PHYSICAL ACTIVITY, EXERCISE AND CANCER

REVIEW ARTICLE

Relationship between physical exercise load and return-to-work in female breast cancer survivors: Systematic review

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ABSTRACT

Introduction: Evidence has shown physical exercise leads health benefits in breast cancer survivors, for example reducing return-to-work (RTW) time. However, what exercise component has (if any) the greatest impact on the recovery time after breast cancer. The aim of this study is to determine the exercise load variables (type, frequency, intensity, exercise time, volume, density and progression) that are best associated with recovery time in female breast cancer survivors (measured as time off work). Methods: In this systematic review, we included experimental, cohort, and observational studies of female breast cancer survivors engaging in physical exercise programs. We searched PubMed, Web of Science, Sport Discus, and Scopus (Sep 2021-Sep 2022) using the PICOS strategy and PRISMA 2020 guidelines. Studies were independently screened and data extracted into a database, focusing on exercise variables association with return-to-work time. Methodological quality was assessed using ROB 2.0, considering study design, intervention details, and bias risk. Results: Following screening, seven studies were included in this review, with five defining a minimum of one exercise component. Two studies specified frequency and density, while three defined the type, frequency, volume, intensity, density, and progression of interventions. No study found a direct correlation between exercise components and RTW time. Conclusions: In the literature reviewed in this systematic review, it is not possible to identify which exercise variable(s) have the strongest correlation with RTW outcomes. The existing studies demonstrate a lack of comprehensive intervention descriptions, limiting our understanding of the distinct exercise components and their potential effects on RTW results.
Keywords: Fitness, Breast neoplasms, Recovery time, Rehabilitation, Employment.

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INTRODUCTION

Breast cancer is the most common type of cancer, with more than 2.2 million cases in 2020 worldwide (Wild CP, 2020). About 685,000 women died of breast cancer and it is estimated that approximately one in 12 women will develop breast cancer in her lifetime (Wild CP, 2020). Scientific evidence has shown that physical activity in the form of exercise (i.e., regular physical activity that is structured, planned with the aim to improve or maintain physical fitness) (Caspersen et al., 1985; Magal & Scheinowitz, 2018) has many positive effects on both the prevention and treatment of breast cancer (Baumann et al., 2018; Irwin, 2009; Lahart et al., 2018). Many of these improvements directly affect health-related physical fitness such as improved strength, endurance and flexibility (Magal & Scheinowitz, 2018). Other relevant benefits of regular exercising include reducing the likelihood of lymphoedema (Baumann et al., 2018; Di Blasio et al., 2016), improving sleep quality (Bicego et al., 2009; Matthews et al., 2018; Savard et al., 2011), improving quality of life (Herrero et al., 2007) and improving self-esteem (Juvet et al., 2017).

