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ORIGINAL ARTICLE

Exercise bra discomfort is associated with insufficient exercise levels among Australian women treated for breast cancer

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Abstract
Purpose Although participating in exercise is beneficial for breast cancer survivors, not being able to find a comfortable exercise bra can be a barrier to exercise. It is likely that side effects specific to breast cancer treatment exacerbate exercise bra discomfort. This study aimed to determine the relationship between patient characteristics, physical side effects, exercise bra discomfort and exercise behaviours.
Methods Four hundred thirty-two breast cancer survivors completed an online survey related to their treatment and demographic background, current exercise levels, reported exercise bra discomfort and breast cancer treatment side effects. Patient characteristics and exercise levels were considered in a binary logistic regression against reporting bra discomfort to ascertain significant relationships ($p < 0.05$) and predictive value (odds ratio). Pearson's chi-square statistics was used to determine significant relationships between reporting a side effect and exercise bra discomfort.
Results Eight out of nine physical side effects were significantly related to reporting exercise bra discomfort. Reporting exercise bra discomfort was significantly related to not achieving a minimal recommended level of exercise.
Conclusions This is the first study in the scientific literature that systematically links the reporting of exercise bra discomfort to not achieving recommended levels of exercise. This effect of bra discomfort on exercise was found after controlling for age, surgery type and current treatment among a large cohort of women treated for breast cancer. Furthermore, results from this study suggest that physical side effects, as a result of surgery and treatment associated with breast cancer, are linked to experiencing bra discomfort during exercise.

Keywords Breast cancer · Bra discomfort · Exercise · Online survey

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Introduction

Participating in exercise has repeatedly been shown to be highly beneficial for the health and well-being of women who are treated for breast cancer [1–5]. Current literature indicates, however, that perceived barriers to exercise are associated with a reduced ability of these women to achieve recommended exercise levels [6–9]. Therefore, to encourage exercise participation among breast cancer survivors, these barriers to exercise need to be identified and minimised or removed [3]. In a recent study investigating 19 potential barriers to exercise, a lack of discipline, procrastination, being fatigued by exercise and not being able to find a comfortable bra to exercise in were ranked as the top four barriers to exercise by women treated for breast cancer [10]. Of these 19 barriers, bra discomfort is the highest ranked barrier that can be modified through an external intervention, such as by providing exercise bras that suit the needs of breast cancer survivors.

Bra discomfort presents a unique challenge to women treated for breast cancer due to the significant physical changes to the breast and surrounding tissue as a result of breast cancer treatment. Despite this, only one other study could be located which investigated the impact of bra discomfort on exercise levels among breast cancer survivors [10]. In that study, a significant proportion of respondents (70 %) experienced exercise bra discomfort, although this was not related to weekly exercise levels or reported physical side effects. This previous work, however, was limited by a small sample size,

and an investigation of the effect of exercise bra discomfort on exercise behaviour, with sufficient statistical power to control for confounding demographic and treatment variables, is warranted.

Targeting patients who would benefit the most is vital when planning health or lifestyle interventions. As such, a better understanding of the women more likely to report exercise bra discomfort is essential when identifying women most likely to benefit from interventions aimed at improving exercise bra design. Patient characteristics, such as age, surgery type or whether the respondent was undergoing current treatment, have previously provided moderate associative value when analysed with respect to potential side effects of breast cancer treatment [11]. We postulate that using these same patient characteristics to identify women who are more likely to experience exercise bra discomfort could be an informative first step in developing strategies to improve exercise bra comfort. These strategies may include improving bra design or educating women towards improving bra fit.

Given the impact exercise barriers can have on exercise levels [6–9] and that exercise bra discomfort has been reported as a potential barrier to exercise [10], the effect of exercise bra discomfort on exercise behaviour while controlling for the potentially participant characteristics should be explored. In order to develop strategies aimed at improving exercise bra comfort for women treated for breast cancer, a clearer understanding of the women who experience bra discomfort the most, as well as the physical side effects related to this bra discomfort, is needed. Therefore, the primary aim of this study was to determine the relationship between exercise bra discomfort, exercise behaviours and patient characteristics among a large cohort of women who had been treated for breast cancer. The secondary aim of this study was to assess the relationship between physical side effects of breast cancer treatment and exercise bra discomfort. We hypothesised that women who experience exercise bra discomfort do not achieve sufficient levels of exercise, after controlling for patient characteristics. We also hypothesised that experiencing exercise bra discomfort is related to experiencing physical side effects as a result of breast cancer treatment.

