Supportive Care in Cancer (2021) 29:3593–3602
https://doi.org/10.1007/s00520-020-05858-3

ORIGINAL ARTICLE

Physical activity level, exercise behavior, barriers, and preferences of patients with breast cancer–related lymphedema

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Received: 19 June 2020 / Accepted: 26 October 2020 / Published online: 10 November 2020

Abstract

Purpose To identify physical activity level, exercise behavior, barriers, and preferences in female patients with breast cancer–related lymphedema (BCRL).

Methods Patients with BCRL consulted to physical therapy to receive lymphedema treatment were included. Age, gender, body mass index matched healthy controls (HC) were included to identify differences. The transtheoretical model was used to determine exercise behavior. Physical activity level was assessed by the International Physical Activity Questionnaire-Short Form (IPAQ-SF). The exercise barriers and preferences of patients with BCRL were recorded using a checklist based on the previous studies.

Results A total of 48 female patients with BCRL and 38 female HC participated in the study. Physical activity level was significantly lower in patients with BCRL when compared to HC ($p < 0.05$). However, the number of participants who engaged in regular exercise was significantly higher in patients with BCRL than HC (33.2% vs 7.9%, $p < 0.05$). The most common exercise barriers were fatigue (64.5%), having other responsibilities (60.4%), and weather-related factors (56.2%). Majority of the participants preferred to participate in a supervised (79.1%), structured (66.6%), combined-type (77.1%), and moderate intensity (79.1%) exercise program, and they preferred to be informed at the time of the cancer diagnosis (45.8%) by a physiotherapist (66.6%). Moreover, the most preferred exercise type was walking/jogging (66.6%).

Conclusion The present study showed inadequate physical activity and exercise behavior in patients with BCRL. Supportive care interventions are needed to overcome barriers for patients with BCRL. Preferences of patients and exercise enjoyment should also be taken into consideration to increase the participation in exercises.

Keywords Barriers · Breast neoplasms · Exercise · Lymphedema · The transtheoretical model

Introduction

According to the GLOBOCAN 2018 report, breast cancer is the most common cancer among women and the leading cause of cancer death [1]. Despite the increase in the number of cases, survival rates have also increased in recent years based on the improved treatment approaches [2]. Along with the developments in cancer treatments, there are various disease and treatment-related side effects that negatively affect breast cancer survivors [3–5]. Breast cancer–related lymphedema (BCRL) is one of the most prevalent complications in patients having more invasive breast cancer surgeries such as mastectomy and/or axillary lymph node dissection than those having breast-conserving surgery and/or sentinel lymph node biopsy [6]. Additionally, radiotherapy and chemotherapy are associated with the increased risk for the development of BCRL [6]. According to the result of a meta-analysis, the incidence of BCRL after breast cancer treatment ranges between 16 and 21% [7]. Lymphedema is a chronic condition and one of the most stressful symptoms for individuals because of its prognosis [8].

Regular physical activity and exercise have various beneficial effects for patients with breast cancer during and after treatments. These include reduced treatment-related side effects, e.g., fatigue [9], gastrointestinal symptoms [10, 11], and emotional problems [12]. In addition, regular

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exercises have positive effects including increased cardiopulmonary capacity and muscle strength [13], improved immune functioning [14], and improved survival rates [15]. Despite these beneficial effects, decline in physical activity level has been reported in patients with breast cancer after diagnosis [16].

It has been reported that patients with BCRL have more severe health-related symptoms, poorer quality of life, and lower performance in activities of daily life than breast cancer survivors without BCRL [17, 18]. For these reasons, regular exercise has become an important approach for alleviating these side effects in patients with BCRL. In addition, exercise is beneficial for the improvement of the use of the muscle pumps and accordingly, the stimulation of the lymphatic transport in patients with BCRL [19]. On the other hand, insufficient physical activity level has been found as a risk factor for the development of functional problems in activities of daily life in patients with BCRL [20]. Accordingly, it is important to determine physical activity level in patients with BCRL, and to encourage patients in terms of achieving sufficient physical activity level.

In the past, there was a protective approach to patients with BCRL because of a fear that exercise results with the induction of BCRL or an increase in the severity of edema volume [21]. Consequently, that protective behavior may lead to decreased physical activity and exercise participation in patients with BCRL [20]. Based on the recent guideline published by Gebruers et al., many breast cancer survivors (up to 70%) still believe that they should avoid strenuous exercises [19]. However, there has been growing evidence regarding no increased risk for the development or the exacerbation of lymphedema in patients who participated strenuous exercises [22, 23]. Recent guidelines have recommended to increase the physical activity level and to achieve lifelong exercise behavior in patients with BCRL [13]. For this purpose, identifying exercise barriers and preferences of patients with BCRL may guide health professionals who prescribe physical activity and exercise programs, consequently increased participation in physical activities and exercises would be expected [24].

In the literature, treatment-related, individual, environmental, and psychological factors have been indicated as exercise barriers in cancer survivors [24–27]. However, there is a lack of evidence in terms of barriers to prevent participating regular physical activity and exercises or preferences of the exercise program in patients with BCRL [28]. Because of the unique challenges experienced by breast cancer patients with BCRL compared to patients without BCRL, it is essential to have specific knowledge on exercise barriers and preferences in patients with BCRL. Therefore, the aim of the present case-control study was to determine physical activity level, exercise behavior, exercise barriers, and exercise program preferences in patients with BCRL.

Materials and methods

Study design

The present study was designed as a cross-sectional study and was performed at Hacettepe University, Faculty of Physical Therapy and Rehabilitation in Turkey.

