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Cardiovascular Exercise Intensity in Cancer Treatment: Impact on treatment efficiency in women with breast cancer

Bachelor's thesis in Human Movement Science
Supervisor: Xiao-Mei Mai
March 2024

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Abstract

Abstrakt

Hensikt: Hensikten med denne studien er å undersøke om ulike kardiovaskulære treningsintensiteter påvirker effektiviteten av kreftbehandlingen hos kvinner med bryst kreft. **Metode**: Dette litteraturstudiet er basert på studiene som ble funnet gjennom databasen PubMed 29.01.24. Utvalget måtte være kvinner mellom 18-80 år, som gjennomgikk aktiv kreftbehandling. Studiene måtte være kliniske studier gjort på mennesker, og gjennomført på 2000-tallet. **Resultat:** Åtte studier ble inkludert i litteraturstudiet. Alle studiene fant positive effekter av fysisk aktivitet på behandlingseffektiviteten, men signifikansen varierte avhengig av treningsmengde og intensitet. **Konklusjon:** HIIT forbedret CRF og lettet fatigue plagene hos pasientene som trente minst to ganger i uken. HIIT hadde mest signifikant reduksjon av dødeligheten av brystkreft. Det ble ikke funnet noe sammenheng mellom kroppssammensetning og trening hos BC pasienter, verken ved HIIT eller ved lavere intensiteter.

Abstract

Purpose: The purpose of this study is to investigate whether different cardiovascular exercise intensities affect the efficacy of cancer treatment in women with breast cancer. **Method:** This literature study is based on the studies found through the database PubMed 29.01.24. The sample had to be women between the ages of 18-80 who underwent active cancer treatment. The studies had to be clinical trials on humans and conducted in the 2000s. **Result:** Eight studies were included in the literature study. All the studies found a positive impact of physical activity on treatment efficiency, but significance varied depending on the training load and intensity. **Conclusion:** HIIT improved CRF and relieved fatigue symptoms in patients who exercise at least two times a week. HIIT had the most significant reduction in mortality rate from BC. No association was found between body composition and exercise in BC patients, neither at HIIT nor at lower intensities.

Keywords:

Cancer related fatigue • Cardiorespiratory fitness • Low intensity training • Moderate intensity training • Training

Introduction

There has been a notable increase in new cancer cases in Norway since the early 2000s (1). Given the diverse nature of cancer, with over 100 different types identified (2), it is essential to focus the study efforts. Notably, breast cancer (BC) ranks among the most frequently diagnosed cancers globally, contributing significantly to cancer-related mortality, particularly among women (3). Therefore, this study will concentrate on women diagnosed with BC.

Previously, the perception was that cancer was difficult both to prevent and to treat. It was believed that cancer patients should rest and reduce their physical activity (PA). Recent studies show that inactivity during treatment can lead to loss of muscle strength, fitness, ability to move and weight gain in patients (2). Today it is understood that although PA can provoke some pain or injuries, it still yields a preponderance of positive effects in cancer patients (2).

New studies have shown that PA and exercise during cancer treatment can help improve life quality and reduce the side effects of cancers demanding treatment regimens (2). PA will also help prevent the adverse effects of inactivity on the body (2). Furthermore, there is compelling evidence that regular exercise is among the most influential factors individuals can control to prevent various cancers (2). Post-treatment exercise enhances quality of life and reduces the risk of recurrence (4).

Recent studies have investigated the impact of exercise during active cancer treatment for cancer survival, particularly among patients with BC (2). Consequently, this study investigates the efficacy of high-intensity cardiovascular exercise as opposed to low and moderate intensities in improving treatment efficiency for women undergoing active BC treatment. These intensities are based on heart rate and breathing patterns. Low intensity is characterized by minimal effects and little impact on heart rate (5). Moderate intensity induces increased heart rate and breathing. High intensity significantly elevates heart rate and causes noticeable breathlessness (5). Active treatment refers to women who have either undergone a mastectomy, lumpectomy, neoadjuvant chemotherapy or radiotherapy (6).

