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Exercise medicine considerations for pregnancy-associated breast cancer: Characteristics, prognosis and treatment

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Abstract

Breast cancer is the most prevalent cancer in women worldwide and is the most common cancer diagnosis made during pregnancy or in the postpartum period. When breast cancer is diagnosed either during pregnancy or in the first-year postpartum, it is referred to as pregnancy-associated breast cancer. The aim of this review is to assess existing literature regarding the recommendations and outcomes of participating in exercise for people with pregnancy-associated breast cancer. The occurrence of pregnancy-associated breast cancer is increasing as a growing number of women delay first pregnancies. Women undergoing treatment for pregnancy-associated breast cancer are dealing with both cancer and its treatment as well as a pregnancy or postpartum period, and often encounter symptoms associated with cancer diagnosis and treatment, such as nausea, pain and fatigue while simultaneously navigating a pregnancy or early motherhood. These experiences can be barriers to participating in exercise, despite exercise being associated with numerous benefits for both pregnancy health and breast cancer outcomes. Numerous studies report the benefits of exercising during breast cancer treatment in ameliorating associated symptoms, and some studies report that engaging in exercise can lead to healthier and lower risk pregnancies. However, there is a lack of consensus around appropriate exercise programmes for this specific population. Given the associated benefits of participating in exercise for both breast cancer patients and pregnant/postpartum women as separate groups, research into exercise medicine designed specifically for the pregnancy-associated breast cancer population is needed.

Keywords

antenatal, oncology, physical activity, postpartum, prenatal

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Introduction

Female breast cancer is the most commonly diagnosed cancer worldwide.¹ Of those diagnosed, approximately 20% are below the age of 50,² with cases of breast cancer in women below 50 increasing by an average of 0.06% each year, accounting for 21.2% of all breast cancer deaths.³ Pregnancy-associated breast cancer (PABC) is defined as a breast cancer diagnosis being made either during pregnancy or within a year following pregnancy.⁴ In studies from Denmark, Australia, Canada, Sweden, Italy, the United States and an international cohort study, including 37 centres across 16 countries, breast cancer was found

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to be within the top three pregnancy-associated cancers diagnosed.^{5–11} Population-based studies between 1963 and 2002 in Sweden and 1999 and 2012 in the United States sought to identify cases of PABC, and researchers from both studies reported that the incidence of PABC is significantly increasing.^{12,13} Andersson et al.¹² found that the highest proportion of breast cancer cases was within the 25- to 29-year-old age group (30.1%) while Shetcher Maor et al.¹³ found that women diagnosed with PABC were more likely to be older, more likely to be Caucasian and more likely to belong to a higher income quartile. Moreover, in pregnancies complicated by breast cancer, there was a greater risk of preterm delivery (odds ratio (OR): 4.84, 95% confidence interval (CI): 4.05–5.79) and preterm premature rupture of membranes (OR: 1.79, 95% CI: 1.06–3.05).⁹ In this review, we describe the symptoms and treatment of PABC, focusing on how these symptoms are important to consider when prescribing exercise medicine for PABC, given the recommendations and beneficial effect of exercise for both pregnant/postpartum women and breast cancer patients as separate populations.

Symptoms and characteristics of PABC

The most common symptom of breast cancer is a painless lump or thickening in the breast.¹⁴ Other signs and symptoms can include a difference in size, shape or appearance of the breast¹⁵; breast pain¹⁵; dimpling redness, pitting or other alteration of the skin¹⁴; change in nipple appearance or skin surrounding the nipple¹⁴; inversion of nipples¹⁴; and/or abnormal nipple discharge^{14,15} and axillary lumps or symptoms of distant spread such as bone pain. Al-Amri¹⁶ reports that signs and symptoms of locally advanced disease, including pain, skin thickening, ulcers, skin redness, nipple retraction and discharge, were more than double in PABC patients than non-PABC patients.