Participants

Since more than 99% of the breast cancer patients are women, only female patients were recruited to the present study [1]. Patients were included by meeting the following criteria: (1) female patients diagnosed with BCRL and consulted to physical therapy, (2) completed cancer treatments (chemotherapy and radiotherapy), (3) having unilateral upper extremity BCRL, (4) > 18 and < 65 years old. Exclusion criteria were having a serious cardiopulmonary, orthopedic, neurologic, cognitive, or emotional problems, metastatic cancer, or active infection. Age, gender, and body mass index (BMI) matched healthy controls (HC) consisted of individuals who were caregiver or relatives of the patients and living in the same city. The inclusion criteria for HC were being female, and between the age of 18 and 65 years, having no chronic disease or injury that might prevent to do physical activity. The Hacettepe University Ethical Committee approved the present study and informed consent was obtained from each participant.

Instruments

The present study was conducted by face-to-face interviews with the participants. Patients with BCRL were assessed at the first session in the physical therapy department.

Demographic information and medical history

Demographic characteristics including age, gender, education, employment, and marital status were recorded. Additionally, medical history of the patients with BCRL including time since breast cancer diagnosis, type of surgery, received treatments including chemotherapy, radiotherapy, and/or hormonal therapy, and current medications were recorded.

Body mass index

Self-reported height and weight scores of the participants were recorded and the score of BMI were calculated as weight divided the square of height (kg/m^2) [29].

Physical activity level

In the present study, Turkish version of the International Physical Activity Questionnaire-Short Form (IPAQ-SF),

which has been found to have good validity and reliability, was used to evaluate physical activity level of the participants [30]. The IPAQ-SF consists of questions regarding activities performed for at least 10 min in the last 7 days. Vigorous and moderate level of physical activities and walking duration and frequency was recorded. The activity duration and frequency was multiplied by the corresponding metabolic equivalent of task (MET) score. Then, the total physical activity score was recorded as MET-min/week. According to the total score of MET-min/week, participants were classified into one of three categories as sedentary (< 600 MET-min/week), minimally active (600–3000 MET-min/week), or active (> 3000 MET-min/week) [30].

Current exercise behavior status

The transtheoretical model (TTM) was used to determine exercise behavior of participants and their stage of change. The state of change includes totally 6 phases, i.e., precontemplation (individuals who do not intent to start regular exercise within the next 6 months), contemplation (individuals who intent to start regular exercise within the next 6 months), preparation (individuals who seriously intent to start exercise next month or have begun to exercise which is not regular), action (individuals who regularly doing exercise within the last 6 months), maintenance (individuals who continue to regular exercise more than 6 consecutive months), and termination (individuals who maintained exercise behavior more than 5 years). Individuals who are in action or maintenance phase are considered as having regular exercise behavior [31].

Importance of exercise, exercise barriers, and preferences

Participants were asked that how important (not at all/a little/moderate/very much) doing exercise is for them. The exercise barriers and program preferences were evaluated with a survey that prepared based on the similar studies in the literature [24, 25, 32, 33]. Our expert committee including all authors of the manuscript who are experienced physiotherapists, have doctoral degree on women's health physiotherapy (in the domain of lymphedema) or cancer rehabilitation, and have clinical expertise on the assessment and management of lymphedema and/or exercise prescription for cancer patients. Experts were defined for the following criteria in the present study: (1) those having at least 5 years of experience on exercise programs for lymphedema or cancer patients and/or (2) having at least one peer-reviewed publication on lymphedema or cancer management. Exercise barriers and preferences of the participants indicated in the previous studies [24, 25, 32, 33] were discussed by the expert committee, and after the full agreement, the items were included in the final checklist. The items specific to BCRL were also added (e.g., lymphedema, fear of exacerbation of lymphedema). Additionally, when the items for exercise barriers and preferences were selected, culture specific factors such as environmental barriers and preferred type of exercise were taken into account. A total of 35 barriers were identified and divided in to four categories, i.e., symptom-related (n = 10), individual (n = 10), psychosocial (n = 8), and environmental (n = 7) factors. The checklist was asked to the patients and their responses were recorded. Regarding the exercise program preferences, patients were asked that which type, where, when, with whom, and how they prefer to do exercise.

Statistical analysis

Statistical analyses were performed by using the IBM SPSS 23.0 software (SPSS Inc., Chicago, IL, USA). The results were expressed as number and percentages (n, %) or mean ± standard deviation. The level of significance was determined as $p < 0.05$. As the normality assumptions were provided, the Student's t test was used to compare quantitative variables between the groups. The chi-square test was used to compare percentages of the categorical variables between the groups, and if needed, post hoc analysis was performed. The power analysis was performed for the group comparisons by using the G*Power program. The post hoc power analysis of the Mann-Whitney U test results for the IPAQ total score showed that sample sizes of the groups achieved a power of 80.1% with a significance level of 0.05.

Results

A total of 86 middle-aged females including patients with BCRL (n = 48) and HC (n = 38) were recruited in the present study. Demographic characteristics of the participants were presented in Table 1. According to the group comparisons, there were no significant differences in demographic characteristics between the patients with BCRL and HC ($p > 0.05$). Majority of the participants in both groups were overweight (BMI > 30 kg/m^2). Treatment-related variables of patients with BCRL are shown in Table 2. The mean time spent in physical activity and walking was significantly lower in patients with BCRL than that in HC ($p < 0.05$). Mastectomy was implemented as a part of the cancer treatment in majority of the patients with BCRL. Majority of the study population received chemotherapy, radiotherapy, and hormonal therapy.