The current activity recommendations for BC patients are primarily high intensities exercise (7), but the reality is that this form of exercise is still avoided (8). It has largely been avoided due to fear of potential deterioration in the patients' condition, and because the patients themselves experience it as overwhelming (8). Due to the difference between recommendations and practice, we want to investigate whether there is a true correlation between the intensity of exercise and the progression of BC.

By examining treatment efficacy, this study will also delve into several key parameters, including cardiorespiratory fitness (CRF), body composition and fatigue. These parameters are crucial for comprehensively assessing the impact of exercise intensity on BC patients' physical, physiological, and psychological well-being throughout their treatment process. Incorporating CRF, body composition and fatigue allows us to understand how they fit into our understanding of patients' conditions and how various treatment modalities may influence them.

Method

The database utilized for this study was PubMed. A search was conducted yielding 603 results on 29.01.24. The search process is presented in a Prisma flow chart (Figure 1). Additionally, specific filters were applied, restricting searches to articles published after the year 2000, written in English or Norwegian, involving human subjects. After reviewing titles, abstracts and assessments of the articles, the result was eight articles eligible for this study. Table 1 outlines the different inclusion- and exclusion criteria.

Figure 1: Literature search Prisma flow chart

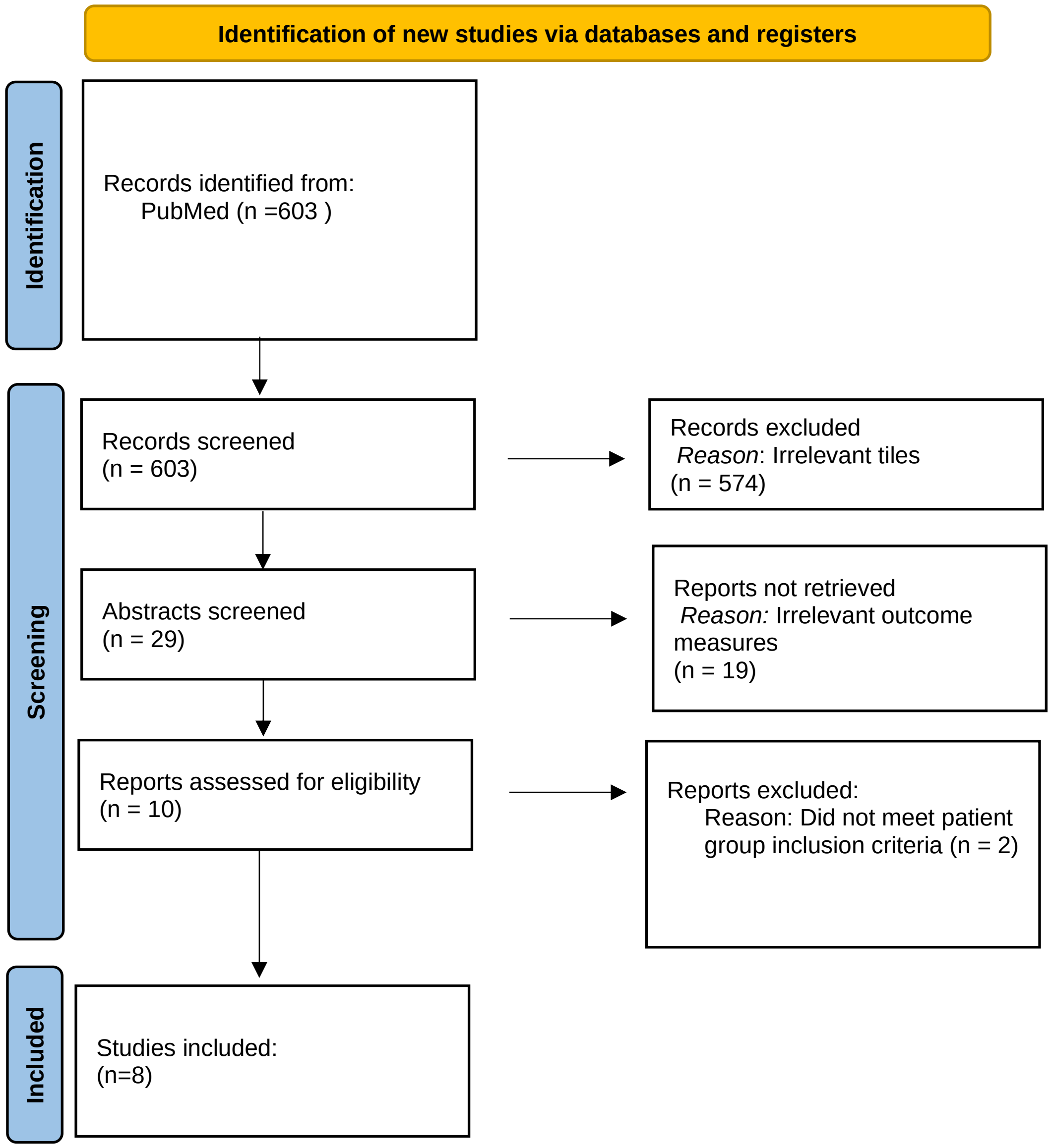