Participants and methods

Participants and survey implementation

Breast cancer patients who had a registered e-mail address with the Breast Cancer Network Australia (BCNA) Survey and Research Group or the Cancer Councils of Victoria or Western Australia were invited by e-mail to complete an internet-based survey. Of the 482 women who visited the initial URL, 432 completed the survey (89.6 % completion rate). This surpasses the calculated $n = 384$ required sample size (based on a conservative 50 % probability of obtaining statistical significance, assuming 95 % confidence interval (CI), and a 10 % margin of error), thus providing sufficient statistical power for the following analysis [12]. Participant informed consent was obtained, and the University Human Research Ethics Committee approved all data collection procedures (HREC08/326). The survey used in the present study formed part of a larger body of work, and details of the development, validation and content of the online survey instrument have been published elsewhere [11]. Survey items specific to the aims of the present study are described below.

Analytical variables

Participant characteristics

Participant age was an open-ended response to "What is your date of birth?", calculated with respect to the survey submission date (providing age at time of survey completion). Following this calculation, participants were split into categories of being "Under 50 years old" or "50 years and over" for the purpose of the binary logistical regression. Participant surgery type was assessed by a closed-ended question for which the responses were either a lumpectomy or mastectomy of either the right or left breast. Responses were not mutually exclusive, permitting participants to indicate whether they had undergone surgery on both breasts or had a lumpectomy followed by a mastectomy. Participants were then grouped into categories of a "lumpectomy" or a "mastectomy" for the binary logistic regression.

Finally, participants were asked "Are you CURRENTLY undergoing any of the following treatments for your breast cancer?" with closed-ended, non-mutually exclusive, response categories of chemotherapy, radiotherapy and hormonal treatment. For the purpose of the binary logistic regression, participants were divided into categories of "currently undergoing treatment" versus "finished treatment". Women who were still taking any medication for their breast cancer were classified as "currently undergoing treatment". Women were also asked the date of their "last treatment ever" if they had finished treatment. The difference between the survey completion date and treatment completion date was calculated to give a time since treatment completion at the time of survey completion.

Side effects

Physical side effects deemed to potentially have a direct effect on bra discomfort included lymphoedema, broken and painful ribs, weight gain, shoulder limitations, aching muscles, hot flushes, burning, sensitive skin or chafing, pain and muscular chest wall pain. Participants were asked to rate their experience of each of these side effects on a five-point Likert scale

from none (1) to severe (5). For the purpose of binary logistic regressions, women were divided into categories of "No symptom experience" (Likert response = 1) versus "Any level of experience" (Likert response = 2–5).

Bra discomfort

The exercise bra discomfort question was a direct, closed-ended response item which queried "Do parts of the bra you wear during exercise cause you discomfort?", to which participants responded either "Yes" or "No".

Exercise levels

Recreational exercise levels were assessed using the Recreational Activities domain of the World Health Organisation's (WHO) Global Physical Activity Questionnaire Version 2 (GPAQ2) [13]. Based on GPAQ2 analysis guidelines, respondents were then classified into those who met the GPAQ2 threshold for achieving moderate or high levels of exercise and those who achieved low levels or no exercise. These classifications included any combination of moderate or vigorous intensity exercise resulting in ≥600 MET minutes a week, ≥3 days/week of vigorous intensity exercise for ≥20 min/day, ≥5 days/week of moderate intensity exercise or walking for ≥30 min/day, as per GPAQ2 guidelines [13]. Achieving moderate or vigorous exercise as identified by GPAQ2 is also equivalent to meeting WHO's recommendation of 150 weekly minutes of moderate exercise, 75 weekly minutes of vigorous exercise or an equivalent combination of both [14]. For the purpose of the binary logistic regression analysis, women who achieved moderate or high levels of exercise were deemed as "sufficiently active", whereas women who achieved only low levels or no level of exercise were deemed as "insufficiently active".