Physical activity level, exercise behavior, and the self-reported importance level of exercise for the participants were presented in Table 3. The mean total IPAQ score and walking MET-min/week score of the patients with BCRL were significantly lower than HC ($p < 0.05$). According to the IPAQ activity categories, the percentage of individuals who were inactive in patients with BCRL was significantly higher than HC ($p < 0.05$). A few percent of participants had regular exercise behavior (who were in action or maintenance phase)

Table 1 Demographic characteristics of the participants (n = 86)

Demographic characteristics	Patients with BCRL (n = 48)	Healthy Controls (n = 38)	p value
Age (years), mean ± SD	48.56 ± 9.66	48.71 ± 9.35	0.469
BMI (kg/m^2), mean ± SD	27.73 ± 4.95	27.06 ± 4.50	0.521
BMI classification (kg/m^2), n (%)			0.700
Underweight (< 18.50)	2 (4.1)	2 (5.2)	
Normal weight (18.50–24.99)	16 (33.3)	11 (28.9)	
Overweight (25.00–29.99)	17 (35.4)	14 (36.8.4)	
Obesity (≥ 30.00)	13 (27.0)	11 (28.9)	
Marital status, n (%)			0.192
Married	34 (70.8)	32 (84.2)	
Single	14 (29.1)	6 (15.7)	
Educational level, n (%)			0.115
Illiterate	2 (4.1)	-	
Elementary school	10 (20.8)	10 (26.3)	
Secondary school	4 (8.2)	9 (23.6)	
High school	13 (27.0)	7 (18.4)	
Graduate	17 (35.4)	10 (26.3)	
Postgraduate	2 (4.1)	2 (5.2)	
Employment status, n (%)			0.734
Yes	19 (39.5)	16 (42.1)	
No	29 (60.5)	22 (57.8)	

BMI, body mass index; *BCRL*, breast cancer–related lymphedema

Student's t test, chi-square test, $p < 0.05$

according to the TTM in both groups. On the other hand, the numbers of individuals who had regular exercise behavior were significantly higher in patients with BCRL than HC (33.2 vs 7.9%, $p < 0.05$). Over ninety percent of the patients with BCRL reported that exercise is "very important" for them, and when post hoc analysis was performed for the chi-square test, this rate was higher than HC ($p < 0.05$).

Exercise barriers of the patients with BCRL are shown in Table 4. In terms of exercise barriers, fatigue, having other responsibilities related to home and work, and weather-related factors were the most reported three barriers by patients with BCRL. Fatigue, pain, and lymphedema were the most reported symptom-related barriers. Other responsibilities related to homeworks and child care, the lack of priority, and busy schedule were the most commonly reported individual barriers. The most common psychosocial barriers were feeling unwell, fear of being fatigued, and less exercise enjoyment. Lastly, the most common environmental barriers were indicated as follows: weather condition, lack of someone to help them during exercise, and lack of exercise partner.

Exercise preferences of the participants are presented in Table 5. Majority of the patients with BCRL preferred to do exercise in a clinic/sport center, in the morning, moderate intensity, combined-type, supervised, and structured exercise program. They preferred to be informed during the diagnosis by a face-to-face interview. Lastly, the most preferred type of exercise was walking/jogging.

Table 2 Treatment-related variables of the patients with breast cancer–related lymphedema

Treatment characteristics, n (%)	Patients with BCRL
Time since cancer diagnosis (month), mean ± SD	50.09 ± 30.19
Type of surgery	
Breast conserving	10 (20.8)
Modified radical mastectomy	20 (41.6)
Radical mastectomy	18 (37.5)
Chemotherapy	
Yes	40 (83.3)
No	8 (16.6)
Radiotherapy	
Yes	32 (66.6)
No	16 (33.3)
Hormonal therapy	
Yes	41 (85.4)
No	7 (14.5)

BCRL, breast cancer–related lymphedema

Table 3 Physical activity level, exercise behavior, and self-reported importance level of exercise in participants

Outcome variables	Patients with BCRL (n = 48)	Healthy controls (n = 38)	p value
IPAQ-SF total, MET-min/week	952.65 ± 718.21	1319.68 ± 922.79	0.046*
Vigorous intensity, MET-min/week	53.61 ± 199.87	152.36 ± 462.72	0.197
Moderate intensity, MET-min/week	198.29 ± 381.09	162.85 ± 289.42	0.647
Walking, MET-min/week	700.74 ± 538.83	1013.17 ± 794.80	0.037*
IPAQ categories, n (%)			0.006*
Inactive	24 (50)	8 (21.1)	
Minimally active/active	24 (50)	28 (78.9)	
Exercise behavior, n (%)			0.005*
Pre-contemplation/contemplation/preparation	32 (66.7)	35 (92.1)	
Action/maintenance/termination	16 (33.3)	3 (7.9)	
Self-reported exercise importance, n (%)			0.001*
Not at all	-	2 (5.2)	
A little	-	12 (31.5)	
Moderately	4 (8.3)	14 (36.8)	
Very much	44 (91.7)	10 (26.3)	

IPAQ, International Physical Activity Questionnaire-Short Form; *BCRL*, breast cancer–related lymphedema
Student's t test, chi-square test, $p < 0.05$

Discussion

The present study highlights some aspects that need to be addressed in order to encourage patients with BCRL to participate in a regular exercise program and to be more physically active during lifelong. The present study showed that patients with BCRL had significantly lower physical activity level when compared to HC, and only one-third of those had regular exercise behavior according to the TTM classification. The most common exercise barriers were fatigue, having other responsibilities, and weather conditions in the present study. Additionally, we found the symptom of pain and lymphedema as the other most reported symptom-related barriers. Majority of the participants preferred to participate in a moderate intensity, supervised, and structured exercise program in a clinic or sport center. Most of the patients with BCRL reported that they prefer to be informed at the time of cancer diagnosis by a face-to-face interview. Moreover, the most preferred type of exercise was walking/jogging.