The dose-response effects of exercising vary according to the type of training. For instance, regular strength training, which includes weightlifting, elastic resistance exercises, or bodyweight activities, consistently leads to improvements in body composition by increasing muscle mass and reducing body fat (Ramírez-Vélez et al., 2020). Also, when exercising at moderate or high intensity, additional benefits are observed such as improved bone density, resulting in a reduced risk of osteoporosis and fractures (Hurst et al., 2022). Similar principles apply to aerobic training, where the intensity and duration of exercises significantly impact the achieved results. For instance, comparing moderate-intensity continuous training with high-intensity interval training reveals distinct outcomes, with high-intensity interval training proving particularly effective in increasing VO_{2peak} and enhancing cardiovascular fitness when compared to moderate-intensity continuous training (SCHOENFELD et al., 2019). Moreover, within high-intensity aerobic training, variations in exercise density, such as intervals or repetitions, can lead to different results, such as variations in glucose response time or cortisol concentration (both higher after high-intensity interval exercise) (Androulakis-Korakakis et al., 2020). Not only the type of exercising, but also other components are relevant to achieve specific health outcomes. The volume of a training session (e.g., duration or sets and repetitions) significantly impacts the outcomes. Higher volumes lead to greater muscular adaptations, improvements in cardiovascular capacity and aerobic endurance, as well as increased fat loss (SCHOENFELD et al., 2019). Nevertheless, individuals new to exercise programs may benefit from a lower training volume initially to establish a foundation of fitness and allow for adaptation (Androulakis-Korakakis et al., 2020). The frequency of exercising training, which refers to the number of training sessions within a given time period, directly impacts session volume, recovery time, and physiological adaptations. For instance, higher training frequency has been observed to have a significant impact on muscle hypertrophy, leading to greater muscular gains compared to lower frequency training (Schoenfeld et al., 2016). Achieving the same physiological outcomes is unlikely when comparing two days of training per week to four days per week, even if the total workload is equivalent (Dalager et al., 2015). Managing and implementing a gradual increase in training load (i.e., the combination of volume and intensity) and difficulty over time is essential for effective progression (Escriche-Escuder et al., 2020). A good progression comprises a control on the increase of training load, allowing the body to adapt gradually to new demands. Conversely, poor progression can overload the system and heighten the risk of injury (Impellizzeri et al., 2020). Individualization remains a crucial aspect in designing a successful exercise program, accounting for personal capabilities and limitations. By considering these factors and tailoring exercise program accordingly, individuals can maximize their potential for achieving desired health outcomes and minimize the risk of setbacks or injuries (Heredia-Elvar et al., 2007).

The specific components of exercise interventions in breast cancer are scarcely described in the studies (specific dose-response), therefore, what component has (if any) the greatest impact on the recovery time after being diagnosed with a breast cancer. The components of the external exercise load are: exercise type, frequency, volume, intensity and density (Ferguson, 2014). The aim of this study is to determine the exercise load variables (type, frequency, intensity, exercise time, volume and progression) that are best associated with recovery time in female breast cancer survivors (measured as time off work prior to return-to-work).

The hypothesis of this study is that the current evidence relating exercise as an independent variable to return-to-work time is inconclusive.

METHODS

Design

This systematic review, conducted in accordance with the PRISMA 2020 guidelines (Page et al., 2021) and registered in the International Prospective Register of Systematic Reviews (PROSPERO) in September 2022 (registration number: CRD42022302738), aimed to determine which exercise load variables are most closely associated with return-to-work time in female breast cancer survivors. The search strategy employed the PICOS framework (Santos et al., 2007) with adaptations in the final equation formatting tailored to each database.

Search strategy

A comprehensive literature search was conducted in electronic databases including PubMed, Web of Science, Sport Discus, and Scopus, spanning from September 2021 to September 2022. Additionally, the search extended to tracing the references of the included literature to ensure a thorough exploration of relevant studies.

Inclusion and exclusion criteria

Studies meeting the following criteria were considered for this review: experimental, cohort and observational studies; the population included female breast cancer survivors over 18 years of age; and participants in supervised or home-based physical exercise programmes. Interventions that did not differentiate by cancer type, that included participants with metastases, or that included participants who were still on sick leave at the time of data collection were excluded so that it does not conflict with measuring total duration of sick leave as an outcome.

Data extraction

All abstracts identified following the search strategy were imported into the Mendeley bibliographic manager. The primary outcomes of this review were sample size (n); study design; definition of the intervention performed; quantified loading component (frequency, intensity, time, exercise, volume and/or progression); temporality of testing and time off work (TBL) (day count) or return-to-work (RTW) (day count).

Data evaluation

Two authors (HCG) and (JAF) independently screened the studies by title and abstract. In case of discrepancy between authors, studies were selected from their full text. The selected articles were retrieved and the same two authors reviewed each study on a full-text basis. Discrepancies at this stage were resolved by two other reviewers (SMA and APA). The authors (HCG and JAF) independently extracted the results of each study in a MS Excel ® spreadsheet software. They were merged and discrepancies between the two extractions were resolved by the whole team.

