



Use of compression garments by women with lymphoedema secondary to breast cancer treatment

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Abstract

Purpose This aim of this study was to determine the use of compression garments by women with lymphoedema secondary to breast cancer treatment and factors which underpin use.

Methods An online survey was distributed to the Survey and Review group of the Breast Cancer Network Australia. The survey included questions related to the participants' demographics, breast cancer and lymphoedema medical history, prescription and use of compression garments and their beliefs about compression and lymphoedema. Data were analysed using principal component analysis and multivariable logistic regression.

Results Compression garments had been prescribed to 83% of 201 women with lymphoedema within the last 5 years, although 37 women had discontinued their use. Even when accounting for severity of swelling, type of garment(s) and advice given for use varied across participants. Use of compression garments was driven by women's beliefs that they were vulnerable to progression of their disease and that compression would prevent its worsening. Common reasons given as to why women had discontinued their use included discomfort, and their lymphoedema was stable. Participant characteristics associated with discontinuance of compression garments included their belief that (i) the garments were not effective in managing their condition, (ii) experienced mild-moderate swelling and/or (iii) had experienced swelling for greater than 5 years.

Conclusion The prescription of compression garments for lymphoedema is highly varied and may be due to lack of underpinning evidence to inform treatment.

Keywords Breast cancer · Lymphedema · Compression garments · Adherence · Protection motivation theory

Introduction

Lymphoedema is a common sequela following treatment for breast cancer [7, 33] with up to one in five women developing this chronic, incurable condition [7]. Superficially, the disease presents as a swelling of the upper limb, breast or chest wall in isolation or in combination. However, women living with lymphoedema may experience a range of physical and psychosocial symptoms that interfere with their ability to complete activities of daily living, hobbies and paid work [14, 27, 32]. Consequently, women living with lymphoedema can experience a poorer quality of life when compared with women

who do not develop lymphoedema following treatment for breast cancer [2, 13].

Compression garments are considered to be the keystone of lymphoedema management [3, 21]. They are routinely prescribed by clinicians to reduce swelling or maintain limb volume of the affected region throughout different stages of treatment [1, 11, 17, 35]. Despite the considered importance of compression garments, little is known about what garments are prescribed, what advice in relation to wear and replacement is provided and the extent to which they are actually used by women living with lymphoedema. Only two studies have investigated whether women use compression as prescribed, with both highlighting that some women choose not to do so [4, 30]. However, the underlying reasons why women chose not to use compression garments as prescribed were not explored. The current study was undertaken to explore issues around use of compression garments by women with secondary lymphoedema arising from treatment of breast cancer. The Protection Motivation Theory was used to inform questions

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related to women's motivation in regard to use of compression garments.

The Protection Motivation Theory (PMT) is a socio-cognitive model that is used to explain why individuals engage in or persist with unhealthy behaviours [28]. It has been established as a reliable predictive model in a variety of health contexts [12] and may be able to explain why some women living with lymphoedema discontinue the use of their compression garments. The model proposes that an individual's intention to engage in a protective behaviour, or conversely a harmful behaviour, is driven by two internal appraisal processes: a threat appraisal and a coping appraisal. The threat appraisal consists of an individual's perception of the severity of a health risk and their perceived vulnerability to the health risk. The coping appraisal consists of an individual's self-efficacy and their perception of the efficacy of the recommended behaviour in managing the health risk. A combination of these two appraisal processes influences intention, which is a strong predictor of behaviour [20, 34]. The Protection Motivation Theory, therefore, provides an excellent model to explore women's intention to use compression garments for the management of their lymphoedema.

The aims of this study, therefore, are to (a) describe the use of compression garments by women living with lymphoedema, (b) determine the beliefs that drive use of compression garments by women living with lymphoedema and (c) determine factors that are associated with both use and discontinued use of compression garments by women living with lymphoedema.

Methods

An online survey was designed to capture information specifically about women treated for breast cancer who currently experience lymphoedema and have used compression within the last 5 years. It was adapted from a previous survey created by this research team which explored the factors that contribute to women's intention to avoid strenuous arm activity after breast surgery [19]. Feedback was obtained from the Breast Cancer Network of Australia (BCNA) and other experts. Questions were further altered to ensure that the final survey would not cause distress and participants would interpret the questions accurately. Face validity of the questions was assessed by the authors.