Regular physical activity and exercise have various beneficial effects through decreased body weight and body fat rate, changed in sexual (e.g., estrogen, androgen) and metabolic (e.g., insulin, IGF-1) hormone levels, reduction of endogenous oxidative stress, reduction of systemic inflammation, and a boost of immune system [34]. These physiological effects are important for especially patients with breast cancer because of increased body weight and body fat rate were associated with cancer recurrence [35]. These effects of exercise are also essential for patients with BCRL since they had a chronic condition and higher functional limitations in daily life than patients without BCRL [17, 18]. While there have been various studies assessing physical activity level in patients with breast cancer [16, 36], considerably, scarce data was found regarding physical activity level of patients with BCRL. In the present study, insufficient physical activity level was determined in patients with BCRL and there was higher rate of individuals who were inactive when compared to controls. Similarly, patients with BCRL have reported reduced physical activity in a previous study [37]. Since it has been stated that physical activity was associated with functionality in daily life in patients with BCRL [20], we suggest that health professionals should encourage patients to be more active in daily life. On the other hand, according to the TTM, one-third of the patients with BCRL had a regular exercise behavior at least 6 months, while this rate was significantly higher than HC. Higher healthy lifestyle behaviors in cancer survivors when compared to HC were also found in the previous studies [38]. However, this rate is still insufficient for the patients when considered they had a chronic condition that affects their shoulder and arm movements, and exercise has been showed as essential to regain upper extremity functioning during daily activities in these patients [13]. On the other hand, over ninety percent of patients with BCRL reported that exercise is very important for them, which was similar to a previous study that reported patients' experiences who had BCRL [37]. Interestingly, in the present study while patients believed that exercise was important for their health, majority of patients with BCRL still had no regular exercise behavior and half of them were active. A previous study in breast cancer survivors including mixed population with and without lymphedema reported that majority of the participants believed that exercise was beneficial [21]. However, in contrast to our study,

Table 4 Exercise barriers reported by the patients with breast cancer related lymphedema

Exercise barriers, *n* (%)	Patients with BCRL (*n* = 48)
Symptom-related	
Fatigue	31 (64.5)
Pain	18 (37.5)
Lymphedema	18 (37.5)
Having flu/cold	15 (31.2)
Cardiopulmonary problems	13 (27.0)
Headache	12 (25)
Nausea	6 (12.5)
Weight gain/loss	5 (10.4)
Gastrointestinal problems	2 (4.1)
Poor balance	2 (4.1)
Individual	
Other responsibilities	29 (60.4)
Lack of priority	26 (54.1)
Busy schedule	24 (50)
Lack of time	23 (47.9)
Unwillingness	23 (47.9)
Lack of self-control	19 (39.5)
Not knowing what to do	16 (33.3)
I am working	11 (22.9)
Not knowing the importance	9 (18.7)
Do not want to sweat	8 (16.6)
Psychosocial	
Feeling unwell	15 (31.2)
Fear of being fatigued	15 (31.2)
Less exercise enjoyment	15 (31.2)
Fear of exacerbation of lymphedema	13 (27.0)
Exercise is boring	12 (25)
Fear of falling	10 (20.8)
Thinking that exercise is harmful	4 (8.3)
Fear of getting sore	3 (6.2)
Environmental	
Weather condition	27 (56.2)
Nobody to help during exercising	14 (29.1)
Nobody to do exercise together	13 (27.0)
No information from health professionals	13 (27.0)
Non-availability of exercise places	10 (20.8)
Lack of exercise equipment	9 (18.7)
Inconvenient exercise programs	7 (14.5)

BCRL, breast cancer–related lymphedema

Table 5 Exercise preferences of the patients with breast cancer related lymphedema

Exercise Preferences, n (%)	Patients with BCRL (*n* = 48)
Where do you prefer to do exercise?	
- In a clinic/sport center	24 (50)
- Inside	12 (25)
- Outside	12 (25)
When do you prefer to do exercise?	
- Morning	29 (60.4)
- Afternoon	11 (22.9)
- Evening	4 (8.3)
- No preference	4 (8.3)
Which days do you prefer to do exercise?	
- Weekdays	14 (29.1)
- Weekends	3 (6.2)
- Both	31 (64.5)
How do you prefer to do exercise together?	
- By myself	17 (35.4)
- With friends	15 (31.2)
- With someone from my family	9 (18.7)
- With other cancer patients	7 (14.5)
How do you prefer to be informed regarding exercise?	
- Face to face interview	32 (66.6)
- Written materials (brochure, booklet)	9 (18.7)
- Video	1 (2.0)
- All of them	6 (12.5)
When do you prefer to be informed regarding exercise?	
- At diagnosis	22 (45.8)
- At the beginning of the treatments	14 (29.1)
- After treatments were completed	12 (25)
Which intensity of the exercise program do you prefer?	
- Low-intensity	4 (8.3)
- Moderate	38 (79.1)
- Vigorous	2 (4.1)
- No preference	4 (8.3)
Which type of exercise sessions do you prefer?	
- Combined-type	37 (77.1)
- Same-type	11 (22.9)
Which type of exercise program do you prefer?	
- Supervised exercise program	38 (79.1)
- Non-supervised exercise program	10 (20.9)
Which exercise program do you prefer?	
- Structured	32 (66.6)
- Flexible	16 (33.3)
Which type of exercise do you prefer to do?	
- Walking/jogging	32 (66.6)
- Swimming	9 (18.7)
- Cycle	3 (6.2)
- Pilates	2 (4.1)
- Dance	2 (4.1)

