

REVIEW

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Challenges and opportunities for improving cardiovascular health in women with breast cancer: a review

Sana Ali^{1,4*} and Kerri A. Mullen^{2,3}

Abstract

Background Breast cancer survivors are at a high risk of developing cardiovascular disease (CVD) owing to cancer treatment. Breast cancer and CVD share common risk factors, necessitating CVD risk assessment along with cancer screening. This review aimed to explore the challenges and opportunities associated with promoting cardiovascular health in women with breast cancer.

Main text Cardio-oncology is a rapidly developing discipline that focuses on identifying, monitoring, and managing CVD in cancer patients. Preventing and managing CVD in patients with breast cancer involves evaluating risk factors, initiating cardioprotective medications, and implementing cardio-oncology rehabilitation. Major barriers to cardio-oncology prevention and management include inadequate programs, sex/gender-specific issues, financial constraints, underutilization of cardiac rehabilitation (CR), determination of the appropriate time to begin CR, physical limitations, psychological issues, and social and racial disparities.

Conclusion A preventive cardio-oncology approach; early identification of cardiotoxicity, CVD risk factors, anxiety, and depression; individualized CR programs; early CR referrals; home/community and virtual CR models; dedicated funding, resources, and personnel; a multidisciplinary team approach; and culturally tailored cardio-oncology care can be beneficial for addressing CVD health challenges and disparities in women with breast cancer.

Keywords Cardio-oncology, Cardiovascular health, Breast cancer, Cardiotoxicity, Cardiac rehabilitation, CVD risk factors, Prevention, Challenges

Introduction

Approximately one-quarter of all new cancer cases diagnosed in women in Canada are breast cancer and the five-year net survival rate of women with breast cancer is 89% [1, 2]. The improved survival rate of patients with breast cancer is attributable to advancements in cancer screening and treatment. Anthracyclines, radiation therapy to the chest, and human epidermal growth factor receptor 2 (HER2) treatments, such as trastuzumab, have contributed to improved survival rates in patients with breast cancer; however, these treatments are also associated with cardiotoxicity [3–6]. These cardiotoxicities include left ventricular (LV) dysfunction (> 10% decrease from baseline or LVEF < 53%), hypertension, myocardial

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ischemia, arterial thrombosis, and arrhythmias [7]. The risk of cardiovascular disease (CVD) increases in postmenopausal women receiving anti-estrogen therapy for breast cancer [8] and in patients with breast cancer receiving left-sided radiation therapy [9]. Tamoxifen appears to have cardioprotective effects; however, these effects do not persist long-term, and there is no reduction in cardiovascular (CV) events [8, 10, 11]. Aromatase inhibitors (AIs) are associated with a higher risk of hypercholesterolemia and CV events. The selection between AIs and tamoxifen is primarily influenced by the benefits and risks of venous thrombosis (tamoxifen), bone loss (AIs), and arthralgia (AIs) [8, 10].

Cancer and CVD are significant factors contributing to global morbidity and mortality. In the United States, women are typically diagnosed with breast cancer at a median age of 62 [12], and 83% of breast cancer cases in Canada are diagnosed in women over 50 years of age [13]. The management of pre-existing comorbidities, such as diabetes and hypertension, affects the prognosis of older patients with breast cancer [8]. Identifying and managing CV risk factors in this group is crucial because CVD is the leading cause of mortality among elderly women, surpassing breast cancer [8, 14]. Individuals living five years following cancer diagnosis face a 1.3 to 3.6 times higher risk of dying from CV-related death and a 1.7 to 18.5 times greater likelihood of developing CVD risk factors, including hypertension, diabetes mellitus, and dyslipidemia, compared to individuals who do not have a history of cancer [15]. Therefore, it is essential to prioritize improving risk assessment and developing personalized preventive strategies in cancer survivorship programs to decrease CVD mortality and improve the health outcomes of patients with breast cancer [8]. Cardio-oncology is a rapidly developing field that focuses on identifying, monitoring, and managing CVD that can occur as an adverse effect of chemotherapy and radiation therapy [16]. This review aimed to explore the challenges and opportunities for CVD prevention and health promotion in women with breast cancer, extending beyond the existing recommendations for managing CVD.