Statistical treatment

Patient characteristics, exercise levels and exercise bra discomfort

Exercise bra discomfort was considered in a binary logistic regression against patient characteristics and exercise levels to ascertain any significant relationships. Whether a participant reported experiencing bra discomfort (none versus any level of discomfort) was inserted as a dependent variable against the independent variables of age (<50 years versus ≥50 years), type of surgery (lumpectomy versus mastectomy), whether women were currently undergoing treatment (current treatment versus finished treatment) and exercise levels (sufficiently active versus insufficiently active). This method of analysis has been previously employed in a cross-sectional survey data analysis with this population [11, 15] and ensures each independent variable is analysed while controlling for the other three independent variables.

Side effects and exercise bra discomfort

Whether a participant reported a side effect (none versus any) was analysed by a 2×2 cross tabulation relative to whether the participant reported exercise bra discomfort in response to direct questioning (Yes/No). Relationship significance was assessed using a Pearson's chi-square test of independence ($p < 0.05$). All statistical analyses were completed using SPSS for Windows software (Version 17.0, SPSS Inc, Chicago, IL, USA).

Results

Sample overview

Participants were 432 women who had been treated for breast cancer, aged between 23 and 77 years (mean 53.3±9.8 years; see Table 1). Table 1 provides information on the participant's self-reported health status, location, age and exercise levels with comparisons to Australian population data. The age spread of the sample was generally lower than the age of the wider Australian breast cancer population, which may skew results towards a younger breast cancer population. Despite this, the self-reported health status of the participants was similar to the general Australian female population, and the survey sample was spread across Australian states and territories in similar proportions to the wider breast cancer population, with the exception of the Australian Capital Territory, which formed 10 % of the sample and only 2 % of the national spread. The proportion of women deemed sufficiently active in the survey sample was very comparable to an age-matched general Australian female population (36.5 % versus 37.6 %).

One hundred eighty-eight women had undergone a lumpectomy during treatment for their breast cancer, 241 women had undergone a mastectomy, and 3 women reported no surgery (43.5, 55.8 and 0.7 %, respectively; see Table 2). None of the women had differing procedures on both breasts, and the mastectomy classification included women who had a lumpectomy followed by a mastectomy. Two hundred thirty-nine women were currently undergoing treatment (or still taking medication for their breast cancer), 148 women finished all treatment, and 45 women did not respond to the question (55.3, 34.3 and 10.4 %, respectively; see Table 2). Only 158 women (36.5 %) were considered sufficiently active, which is close to the percentage of sufficiently active women in an age-matched general Australian female population (37.6 %; see Table 1) [18]. Exercise data were missing for nine participants. In all categories, missing data were treated using listwise deletion, and although this resulted in data loss

Table 1 Respondents' demographic information with comparisons to Australian population data

	Present study		Comparison data (%)
	Number	Percentage	
Health status	428		Australian general female population [16]
In general, would you say your health is			
Excellent	55	12.9	57 (excellent or very good)
Very good	167	39.0	
Good	150	35.0	29 (good)
Fair	44	10.3	14 (fair or poor)
Poor	6	1.4	
Missing data	4	0.9	
State or territory	428		Australian breast cancer population [17]
What is your postcode?			
New South Wales	114	26.6	34
Victoria	119	27.8	25
Queensland	65	15.2	18
Western Australia	26	6.1	9
South Australia	41	9.6	9
Tasmania	15	3.5	2
Australian Capital Territory	44	10.3	2
Northern territory	4	0.9	0
Missing data	4	0.9	
Age	432		Australian breast cancer population [17]
What is your date of birth?			
<30 years old	2	0.5	0
30–49 years old	142	32.9	12
50–69 years old	271	62.7	51
>70 years old	17	3.9	37
Missing data	0		
Exercise	423		Age-matched Australian female population [18]
Sufficiently active	158	36.5	37.6
Missing data	9	2.2	

of up to 13 %, this approach was deemed appropriate to provide unbiased parameter estimates.