BCRL, breast cancer–related lymphedema

participants were generally active [21]. In another study, high level of willingness to participate in physical activity has been found in prostate cancer patients receiving androgen deprivation therapy. However, similar with our findings, small number of participants have reported to meet the recommended guidelines [39]. We suggest that identifying exercise facilitators, barriers, and preferences may highlight the gap regarding conceptions, beliefs, and practices of patients with BCRL.

Regarding the exercise barriers in our study population, fatigue was the most frequent symptom-related barrier, followed by pain and lymphedema, respectively. Similarly, fatigue has been showed the most common symptom-related barrier in the previous studies in breast cancer and other cancer survivors [24, 27, 32]. In addition, fear of being fatigued was also an important barrier

in our study population reported by nearly one-third of the patients. We suggest that patients with BCRL should be evaluated in terms of fatigue when prescribed with an exercise program. In addition, improving patients' knowledge regarding the beneficial effects of regular exercises and physical activities on fatigue may be helpful to increase patients' participation to exercise programs.

Lymphedema was the second common exercise barrier for the patients and 27% of those had fear of exacerbation of lymphedema. There was a misunderstanding that especially strenuous aerobic exercises and/or resistive training of the upper limb may lead to the increased risk of the development of BCRL or an increase in edema volume in the affected limb in the past [21]. However, that misconception has changed in the recent years. According to a Cochran review (2016), a structured exercise program supervised by a physiotherapist has been reported as more beneficial and there has been no evidence that upper limb exercises resulted in the increased risk of the development of BCRL [13]. Additionally, muscle pumps during exercise can stimulate the lymphatic transport, and increase in functionality improves coping with lymphedema in patients with BCRL [40, 41]. Following these findings, there has been growing evidence for supervised strengthening and endurance exercises with compression garments or bandages that proven to be effective without any adverse event for patients with BCRL [19, 22, 23]. Though these improvements in the literature, this trend has been considerably unchanged in clinical practice, and patients with BCRL may have kinesiophobia and continue to fear and worry regarding doing activities and participating in exercise programs [37]. In a previous qualitative study ($n = 29$), many patients with lymphedema had various cancer diagnosis that reported a fear of worsening lymphedema [37]. In the present study, while patients had beliefs that exercise may increase their fatigue or lymphedema, they reported that exercise is very important for their health. Accordingly, it seems that patients were confused regarding doing exercise. We suggest that exercise interventions for patients with BCRL should include two components, i.e., one is a supervised or string-controlled exercise prescription and the other one is patient education to overcome these barriers and beliefs, and lack of or inaccurate information regarding exercise.

Pain was found as one of the most reported exercise barrier, which had the same percentages with the presence of lymphedema. This finding related to the high rate of radical surgery (e.g., mastectomy) was implemented in our study population, which may result with higher musculoskeletal problems than minimally invasive surgeries such as breast-conserving surgery [42]. In addition, radiotherapy can cause the presence of musculoskeletal upper limb dysfunctions (e.g., decreased shoulder range of motion and muscle strength and/or impaired shoulder and scapular kinematics) due to tissue adhesions and fibrosis that may lead to pain [43]. Furthermore, surgery and adjuvant therapies (e.g., radiotherapy and chemotherapy) are related to the presence of neuropathic pain and sensory changes due to the nerve damage [44, 45]. Similarly, pain has been found a significant exercise barrier in the previous studies in patients having other cancer diagnosis [24, 26]. Accordingly, we suggest that assessment of musculoskeletal problems and underlying mechanisms of pain should be taken into consideration in patients with BCRL when planning an exercise program. Current pain management strategies for breast cancer patients such as pain neuroscience education, cognitive behavioral therapy, body awareness therapy, and myofascial relaxing treatment may be helpful to patients who had pain, and through these interventions, patients with BCRL can gain exercise behavior more easily [46, 47].

The present study revealed that having other responsibilities related to home, children, or work, no priority, busy schedule were the most common individual barriers. The most common environmental factors were weather and social support from the others to do exercise. Majority of these barriers were similar with the other studies in breast cancer or other cancer diagnosis [28, 33]. Sixty percent of the patients with BCRL had no occupation in the present study, yet all of those were housewives. In the Turkish culture, women have various responsibilities at home regarding housework (cooking and cleaning activities) or childcare, and these responsibilities have been recognized as carried out only by women and usually additional support may not be provided by other members of the family associated with the cultural beliefs and cognitions of Turkish people. In the previous study, responsibilities related to home and family have been reported highly prevalent in healthy Turkish women and reported as a significant barrier preventing the participation in physical activity [48]. We suggest that demographic characteristics such as age, gender, educational level, or cultural background of different regions such as Eastern countries should be further investigated in order to better understand individual and environmental barriers in cancer patients. To overcome individual exercise barriers, motivational interviewing, behavioral education (e.g., time efficient exercise routines), and cognitive restructuring (e.g., confidence building, self-efficacy, shaping positive attitudes towards exercise) can be implemented [36].