Search strategy

A search of MEDLINE via Ovid and PubMed was conducted using the following terms: breast cancer AND (cardiovascular disease OR cardiac) AND (prevention OR rehabilitation OR cardiac health promotion OR management) AND (challenges OR barriers OR facilitators). Articles published in English between 2013 and 2024 were included in this review.

Prevention and management of cardiovascular diseases in patients with breast cancer

The management and prevention of CVD in patients with breast cancer involves 1) evaluation of pre-existing CVD and baseline CV and breast cancer risk factors and cancer treatment-related cardiovascular toxicity (CTR-CVT), 2) initiation of pharmacological therapies for patients at high and very high risk of CTR-CVT, and 3) implementation of a cardio-oncology rehabilitation program that encompasses exercise and management of CV risk factors (Fig. 1).

Identification of cardiotoxicity and cardiovascular risk factors

Patients diagnosed with breast cancer are at risk of developing CVD, which can be attributed to various factors, such as cardiotoxicity caused by cancer treatment, pre-existing CV conditions, risk factors, and lifestyle issues (e.g., unhealthy diet, tobacco use, increased stress, physical inactivity, and weight gain) [17]. It is crucial to identify CTR-CVT and its risk factors for the early identification of cardiotoxicity in patients with breast cancer and to provide appropriate cardio-oncology care. Patients with cancer, as defined by the American Society of Clinical Oncology (ASCO), are at an increased risk of developing cardiac dysfunction if they receive high-dose anthracyclines, high-dose radiation when the heart is within the treatment area, lower-dose anthracyclines followed by trastuzumab treatment, low-dose anthracyclines combined with low-dose radiation, low-dose anthracyclines, or trastuzumab with additional risk factors such as age greater than 60 years, ≥ 2 CVD risk factors, and a history of CVD [8].

Breast cancer and CVD share numerous common risk factors, including age, family history, diet, alcohol consumption, obesity, hormone therapy, tobacco use, and lack of physical activity [8, 14]. For example, obesity increases the probability of developing breast cancer and CVD, particularly in postmenopausal women [9]. One study found that in postmenopausal women with early stage breast cancer, cardiometabolic risk factors, such as waist circumference, hypertension, high cholesterol, and type-2 diabetes, were associated with increased mortality related to CVD and other causes; however, not significantly associated with breast cancer mortality [18].

CV risk assessment should be concurrently considered with cancer screening or management, and utilization of CVD risk scores may prove to be of great significance in this regard. CVD risk scores designed for the general population or individuals with a history of adult or childhood cancer [19–21] may be invaluable for predicting the late effects of cancer treatment and cardio-oncology prevention owing to the lack of validation, short follow-up,