Table 1: Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
Diagnosed with breast cancer	Diagnosed with other types of cancer
Human studies	Animal studies
Published in the last 24 years	Published earlier than the year 2000
Patients are undergoing active treatment.	Looking mainly at cancer prevention or rehabilitation after cancer treatment
Women	Men
18-80 years	Younger than 18 or older than 80 years
Written in Norwegian or English	Written in other languages
Clinical studies	Have underlying cardiovascular diseases

Results

Eight studies were included, with 890 participants in total, who were either put in an intervention group (IG) or a control group (CG) (see Table 2). Although all participants had been diagnosed with BC, their stage and the course of treatment varied, but all participants had either undergone surgery or underwent chemotherapy and/or radiation. The type of exercise included is low-, moderate-, or high intensity cardiovascular exercise. Table 2 will provide a brief overview of the main findings of the studies included.

Table 2: Results of the studies with reported outcome measures

Study	**Sample**	**Intervention procedure**	**Outcome measures and findings**
Hsieh (2008)	(*n* = 96) Mean age = 57,9	40-70% (HR_{max}) 60min*2-3d/w for 26 weeks	*CRF*: - Significantly improved *Body composition:* - No significant difference *Fatigue*: - Significant reduction in fatigue
Isanejad (2023)	*(n=30)* Age = ≥30 IG1 (*n*=10) IG2 (*n*=10)	IG1: HIIT 3d/w: 60-90% VO_{2peak} for 12 weeks IG2: MICT 3d/w: 50-60% VO_{2peak}	*CRF:* - HIIT superior to MICT VO_{2peak} improvement *Body composition:* - No significant difference