Methodological quality was assessed using the ROB 2.0 tool for randomised studies (Higgins et al., 2019). The elements assessed were: intervention time period, groups, dropouts, physical capacities mainly developed in the intervention, intervention definition, age, participants and study design. Responses were then scored with five points. 1 for "*yes*", 2 for "*probably yes*", 3 for "*probably no*", 4 for "*no*" and 5 for "*no information*". Finally, the tool's algorithm was used which categorises the study by: "*low risk of bias*", "*some concerns*" or "*high risk of bias*". Quality assessment was performed by one author (HCG) and queries were resolved by the whole team.

RESULTS

The flow chart (PRISMA) shown in Figure 1, shows the identification of 763 records during the initial search of the PubMed, Web of Science, Sport Discus and Scopus databases. Eight more records were added, identified by serendipity. Titles and abstracts were read and a total of 372 were discarded as they did not meet the inclusion criteria. The remaining 78 articles were suitable for full-text reading. Finally, a total of seven studies were eligible for this review (see Table 1) (Berglund et al., 1994; Björneklett et al., 2013; Bolam et al., 2019; Jong et al., 2018; Mijwel et al., 2019; Rogers et al., 2009; Van Waart et al., 2015). All included studies were experimental, none of them followed a cohort or observational design.

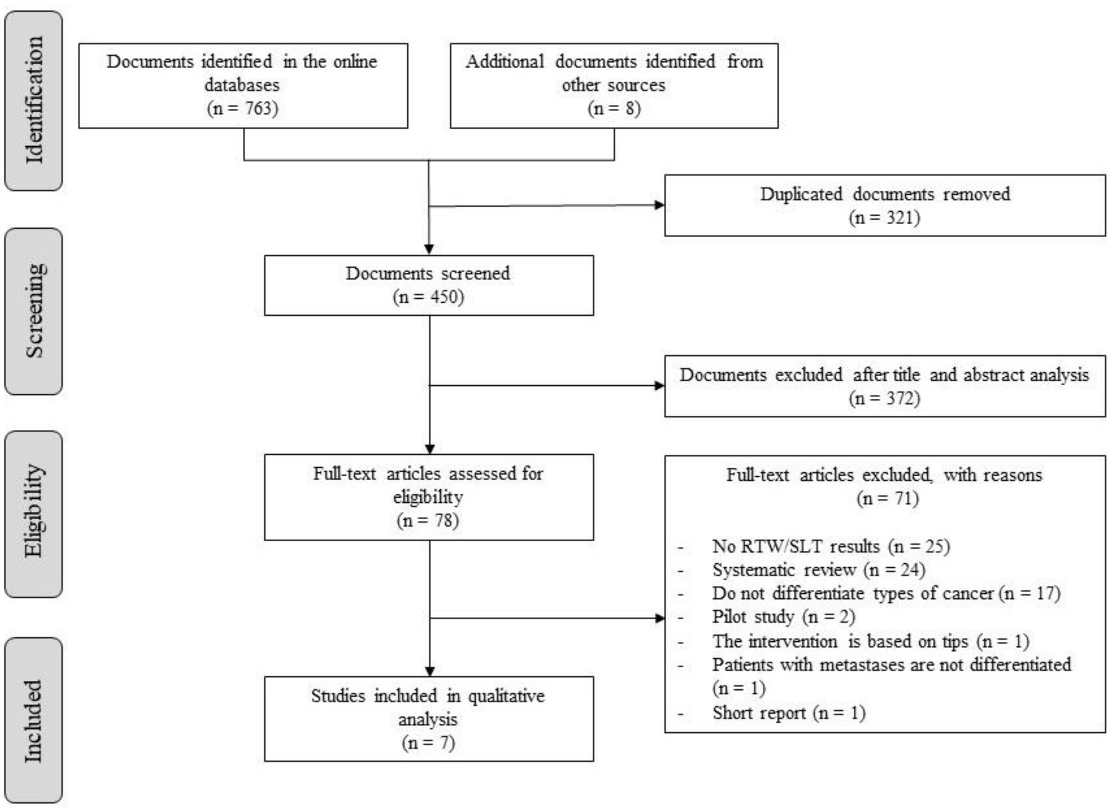

Figure 1. Flow chart.