Patient characteristics, exercise levels and exercise bra discomfort

Among respondents aged 50 years and over, the proportion of women reporting bra discomfort (28 %) was lower than the proportion who reported no bra discomfort (36 %). The same trend was observed to a smaller extent among women under 50 years old (15 % reporting discomfort; 17 % reporting no discomfort). Between lumpectomy and mastectomy groups, the same trend was observed again, whereby the proportion of women reporting bra discomfort (18 % lumpectomy; 25 % mastectomy) was lower than the proportions of women reporting no bra discomfort (24 and 28 % respectively). This trend was also observed in current treatment groups, whereby the proportion of women reporting bra discomfort (25 % current treatment; 14 % finished all treatment) was lower than the proportions of women reporting no bra discomfort (29 and 19 % respectively). However, the trend was reversed among insufficiently active respondents, whereby the proportion of women reporting bra discomfort (31 %) was greater than the proportion who reported no bra discomfort (29 %).

Consistent with these sample proportion observations, none of the patient characteristics of age, undergoing current treatment or surgery type was significantly related to whether a participant reported experiencing exercise bra discomfort (see Table 3). However, reporting exercise bra discomfort was significantly related to a participant being sufficiently active. Specifically, women who reported exercise bra discomfort were less likely to be sufficiently active, while controlling for age, time post treatment and surgery type (OR 2.04; 1.32–3.16 95 % CI; $p = 0.04$).

Table 2 Respondents' characteristics divided into binary logistic regression groups

Binary logistic regression groups	Number	Percentage	Categories
Age	432		
What is your date of birth?			
<30 years	2	0.0	Under 50 years old, *n* = 144; 33 %
30–49 years	142	33.0	
50–69 years	271	63.0	50 years and over, *n* = 288; 67 %
>70 years	17	4.0	
Exercise	423		
In a typical week, on how many days do you do (moderate-intensity or vigorous-intensity) sports, fitness or recreational activities? (number of days per week)			
How much time do you spend doing (moderate-intensity or vigorous-intensity) sports, fitness or recreation ON A TYPICAL DAY? {{Hours} {Minutes}}			
Insufficiently Active	265	61.3	Insufficiently active
Sufficiently Active	158	36.5	Sufficiently active
Missing data	9	2.2	
Surgery undergone	429		
Please indicate ALL the surgeries you have undergone for your breast cancer. If you have not undergone any surgery, please skip this question. {Lumpectomy} {Mastectomy} with {Right} {Left}			
Unilateral lumpectomy	179	41.4	Lumpectomy, *n* = 188; 43.5 %
Double lumpectomy	9	2.1	
Unilateral lumpectomy followed by mastectomy	75	17.4	Mastectomy, *n* = 241; 55.8 %
Double lumpectomy followed by mastectomy	24	5.6	
Unilateral mastectomy	107	24.8	
Double mastectomy	35	8.1	
Missing data	3	0.7	
Time since completion of treatment	387		
Are you CURRENTLY undergoing any of the following treatments? {Chemotherapy} {Radiotherapy} {Hormonal therapies}			
For the treatments you have FINISHED, what was the date of your last session ever? {Month} {Year}			
Current chemotherapy	14	3.2	Currently undergoing treatment, *n* = 239 [a]; 55.3 %
Current radiotherapy	3	0.7	
Current hormonal therapies	226	51.4	
<1 years	20	4.6	Finished treatment, *n* = 148; 34.3 %
1–2 years	50	11.5	
3–4 years	23	5.3	
5–7 years	29	6.7	
8–10 years	9	2.1	
>10 years	17	3.9	
	Mean (±SD) years of treatment completion (excluding current Tx)		4.3±4.2 years
Missing data	45	10.4	

[a] Two respondents were simultaneously undergoing chemotherapy and hormonal therapies, while another two respondents were undergoing radiotherapy and hormonal therapies

Side effects and exercise bra discomfort

The most commonly reported physical side effects were hot flushes ($n = 257$), aching muscles ($n = 242$), shoulder limitations ($n = 190$) and pain ($n = 185$). Across all physical side effects except hot flushes, the proportion of women reporting exercise bra discomfort was greater than the proportion of women not reporting this discomfort (see Fig. 1). Also with the exception of hot flushes, all of the physical side effects reported by the respondents were significantly related to exercise bra discomfort (Pearson's chi-square statistic; $p < 0.05$).