	CG (*n*=10)	for 12 weeks CG: UC	*Fatigue:* - Not included
Kirkham (2019)	*(N=73)* Age=29-77 Mean=50.8	1 group, 3 stages of exercise intervention: Stage 1:3d/w 50-75%HRR 20-30min Stage 2: 2d/w 70-75% HRR, 30-32min Stage 3: 1d/w 70-75% HRR, 30-32min	*CRF:* - Improved VO_{2peak} at end of program *Body composition:* - Maintained wight *Fatigue*: - Decreased fatigue
Mijwel (2017)	(*n*=240) Age = 18-70 IG1 (*n*=74) IG2 (*n*=72) CG (*n*=60)	IG1: RT-HIIT, 80% of 1-rep max, IG2:AT-HIIT, 13-15 on the borg scale, CG: UC 60min* 2d/w for 16 weeks	*CRF*: - Not included *Body composition:* - Not included *Fatigue*: - RT-HIIT group superior, but positive improvements for AT-HIIT.
Mijwel (2018)	(*n* = 240) 18-70 years IG1 (*n*=74) IG2 (*n*=72) CG (*n*=60)	IG1: RT-HIIT, 80% of 1-rep max, IG2: AT-HIIT, 13-15 on the borg scale CG: UC 60min* 2d/w for 16 weeks	*CRF:* - RT and AT prevented declines *Body composition:* - RT and AT prevented gaining body mass *Fatigue*: - RT-HIIT group superior, but positive improvements for AT-HIIT.
Møller (2020)	(*n* =153) Mean age 51,7 IG1= *n* 75 IG2= *n* 77	IG1: Moderate-high intensity hospital-based program. Part 1: 9h/w for 6 weeks Part 2: 6h/w for 6 weeks IG2: Low intensity home based pedometer program for 12 weeks	*CRF:* - Both effective restoring VO_{2peak}. *Body composition:* - Both effective in bodyfat prevention. Gr 1&2 increased lean BM *Fatigue*: - Correlation between higher VO_{2peak} and lower fatigue
Uth (2020)	(*n = 68)* *IG=46* *CG=22* Age: 18-76	IG:60-90% (HR_{max}) 60min*1-2 days * 52 weeks CG: UC	*CRF:* - No significant differences *Body composition:* - No significant differences *Fatigue*: - *Not* included
Waart (2015)	*(n=230)* Mean age: 51 IG1=n:77 IG2=n:76 CG=n: 77	IG1: Onco-Move/home based (IG1): 30min*5d/w for 6 moths 12-14 borg scale IG2: OnTrack/ moderate-high (IG2): 30min*2d/w for 6 moths 12-16 borg scale CG: UC: 2-5d/m for 6 moths	*CRF:* – IG1 & IG2 gave less decline. - IG2 gave better results *Body composition:* - Not included *Fatigue*: - IG2 gave less physical fatigue.

n – Sample size, *IG* – intervention group, *UC* – usual care, *HIIT* – High-intensity interval training, *MICT* – Moderate-intensity continuous training, *AT-HIIT* – moderate-intensity aerobic and high-intensity interval training, *RT-HIIT* – resistant training and high-intensity interval training, *CRF* – cardiorespiratory fitness, HR_{max} – Maximum heart rate, VO_{2peak} – Peak oxygen uptake, *BM* – Body mass.

Primary outcomes

CRF

In the assessment of CRF across various clinical trials, significant impacts on VO_{2peak} and the different effects of exercise intensities were observed. In the randomized controlled trial by Møller et al. (2020) both low and moderate- to high intensity groups had 90% lower VO_{2peak} at baseline compared to the age-matched background population of Scandinavian women (9). In the first 12 weeks of the program, there was a significant decrease in VO_{2peak} with no difference between the groups (9). Both groups restored VO_{2peak} from week 12-39, there were no significant differences between the groups (9). Mijwel et al., (2018) compared AT-HIIT and RT-HIIT to UC. In this clinical trial, Mijwel et al., (2018) saw a drastic decrease in VO_{2peak} in the UC-group (10). In contradiction to Møller et al., (2020), in this trial both HIIT groups had no significant decrease (10).

The randomized controlled trial by Isanejad et al., (2023) compared the effects of HIIT, MICT, and UC and found significant differences between the groups. The baseline values for VO_{2peak} had no significant differences between groups. After implementing the HIIT and MICT programs, they observed a 16.8% increase in VO_{2peak} in the HIIT group (8). This is a significant difference from both the MICT group and the UC group. Results indicated no significant effects on VO_{2peak} in the MICT group compared to the control group (8).