Studies suggest that there can be a delay in the diagnosis of PABC, with one study reporting that 60% of PABC patients received a late diagnosis.^{16,17} In this study, 56 patients, including PABC and non-PABC patients, were interviewed to assess delays in diagnosis and causes of delays.¹⁶ None of the non-pregnant breast cancer patients received a late diagnosis. This could be due to physical breast changes associated with pregnancy, which can make it difficult to distinguish a breast mass in a pregnant woman,¹⁸ resulting in PABC patients tending to receive a more advanced diagnosis.^{17,19}

PABC treatment

Breast cancer treatment can vary with cancer stage, hormone receptor and other biomarker status as well as general health status.²⁰ The main treatments for breast cancer include surgery, radiation therapy and systemic

treatments.¹⁴ However, when a breast cancer patient is pregnant, there are additional factors such as the clinical presentation and trimester of pregnancy²¹ that must be taken into consideration when planning treatment, with treatment sequencing and planning needing expert multi-disciplinary input, including both the cancer team and the obstetric and neo-natal teams. Otherwise, treatment for PABC should follow standard treatment for non-PABC as closely as possible.¹⁹ Timing of surgery, anaesthesia and type of surgery considerations will depend on the trimester of pregnancy and the patient, with more patients undergoing mastectomy and reconstruction avoided. Radiotherapy is not given during pregnancy, chemotherapy is reserved until after the first trimester and targeted and endocrine therapies delayed until after delivery.^{14,17,22–25}

Adverse effects associated with treatment

There are undesirable physical impacts that are associated with cancer treatments.²⁶ Cancer treatments, particularly chemotherapy, generally have a negative impact on patients' quality of life.²⁷ Fatigue, nausea and vomiting are common with chemotherapy.²⁶ Numbness, pain, insomnia, distress, dyspnoea, memory loss and sadness also worsen during treatment.²⁷ Women undergoing chemotherapy are also likely to have vulnerable immune systems.²⁶ Treatment-related side effects are among the most common barriers to commencing or maintaining physical activity (PA).^{28,29}

Cancer treatment can also be associated with psychological distress, including increasing the risk of anxiety and depression.^{26,27} Cancer-related issues such as poor body image can negatively affect breast cancer patients' social relationships. As a result, a strong support network is associated with improved health outcomes for breast cancer patients.²⁶ For example, women who are socially integrated are more likely to survive breast cancer than socially isolated women and are less likely to experience a relapse when they have larger social networks.²⁶

Prognosis for PABC

There appears to be a poorer prognosis for people diagnosed with PABC compared with non-pregnant breast cancer patients. A population-based cohort study of women diagnosed with breast cancer between 1994 and 2009 in Sweden concluded that PABC patients have a higher mortality rate than other breast cancer patients,³⁰ and a systematic review found PABC to be associated with poorer prognosis for overall, disease-free and cause-specific survival.³¹ This could be attributed to a delayed diagnosis due to pregnancy and breastfeeding, but the exact reasons for poorer prognosis are not well understood.³¹ However, some studies have reported that prognosis in PABC patients is similar to that of the non-PABC patients.^{32,33}

Exercise medicine for PABC: current literature

To evaluate the relationship between exercise and PABC, we performed a literature search of the PubMed database from 1988 until November 2022 with the following search terms used: ‘breast cancer’ and (‘pregnancy’ or ‘post-partum’) and (‘Exercise’ or ‘Physical activity’). We excluded studies if (1) they involved mixed cancer patients without specific information on results from patients with breast cancer and (2) they were written in a language other than English. The search returned 114 results. The titles and abstracts of all articles identified through the search strategy were screened and evaluated by 2 reviewers (B.F. and F.S.). However, we found no articles that referred to breast cancer during pregnancy or the postpartum period and exercise or PA, and moreover no recommendations for exercising with PABC were found. However, recommendations exist for exercise medicine associated with cancer treatment^{34,35} during pregnancy and the postpartum period,^{36–38} with an array of benefits accruing for both breast cancer patients and those pregnant or postpartum.

Physiological basis of exercise

Participation in exercise results in numerous acute and chronic physiological changes that can improve health outcomes. Engaging in exercise leads to improvements in physical function,³⁹ muscular strength,⁴⁰ muscle mass⁴¹ and bone density,⁴² and reduces the risk of and improves metabolic syndrome.^{43–45} Cardiovascular functioning can also be improved through increasing oxygen carrying capacity, heart mass and cardiac output as well as more efficient energy production in the muscles.⁴⁶ In addition, it can decrease inflammation, and moderate-intensity exercise specifically is associated with a lower risk of illness.⁴⁷ Breast cancer patients can experience a range of treatment-related side effects, including decreased bone mineral density,⁴⁸ aerobic capacity,⁴⁹ strength,⁵⁰ physical function and negative changes in body composition.⁵¹ Given the physiological response and adaptations to exercise and the resulting potential positive effect exercise has on treatment-related side effects,³⁵ exercise therefore has an important role in cancer care.

