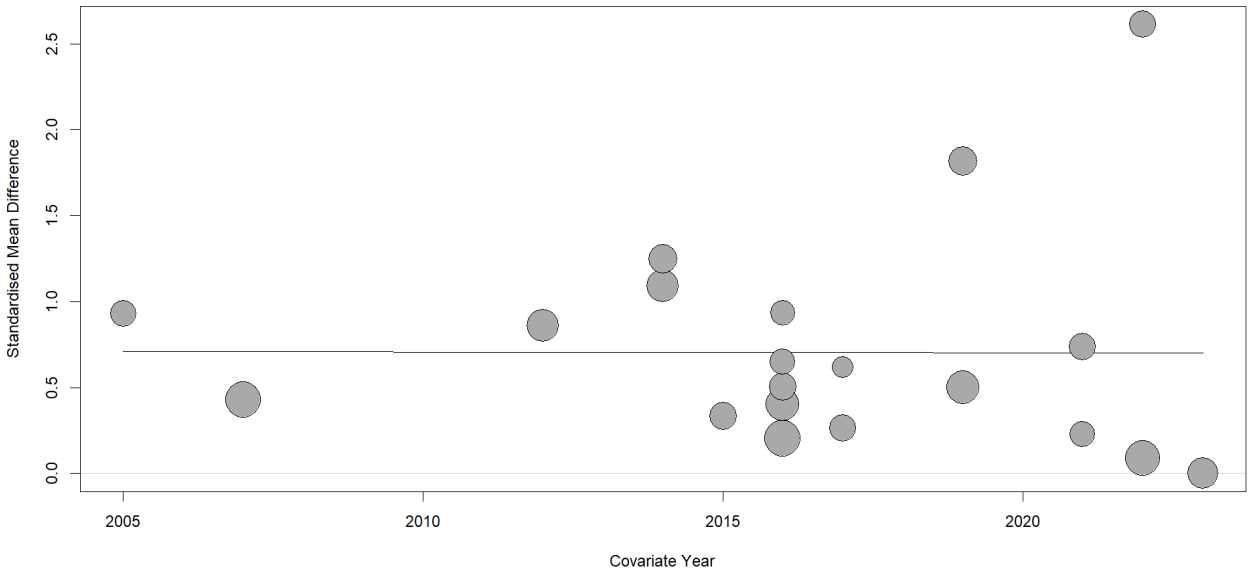

Figure 5. Meta-Regression of the Relationship between the Year of Publication and the Effect of Physical Exercise on the HRQOL Index

Results of the sensitivity analysis indicated that removing each study did not greatly change the findings (Supplementary Figure 9).

Discussion

An in-depth examination was conducted to determine how physical activity impacts the quality of life of individuals with breast cancer. The results from 20 articles and 2556 participants indicated a beneficial impact of physical activity on overall health-related quality of life. Wei X et al. [21] reported the most significant effect, whereas Alberto et al. [4] reported the least significant effect.

In their research, Alberto and colleagues discovered that aerobic or combined training interventions can enhance cardiorespiratory fitness in breast cancer survivors [4]. Wei X et al's research showed that Baduanjin exercise enhanced the quality of life for breast cancer patients during the 8th and 12th week. Furthermore, the research demonstrated that both groups saw enhancements in shoulder joint function during the 8th and 11th week, suggesting that Baduanjin can help improve shoulder joint function, specifically the active range of motion.

Another meta-analysis conducted by Lipsett et al. [40] found that engaging in exercise during adjuvant radiotherapy for breast cancer patients led to positive enhancements in fatigue and quality of life. Researchers reviewed nine studies, each focusing on different types of exercise (aerobic, resistance, combination) [40]. The primary results indicate that engaging in physical activity while undergoing additional radiotherapy can help improve fatigue and quality of life. Supervised aerobic resistance exercise appears to be the most effective method for reducing fatigue.

The study on a specific group showed that the impact was greater in Asian nations than in Europe, America, and Australia. Furthermore, the meta-regression analysis indicates a decline over time in the impact of exercise on quality of life, with more recent studies showing a stronger relationship compared to older ones. Metaregression analysis with sample size as a covariate found that studies with lower sample sizes show higher effects as compared to those with the highest sample size.

Metaregression analysis with the mean age of the patients as a covariate tells that young individuals have a better effect of exercise on quality of life as compared to older individuals. Therefore, Age is also an important factor in determining the effect of exercise on quality of life. According to Harrison SA et al (2010), Age may influence the potential to evaluate the effect of an exercise intervention on QOL among breast cancer survivors, as increasing age may be related to the likelihood of sedentary behaviours [41].