The study by Hsieh et al. (2008) conducted aerobic training with a moderate- to high intensity of 40%-75% of maximal heart rate (HR) (11). From the pre- test to the post-test experiments they saw significantly improved VO_{2max} and endurance time. In addition, resting HR showed significant reductions (11). The randomized clinical trial from Van Waart et al., (2015) presents a significantly higher maximal short capacity for the moderate- to high intensity group, than the low-intensity group and UC group. Both exercise groups had significantly longer mean endurance time compared to the UC group. There was a great difference between the two exercise groups, with respectively four minutes longer for moderate- to high intensity groups with a mean of eight minutes (12). In the football fitness trial, by Uth et al., (2020), they examined CRF and resting heart rate (HR_{rest}) for 12 months and found no significant changes within the intervention and control group (3). Kirkham et al. (2019) found no significant difference between baseline-end of treatment and end of treatment-end of program in their HIIT group. While there was a significant difference between end of program relative to baseline results (13).

Body composition

In the trial by Uth et al. (2020), patients exercised at high intensity within 60-90% of $HR_{max.}$ They did not find a correlation between body fat mass and exercise, at either the 6- or the 12-month follow-ups (3). Conforming to this pattern Hsieh et al. (2008) found no correlation between body composition and the exercise intervention in their study, when patients trained with moderate- to high intensity with 40-70% of HR_{max} (11). In comparison, Mijwel et al. (2018) reported that body weight remained stable during the intervention period. Results showed significantly decreased body weight at follow-up in the supervised exercise intervention (10). Additionally, there was an increase in lean body mass and a decrease in fat mass in the supervised exercise intervention at follow-up, while the UC group gained weight (10). Similarly, Kirkham et al., (2019) observed that waist circumference did not change during the program or at follow-up in their HIIT group. Body weight did not change from baseline to end of treatment but was significantly lower at end of program and 1-year follow up (13).

Fatigue

The study by Uth et al. (2020) observed improvements in self-perceived health-related limitations post-intervention, although direct fatigue assessment was lacking (3). Hsieh et al. (2008) revealed significant reductions in various fatigue domains following exercise interventions when patients trained at moderate- to high intensity of 40-70% of HR_{max}. Similarly, Mijwel et al. (2017) highlighted the association between self-reported fatigue, observing its reduction with interventions such as RT-HIIT (14). Additionally, Møller et al. (2020) uncovered a negative correlation between VO_{2peak} and fatigue levels in both intensity groups (9). Isanejad et al. (2023) demonstrated improvements in physical capacity through HIIT interventions (8). Results from Mijwel et al., (2017) show that PA, especially HIIT, alleviates or reduces fatigue symptoms (14). Mijwel et al., (2017) found significant evidence of the benefits of HIIT in managing fatigue effectively, affecting treatment efficiency and outcome in women undergoing active BC treatment (14).

Secondary outcomes

The study by Møller et al., (2020) highlights that moderate to high-intensity exercise yields the most significant impact on CRF and mortality. It is noteworthy that a decline in CRF has been shown to be a recurring effect in BC patients (9). In addition, Isanejad et al., (2023) found that women with moderate to high CRF had a 33% and 55% lower risk of dying from BC (8).

In the clinical trial by Van Wart et al., (2015) they looked at chemotherapy treatments across various groups. A total of 61 patients required chemotherapy dose adjustments (31%). In the UC- and Low-intensity groups, 34% required dose reductions (12). In the moderate- to high intensity group, 12% required a dose reduction, which is four times lower incidence compared to the two other groups (12). Both exercise groups received a 10% dose reduction, compared to the 25% dose reduction in UC (12). This highlights evidence from Van Waart et al.'s (2015) clinical trial. Their results indicate that higher exercise intensity is associated with fewer chemotherapy dose reductions in BC patients, suggesting potential benefits in treatment management.