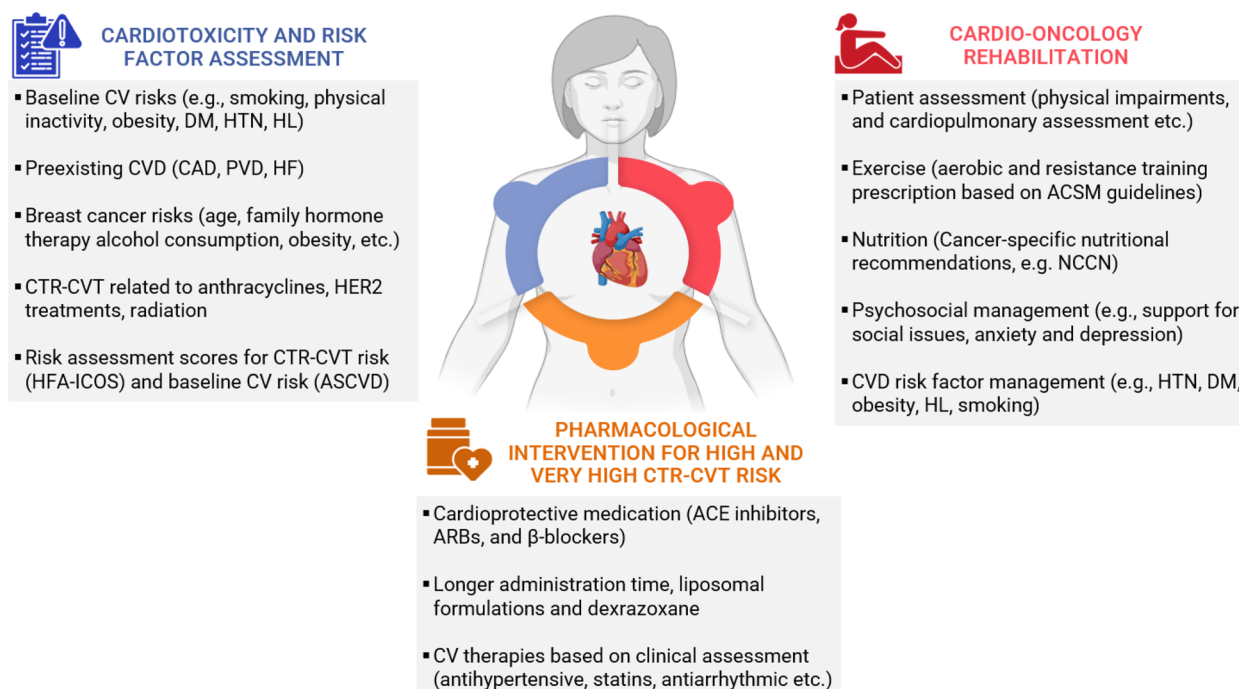


Fig. 1 Prevention and management of cardiovascular diseases (CVD) in patients with breast cancer

ACSM: American College of Sports Medicine; ACE inhibitors: angiotensin converting enzyme inhibitors; ARBs: angiotensin receptor blockers; ASCVD: atherosclerotic cardiovascular disease; BC: breast cancer; CAD: coronary artery disease; CTR-CVT: cancer treatment-related cardiovascular toxicity; CV: cardiovascular; CVD: cardiovascular diseases; DM: diabetes mellitus, HER2: human epidermal growth factor receptor 2; HF: heart failure; HFA-ICOS: Heart Failure Association-International Cardio-oncology Society HL: hyperlipidemia; HTN: hypertension; NCCN: National Comprehensive Cancer Network; PVD: peripheral vascular disease. Acknowledgements: Icon created by Wahyu Eko Prasetyo, BinikSol, & Shocho from Noun Project and picture from <https://BioRender.com>

and retrospective design that lacks contemporary treatment regimens [14, 22]. In addition, few retrospective risk scores exist for patients with cancer, with the majority being developed for specific cancer types and not readily applicable to other malignancies. To evaluate the pretreatment risk of CTR-CVT, HFA-ICOS risk assessment tools should be considered because of their ease of use and implementation in oncology and hematology settings [23]. Alternative CV risk calculators (e.g., SMART risk score, ADVANCE risk score, SCORE2, SCORE2-OP, U-Prevent, lifetime risk calculators, and ASCVD risk score) can be considered for CV risk assessment at baseline, considering that cancer itself may increase the risk of CVD [23].

Initiating cardioprotective medication

Patients who have pre-existing CVD and are receiving potentially cardiotoxic therapy may be treated with cardioprotective medications, which are typically initiated by cardiologists in collaboration with an oncologist. Pharmacotherapies, including angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs)

and beta-blockers, have clinical evidence suggesting cardioprotective effects and risk reduction during breast cancer treatment [10, 14, 23–25]. These medications are commonly used as cardioprotective agents, particularly in patients with hypertension [8, 10, 14]. The use of cardioprotective medications and CV therapies (mineralocorticoid receptor antagonists, antiarrhythmic medications, antihypertensive medications, statins, and antiplatelet therapies) for any CTR-CVT necessitates comprehensive clinical assessment and diagnostic evaluation [23]. The use of cardioprotective agents can help prevent clinical heart failure and chemotherapy-induced cardiotoxicity, thereby reducing the risk of cardiac-related mortality and morbidity [14, 26]. The 2022 European Society of Cardiology guidelines recommends considering the use of ACEIs, ARBs, and beta blockers for patients who are at high or very high risk of CV toxicity receiving anthracycline and/or anti-HER2 therapies [23]. Multiple methods have been proposed to improve the safety of anthracyclines, including administering them for longer periods and using liposomal formulations and dexrazoxane in patients at high and very high risks of CTR-CVT [10,

14, 23]. Dexrazoxane has been established as an effective cardio protectant and can be used in conjunction with doxorubicin in breast cancer patients with high or very high risk of CTR-CVT who receive a cumulative dose of 300 mg/m² and scheduled to continue receiving this therapy [8, 23, 24, 27]. Although dexrazoxane has potential benefits, its use in clinical practice is limited. The previously held perception that dexrazoxane reduces the efficacy of anthracycline persists despite the lack of supporting evidence in the current studies [27]. A Cochrane review demonstrated the efficacy of dexrazoxane in preventing and reducing cardiotoxicity in adults receiving anthracycline, with no negative effects on the tumor response rate, overall survival, and progression-free survival [28].