With regard to exercise program preferences, majority of the participants preferred to participate in a moderate intensity, supervised, combined-type, and structured exercise program in a sport center and in the morning. Exercise preferences for moderate intensity, structured exercise program, and in the morning were similar with the previous studies on cancer survivors and breast cancer patients during treatments [27, 49, 50]. In these studies, generally unsupervised exercise programs were preferred. Because of BCRL, patients may have preferred supervised sessions to monitor their symptoms in the present study. We suggest that supervised or more string-

controlled exercise and physical activity programs should be considered to increase participation in patients with BCRL. In addition, similar with a previous study, majority of the cancer patients preferred to get information by a face-to-face interview at the time of the diagnosis [50]. We suggest that exercise sessions should be started as early as possible and patient education should be provided by a face-to-face interview. Lastly, the most preferred exercise was walking/jogging, which has been reported previously [50], suggesting that exercise programs should include walking in order to increase patients' compliance.

The present study had some limitations. Firstly, cross-sectional design of the study prevented to reveal temporal relations. Secondly, the number of study population was small when compared to previous studies investigating the exercise barriers and preferences of breast cancer survivors. However, no study focused on BCRL apart from a qualitative study that reported quantitative data on experiences of patients regarding physical activity and BCRL [37]. Lastly, the majority of the outcome measures were based on self-report and the psychometric analysis of the used checklists/questionnaires for barriers and preferences could not be performed.

Conclusion

The present study provided detailed information regarding physical activity level, exercise behavior, exercise barriers, and preferences reported by patients with BCRL. Insufficient physical activity level and exercise behavior were determined in patients with BCRL. Patients had various symptom-related barriers and beliefs regarding exacerbation of symptom severity by doing exercise. We suggest that exercise interventions should include symptom management strategies and patient education regarding doing exercise within safe limits, positive effects of regular exercise, and motivational interviewing to increase exercise participation in patients with BCRL. When considering exercise preferences of patients with BCRL, exercise interventions should be supervised and planned based on the most enjoyed activities (e.g., walking), and started as early as possible after the diagnosis. We suggest that further longitudinal studies with larger sample size including culturally adapted valid and reliable questionnaires for the assessment of exercise barriers and preferences of exercises in patients with BCRL should be conducted.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval The Hacettepe University Ethical Committee approved the present study.

References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A (2018) Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 68(6):394–424. https://doi.org/10.3322/caac.21492
2. Sant M, Francisci S, Capocaccia R, Verdecchia A, Allemani C, Berrino F (2006) Time trends of breast cancer survival in Europe in relation to incidence and mortality. Int J Cancer 119(10):2417–2422. https://doi.org/10.1002/ijc.22160
3. Abrahams HJ, Gielissen MF, Schmits IC, Verhagen CA, Rovers MM, Knoop H (2016) Risk factors, prevalence, and course of severe fatigue after breast cancer treatment: a meta-analysis involving 12 327 breast cancer survivors. Ann Oncol: Off J Eur Soc Med Oncol 27(6):965–974. https://doi.org/10.1093/annonc/mdw099
4. Verbelen H, Gebruers N, Eeckhout FM, Verlinden K, Tjalma W (2014) Shoulder and arm morbidity in sentinel node-negative breast cancer patients: a systematic review. Breast Cancer Res Treat 144(1):21–31. https://doi.org/10.1007/s10549-014-2846-5
5. Ewertz M, Jensen AB (2011) Late effects of breast cancer treatment and potentials for rehabilitation. Acta Oncol (Stockholm, Sweden) 50(2):187–193. https://doi.org/10.3109/0284186x.2010.533190
6. Hayes SC, Janda M, Cornish B, Battistutta D, Newman B (2008) Lymphedema after breast cancer: incidence, risk factors, and effect on upper body function. J Clin Oncol: Off J Am Soc Clin Oncol 26(21):3536–3542. https://doi.org/10.1200/jco.2007.14.4899
7. DiSipio T, Rye S, Newman B, Hayes S (2013) Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis. Lancet Oncol 14(6):500–515. https://doi.org/10.1016/s1470-2045(13)70076-7
8. Cormier JN, Askew RL, Mungovan KS, Xing Y, Ross MI, Armer JM (2010) Lymphedema beyond breast cancer: a systematic review and meta-analysis of cancer-related secondary lymphedema. Cancer 116(22):5138–5149. https://doi.org/10.1002/cncr.25458
9. Kangas M, Bovbjerg DH, Montgomery GH (2008) Cancer-related fatigue: a systematic and meta-analytic review of non-pharmacological therapies for cancer patients. Psychol Bull 134(5):700–741. https://doi.org/10.1037/a0012825
10. Winningham ML, MacVicar MG (1988) The effect of aerobic exercise on patient reports of nausea. Oncol Nurs Forum 15(4):447–450
11. Mustian KM, Griggs JJ, Morrow GR, McTiernan A, Roscoe JA, Bole CW, Atkins JN, Issell BF (2006) Exercise and side effects among 749 patients during and after treatment for cancer: a University of Rochester Cancer Center Community Clinical Oncology Program Study. Support Care Cancer: Off J Multinatl Assoc Support Care Cancer 14(7):732–741. https://doi.org/10.1007/s00520-005-0912-6
12. Duijts SF, Faber MM, Oldenburg HS, van Beurden M, Aaronson NK (2011) Effectiveness of behavioral techniques and physical exercise on psychosocial functioning and health-related quality of life in breast cancer patients and survivors-a meta-analysis. Psychooncology 20(2):115–126. https://doi.org/10.1002/pon.1728
13. Furmaniak AC, Menig M, Markes MH (2016) Exercise for women receiving adjuvant therapy for breast cancer. Cochrane Database Syst Rev 9(9):Cd005001. https://doi.org/10.1002/14651858.CD005001.pub3
14. Fairey AS, Courneya KS, Field CJ, Mackey JR (2002) Physical exercise and immune system function in cancer survivors: a comprehensive review and future directions. Cancer 94(2):539–551. https://doi.org/10.1002/cncr.10244
15. Chen X, Lu W, Zheng W, Gu K, Matthews CE, Chen Z, Zheng Y, Shu XO (2011) Exercise after diagnosis of breast cancer in