Discussion

As exercise bra discomfort has been identified as a significant barrier to exercise for women treated for breast cancer [10], this study aimed to increase the body of knowledge in this sparse area

Table 3 Group percentage numbers and binary logistic regression values (with odds ratio) of patient characteristics and exercise levels against reported bra discomfort

Bra discomfort[a]	Independent variables							
	Age		Surgery		Current treatment		Exercise	
	Under 50 years old vs. 50 years and over		Lumpectomy vs. mastectomy		Current treatment vs. finished treatment		Insufficiently active vs. sufficiently active	
Odds ratio (95 % CI)[b]	1.01 (0.65–.58)		1.25 (0.81–1.92)		0.88 (0.58–1.35)		2.04* (1.32–3.16)	
	<50 years	≥50 years	Lumpectomy	Mastectomy	Current treatment	Finished treatment	Insufficiently active	Sufficiently active
Number reporting bra discomfort (%)	64 (15)	120 (28)	76 (18)	107 (25)	106 (25)	59 (14)	133 (31)	51 (12)
Number reporting no bra discomfort (%)	74 (17)	156 (36)	105 (24)	123 (28)	126 (29)	82 (19)	125 (29)	105 (24)
Data missing	18 (4 %)		21 (5 %)		59 (13 %)		18 (4 %)	

[a] "Do parts of the bra you wear during exercise cause you discomfort?"; closed-ended response question, "Yes" or "No" response options

[b] OR = 0, event equally likely in both groups; OR > 1, event more likely in first group; OR < 1, event more likely in second group

* $p = 0.04$

of research by determining whether any relationships existed between patient characteristics, exercise levels and exercise bra discomfort. In agreement with our first hypothesis, women who experienced exercise bra discomfort were more likely to not achieve sufficient levels of exercise, after controlling for patient characteristics. In agreement with our second hypothesis, results from this study suggest that the physical side effects experienced as a result of surgery and treatment associated with breast cancer are linked to experiencing bra discomfort during exercise. The implications of these unique findings are discussed below.

Exercise bra discomfort and exercise levels

To maintain overall health, WHO recommends that adults aged 18–64 years should do at least 150 min of moderate-intensity aerobic physical activity throughout the week, do at least 75 min of vigorous-intensity aerobic physical activity throughout the week, or do an equivalent combination of moderate- and vigorous-intensity activity [14]. Within this study, irrespective of age, current treatment or type of surgery, women who reported bra discomfort were significantly less likely to achieve the minimum recommended level of exercise. We postulate that this result implies that the level of bra discomfort experienced by a respondent was sufficient to impede that respondent's ability to achieve these recommended levels of exercise. This finding is of concern given the well-established benefits of exercise for this cohort and the potential for this barrier to be alleviated or reduced by providing more effective and comfortable exercise bra designs, which are specific to the needs of breast cancer survivors. The

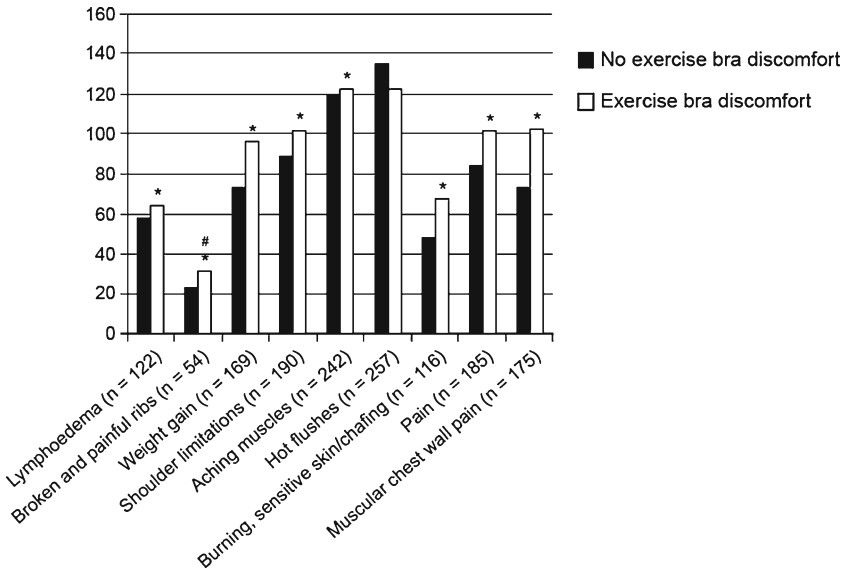

Fig. 1 Proportion of women who reported experiencing exercise bra discomfort and the associated physical side effects. *Asterisk* denotes significance (Pearson's chi-square statistic; $p < 0.05$). *Number sign* indicates that it is interpreted with caution due to small response number ($n = 54$)