Cardio-oncology rehabilitation for patients with breast cancer

Cardiac rehabilitation (CR) plays an important role in CVD prevention and management [17, 29, 30], and the benefits of exercise-based CR have been well documented in reducing CVD mortality and hospital admissions while enhancing the quality of life for individuals with CVD [31, 32]. The Cardio-Oncology Rehabilitation (CORE) guidelines developed by the American Heart Association (AHA) identify patients at high risk for CVD, particularly those who experience cardiotoxicity as a result of cancer therapies, and use a comprehensive approach to address the cardiovascular health and overall well-being of patients with cancer [15]. This model employs a CR multimodal approach that incorporates various components such as patient assessment, exercise, nutrition, management of CVD risk factors (including high blood pressure, diabetes mellitus, weight, lipids, and smoking), and psychosocial interventions to improve physical and psychological health outcomes [15]. In addition, multimodal cardio-oncology prehabilitation prior to cancer treatment, which incorporates exercise, nutrition, psychological intervention, education, and smoking cessation, has been shown to enhance functional capacity, quality of life, and mental health, reduce morbidity and healthcare expenditure, and prepare patients for intensive cancer treatments [14, 33].

Research has demonstrated that CR programs for breast cancer survivors improve cardiorespiratory fitness (direct VO₂ peak), physical activity, fatigue, depression, and quality of life. [34, 35]. Recent trials have demonstrated that exercise training is safe in patients undergoing anthracycline and trastuzumab treatment, and significantly improves cardiorespiratory fitness [36, 37]. The 2019 AHA scientific statement recommends the American College of Sports Medicine guidelines for prescribing the initial exercise dose and volume (duration,

frequency, and intensity) [15]. Gradual progression of exercise volume results in improved cardiorespiratory fitness and reduced CV risk [38, 39]. Incorporating both aerobic and resistance exercises offers functional and psychological benefits and alleviates arthralgia pain related to aromatase inhibitor use in postmenopausal cancer survivors [40]. Supervised moderate-to-high-intensity aerobic training can be safely implemented in women undergoing breast cancer treatment with improved cardiovascular function [41]. Resistance training enhances muscular strength, increase lean body mass, decrease the body fat percentage; in addition, it reduce the incidence of exacerbations of lymphedema and alleviate symptoms [40].

Challenges and opportunities for improving cardiovascular health in women with breast cancer

The management of cardiovascular health in women with breast cancer presents both challenges and opportunities. The field of cardio-oncology has made substantial progress; however, there remains considerable scope for improvement in the prevention, early detection, and management of cardiovascular complications. The key areas of focus are further discussed (Fig. 2).

Current cardio-oncology and cardiac rehabilitation programs

Recently, the number of cardio-oncology programs has increased. However, most of these programs focus on treating and managing CVD as a consequence of cancer therapy, with comparatively less emphasis on prevention before the emergence of cardiotoxicity [8]. The approach to preventive cardio-oncology is progressively evolving to focus on patients who have not yet developed CVD risk factors (e.g., hypertension and diabetes) following a cancer diagnosis, rather than primarily directing efforts towards managing cardiovascular toxicities that have already developed [14, 42]. It is crucial to consider disparities in the distribution of cardioprotective medications and the monitoring and occurrence of adverse cardiovascular events resulting from cancer therapies across various ethnic, racial, socioeconomic, and gender minority groups [9].