association with survival. Cancer Prev Res (Phila) 4(9):1409–1418. https://doi.org/10.1158/1940-6207.Capr-10-0355
16. Irwin ML, Crumley D, McTiernan A, Bernstein L, Baumgartner R, Gilliland FD, Kriska A, Ballard-Barbash R (2003) Physical activity levels before and after a diagnosis of breast carcinoma: the Health, Eating, Activity, and Lifestyle (HEAL) study. Cancer 97(7):1746–1757. https://doi.org/10.1002/cncr.11227
17. Ridner SH, Dietrich MS, Kidd N (2011) Breast cancer treatment-related lymphedema self-care: education, practices, symptoms, and quality of life. Support Care Cancer: Off J Multinatl Assoc Support Care Cancer 19(5):631–637. https://doi.org/10.1007/s00520-010-0870-5
18. Carter BJ (1997) Women's experiences of lymphedema. Oncol Nurs Forum 24(5):875–882
19. Gebruers N, Verbelen H, De Vrieze T, Vos L, Devoogdt N, Fias L, Tjalma W (2017) Current and future perspectives on the evaluation, prevention and conservative management of breast cancer related lymphoedema: a best practice guideline. Eur J Obstet Gynecol Reprod Biol 216:245–253. https://doi.org/10.1016/j.ejogrb.2017.07.035
20. De Vrieze T, Gebruers N, Nevelsteen I, Tjalma WAA, Thomis S, De Groef A, Dams L, Van der Gucht E, Devoogdt N (2020) Physical activity level and age contribute to functioning problems in patients with breast cancer-related lymphedema: a multicentre cross-sectional study. Support Care Cancer: off J Multinatl Assoc Support Care Cancer. https://doi.org/10.1007/s00520-020-05375-3
21. Sander AP, Wilson J, Izzo N, Mountford SA, Hayes KW (2012) Factors that affect decisions about physical activity and exercise in survivors of breast cancer: a qualitative study. Phys Ther 92(4):525–536. https://doi.org/10.2522/ptj.20110115
22. Cormie P, Pumpa K, Galvão DA, Turner E, Spry N, Saunders C, Zissiadis Y, Newton RU (2013) Is it safe and efficacious for women with lymphedema secondary to breast cancer to lift heavy weights during exercise: a randomised controlled trial. J Cancer Surviv: Res Pract 7(3):413–424. https://doi.org/10.1007/s11764-013-0284-8
23. Paramanandam VS, Roberts D (2014) Weight training is not harmful for women with breast cancer-related lymphoedema: a systematic review. J Phys 60(3):136–143. https://doi.org/10.1016/j.jphys.2014.07.001
24. Rogers LQ, Courneya KS, Robbins KT, Malone J, Seiz A, Koch L, Rao K (2008) Physical activity correlates and barriers in head and neck cancer patients. Support Care Cancer: Off J Multinatl Assoc Support Care Cancer 16(1):19–27. https://doi.org/10.1007/s00520-007-0293-0
25. Clifford BK, Mizrahi D, Sandler CX, Barry BK, Simar D, Wakefield CE, Goldstein D (2018) Barriers and facilitators of exercise experienced by cancer survivors: a mixed methods systematic review. Support Care Cancer: Off J Multinatl Assoc Support Care Cancer 26(3):685–700. https://doi.org/10.1007/s00520-017-3964-5
26. Fisher A, Wardle J, Beeken RJ, Croker H, Williams K, Grimmett C (2016) Perceived barriers and benefits to physical activity in colorectal cancer patients. Support Care Cancer: Off J Multinatl Assoc Support Care Cancer 24(2):903–910. https://doi.org/10.1007/s00520-015-2860-0
27. Rogers LQ, Courneya KS, Shah P, Dunnington G, Hopkins-Price P (2007) Exercise stage of change, barriers, expectations, values and preferences among breast cancer patients during treatment: a pilot study. Europ J Cancer Care 16(1):55–66. https://doi.org/10.1111/j.1365-2354.2006.00705.x
28. Buchan J, Janda M, Box R, Rogers L, Hayes S (2015) Exercise barriers self-efficacy: development and validation of a subcale for individuals with cancer-related lymphedema. Health Qual Life Outcomes 13:37. https://doi.org/10.1186/s12955-015-0223-7
29. Nieto-García FJ, Bush TL, Keyl PM (1990) Body mass definitions of obesity: sensitivity and specificity using self-reported weight and height. Epidemiology (Cambridge, Mass) 1(2):146–152
30. Saglam M, Arikan H, Savci S, Inal-Ince D, Bosnak-Guclu M, Karabulut E, Tokgozoglu L (2010) International physical activity questionnaire: reliability and validity of the Turkish version. Percept Mot Skills 111(1):278–284. https://doi.org/10.2466/06.08.Pms.111.4.278-284
31. Prochaska JJ, Nigg CR, Spring B, Velicer WF, Prochaska JO (2010) The benefits and challenges of multiple health behavior change in research and in practice. Prev Med 50(1-2):26–29. https://doi.org/10.1016/j.ypmed.2009.11.009
32. Ottenbacher AJ, Day RS, Taylor WC, Sharma SV, Sloane R, Snyder DC, Kraus WE, Demark-Wahnefried W (2011) Exercise among breast and prostate cancer survivors–what are their barriers? J Cancer Surviv: Res Pract 5(4):413–419. https://doi.org/10.1007/s11764-011-0184-8
33. Satia JA, Walsh JF, Pruthi RS (2009) Health behavior changes in white and African American prostate cancer survivors. Cancer Nurs 32(2):107–117. https://doi.org/10.1097/NCC.0b013e3181982d4c
34. Hojman P, Gehl J, Christensen JF, Pedersen BK (2018) Molecular mechanisms linking exercise to cancer prevention and treatment. Cell Metab 27(1):10–21. https://doi.org/10.1016/j.cmet.2017.09.015
35. Ecker BL, Lee JY, Sterner CJ, Solomon AC, Pant DK, Shen F, Peraza J, Vaught L, Mahendra S, Belka GK, Pan TC, Schmitz KH, Chodosh LA (2019) Impact of obesity on breast cancer recurrence and minimal residual disease. Breast Cancer Res: BCR 21(1):41. https://doi.org/10.1186/s13058-018-1087-7
36. Pudkasam S, Polman R, Pitcher M, Fisher M, Chinlumprasert N, Stojanovska L, Apostolopoulos VJM (2018) Physical activity and breast cancer survivors: importance of adherence, motivational interviewing and psychological health. Maturitas 116:66–72
37. Meiklejohn J, Heesch K, Janda M, Hayes SCJL (2012) Physical activity in the lives of those living with lymphoedema following cancer treatment. Lymphology 44(Sup):131–137
38. Green HJ, Steinnagel G, Morris C, Laakso EL (2014) Health behaviour models and patient preferences regarding nutrition and physical activity after breast or prostate cancer diagnosis. Europ J Cancer Care 23(5):640–652. https://doi.org/10.1111/ecc.12190
39. Harrington JM, Schwenke DC, Epstein DR (2013) Exercise preferences among men with prostate cancer receiving androgen-deprivation therapy. Oncol Nurs Forum 40(5):358–367. https://doi.org/10.1188/13.ONF.E358-E367
40. Kwan ML, Cohn JC, Armer JM, Stewart BR, Cormier JN (2011) Exercise in patients with lymphedema: a systematic review of the contemporary literature. J Cancer Surviv: Res Pract 5(4):320–336. https://doi.org/10.1007/s11764-011-0203-9
41. Cormie P, Galvão DA, Spry N, Newton RU (2013) Neither heavy nor light load resistance exercise acutely exacerbates lymphedema in breast cancer survivor. Integr Cancer Ther 12(5):423–432. https://doi.org/10.1177/1534735413477194
42. Arndt V, Stegmaier C, Ziegler H, Brenner H (2008) Quality of life over 5 years in women with breast cancer after breast-conserving therapy versus mastectomy: a population-based study. J Cancer Res Clin Oncol 134(12):1311–1318. https://doi.org/10.1007/s00432-008-0418-y
43. Tait RC, Zoberi K, Ferguson M, Levenhagen K, Luebbert RA, Rowland K, Salsich GB, Herndon C (2018) Persistent post-mastectomy pain: risk factors and current approaches to treatment. J Pain: Off J Am Pain Soc 19(12):1367–1383. https://doi.org/10.1016/j.jpain.2018.06.002
44. Baron RH, Fey JV, Raboy S, Thaler HT, Borgen PI, Temple LK, Van Zee KJ (2002) Eighteen sensations after breast cancer surgery: a comparison of sentinel lymph node biopsy and axillary lymph