In another meta-analysis by Zeng Y et al. [7], Subjects in the exercise interventions had higher overall QOL than subjects in the control group .

Physical activity can promote a favourable outlook for cancer biomarkers, normal energy balance, and a reduction in the risk of cardiovascular disease, which is one of the major causes of death for many people who survive cancer [42].

Limitations and Future Implications

One restriction of our meta-analysis is the lack of discussion on comparing various types of exercises and their varying impacts on the quality of life of cancer patients and survivors. Future studies can investigate how different types of exercise impact the quality of life in diverse ways.

Conclusion and Recommendations

Healthcare professionals may want to incorporate exercise interventions into the care of breast cancer survivors, recognizing the positive impact on quality of life.

Author Contribution Statement

BG, KN, and KG: conception and design and typographical logic of the article. BG, PS, and KG: literature selection and acquisition of data. BG, PS, and AM: analysis and interpretation of data and editing the article. BG, PS, and KG: study supervision and revising the article. All authors contributed to the article and approved the submitted version.

Acknowledgements

Ethical permission and study approval

Since it is a meta-analysis and systematic review, no ethical permission was required for the study. This study was approved by PROSPERO which is the international Prospective Register of Systematic Reviews.

Registering Authority

This study was registered by PROSPERO (CRD42024539204).

Conflicts of interest

There were no conflicts of interest.

References

1. 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. https://doi.org/10.3322/caac.21492
2. World Health Organization. Breast cancer. 2024. Available from: https://www.who.int/news-room/fact-sheets/detail/breast-cancer. Accessed 5 Sept 2024.
3. American Cancer Society Cancer facts & figures 2024. American Cancer Society, Atlanta. 2024. Available from: https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/2024-cancer-facts-figures.html. Accessed 5 Sept 2024.
4. Soriano-Maldonado A, Díez-Fernández DM, Esteban-Simón A, Rodríguez-Pérez MA, Artés-Rodríguez E, Casimiro-Artés MA, et al. Effects of a 12-week supervised resistance training program, combined with home-based physical activity, on physical fitness and quality of life in female breast cancer survivors: the EFICAN randomized controlled trial. J