Exercise and breast cancer treatment

Exercise is a well-known and effective strategy to manage cancer and treatment-related adverse effects and to improve quality of life.^{52,53} Exercise refers to planned, repetitive and structured PA with the main objective of improving health and physical fitness, whereas PA is any bodily movement produced by skeletal muscle requiring energy expenditure above resting levels, and could include daily activities such as housekeeping, transportation (e.g.

walking/cycling) or be occupationally related.⁵⁴ It is well established that exercise is a safe and feasible intervention that can improve fatigue,^{55,56} cardiorespiratory fitness, neuromuscular strength³⁵ and physical functioning in breast cancer patients undergoing radiation and chemotherapy⁵⁷ and after completion of treatment.⁵⁸ In addition, exercise can also improve chemotherapy tolerance.⁵⁹

Cancer-related fatigue can be caused by either the tumour itself or the cancer treatment and is associated with a loss of muscle mass, decline in cardiorespiratory capacity, and other negative patient outcomes. Exercising for 90 min per week during radiotherapy and chemotherapy can combat cancer-related fatigue and promote a higher functional capacity.^{60,61} Specifically, resistance training can inhibit muscle loss and weakness and aerobic training can ameliorate the decline in endurance performance that is often induced by these treatments.⁴⁰ A study conducted by Reis et al.⁶² tested the effects of aerobic, resistance and flexibility exercise in breast cancer patients undergoing chemotherapy and radiation treatment. The findings were a decrease in total pain and the extent to which pain interfered in daily life. Moreover, the patients’ maximum oxygen uptake, flexibility and muscle strength also increased as a result of exercise training. Similar results for physical functioning and aerobic capacity have also been reported in early randomized controlled trials of exercise during breast cancer treatment by Courneya et al.⁶³ and Segal et al.⁶⁴

In addition to physical benefits, exercise improves breast cancer patients’ mental health. Physical exercise could act as a protective measure for depression and reduce mental stress through aiding functional improvements and overall strength.⁶⁰ Ortega et al.⁶⁵ reported that patients who engaged in PA and improved their mental well-being also improved their perceived quality of life. They also noted that PA is often associated with improved quality of sleep through reduced sleep disturbance, improved emotional aspects and reduced depression and anxiety. A summary of the benefits associated with exercise participation for breast cancer patients can be seen in Figure 1.

Facilitators and barriers to exercising in breast cancer patients

The main facilitators to engage in exercise and PA for breast cancer patients include managing emotional and mental well-being,²⁸ body image improvements, peer social support and interaction, gaining a sense of independence and control and health improvements.^{29,66} Some of the barriers to patients participating in PA include cancer symptoms and treatment-related side effects, lack of clear information about PA, time, motivation and access to facilities.^{28,29,66} Treatment-related side effects are one of the most common barriers, and most of these can be alleviated by engaging in exercise.⁶⁷ Fatigue in breast cancer patients can

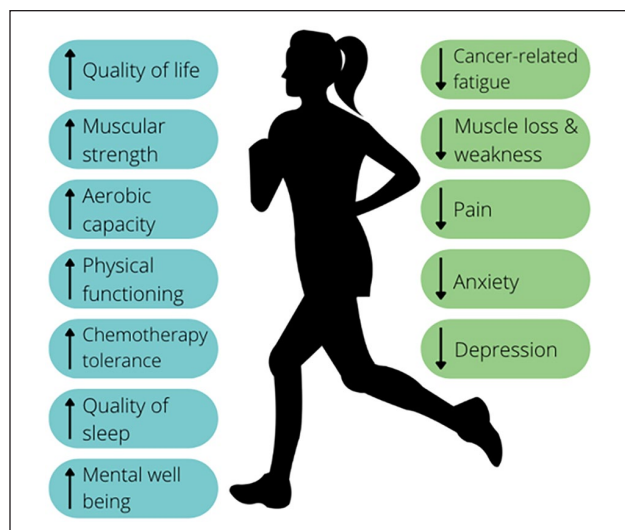


Figure 1. Benefits associated with exercise for breast cancer patients.

lead to a vicious cycle of inactivity, which contributes to deconditioning, emotional stress and sleep disturbance further exacerbating fatigue.⁶⁸ Therefore, facilitators and barriers need to be considered in order to enhance participation of patients in exercise.