Discussion

The primary outcomes of the reviewed studies on BC patients undergoing exercise interventions show varying effects on CRF, body composition, and fatigue levels. While some trials indicate significant improvements in CRF, stability in body composition, and reduced fatigue, others show mixed results. Secondary outcomes underscore the potential benefits of exercise in improving treatment efficiency. These findings emphasize the importance of tailored exercise programs in enhancing the well-being of BC patients.

Connection between primary and secondary outcomes

An interesting finding in our research was the treatment outcomes of chemotherapy. Chemotherapy is a treatment that greatly improves BC survival (12). Results indicate that the general PA level helped patients manage the treatment, and the higher exercise intensity is favorable (12). This finding is further supported by Courneya et al. (2016), who found that exercise groups had a higher completion rate than UC (15). A study by An et al., (2021) presents that the top 20% of VO_{2peak} performers were twice as likely to complete treatment without major dose adjustments (16).

In accordance with this, Lahart et al. (2015) found that PA was associated with a 41% and 34% reduction in overall mortality and BC related mortality. These effects were seen in groups that engaged in moderate to high intensity exercise. In addition, they observed a 24% reduction in BC recurrence (17).

Commonly, BC patients gain an average of 5kg bodyweight during chemotherapy, and only a few are able to return to their former body weight (10). Weight gain is associated with both higher mortality risk and recurrence, maintaining pre-diagnosis weight is important (10). Lack of PA has also been shown to be related to weight gain (18). Weak results on the various intensities provides a difficult task to understand which intensity that provides the favorable efficiency on body composition. However, training during treatment can help reduce obesity and keep a stable, healthy weight (7).

Due to the side effects of the treatment, these patients are at greater risk of cardiovascular disease (8). Positive changes in CRF are associated with reduced risk of cardiovascular disease and mortality (3). Observations show that women with moderate and high CRF, respectively had a 33% and 55% lower risk of BC related death (8). Results covered in this article indicate that HIIT has a favorable effect on CRF, which can translate to a reduction in mortality rate.

These results combined build a foundation for the argument that HIIT is a viable exercise method for BC patients. Higher CRF is also associated with maintaining weight, which is recommended during and post-treatment, as it improves BC treatment efficiency (8).

While some studies do not report a significant relationship between exercise and body composition, the correlation with exercise intensity is not found. Existing literature has established an association between overweight, obesity, and mortality (18), (19).

Comparative Review

Researching the various articles and results from the CRF assessment, some differences were found, but most presented related results. First, Møller et al., (2020) and Mijwel et al., (2018) saw a drastic decrease in VO_{2Peak} during treatment. This decrease is likely attributed to a multifactorial involving the treatment side effects after the onset of chemotherapy (9).

The main difference is that Mijwel et al., (2018) had two HIIT groups, where neither had a decrease. Only their UC group saw VO_{2peak} lower significantly (10). These results are strengthened by Isanejad et al., (2023), where only the HIIT group saw an increase VO_{2peak}, while the UC group had a decrease (8). With the moderate- to high intensity exercise program in Kirkham et al., (2019) the exercise group did not experience a decrease. VO_{2peak} was maintained relative to baseline (13). Comparing these to other existing literatures, we can see comparable results in the review article by Galvão & Newton (2015). They found that moderate- to high intensity training gave far more favorable VO_{2peak} results than low and moderate intensity (20). Observing a 16% VO_{2peak} increase in high intensity group (20).

As mentioned, the incidence of new cancer cases in Norway has increased since the beginning of the 2000s (1). This may be related to the increasingly inactive lifestyle habits of the population (2). The studies in this article did not find an association between exercise and body composition; however, other researchers have found clear correlations between body weight, body composition and exercise (18), (7), (15). In the Kolden et al. (2002) study, women with BC underwent 16 weeks of training with moderate intensity of 40-60% HR_{max}. Throughout the intervention, there was no significant correlation between exercise levels and body weight or skinfold measures (21). Based on results found in this article and existing literature there is an indication that exercise affects body composition in BC patients. There is not enough evidence on exercise intensity to conclude which gives the strongest effect.