In addition, CR programs should involve a multimodal approach, including exercise, psychosocial support, and modifiable CVD risk factor management (such as blood pressure, glucose, lipids, and tobacco use). However, a recent systematic review assessing the structure of 33 multimodal rehabilitation programs for patients with cancer revealed that these programs did not consistently incorporate all the essential components recommended by the AHA, particularly gaps in integrating

	Challenges	Opportunities and Recommendations
Integrated Cardio-oncology and Cardiac Rehabilitation Programs	<ul style="list-style-type: none"> - Current cardio-oncology programs prioritize CVD treatment over prevention - CR programs lack a multimodal approach 	<ul style="list-style-type: none"> - Preventive cardio-oncology strategies/ Multidisciplinary team approach - Better cardiology and oncology coordination - Access to cardiac clinics and diagnostic centers - Cardio-oncology prehabilitation, habilitation, and rehabilitation research
Sex and Gender-specific considerations	<ul style="list-style-type: none"> - Women are underdiagnosed, undertreated, and underrepresented in CVD clinical trials - Sex-specific issues (e.g., increased risk of HF with preserved EF in postmenopausal BC survivors, immune checkpoint inhibitor toxicities) 	<ul style="list-style-type: none"> - Increase representation of women in research - Investigate sex-specific and gender-related risk factors - Increase access to and referral of women CR
Financial Considerations	<ul style="list-style-type: none"> - Insufficient funding, resources, and personnel - Lack of a reimbursement plan - Patients paying out of pocket 	<ul style="list-style-type: none"> - Allocate dedicated funding, resources, and personnel - Increase the capacity for exercise-based CR
Underutilization of Cardiac Rehabilitation	<ul style="list-style-type: none"> - Gender-related barriers - Women less likely to receive treatment, CR referrals - Women less likely to participate in secondary prevention and CR 	<ul style="list-style-type: none"> - Provide flexible, remote, or home-based CR programs - Offer education, e-counseling, peer support services - Personalize CR interventions and include alternative exercises (e.g., HIIT) - Promote early and automatic CR referrals and raise CR awareness
Timing Considerations	<ul style="list-style-type: none"> - Uncertainty related to the optimal timing, type, and intensity of exercise 	<ul style="list-style-type: none"> - AHA recommends individualized CR Referral that is determined by CVD history, risk, cardiac, and symptoms, rather than BC treatment timing
Physical Limitations	<ul style="list-style-type: none"> - Neuromuscular, musculoskeletal, and functional disorders that may limit CR participation (e.g., peripheral neuropathy and lymphedema) - Fear of cancer recurrence, lymphedema, and exercise-related pain 	<ul style="list-style-type: none"> - Consults with physical and occupational therapists for impairment before CR - Oncology providers to encourage CR attendance, offer reassurance, boost confidence, and address fears of injury and fatigue
Underrecognized Psychological Issues	<ul style="list-style-type: none"> - Anxiety, depression, and distress related to cancer diagnosis, treatment decisions, and adverse effects of cancer therapies - Anxiety and depression can increase CVD risk in patients with BC 	<ul style="list-style-type: none"> - Early psychological screening - Emotional and psychological support - Exercise can improve physical and mental well-being and quality of life
Social and Racial Disparities	<ul style="list-style-type: none"> - Black women face higher risk of ASBC, HTN, cardiotoxicity, and CV death - Racial and ethnic disparities in research, access to specialty care, cardiotoxicity screening, surveillance, treatment, and prevention - Social determinants (disadvantaged areas, inadequate social support) 	<ul style="list-style-type: none"> - Expand access to cardio-oncology providers in low-SES areas - Address psychological distress via social support - Increase awareness of disparities, cultural competency training, and culturally tailored cardio-oncology care

Fig. 2 Improving cardiovascular health in women with breast cancer: challenges, opportunities and recommendations

AHA: American Heart Association; ASBC: advanced stage breast cancer; BC: breast cancer; CR: cardiac rehabilitation; CV: cardiovascular; CVD: cardiovascular diseases; EF: ejection fraction; HF: heart failure; HIIT: high-intensity interval training; HTN: hypertension, SES: socioeconomic status; VTE: venous thromboembolism. Acknowledgements: Icon created by Frenki, BusinessIcons13, Puspito, Pinky, Warunk Icon, Mrfa Studio, & Fahmi from Noun Project

multidisciplinary and cancer-specific interventions and adequate program support professionals [43].