To facilitate the analysis and reading of the results, the numbers of the studies correspond to the number appearing in the tables of this study: Studies 2, 4 and 5 show a difference between the number of participants in the intervention and control groups that may affect the results, that is, Study 2 (control n = 27, intervention group n = 40) Study 4 (control n = 52, intervention group 1 n = 62, intervention group 2 n = 59) Study 5 (control n = 48, intervention group 1 n = 58, intervention group 2 n = >54). Using the RoB 2.0 tool (Table 2) these studies were rated with "*some concerns*". Study 6 shows a result using an index that was not described in the study, consequently it could not be identified and was rated as "*high risk*". However, it was decided to keep it in this review because it met all inclusion criteria.

Table 1. Characteristics of the studies added.

Nº	Study	Population	Design	Intervention	Exercise-load component defined	Outcome	Physical exercise definition
1	Björneklett et al., 2013	382	RCT	Physical exercise intervention	None	SLT	No
				Control	None		
2	Jong et al., 2018	83	RCT	Physical exercise intervention	Frequency Density	RTW	Partially
				Control	None		
3	Van Waart et al., 2015	230	RCT	Physical exercise recommendation	None	RTW	Yes
				Physical exercise intervention	All*		
				Control	None		
4	Mijwel et al., 2019	240	RCT	Physical exercise intervention (1)	All*	RTW	Yes
				Physical exercise intervention (2)	All*		
				Control	None		
5	Bolam et al., 2019	240	RCT	Physical exercise intervention (1)	All*	RTW	Yes
				Physical exercise intervention (2)	All*		
				Control	None		
6	Rogers et al., 2009	41	RCT	Physical exercise intervention	None	RTW	No
				Control	None		
7	Berglund et al., 1994	25	RCT	Physical exercise intervention	Volume Frequency	SLT	Partially
				Control	None		

*Note. RCT: Randomized Controlled Trial. RTW: Return-To-Work. SLT: Sick Leave Time. *All: exercise name, frequency, volume, intensity, density, individualisation and progression.*

Table 2. Risk of Bias.

		D1	D2	D3	D4	D5	Overall
1	Björneklett et al., 2013	+	+	+	+	+	+
2	Jong et al., 2018	!	+	+	+	+	!
3	Van Waart et al., 2015	+	+	+	+	+	+
4	Mijwel et al., 2019	!	+	+	+	+	!
5	Bolam et al., 2019	!	+	+	+	+	+
6	Rogers et al., 2009	+	+	+	-	+	-
7	Berglund et al., 1994	+	+	+	+	+	+

Note. D1: Randomisation process. D2: Deviations from the intended interventions. D3: Missing outcome data. D4 Measurement of the outcome. D5: Selection of the reported result. +, Low risk. !, Some concerns. -, High risk.

Table 3 shows the results obtained by the studies ordered by test timing as well as statistical significance. By regards of the quantification of burden five out of the seven studies (Studies 2, 3, 4, 5 and 7), define a minimum of one component of the exercise load. Of those five, two studies (2, 7) include the frequency and density of exercising. These studies quantify how many training sessions and how they were distributed during the intervention period, but do not define what type of exercise they performed or any of other workload components. Finally, three out of seven studies (3, 4 and 5) define all components of the exercise: exercise name, frequency, volume, intensity, density, individualisation and progression. Three experimental studies (studies 2, 3, 4) show a higher percentage of patients returning to work earlier in the intervention group compared to the control group. In contrast, the control group shows better results in one study (1), two studies (5, 7) show the same results in the intervention group compared to the control group.