Cancer Surviv. 2023;17(5):1371-85. https://doi.org/10.1007/s11764-022-01192-1
5. Mishra SI, Scherer RW, Geigle PM, Berlanstein DR, Topaloglu O, Gotay CC, et al. Exercise interventions on health-related quality of life for cancer survivors. Cochrane Database Syst Rev.2012;2012(8):CD007566. https://doi.org/10.1002/14651858.CD007566.pub2
6. Meneses-Echávez JF, González-Jiménez E, Ramírez-Vélez R. Effects of supervised exercise on cancer-related fatigue in breast cancer survivors: a systematic review and meta-analysis. BMC Cancer. 2015;15:77. https://doi.org/10.1186/s12885-015-1069-4
7. Zeng Y, Huang M, Cheng ASK, Zhou Y, So WKW. Meta-analysis of the effects of exercise intervention on quality of life in breast cancer survivors. Breast Cancer. 2014;21(3):262–74. https://doi.org/10.1007/s12282-014-0521-7
8. Bedillion MF, Ansell EB, Thomas GA. Cancer treatment effects on cognition and depression: the moderating role of physical activity. Breast. 2019;44:73–80. https://doi.org/10.1016/j.breast.2019.01.004
9. Lindquist H, Enblom A, Dunberger G, Nyberg T, Bergmark K. Water exercise compared to land exercise or standard care in female cancer survivors with secondary lymphedema. Lymphology. 2015;48(2):64-79.
10. Cantarero-Villanueva I, Fernández-Lao C, Cuesta-Vargas AI, Del Moral-Avila R, Fernández-de-Las-Peñas C, Arroyo-Morales M. The effectiveness of a deep water aquatic exercise program in cancer-related fatigue in breast cancer survivors: a randomized controlled trial. Arch Phys Med Rehabil. 2013;94(2):221-230. https://doi.org/10.1016/j.apmr.2012.09.008
11. Enblom A, Lindquist H, Bergmark K. Participation in water exercising long-term after breast cancer surgery: experiences of significant factors for continuing exercising as a part of cancer rehabilitation. Eur J Cancer Care (Engl). 2018;27(1). https://doi.org/10.1111/ecc.12736
12. Şener HO, Malkoç M, Ergin G, Karadibak D, Yavuzşen T. Effects of clinical Pilates exercises on patients developing lymphedema after breast cancer treatment: a randomized clinical trial. J Breast Health. 2017;13(1):16-22. https://doi.org/10.5152/tjbh.2016.3136
13. Dangi AA, Aurangabadkar SK, Deo MV. Effect of a structured yoga program on fatigue, depression, cardiorespiratory fitness, and quality of life in a postmenopausal breast cancer survivor. Int J Yoga. 2018;11(3):255-257. https://doi.org/10.4103/ijoy.IJOY_61_17
14. Hughes DC, Darby N, Gonzalez K, Boggess T, Morris RM, Ramirez AG. Effect of a six-month yoga exercise intervention on fitness outcomes for breast cancer survivors. Physiother Theory Pract. 2015;31(7):451-460. https://doi.org/10.3109/09593985.2015.1037409
15. McCall M. Yoga intervention may improve health-related quality of life (HRQL), fatigue, depression, anxiety and sleep in patients with breast cancer. Evid Based Nurs. 2018;21(1):9. https://doi.org/10.1136/eb-2017-102673
16. Galantino ML, Tiger R, Brooks J, Jang S, Wilson K. Impact of somatic yoga and meditation on fall risk, function, and quality of life for chemotherapy-induced peripheral neuropathy syndrome in cancer survivors. Integr Cancer Ther. 2019;18:1534735419850627. https://doi.org/10.1177/1534735419850627
17. Sun H, Huang H, Ji S, Chen X, Xu Y, Zhu F, Wu J. The efficacy of cognitive behavioral therapy to treat depression and anxiety and improve quality of life among early-stage breast cancer patients. Integr Cancer Ther. 2019;18:1534735419829573. https://doi.org/10.1177/1534735419829573
18. Gonzalez-Hernandez E, Romero R, Campos D, Burychka D, Diego-Pedro R, Baños R, et al. Cognitively-based compassion training in breast cancer survivors: a randomized clinical trial study. Integr Cancer Ther. 2018;17(3):684-696. https://doi.org/10.1177/1534735418772095
19. Nakano J, Hashizume K, Fukushima T, Ueno K, Matsuura E, Ikio Y, et al. Effects of aerobic and resistance exercises on physical symptoms in cancer patients: A meta-analysis. Integr Cancer Ther. 2018;17(4):1048-58. https://doi.org/10.1177/1534735418807555.
20. 2. 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. https://doi.org/10.1136/bmj.n71.
21. Wei X, Yuan R, Yang J, Zheng W, Jin Y, Wang M, et al. Effects of Baduanjin exercise on cognitive function and cancer-related symptoms in women with breast cancer receiving chemotherapy: a randomized controlled trial. Supportive Care in Cancer. 2022;30(7):6079-91. https://doi.org/10.1007/s00520-022-07015-4
22. Heiman J, Onerup A, Bock D, Haglind E, Olofsson Bagge R. The effect of nonsupervised physical activity before and after breast cancer surgery on quality of life: results from a randomized controlled trial (PhysSURG-B). Scand J Surg. 2022;111(4):75-82. https://doi.org/10.1177/14574969221123389
23. Lee K, Norris MK, Wang E, Dieli-Conwright CM. Effect of high-intensity interval training on patient-reported outcomes and physical function in women with breast cancer receiving anthracycline-based chemotherapy. Supportive Care in Cancer. 2021;29(11):6863-70. https://doi.org/10.1007/s00520-021-06294-7
24. Basoglu C, Sindel D, Corum M, Oral A. Comparison of complete decongestive therapy and kinesiology taping for unilateral upper limb breast cancer-related lymphedema: A randomized controlled trial. Lymphology. 2021;54(1):41-51.
25. Rossen S, Trier K, Christensen B, Eriksen MA, Zwisler AD, Vibe-Petersen J. Municipality-based pragmatic rehabilitation stratified in accordance with individual needs—results from a longitudinal survey study. Support Care Cancer. 2020;28(4):1951-61. https://doi.org/10.1007/s00520-019-04993-w
26. Kim M, Lee M, Kim M, Oh S, Jung S, Yoon B. Effectiveness of therapeutic inflatable ball self-exercises for improving shoulder function and quality of life in breast cancer survivors after sentinel lymph node dissection. Support Care Cancer. 2019;27(7):2349-60. https://doi.org/10.1007/s00520-019-4656-0
27. De Jesus S, Fitzgeorge L, Unsworth K, Massel D, Suskin N, Prapavessis H, Sanatani M. Feasibility of an exercise intervention for fatigued breast cancer patients at a community-based cardiac rehabilitation program. Cancer Manag Res. 2017:29-39. https://doi.org/10.2147/CMAR.S117703.
28. Desbiens C, Filion M, Brien MC, Hogue JC, Laflamme C, Lemieux J. Impact of physical activity in group versus individual physical activity on fatigue in patients with breast cancer: a pilot study. Breast. 2017;35:8-13. https://doi.org/10.1016/j.breast.2017.06.001
29. Phillips SM, Awick EA, Conroy DE, Pellegrini CA, Mailey EL, McAuley E. Objectively measured physical activity and sedentary behaviour and quality of life indicators in survivors of breast cancer. Cancer. 2015;121(22):4044-52. https://doi.org/10.1002/cncr.29620
30. Stan DL, Croghan KA, Croghan IT, Jenkins SM, Sutherland SJ, Cheville AL, Pruthi S. Randomized pilot trial of yoga