Sex and gender-specific considerations

Women face unique risks that lead to the development of cancer treatment-related CVDs [9]. Breast cancer treatments, including anthracyclines and trastuzumab, have been found to increase the likelihood of cardiac dysfunction in women, with an incidence ranging from 10 to 14% [9]. Young breast cancer survivors are at a heightened risk of CVD due to cancer treatment, which may be exacerbated by endocrine therapy and changes in menopausal status [44]. Postmenopausal breast cancer survivors have an increased risk of heart failure, with a preserved ejection fraction contributing to long-term morbidity and mortality. However, this has often been underrecognized and understudied [9, 45]. Women who received both chemotherapy and endocrine therapy, including tamoxifen and aromatase inhibitors, were found to have a higher risk of developing venous thromboembolism (VTE) [46]. In addition to the elevated VTE risk, tamoxifen is associated with a higher incidence of ischemic stroke, despite its potential cardioprotective benefits [11]. Furthermore, women have an increased

likelihood of experiencing toxicities related to immune checkpoint inhibitors, which are associated with sex-specific cardiotoxic mechanisms [9]. However, women with CVD remain underdiagnosed, undertreated, and underrepresented in clinical trials despite a greater understanding of the cardiovascular burden experienced by women [47, 48].

Women are less likely to receive appropriate pharmacological treatment for cardiac conditions, be referred to, and participate in secondary prevention and CR programs following an acute CV event or diagnosis, despite experiencing similar or even greater benefits than men [49]. This disparity is largely attributed to demographic, socioeconomic, medical, societal, and gender-related challenges such as financial insecurity, excessive responsibilities, and psychological symptoms, prohibition of time, financial resources, and barriers to participate in rehabilitation activities [22, 49]. Research suggests that women with breast cancer often face a multitude of barriers that impede their ability to exercise, including institutional (e.g., inadequate funding, undefined roles, and limited time spent with patients), situational (e.g., bad weather, insufficient time, and limited access to facilities), and individual (e.g., lack of motivation, fatigue, changes

in body appearance, fear of injury, lack of interest, functional limitations, comorbidities, health literacy, language, and cancer treatment) [14, 50–53]. Traditional CR may not align with women's interests; therefore, exploring alternative exercise therapies may address the elevated risk of CVD. For example, high-intensity interval training is a safe, efficient and enjoyable exercise strategy that may contribute to improvements in vascular function, blood pressure, cardiorespiratory fitness, and glycemic control in people with cardiometabolic diseases [39, 48, 54]. Evidence suggests that this can enhance the physical and mental health of women with CVD; however, robust data are limited because of insufficient studies involving adequate female participants [48].

Financial constraints

Integrating cardio-oncology rehabilitation programs into the existing infrastructure for cardiac or pulmonary rehabilitation has the potential to provide cost-effective solutions for cancer survivors. However, financial constraints may restrict the number of cancer survivors who can access these programs [43]. In Canada, there is an insufficient number of CR spots, with only one available per 4.55 patients with ischemic heart disease, requiring an additional 186,187 spots annually to meet this demand [55]. Most CR programs in Canada are funded by government or hospital sources (66.7%); however, in 31.5% of the programs, patients were required to pay out-of-pocket [55]. The lack of a reimbursement plan for cancer patients engaging in CR emphasizes the need to establish effective CR programs for this group [15]. The allocation of dedicated funding, resources, and personnel is required to increase the capacity of patients with breast cancer to participate in exercise-based rehabilitation programs [17].

Underutilization of cardiac rehabilitation

Despite the cost-effectiveness of CR, it is underutilized and referral for cardiac and pulmonary rehabilitation is significantly low [14, 43, 48, 53, 56]. In addition, women's participation in CR programs is particularly low, possibly due to gender-specific factors. Studies have indicated that women with breast cancer can tolerate exercise and may benefit from CR; however, they have significant withdrawal rates, similar to those of other women with CVD participating in CR programs [34, 35, 57]. Reasons for breast cancer women withdrawal from the CR program include transportation issues, lack of interest, returning to work, non-medical reasons such as work and family obligations, early discharge due to medical reasons, and changes in body appearance. [34, 35, 57].