Recommendations for exercise medicine in breast cancer management

The way that exercise and PA are communicated and promoted to each breast cancer patient is important. Ortega et al.⁶⁵ stress the importance of health professionals communicating clear and detailed information about PA once a diagnosis has been established. Segal et al.⁶⁹ conducted a systematic review on existing guidelines on exercising for cancer patients and concluded that moderate amounts of exercise can be safely undertaken by people receiving cancer treatment and those who have concluded cancer treatment. Ideally, people living with cancer should aim to participate in 150 min of moderate-intensity aerobic exercise over 3–5 days, and resistance training involving the major muscle groups at least 2 days per week. It is also recommended that patients exercise in a group or supervised environment. In a similar fashion, Luan et al.⁷⁰ recommend low- to moderate-intensity aerobic and resistance exercise over the long term to be helpful for breast cancer patients' rehabilitation, and that aerobic exercise, resistance exercise and combination training are the main modes of exercise. A systematic review of clinical practice guidelines on exercise for post-treatment breast cancer patients by del-Rosal-Jurado et al.⁷¹ found that a common recommendation across clinical guidelines was for exercise to be individualized to the patient by considering the personal characteristics of the patient, type of treatment received

and any adverse effects being experienced. In addition, exercise should be supervised by a healthcare professional to promote greater benefits.

Exercise & Sports Science Australia (ESSA) has similar recommendations, encouraging clinicians to also utilize an individualized exercise prescription to ensure the greatest benefits are achieved with the lowest time commitment and risk of harm.³⁵ Clinicians and exercise professionals should take into consideration the patient's family history, comorbidities, cancer diagnosis, treatment, side effects and exercise history, and prioritize current issues with the biggest impact on health and survival. Each patient's contraindications, constraints (psychological, physiological and economic), accessibility, preferences, self-efficacy, barriers and facilitators to exercise and individual goals should also be considered in developing the exercise prescription.³⁵ A combination of aerobic and resistance training has been shown to have numerous benefits for complications that can arise from breast cancer and treatment undertaken,^{60,65} and supervised exercise programmes are more effective in improving physical function and quality of life than unsupervised exercise programmes.⁷² Exercise dose should be targeted and individualized to each patient. To achieve this, Hayes et al.³⁵ recommend following a process that considers patient health issues to focus on ameliorating the most impactful issues on health and survival, their capacity to exercise, suitability of intervention and recommend prescribing exercise based on patient exercise-related goals.

Current exercise recommendations for pregnant women

The World Health Organization⁷³ recommends that pregnant and postpartum women engage in 150 min of moderate-intensity PA per week, to include a variety of both aerobic and muscle-strengthening activities and to limit the amount of sedentary time.⁷³ Savvaki et al.³⁸ reviewed international guidelines for exercise during pregnancy, finding recommendations from nine countries, including Australia, Canada, the United Kingdom and the United States. All guidelines recommend between 60 and 150 min per week of aerobic training, with a maximum of 30 min per day, and five guidelines also recommend resistance training. However, there were discrepancies among the guidelines on the intensity of exercise and its evaluation. Guidelines from some countries recommend using heart rate to gauge intensity, although the recommended heart rate targets differed among countries, while others recommended subjective measures such as Borg's Rating of Perceived Exertion (RPE) scale⁷⁴ and the talk test in their exercise guidelines. Overall, Savvaki et al.³⁸ recommend that exercise should be adapted to meet the needs of the pregnancy and woman.

In Australia, renewed government guidelines for PA during pregnancy were released in May 2021³⁶ and are similar to the Canadian guidelines that were proposed by Mottola et al.⁷⁵ as a preventive and therapeutic measure to reduce pregnancy complications, optimize health and improve quality of life. The Canadian recommendations suggest that pregnant women should participate in moderate PA for at least 150 min per week over a minimum of 3 days in order to achieve clinically meaningful reductions in the odds of developing gestational complications.⁷⁵ The Australian guidelines recommend participating either in moderate PA for between 150 and 300 min per week or in vigorous PA for between 75 and 150 min per week over most days of the week.³⁶ Resistance training is recommended at least 2 days a week, and breaking up long periods of sitting or standing and engaging in pelvic floor exercises are also encouraged.³⁶ A variety of aerobic and resistance training activities are recommended for greater benefits, while yoga or gentle stretching could also have positive impact.^{36,75}

Both the Australian Government Department of Health³⁶ and Mottola et al.⁷⁵ suggest that monitoring heart rate and using the talk test are suitable ways of gauging appropriate intensity. However, if the woman is unable to hold a conversation, then the intensity should be reduced according to Mottola et al.⁷⁵ Savvaki et al.³⁸ state that using Borg's RPE scale⁷⁴ is an appropriate way of gauging intensity, and that intensity should be kept between 12 and 14 (equivalent to moderate or somewhat hard on the 6–20 scale).