versus strengthening exercises in breast cancer survivors with cancer-related fatigue. Support Care Cancer. 2016;24:4005-15. https://doi.org/10.1007/s00520-016-3233-z
31. Swisher AK, Abraham J, Bonner D, Gilleland D, Hobbs G, Kurian S, et al. Exercise and dietary advice intervention for survivors of triple-negative breast cancer: effects on body fat, physical function, quality of life, and adipokine profile. Support Care Cancer. 2015;23(10):2995-3003. https://doi.org/10.1007/s00520-015-2667-z
32. Leach HJ, Danyluk JM, Nishimura KC, Culos-Reed SN. Benefits of 24 versus 12 weeks of exercise and wellness programming for women undergoing treatment for breast cancer. Support Care Cancer. 2016;24(11):4597-606. https://doi.org/10.1007/s00520-016-3302-3
33. Ng AV, Cybulski AN, Engel AA, Papanek PE, Sheffer MA, Waltke LJ, Tjoe JA. Triathlon training for women breast cancer survivors: feasibility and initial efficacy. Support Care Cancer. 2017;25(5):1465-73. https://doi.org/10.1007/s00520-016-3531-5
34. Nock NL, Owusu C, Flocke S, Krejci SA, Kullman EL, Austin K, et al. A Community-Based Exercise and Support Group Program Improves Quality of Life in African-American Breast Cancer Survivors: A Quantitative and Qualitative Analysis. Int J Sports Exerc Med. 2015;1(3):020. https://doi.org/10.23937/2469-5718/1510020.
35. Murtezani A, Ibraimi Z, Bakalli A, Krasniqi S, Disha ED, Kurtishi I. The effect of aerobic exercise on quality of life among breast cancer survivors: a randomized controlled trial. J Cancer Res Ther. 2014;10(3):658-64. https://doi.org/10.4103/0973-1482.137985
36. Anderson RT, Kimmick GG, McCoy TP, Hopkins J, Levine E, Miller G, et al. A randomized trial of exercise on well-being and function following breast cancer surgery: the RESTORE trial. J cancer surviv. 2012;6(2):172-81. https://doi.org/10.1007/s11764-011-0208-4
37. Scott E, Daley AJ, Doll H, Woodroofe N, Coleman RE, Mutrie N, et al. Effects of an exercise and hypocaloric healthy eating program on biomarkers associated with long-term prognosis after early-stage breast cancer: a randomized controlled trial. Cancer Causes Control. 2013;24(1):181-91. https://doi.org/10.1007/s10552-012-0104-x
38. Milne HM, Gordon S, Guilfoyle A, Wallman KE, Courneya KS. Association between physical activity and quality of life among Western Australian breast cancer survivors. Psychooncology. 2007;16(12):1059-68. https://doi.org/10.1002/pon.1211
39. Sandel SL, Judge JO, Landry N, Faria L, Ouellette R, Majczak M. Dance and movement program improves quality-of-life measures in breast cancer survivors. Cancer Nurs. 2005;28(4):301-9. https://doi.org/10.1097/00002820-200507000-00011
40. Lipsett A, Barrett S, Haruna F, Mustian K, O'Donovan A. The impact of exercise during adjuvant radiotherapy for breast cancer on fatigue and quality of life: A systematic review and meta-analysis. Breast. 2017;32:144-55. https://doi.org/10.1016/j.breast.2017.02.002.
41. Harrison SA, Hayes SC, Newman B. Age-related differences in exercise and quality of life among breast cancer survivors. Med Sci Sports Exerc. 2010;42(1):67-74. https://doi.org/10.1249/MSS.0b013e3181b0f2cb.
42. Zagar TM, Cardinale DM, Marks LB. Breast cancer therapy-associated cardiovascular disease. Nat Rev Clin Oncol. 2016;13(3):172-184. https://doi.org/10.1038/nrclinonc.2015.171.