Table 3. Results of added studies.

Nº	**Study**	**Group**	**Initial status**	**Post-Int**	**2 Months**	**3 Months**	**6 Months**	**12 Months**	**24 Months**	***p****
1	Björneklett et al., 2013	Exercise	64.5% BL		44.3% BL		36.2% BL	35.6% BL		No
		Control	63.7% BL		45.7% BL		32.6% BL	27.1% BL		
2	Jong et al., 2018	Exercise	84% W			29% W	53% W			NS
		Control	72% W			27% W	23% W			
3	Van Waart et al., 2015	Recommendation	66% W	34% W			83% W			Yes
		Exercise	70% W	40% W			79 % W			
		Control	70% W	15% W			61% W			
4	Mijwel et al., 2019	Exercise (1)	NS					82% W		Yes
		Exercise (2)	NS					91% W		
		Control	NS					59% W		
5	Bolam et al., 2019	Exercise (1)	NS						86% W	No
		Exercise (2)	NS						89% W	
		Control	NS						89% W	
6	Rogers et al., 2009	Exercise	NS			a				No
		Control	NS			a				
7	Berglund et al., 1994	Exercise	70% BL	20% BL				11% BL		No
		Control	56% BL	20% BL				11% BL		

Note. BL: Percentage of participants on sick leave. W: Percentage of participants working. p: Statistical significance. [a]: Not stated. No: Statically non-significant differences. [a] In the study by Rogers L, et al. (2019) an unknown index is used to present the results.

Two studies showed statistically significant results (3 and 4), four did not obtain statistically significant results (1, 5, 6 and 7) and the study 2 does not include statistical significance.

DISCUSSION

Among the 450 studies encompassing the correlation between physical exercise and return to work (RTW) for breast cancer survivors, none of them specifically pointed out the relationship of exercise components on RTW outcomes independently. This study highlights a common misconception about physical exercise interventions. For example, defining the intervention in terms such as "*12 individual supervised exercise days*" (Rogers et al., 2009) or "*weekly sessions of 75min at the hospital over a period of 12 weeks*" (Jong et al., 2018) or simply "*physical exercise*" (Björneklett et al., 2013) may not be enough to understand what specificity of exercising is related to observed health outcomes. Defining better the exercise load (dose) to better understand the effects (response) of exercise programmes in breast cancer patients may optimise their recovery and return-to-work. In the case of "*walking some days a week*", monitoring may include the intensity of the exercise (walking speed), the volume (distance or time), the rests (density), the geographical characteristics of the route (mental and social health) and, if necessary, the mode of individualisation and the progression of this exercise dose. It follows the traditional principles of exercise training: the principle of overload and adaptation, repetition and periodisation, progression of the load, optimisation between load and recovery, functional unity, specificity, variability, reversibility and individualisation (González-Peris M et al., 2022); and the principle of the reproducibility of the scientific method (Goodman et al., 2016). It might be relevant to describe the muscle groups involved in muscle-strengthening exercise, sets and repetitions (volume), the rhythm of work (intensity) and rest, and the criteria under which the individual load or progression is individualised.

Previous systematic reviews observed positive results on exercising to reduce return-to-work in cancer populations (Algeo et al., 2021; Schutz et al., 2021; Tamminga et al., 2010; Wilson et al., 2023). Their invaluable contribution serves as a pivotal foundation for developing an effective post-operative recovery plan. Nonetheless, without acknowledging the significance of each aspect of the training load in relation to return-to-work, we will fall short of fully optimizing the recovery process. Also, only three studies out of the 450 included in this review, detail specific components of the exercise group (Bolam et al., 2019; Mijwel et al., 2019; Van Waart et al., 2015). In other words, only three interventions may be replicated according with the information provided.