The use of home/community and incentive-based programs, remote and virtual CR models such as

smartphone apps and telehealth, along with posthospital home visits or telephone calls, automatic CR referral, early access to CR, increased CR awareness and education, flexible hours, personalizing intervention, e-counselling, and social support from other breast cancer women, may help overcome barriers to CR referral in women and improve CR attendance and completion rates [14, 43, 52, 53, 56]. These novel CR approaches increase flexibility and patient participation, decrease travel time, reduce gaps in care and economic burden, and produce long-term health benefits by improving muscle strength and fostering a better quality of life for individuals with breast cancer [58–60]. Recent research has demonstrated the potential of telehealth and mobile modalities in cardio-oncology rehabilitation and has shown that these interventions can offer physical and mental benefits to breast cancer patients and survivors [56]. A comprehensive analysis of existing community programs for cancer survivors revealed that fostering collaboration between community exercise facilities, healthcare professionals, hospitals, and not-for-profit or charitable organizations is crucial for effective program implementation. However, there are key knowledge gaps in understanding the factors associated with successful implementation to develop recommendations for future community-based interventions [61].

Time to initiate cardio-oncology rehabilitation

Exercise programs in cancer survivors have been shown to enhance muscle strength, cardiorespiratory fitness, and quality of life during rehabilitation, active cancer treatment, posttreatment/acute recovery, and survivorship phases [38]. One study suggested that pre-diagnosis exercise exposure in long-term breast cancer survivors was linked to a notable decrease in subsequent CV events. [62]. However, the optimum type, timing, and intensity of exercise prescriptions for individual cancer patients remain unclear, as do factors such as diagnosis, treatment type, and recovery trajectory [15, 38]. Therefore, a rehabilitation program must be adaptable to accommodate varying treatment timeframes as patients enroll at different points owing to a range of factors, including their and their physicians' perceptions of the benefits of exercise, participation in clinical studies that prohibit physical activity, preparation for returning to work, and long-term treatment-related complications [34]. Additionally, the AHA's CORE guidelines emphasize that referral for CR should be highly individualized and primarily determined by the patient's underlying CVD risk, cardiac symptoms, or CVD history, rather than the timing of cancer treatment [15, 52].

Physical limitations of participation in cardiac rehabilitation

Breast cancer survivors often encounter neuromuscular, musculoskeletal, and functional disorders, including postmastectomy syndrome, shoulder dysfunction, axillary cording, chemotherapy-induced peripheral neuropathy, and lymphedema [63]. Given that exercise may be limited or unsafe due to these issues, CR staff should provide referrals to services such as physical and occupational therapy before CORE to address these impairments [15, 63]. A study found that patients with breast cancer experience significant stress due to fear of cancer recurrence and lymphedema associated with treatment or exercise-related pain. Thus, the education and training of both staff and patients regarding various treatment options and potential side effects are beneficial [34].

Under recognized psychological issues

Psychological issues, including anxiety and depression, are commonly observed in individuals diagnosed with breast cancer [64]. A prospective study found that the prevalence of anxiety and depression in women with breast cancer was 55.4% over a five-year period where anxiety was most prevalent before treatment (38.0%), whereas depression peaked one year post-treatment (13.1%) [65]. The impact of psychological stressors on the development of CVD in cancer patients has not received sufficient attention. Anxiety is associated with a 26% increased risk of developing coronary heart disease and a 48% increased risk of cardiac death [64]. According to a meta-analysis, the prevalence of clinically significant symptoms of distress related to breast cancer diagnosis before treatment was 39% for nonspecific distress, 20% for depression, 31% for posttraumatic stress, and 34% for anxiety [66]. Therefore, it is essential to conduct early screening and provide emotional and psychological support to patients diagnosed with breast cancer to reduce their CVD risk. Additionally, patients with breast cancer often experience long-term adverse effects, including fatigue, recurrence, peripheral neuropathy, lymphedema, and decreased physical function, which can negatively impact their physical health and are significantly linked to the development of depression and anxiety [14, 60, 67]. The implementation of the CR model, which includes exercise and the adoption of healthy lifestyle behaviors, enhances the physical and mental well-being of breast cancer survivors [34]. Aerobic physical activity primarily enhances cardiovascular function, while resistance training improves upper body muscular strength; engagement in both exercises during and after cancer treatment improves fatigue, strength, and overall quality of life [14, 60, 67, 68].