specific exercise bra design needs of breast cancer survivors are likely linked to the side effects of their treatment, so an investigation into the relationship between treatment side effects and exercise bra discomfort was also warranted. The present study found that, with the exception of hot flushes, all the reported physical side effects associated with respondents' breast cancer treatments were significantly related to the reporting of exercise bra discomfort.

Side effects and bra discomfort

Surgical side effects

Surgery for breast cancer is associated with considerable short- and long-term morbidity, which may include lymphoedema, shoulder limitations and pain [19, 20]. Upper body morbidity, which encompasses both lymphoedema and shoulder limitations, is a severe and chronic condition affecting 19–54 % of breast cancer patients even up to 3 years post treatment [21]. Although outcomes are variable, the more extensive surgeries, such as axillary dissections and accompanying radiation and chemotherapies, are linked to the development of upper body morbidities. Many women who undergo breast surgery also suffer from ill-defined pain syndromes [22]. Pain that is a direct consequence of surgery can be nociceptive (resulting from injury to ligament or muscle) or neuropathic (resulting from injury to the nerves innervating the region) and affects 20–75 % of women following a mastectomy [19, 23]. Nociceptive pain usually resolves as the damaged tissues heal, whereas neuropathic pain may develop into a chronic syndrome [23]. Of particular relevance to bra designs for women following surgery for breast cancer is the development of neuroma pain, a chronic neuropathic pain arising from peripheral nerves being severed or injured and entrapped within scar tissue. These scars can cause spontaneous pain and severe mechanosensitivity [23], which can be exacerbated by both breast motion and contact of the bra over the scar tissue.

The present study found reporting lymphoedema, shoulder limitations, aching muscles, pain and muscular chest wall pain was significantly related to reporting exercise bra discomfort. Considering this link and given that breast cancer surgery side effects are common and may persist for many years post surgery [24], there is a clear need for further investigation into specialised breast support designs for women following surgery for breast cancer who wish to reap the health benefits associated with exercise.

Radiotherapy side effects

The physical side effects of broken and painful ribs as well as burning, sensitive skin and/or chafing are typically linked to radiation therapy [19]. For the remainder of their lives, breast cancer survivors who have undergone radiation therapy are also at risk of developing long-term radiation effects such as lymphoedema, shoulder limitations and fibrosis [19]. Acute skin reactions due to radiation therapy are primarily due to a damaging effect on the basal layer of the epidermis [25]. Within 3 months of radiation, 61 % of the patients report erythema and 55 % report pain and tenderness of the skin or breast [25]. Even 6 months after radiation, up to 44 % of patients still experience pain and tenderness in the breast region and up to 25 % report erythema [25]. It has been suggested that radiation effects have the same frequency and intensity regardless of the type of surgery undergone, and acute and late radiation-related morbidities are independent adverse effects, without a mechanistic relationship [26]. Factors such as treatment technique, beam energy, bra cup size and dose variation across the target volume all have a significant effect on the acute skin reaction observed [27].

The axilla and inframammary fold are commonly the sites of the most severe skin injury following radiation therapy [28]. The band of an exercise bra provides the primary support for the breasts and will sit on these sites, which may lead to greater discomfort as a result of bra band pressure on the skin and underlying hypodermis. Therefore, exercise bras for breast cancer survivors must account for and minimise the exacerbation of this radiation damage by minimising the bra band pressure experienced at these sites.