In the Consensus Statement from International Multidisciplinary Roundtable of 2019, it became clear that most of the research conducted to date does not (Campbell et al., 2019) take into account the principles of training and that the conclusions they show come from secondary results. Several exercise prescription guidelines for different pathologies exist, such as those of the ACSM (Ferguson, 2014), the articles by Pedersen and Saltin (Pedersen & Saltin, 2015), FYSS (Borjesson & Sundberg, 2013) or PEFS (González-Peris M et al., 2022). But some exercise components relevant for expected health outcomes for oncology patients are still missing.

This information gap confirms the hypothesis initially put forward, which anticipated the lack of detail in physical exercise intervention. This opens up a new line of research. This includes cost-effectiveness of the interventions (from the point of view of the patient, but also of public health institutions), optimisation of workloads for this group, the impact on the perception of the quality of life of this population according to the type of training carried out, among others. The high incidence and the high economic cost of this disease, both for patients and for the public health system, are factors that must be taken into account in addition to its mortality rate. The economic cost of cancer worldwide is unknown, but in 2017, the economic burden due to lost productivity was approximately 30 billion dollars in China and the United States and 10.5 billion euros (11 billion dollars) in the European Union (The American Cancer Society, 2019).

Exercise interventions for people with breast cancer should distinguish the participant's previous characteristics as well as their subsequent work demands. The key to good training progression is individualisation. And indicators such as the type of previous work, their physical requirements or the physical affectations that arose as a consequence of their oncological treatment are necessary to set goals and timing. These studies should also take into account previous and subsequent working hours, as working half a day is not the same as working full time. It would also be interesting to know which are the most limiting factors that postpone the return-to-work. Perhaps the optimal physical exercise prescription for this group depends more on their individual needs than on the normal values for each physical capacity.

CONCLUSIONS

The scarcity of studies focusing on the correlation between physical exercise components and return-to-work outcomes among female breast cancer survivors underscores a significant research gap in this field. The existing studies often fall short in providing comprehensive descriptions of the interventions implemented, which limits our understanding of the specific exercise protocols and their potential effects on return-to-work outcomes. Moreover, a noteworthy challenge lies in the presentation of return-to-work results as secondary data, which hampers the accurate interpretation of statistical indices. By relying on secondary data, researchers may miss crucial nuances and contextual factors that could influence the relationship between physical exercise and successful reintegration into the workforce.

Furthermore, an additional limitation is the failure of many studies to specify the initial employment status of participants and their intentions regarding returning to work. This omission overlooks essential factors that could contribute to the decision-making process and the overall success of returning to work post-treatment. It is plausible that some individuals choose not to re-enter the workforce due to personal preferences, emotional considerations, or various reasons not accounted for in the current body of research. Understanding these individual circumstances and motivations is crucial for developing tailored interventions and support systems that address the unique challenges faced by breast cancer survivors in resuming work.

To bridge these gaps in knowledge, future research efforts should aim to conduct more investigations that elucidate the specific relationship between physical exercise and return-to-work outcomes among female breast cancer survivors. These studies should include detailed descriptions of interventions, collect primary data on employment status and intentions, and incorporate qualitative approaches to capture the multifaceted factors influencing individuals' decisions regarding returning to work. By addressing these limitations and filling the existing research void, we can gain a more comprehensive understanding of how physical exercise can effectively support breast cancer survivors in achieving successful reintegration into the workforce.

AUTHOR CONTRIBUTIONS

Hector Carrión Gilabert was responsible for the project's methodology, formal analysis, data curation, and initial writing. Judith Arbós Figueras handled data curation. Sergi Matas contributed to the methodology, provided resources, and ensured validation. Antoni Planas Anzano focused on data visualization and managed the project, also reviewing and editing the manuscript. Sebastià Mas Alòs conceptualized the project, validated findings, and supervised the project, also reviewing and editing the manuscript.

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No potential conflict of interest was reported by the author.

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