The study by Mijwel et al., (2017) describes fatigue as the most debilitating symptom of chemotherapy and is associated with negatively impacting cancer treatment (14). There was observed an increase of fatigue in the UC group, while no increase was found in AT-HIIT or RT HIIT group (10). This study linked the fatigue increase to the CRF decrease during treatment, suggesting the HIIT programs attributes in restoring and improving VO_{2peak}, also transfer to fatigue (10). These results are coherent with the decrease of fatigue in all exercise groups, independent of the treatment program (11). Results from qualitative studies show promising effects of exercise, but a more extensive quantitative review illustrates a weak correlation with little to non-clinical importance (22).

Is it safe?

Articles included in this paper all concluded cardiovascular training to be a safe and efficient intervention for BC patients (8) (10) (21) (22). However, two studies reported injuries that occurred during the exercise intervention. None of the injuries were severe, all the patients recovered without any major consequences. Although the included studies established cardiovascular training to be safe, the study by Furmaniak et al. (2016) emphasizes a lack of evidence for the potential benefits and harms of exercise (23). Previously, the perception was that patients should preferably rest, gather strength and reduce PA (2). The concerns of potential side effects, such as immune suppression, have limited the use of exercise (8). HIIT has particularly been avoided, but sufficient evidence indicates that HIIT is safe (8), (10).

All BC patients should have a doctor, physiotherapist, or certified specialist to help assess their medical history to develop individualized exercise interventions (11). However, there are some absolute contradictions when patients should not exercise; a fever above 39 degrees, significant general malaise, low platelets – under 10, bleeding (nose bleeding), and pain worsened by exercise (7). There are also some relative contradictions that patients should be aware of and only exercise with collaboration with a doctor and/or physiotherapist. This depends on the patients experience of pain, bone metastases, pronounced fatigue or worsening of lymphedema (7).

Extensive research has consistently emphasized exercise's numerous advantages. While the included studies revealed minimal conflict, there was some disagreement regarding exercise's feasibility for BC patients. Further investigation is required beyond the intervention period to determine if these patients can continue to exercise and obtain the full benefits. Given this, the preponderance of articles today can conclude that PA and HIIT are safe.

Feasibility

The PA level is influenced by ongoing treatment, time since the previous treatment, medications, and the patient's fitness- and stress levels (2). Treatment may take a heavy toll on the physical, functional, emotional, spiritual, and social well-being of cancer patients (15). Throughout the treatment, a decline in VO_{2peak} is commonly observed (8), (9). These physiological ailments can cause patients to struggle with implementing HIIT. Therefore, it is recommended to incorporate a supervised exercise program, as health professionals counselling contributes positively to the PA compliance rate (9). Supervised exercise intervention could lead more patients to complete HIIT, allowing more patients to benefit from the improved effects. Group exercises are a highly feasible training intervention, contributing to sustained participant engagement (21). Low intensity exercises have lower efficacy in treating BC patients, but it remains a viable option for patients seeking a home-based program (12). There is sufficient evidence that PA improves CRF and the ability to tolerate medicine. In addition, it reduces the feeling of tiredness, reduces side effects from the treatment such as nausea, gives better sleep, reduces anxiety and depression, alleviates stress symptoms and improves restitution (2) (7). Patients should be encouraged to implement HIIT, even though it can be hard on the body.

Recommendations on exercise

In cases where the patient has no contraindications requiring caution, 30–60 minutes of daily PA is recommended, adapted to the patient's situation and previous experience (2). It is recommended to do activities that involve large muscle groups, such as walking, cycling or skiing (2). The frequency of exercise should be high (2). Patients should avoid heavy loads, but the intensity should be moderate to high, adapted to each individual (2). However, not everyone can exercise at a moderate to high level of intensity (7). According to Galvão et al. (2005), BC patients who exercise with low-moderate intensity will also have a positive effect (20). However, there is a clear dose-response relationship between exercise and the benefits of exercise (2).