The survey included questions related to the following areas:

- Demographics (age, weight, height, employment, education, postcode)
- Breast cancer and lymphedema medical history (side of surgery, dominant side affected, severity of swelling)
- Prescription and use of compression garments

- Perception of the severity of and vulnerability to lymphoedema, as well as efficacy of compression and participant's self-efficacy

Participants classified the severity of their swelling using a validated rating scale [22, 23]. The scale required respondents to consider the severity of their lymphoedema by its visibility: mild (only you would notice), moderate (someone close to you would notice) or severe (anyone would notice). Additional questions relating to perception required a response on a five-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Some questions were reverse-phrased to encourage participants to consider their responses rather than respond to the questions uniformly. All other questions required one or more boxes to be checked. Open-ended responses were optioned when "other" was checked.

The survey took approximately 3 min to complete for women without lymphoedema and 10 min for women with lymphoedema. Participants were excluded from the survey at endpoints if they had not received treatment for breast cancer, were not currently experiencing swelling related to breast cancer treatment or had not been prescribed a compression garment in the last 5 years. This time interval was selected because of concern about the accuracy of participant recall of compression garment use and prescription over a longer time period.

The survey was distributed by the BCNA to members of the BCNA Survey and Review group via an e-mail invitation in June 2016, in which women were specifically invited to participate in a study on the use of compression for lymphoedema. The BCNA is the peak national organisation for Australians affected by breast cancer. Members of the BCNA may elect to join the Survey and Review Group, an online group for those who are interested in participating in research projects. At the time of distribution, there were 2263 members of the BCNA Survey and Review group. Selection of recruitment through the BCNA Survey and Review group was made on the basis that members have registered their willingness to participate in relevant research, are easily accessible and are nationally representative.

The survey was open for 1 month. During this period, participants could leave the survey and return to complete their attempt at any time. Participants were sent a reminder 2 weeks after the initial invitation. The survey was anonymous and completion of the survey was an indication of informed consent. This study was approved by the University of Sydney Human Research Ethics Committee.

Data analysis

Participant characteristics were described using frequencies. Frequencies for responses relating to prescription and use of

compression garments were differentiated based on the participant's severity of swelling.

To determine the beliefs that drive use of compression garments by women with lymphoedema, nine statements were analyzed using factor analysis. Two statements were reverse scored to correct for the varying valence of statements. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity (BTS) indicated that the sample was sufficient to undertake this analysis (KMO = 0.713; BTS $\chi^2 = 597$; $P < 0.001$) [16]. As there could be expected a strong relationship between some of the constructs, an oblique rotation (Promax with Kaiser normalization) was used to identify the component loading of the nine statements. Factors with eigenvalues greater than one were explored and retained if they included two or more statements that had factor loadings ≥ 0.5 . For each identified factor, a score was generated using the regression model. Internal consistency of component was assessed using Cronbach's alpha; 0.6–0.9 was considered acceptable [18]. Analysis of variance was used to assess whether severity of disease, age, body weight, BMI and duration of living with lymphoedema were related to the identified factors from the factor analysis.

To determine the independent variables associated with discontinued use of compression garments, logistic regression was undertaken. Each variable to be considered was dichotomized. For those variables that were continuous, receiver-operator curves were used to identify cut-off points. Unadjusted logistic regression was then conducted to identify variables that were significantly different between participants who used and participants who did not use their compression garments (odds ratio (OR) > 2.0 or $P < 0.1$). These variables were entered into a multivariable logistic regression model to determine the independent predictors of discontinued use of compression garments. The model was built using a sequential method. At each step, the newly added variable was retained if the standard error in the model changed by less than 10% [26]. SPSS 22.0 was used for all data analyses.

Results

Participants

In total, 215 women completed and submitted their survey, of whom 201 (94%) reported currently experiencing swelling on the side of surgery, and 178 (83%) reported having been prescribed a compression garment for their swelling in the last 5 years. Mean age (standard deviation [SD]) was 58.6 years (9.8), and mean body mass index (BMI) was 28.7 kg/m² (5.9). Most women were diagnosed with breast cancer greater than 5 years ago (55.6%). Current swelling most commonly occurred in the arm either solely ($n = 72$) or in combination with other regions of the body ($n = 83$). Seven women reported

currently only have hand swelling and four reported only having either back swelling or breast/chest swelling. The severity of lymphoedema experienced by participants was distributed across mild (31.4%), moderate (42.1%) and severe (26.4%) swelling. Participant demographics and clinical characteristics are presented in Table 1.