There has been some research into vigorous activity in the third trimester. In a systematic review and meta-analysis, Beetham et al.⁷⁶ found that vigorous exercise is safe in the third trimester for most pregnancies but noted that women carrying foetuses with a lower weight should be cautious about undertaking vigorous exercise. In their review, they excluded studies that included participants with gestational diabetes mellitus and found a significant increase in length of gestational age and a small but significant reduction in the risk of prematurity.⁷⁶

Although there are specific time recommendations for PA, daily PA is encouraged, because any activity has some benefit. In fact, there is evidence to suggest that not engaging in PA increases the odds of pregnancy complications.^{75,77} However, some activities are not recommended due to the associated risks, including contact sports, activities with a risk of falling, activities involving a change in atmospheric/hydrostatic pressure (e.g. scuba diving and skydiving), heavy lifting and special considerations for exercising in hot or humid conditions. The importance of maintaining adequate nutrition and hydration as well as continuous consultation with an obstetric healthcare provider for safety reasons is emphasized by both the Australian Government's Department of Health³⁶ and Mottola et al.⁷⁵ A summary of exercise recommendations for both breast cancer patients and for those who are pregnant is shown in Table 1.

The Canadian recommendations note that exercise during pregnancy is associated with a reduced chance of gestational complications, without increasing chances of adverse outcomes, such as preterm birth, miscarriage and prenatal mortality. In the first trimester, odds of miscarriage or congenital abnormalities do not increase with exercise.⁷⁵ However, there are some absolute and relative contraindications to PA during pregnancy, such as higher-order multiple pregnancies, cardiovascular or respiratory disease, type 1 diabetes, malnutrition, significantly underweight, history of an eating disorder or persistent and unexplained vaginal bleeding.^{36,75} A US study found that in 2018, there were 93 per 100,000 births that were twins or higher-order multiple pregnancy.⁷⁸ In a London survey with a sample of 739 participants, 7.5% of pregnant women met the diagnostic criteria for an eating disorder.⁷⁹ Between 2005 and 2008 in Australia, 0.3% of pregnancies were complicated by Type 1 diabetes,⁸⁰ while in another Australian study of 27,814 singleton births, 5.6% of mothers were underweight.⁸¹ As a result, although these contraindications are not commonly encountered, if there is any condition present that is severe enough to prevent a patient from receiving breast cancer treatment, then this would negatively impact their prognosis.

In addition to the positive effect of engaging in PA during pregnancy, there have also been psychological improvements reported. PA is associated with a lower risk of postpartum depressive symptoms⁷⁷ and reduced insomnia, anxiety and depression during pregnancy.⁸² Improved psychological well-being during pregnancy is also associated with positive outcomes for mothers.⁸³

Barriers to exercising for pregnant women

Pregnant women face other barriers to participating in PA in addition to concerns about the health of the foetus. These can include the presence of health conditions, tiredness, pain, lack of motivation, lower self-confidence and a lack of time to engage in PA.⁸⁴ Pregnant women who were active before their pregnancy have similar experiences such as concern for the health of the foetus and pregnancy-related discomfort but are more likely to modify or change activity to a lower intensity than cease PA all together.⁸⁵ A lack of knowledge and understanding of the types of PA that is safe for them to participate in as well as a lack of knowledge on how to access reliable information on PA during pregnancy are also limiting factors.⁸² Although there are benefits to engaging in PA during pregnancy, many women avoid it due to unfounded concerns, which may include increasing the risk of miscarriage, growth restriction, preterm birth, fatigue and causing harm.⁷⁵ These notions could be attributed to a lack of ability to gauge the health of the foetus when engaging in PA, and unclear or inconsistent advice from health professionals.⁸² However, these concerns are not supported by research,⁷⁵ and in fact, there is evidence to suggest that inactivity is

Table 1. Summary of exercise recommendations for both breast cancer patients and for those who are pregnant.