node dissection. Oncol Nurs Forum 29(4):651–659. https://doi.org/10.1188/02.ONF.651-659
45. Ridner SH, Montgomery LD, Hepworth JT, Stewart BR, Armer JM (2007) Comparison of upper limb volume measurement techniques and arm symptoms between healthy volunteers and individuals with known lymphedema. Lymphology 40(1):35–46
46. Nijs J, Leysen L, Pas R, Adriaenssens N, Meeus M, Hoelen W, Ickmans K, Moloney N (2018) Treatment of pain following cancer: applying neuro-immunology in rehabilitation practice. Disabil Rehabil 40(6):714–721. https://doi.org/10.1080/09638288.2016.1261418
47. Tatrow K, Montgomery GH (2006) Cognitive behavioral therapy techniques for distress and pain in breast cancer patients: a meta-analysis. J Behav Med 29(1):17–27
48. Koca C, Henderson KA, Asci FH, Bulgu N (2009) Constraints to leisure-time physical activity and negotiation strategies in Turkish women. J Leis Res 41(2):225–251
49. Wong JN, McAuley E, Trinh L (2018) Physical activity programming and counseling preferences among cancer survivors: a systematic review. Int J Behavl Nutr Phys Act 15(1):48. https://doi.org/10.1186/s12966-018-0680-6
50. Jones LW, Courneya KS (2002) Exercise counseling and programming preferences of cancer survivors. Cancer Pract 10(4):208–215. https://doi.org/10.1046/j.1523-5394.2002.104003.x