Social and racial disparities

Significant factors contributing to ethnic and racial differences in cardio-oncology include higher rates of CVD and CV risk factors, underrepresentation of racial/ethnic minorities in research, socioeconomic and cultural barriers, and lack of access to specialty care [69, 70]. African American women are at a higher risk of being diagnosed with advanced-stage breast cancer and experience higher mortality rates compared to other demographic groups, which is attributed to several factors, such as differences in screening, treatment, genetics, and lifestyle factors, including physical inactivity, and a higher prevalence of coexisting conditions, such as hypertension, diabetes, CVD, and obesity [71]. Chemotherapy, particularly anthracycline treatment, is associated with a disproportionate increase in hypertension and other CVD risk factors among Black patients [9]. Black women have a higher incidence of CVD and cardiotoxicity than White women, which is attributed to the presence of CV risk factors that manifest earlier in Black women in addition to socioeconomic factors that contribute to disparities in cardiotoxicity screening, surveillance, and preventive management [9, 42, 70]. The impact of social determinants such as poverty, racial discrimination, living in disadvantaged neighborhoods, inadequate social support, and social isolation significantly influences the likelihood of developing breast cancer, its stages, and survival rates as well as the risk of CVD among racial and ethnic marginal populations [9, 72]. Furthermore, disparities in access to healthcare services, early detection, screening and treatment, nutritious food, education, employment opportunities, and geographic location can also significantly affect cancer and CV health outcomes [9, 73].

Implications

Establishing cardio-oncology programs within hospitals and communities is essential for preventing, detecting, and alleviating the cardiovascular complications associated with cancer therapy. Effective programs require coordination between cardiologists and oncologists, administrative support, financial planning, conveniently located clinics for follow-up visits, access to diagnostic testing centers, and education of staff, patients, and families [74]. Multidisciplinary cardio-oncology teams have the potential to bridge knowledge gaps, improve consistency in patient care, and enhance patient outcomes by providing comprehensive care that considers the whole person and their mental, physical, and social well-being. This collaboration encourages shared responsibility among professionals to develop a deeper understanding of cancer treatment, cardiotoxic effects, and the importance of early detection of cardiac damage, ultimately leading to better patient outcomes and overall well-being

through the implementation of effective cardioprotective measures [74–77].

Cardio-oncology prehabilitation, habilitation, and rehabilitation can help achieve and maintain optimal CV health. Prehabilitation offers cancer patients an opportunity to improve their quality of life prior to intensive treatments, including surgery, chemotherapy, and radiation. Further research is necessary to explore the benefits of cancer prehabilitation and promote the interdisciplinary implementation of these programs [14, 33]. Future considerations of CR referral, enrollment, and retention are of significant importance [6]. Physicians serve as the primary motivating factor for patients to participate in physical activity by providing reassurance regarding potential health concerns and reinstating confidence, while also addressing fear of injury and fatigue [52]. Cardio-oncology nurses can manage patient care, facilitate interdisciplinary communication, educate patients and families, provide outpatient follow-ups and medication teaching, and conduct functional and CV risk assessments to address urgent CV issues, thus improving patient satisfaction and reducing treatment duration [6, 33, 74, 75, 78]. Advanced practice nurses are crucial in transitioning from treatment to follow-up care by identifying further needs, referring patients to specialists, and mentoring nurses in patient education and self-management during cancer treatment [79].

Further research is required to explore the barriers and potential solutions to women's participation in CR programs considering their unique psychosocial and health perception factors. It is essential to investigate the interplay between gender and ethnicity given that women from underrepresented minority groups often experience disparities in healthcare, including underutilization of CR services [14, 53]. An interprofessional approach is essential for effectively addressing significant health disparities in cardio-oncology, including enhancing providers' awareness of disparities, advancing cultural competency training, and advocating referrals to CORE programs. Moreover, expanding access to cardio-oncology providers in low socioeconomic areas, implementing social support, and employing culturally tailored interventions to address psychological distress are potential strategies for improving screening and surveillance [42, 70].

Conclusion

The incidence of both breast cancer and CVD is expected to increase with a growing aging population. Cancer therapies may pose the risk of both short- and long-term cardiotoxicity. In addition, breast cancer survivors may be at a higher risk of death from CVD than are women

who have not been diagnosed with breast cancer. Hence, it is essential to identify the barriers that impede CVD prevention and management in patients with breast cancer, and to develop effective strategies to overcome these challenges and enhance the CV health of women with breast cancer.

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Data availability

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Declarations

Ethics approval and consent to participate

The authors confirm that ethical approval and patient consent are not applicable to this study.

Consent for publication

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Competing interests

The authors declare no competing interests.

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