	Exercise recommendations for breast cancer patients	Exercise recommendations during pregnancy
Aerobic	<ul style="list-style-type: none"> 150 min of moderate-intensity aerobic exercise over 3–5 days.⁶⁹ 	<ul style="list-style-type: none"> 60–150 min per week of aerobic training, with a maximum of 30 min per day.³⁸ 150–300 min moderate-intensity PA or 75–150 min of vigorous PA.^{36a}
Resistance	<ul style="list-style-type: none"> Resistance training involving the major muscle groups at least 2 days per week.⁶⁹ 	<ul style="list-style-type: none"> Resistance training 2 days per week.³⁶
Combination	<ul style="list-style-type: none"> Include both aerobic and resistance exercise.⁷⁰ 	<ul style="list-style-type: none"> Include both aerobic and muscle-strengthening activities.^{36,73}
Intensity	<ul style="list-style-type: none"> Preferably moderate intensity of aerobic and resistance exercise⁷⁰; however, exercise dose should be targeted and individualized to each patient.³⁵ Aerobic training: 50%–75% VO₂ max or HR reserve, 60%–80% HRmax, or a RPE of 11–14 (moderate-somewhat hard). Resistance training: 50%–80% of 1-repetition maximum or 6–12 repetition maximum. 	<ul style="list-style-type: none"> Moderate-intensity PA.^{73,75} Talk test to gauge intensity.^{38,75} Aerobic training: 50%–60% VO₂ max or 60%–70% of HR reserve, or use Borg's RPE scale, 12–14 is suitable (moderate-somewhat hard).³⁸ Resistance training: 1 set, 12 repetition – light weights.³⁸
Frequency	<ul style="list-style-type: none"> 150 min of moderate-intensity aerobic exercise over 3–5 days.⁶⁹ At least 2 days per week up to 3 times per week of resistance training with rest days between sessions. 	<ul style="list-style-type: none"> 60–150 min per week of aerobic training, with a maximum of 30 min per day over a minimum of 3 days.^{38,75} Resistance training 2 days per week.³⁶
Other	<ul style="list-style-type: none"> Individualized exercise prescription.^{35,71} Preferably exercise in a group environment.⁶⁹ Preferably exercise should be supervised by health professional with exercise science knowledge.⁷¹ Clinicians and exercise professionals should take into consideration the patient's family history, comorbidities, cancer diagnosis, treatment, side effects and exercise history and prioritize current issues with the biggest impact on health and survival.³⁵ 	<ul style="list-style-type: none"> Minimize and break up sedentary time.^{36,73} Perform pelvic floor muscle exercise (e.g. Kegel exercises) on a daily basis.⁷⁵ Exercise should be adapted to meet the needs of the pregnancy and woman.³⁸ Daily PA is encouraged and will have some benefit.^{75,77} Avoid contact sports, activities with a risk of falling, involving a change in atmospheric/hydrostatic pressure (e.g. scuba diving and sky diving), isometric exercise and heavy lifting.^{38,75} Special considerations should be given for exercising in hot or humid conditions.⁷⁵ Maintain adequate nutrition and hydration.^{36,75}

PA: physical activity; VO₂ max: maximal oxygen uptake; HR: heart rate; HRmax: maximal heart rate; RPE: rating of perceived exertion.

^aAustralian guidelines only.

associated with less favourable health outcomes during pregnancy.⁷⁷ Consequently, although there are concerns among women about the effects of exercise while they are pregnant, the evidence suggests that the health benefits associated with PA outweigh the risk of inactivity for pregnant women and their foetuses.^{36,75}

Exercise recommendations for postpartum women

The Australian guidelines state that a gradual return to PA levels prior to pregnancy is generally considered safe after the 6-week postnatal check; however, this varies depending on individual circumstances.³⁶ This variability is attributed to the type of birth, recovery from perineal damage, medical or surgical procedures, blood loss and pre-pregnancy PA levels.⁸⁶ As a result, it is recommended to seek guidance with a healthcare professional before resuming or commencing PA following birth.⁸⁷ In addition, the World Health Organization recommends engaging in at

least 150 min of aerobic activity, incorporating a variety of aerobic and muscle-strengthening exercises, and minimizing sedentary time.³⁷ Reaching the recommended 150 min should be achieved through gradual exercise progression following the 6-week check-up.³⁶