Limitations of the study

There are some limitations in the studies included in this paper. One of the most significant weaknesses is that the patients in the included studies had different starting points before the exercise interventions. There are variations in cancer stages, treatment regimens, and fitness starting points. Several of the studies had set up a certain number of training sessions with a specific frequency, but the adherence to these sessions varied. Another area of improvement is that there are often few participants in the studies; further large-scale studies are required to provide definitive conclusions on the subject matter.

In the Uth et al., (2020) study they were affected by injuries. They experienced 21 recorded injuries in 15 participants, resulting in a median of two weeks away from training. This is a factor that has an unknown effect, but likely change the precision of the results. The attendance at this trial was also relatively low with a 43% attendance in the last 6 months (3). Hsieh et al., (2008), Kirkham et al., (2019) and Møller et al., (2020) did not have a non-exercise group to compare the significance of their results to. In addition, Kirkham et al., (2019) did a lot of home-based exercise, which is difficult to control the adherence to. This could affect the precision of their results. Van Waart et al., (2015) used maximal short exercise capacity instead of VO_{2peak}. Using VO_{2peak} instead would give us a precise comparison of results to other trials, since the majority of the other studies used $VO2_{peak}$ to evaluate CRF. Isanejad et al., (2023) used skinfold measurements to determine body composition. When used correctly skinfold measurements can be a reliable method, but it is not as reliable as an x-ray absorptiometry or hydrostatic weighting which is the gold standard (8). Long term impact of exercise intensities during cancer treatments is absent in all articles. The trials included in this article are generally no longer than a year. A year is enough to get an indication of effect, yet no define long term effects.

Future research

Most of the studies reviewed in this paper agree with the findings, lending them substantial credibility. However, further research is needed to establish a reliable correlation between cardiovascular training intensities and BC treatment efficiency. Future research should investigate whether different treatments should be combined with different exercise-regimes, or whether all forms of BC treatment benefit most from HIIT.

Long-term impact is clinically an important topic of interest. The results from short-term trials have shown promising potential benefits. Trials researching the long-term effects of the different exercise intensities could possibly uncover more benefits. The studies themselves state that while their result is significant, both their sample size and statistical power are not strong enough to prove a correlation between exercise and chemotherapy completion rates. Results show a correlation in relation to exercise, completion rates and dose reduction. Due to the importance of chemotherapy in the treatment process, the results are important and further research is required to confirm a strong correlation (12).

Several of the articles like Isanejad et al., (2023) and Møller et al., (2018) consider results related to mortality. With the addition of the review article by Lahart et al., (2015), there is strong evidence that exercise, especially higher intensity, reduces BC related mortality. A large scale RCT that purely investigates exercise intensity and its relation to mortality would be a clinically important investigation.

Mijwel et al., (2018) hypothesize that the decrease in VO_{2peak} is the reason for increased fatigue. In addition to Møller et al., (2015) presenting a correlation between increased CRF and lowered fatigue. These results present a base for future research on this topic, which could potentially be important for future BC treatment.

Conclusion

This study has explored the effects of varying intensities of cardiovascular exercise on treatment efficacy in BC patients undergoing active treatment. Findings reveal notable improvements in CRF and reductions in fatigue levels, suggesting a potential benefit of tailored HIIT regimens in enhancing the physical condition of BC patients. However, the analysis did not yield a clear correlation between exercise intensity and changes in body composition. Results show that all exercise across the different training intensities improves chemotherapy treatment completion and BC related mortality rates, but the higher intensity shows the most substantial improvements. While the evidence underscores the safety and potential benefits of PA and HIIT for this population, further research is essential to ascertain a clear association between exercise intensity and treatment outcomes over extended durations.

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