In some cases, an early skin reaction to radiation therapy can progress to a chronic injury. A common chronic skin condition following breast cancer radiation is fibrosis, which is characterised by an increase in "stiffness" or loss of compliance in the soft tissue [29, 30]. Fibrosis is typically permanent, and in the skin, subcutis and muscle, fibrosis can cause limitations in the range of motion and substantially affect function [29, 30]. This late effect of fibrosis has implications for exercise bra design for women following radiation therapy for breast cancer, as a "stiffer" breast may impair natural breast motion. An exploratory biomechanical study [31] found that, compared to the unaffected breast, the natural affected breast of four lumpectomy patients moved in an altered and restricted pattern when they ran on a treadmill, which was perceived by the participants as asymmetrical breast motion. We postulate that a prosthetic or reconstructed breast will also display motion changes, which may be detected by patients. These asymmetrical breast motion patterns are not accounted for in bras worn during exercise by breast cancer survivors and thereby may result in exercise bra discomfort or self-consciousness, which may be interpreted as feeling "uncomfortable" in the bra. In fact, breast cancer survivors frequently report a fear of their prosthesis moving or falling out of their bra, which may be exacerbated by exercise, and excessive asymmetrical breast movement may draw unwanted attention to the survivor [32, 33]. Further study is therefore urgently required in order to ensure that exercise bras designed for

women treated for breast cancer account for the differences in movement likely to be displayed by the affected breast or prosthesis compared to the natural breast of these women.

The present study also found that respondent weight gain was significantly linked to exercise bra discomfort. Weight gain is a common side effect of breast cancer treatment and carries with it an increased risk of secondary cancer and the development of other morbidities [19, 34]. Weight gain is also associated with a change in body composition and an increase in body weight without concurrent increases in lean muscle mass (sarcopenic obesity) [19, 34]. Women who gain weight following breast cancer treatment often find asymmetrical gains between their affected and unaffected side, and this is even more poignant for women who use a prosthesis as a result of breast tissue removal [33]. As a result, fluctuations in weight will affect how balanced a survivor feels towards her unaffected side and will also change the fit of a bra. Specifically, breast cancer survivors have reported difficulty matching the affected or unaffected breast and/or prosthesis cup sizes within a bra [31]. Correct bra fit is imperative in order to achieve exercise bra comfort [35], which may explain why women treated for breast cancer who report weight gain also report exercise bra discomfort.

Strengths and limitations

We acknowledge that the primary limitation of this study is that the exercise data are based on self-reported measures. Demographic data regarding marital status, income, education level, region or residence (regional/remote or metropolitan) as well as data regarding exercise behaviours prior to treatment for breast cancer were not collected and therefore could not be controlled for in the analysis of exercise behaviour. As this is the first study to investigate exercise bra discomfort and exercise levels among women living with breast cancer, the study was limited in the comparisons that could be made to existing literature specific to this field of research. Finally, we acknowledge that the coding of side effects into "no symptoms" versus "any level of that symptom" was broad. However, division into categories that accounted for the extent of symptom experience (none, mild to moderate, moderate to severe) was not feasible due to a limited distribution of respondents across the spectrum of symptom experience. Furthermore, even with this broad level of coding, the subsample sizes of these side effects were lower than what was deemed sufficient by a conservative proportional sample size calculation and may limit the significance of these findings. Future studies with a larger study population, which can draw meaningful subsample sizes would be required to achieve this level of analysis. Future research should also gather greater details of which parts of the bra cause discomfort for women treated for breast cancer. Despite these limitations, this study provides valuable insight into an otherwise limited research area. The strengths of the study are that the online survey completion rate was very high (89.6 %), providing responses from a large sample of Australian women treated for breast cancer. Furthermore, the electronic nature of survey delivery allowed for side effect items to be randomised preventing any ordering bias and limited the human error potential, which is present during manual paper survey data transcriptions into electronic statistical packages.

Conclusion

This study links the reporting of exercise bra discomfort to not achieving recommended levels of exercise among women treated for breast cancer. This study also suggests that the physical side effects experienced as a result of breast cancer treatment are linked to experiencing bra discomfort during exercise. Based on these findings, it is postulated that providing better bra designs, which are specific to the needs of breast cancer survivors, may eliminate or reduce one of the important barriers to exercise. This, in turn, will enhance exercise participation in this patient population and enable women treated for breast cancer to enjoy the health benefits associated with an active lifestyle.

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