Clinical implications

Exercise can potentially be an important part of treatment for PABC patients not only to improve treatment-related symptoms but provide physiological and psychological health benefits. Given the numerous positive outcomes that breast cancer patients could gain through engaging in exercise,^{35,55–58} it is vital that PABC patients receive an appropriate exercise prescription based on each patient's priority needs, barriers and circumstances. Patients can be referred to exercise health professionals such as accredited exercise physiologists, so that a targeted and appropriate supervised exercise programme can be prescribed to support and provide an array of benefits.^{71,72}

Exercise medicine considerations for women with PABC

Existing guidelines cover exercise recommendations for breast cancer and its treatment phases (pre-treatment, treatment, survivorship and palliation) and separately for pregnant and postpartum women. However, a substantial gap exists as there has been no research on exercise for women with PABC. As commonly observed, it may be that among women with PABC, exercise promotes significant benefits by reducing treatment-related side effects and enhancing quality of life through the course of treatment and beyond. In addition, there could be benefits for maternal health such as a lower risk of gestational complications and postpartum depression. For instance, there are higher rates of caesarean section, preterm birth and labour induction in women diagnosed with pregnancy-associated cancer.⁹ Similarly, an increased risk of preterm premature rupture of membranes in PABC patients has been reported.¹³ However, Evenson et al.⁸⁸ found that in pregnant women without breast cancer, PA is associated with a lower caesarean rate, preterm birth, preterm/pre-labour rupture of membranes and induction of labour. Given the delivery risks associated with PABC, prescribing exercise to PABC patients based primarily on the recommendations for exercise during pregnancy/postpartum in combination with the exercise recommendations for cancer patients could reduce the risks for some undesirable delivery outcomes while providing additional physical and mental health benefits. Therefore, when prescribing exercise to patients with a PABC diagnosis, clinicians should refer these patients to an exercise health professional. Exercise health professionals are encouraged to use recommended guidelines for exercise during pregnancy while referring to and consulting with guidelines for prescribing exercise for cancer patients, and ensuring that the prescription is individualized and adapted to each PABC patient's capability.

Limitations

To our knowledge, this is the first narrative review focusing on PABC and exercise considerations. Given the lack of published research in this area, a strength of this review is the exercise considerations for this cohort of women within this underdeveloped field which are based on those for women during pregnancy and for persons with cancer. Consequently, limitations of this review are that there are no exercise intervention trials within this field to provide guidance for this patient cohort. Moreover, and as a result, this review does not consider the exercise needs or capability of women specific to the timing of their pregnancy/postpartum (e.g. recommendations for first vs second vs third trimester, or 6 weeks postpartum vs 6 months postpartum) due to gaps in the literature. In addition, it is possible that these exercise recommendations may not translate to this specific population since they are based on separate

recommendations for breast cancer patients and pregnant/postpartum women, given there are presently none for PABC patients. As a result, future well-designed exercise trials in this patient group are required to provide the evidence base for exercise recommendations to enhance patient outcomes.

Conclusions

Breast cancer is one of the most common cancers encountered during pregnancy and the postpartum period, and with the incidence of PABC increasing as more women delay their first pregnancies, there is a need for specific research in women with PABC especially in the use of exercise given the numerous physical and psychological benefits for both breast cancer patients and pregnant women. Consequently, future research should seek to assess the feasibility of prescribed exercise programmes and the benefit of such programmes designed specifically for PABC patients. Presently, clinicians may consider referring patients to exercise health professionals who can use existing exercise guidelines during pregnancy when prescribing for women diagnosed with PABC. Consideration should also be given to recommendations for exercise prescription for breast cancer patients where the exercise health professional can target a specific exercise prescription to ensure the greatest benefit and a low risk of harm to the patient. It would also be beneficial to consider barriers to exercise participation for this population in future projects to help encourage exercise participation.

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Not applicable.

Consent for publication

Not applicable.

Author contribution(s)

Brianna Fleay: Conceptualization; Formal analysis; Investigation; Methodology; Project administration; Writing – original draft; Writing – review & editing.

Favil Singh: Formal analysis; Methodology; Project administration; Supervision; Writing – review & editing.

Christobel Saunders: Conceptualization; Supervision; Writing – review & editing.

Dennis R Taaffe: Methodology; Supervision; Writing – review & editing.

Daniel A Galvão: Methodology; Supervision; Writing – review & editing.

Robert U Newton: Methodology; Supervision; Writing – review & editing.

Caitlin Fox-Harding: Conceptualization; Methodology; Project administration; Supervision; Writing – review & editing.

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