Use of compression garments

Of the participants with lymphoedema, 140 (78.7%) reported that they were currently using a compression garment (Table 2). The most common reasons reported for use of compression garments were 'keeps my arm shape and lymphoedema stable' (79.3%) and 'I want to follow the advice of my health professional' (61.4%). Whilst use of ready-made compression garments for upper limb lymphoedema was related to severity of disease ($\chi^2 = 6.9$; $P < 0.03$), ready-made compression garment use was not related to BMI ($\chi^2 = 2.8$; $P = 0.24$), even when severity was considered. Ready-made garments were more likely to be worn by women with mild (64.3%) or moderate (62.7%) severity whereas custom-made

Table 1 Participants' ($n = 178$) characteristics

Characteristics	% (n)
Age (years)	
30–39	2.8 (5)
40–49	15.2 (27)
50–59	33.1 (59)
60–69	36.0 (64)
≥ 70	12.4 (22)
Missing	0.6 (1)
BMI	
Normal	30.3 (54)
Overweight (25–29.9)	33.2 (59)
Obese (≥ 30 kg/m)	34.3 (61)
Missing	2.2 (4)
Time since breast cancer diagnosis	
Less than 12 months	2.8 (5)
Between 1 and 3 years	20.8 (37)
Between 3 and 5 years	20.8 (37)
Greater than 5 years	55.6 (99)
Dominant side affected	56.7 (101)
Severity of lymphoedema	
Mild	31.5 (56)
Moderate	42.1 (75)
Severe	26.4 (47)
Duration of swelling	
Less than 12 months	11.2 (20)
Between 1 and 3 years	25.3 (45)
Between 3 and 5 years	24.7 (44)
Greater than 5 years	38.8 (69)

Table 2 Compression garment use by severity of lymphoedema

	Severity of Lymphoedema		
	Mild	Moderate	Severe
	(<i>n</i> = 56) % (<i>n</i>)	(<i>n</i> = 75) % (<i>n</i>)	(<i>n</i> = 47) % (<i>n</i>)
Type of garment			
Ready-made garment	64.3 (36)	62.7 (47)	38.3 (18)
Custom-made	35.7 (20)	37.3 (28)	61.7 (29)
Style of compression garment*			
Arm Sleeve	83.9 (47)	85.3 (64)	83.0 (39)
Gauntlet	10.7 (6)	21.3 (16)	40.4 (19)
All-in-one combined arm sleeve with gauntlet	19.6 (11)	8.0 (6)	31.9 (15)
Glove with fingers	10.7 (6)	36.0 (27)	36.2 (17)
Glove with fingers to elbow	0	1.3 (1)	4.3 (2)
Glove with fingers to axilla	1.8 (1)	8.0 (6)	2.1 (1)
Compression vest/top	3.6 (2)	6.7 (5)	4.3 (2)
Velcro-assisted wrap	0	2.7 (2)	10.6 (5)
Other	7.1 (4)	8.0 (6)	8.5 (4)
Instructions for compression garment use*			
Only during ‘at risk’ activities	44.5 (25)	21.3 (16)	6.4 (3)
At least 6 h per day for 5 days per week	7.1 (4)	9.3 (7)	6.4 (3)
Waking hours, every day	30.4 (17)	54.9 (41)	61.7 (29)
Day and night	8.9 (5)	6.7 (5)	21.3 (10)
Other	8.9 (5)	8.0 (6)	2.1 (2)
Do not know	0	0	2.1 (1)
Currently complies with instructions for compression garment use	71.4 (40)	77.3 (58)	72.3 (34)
Currently uses compression garment	71.4 (40)	77.3 (58)	89.4 (42)
Frequency of compression garment replacement			
Six-monthly or less	12.5 (7)	29.3 (22)	36.2 (17)
Between six months and a year	21.4 (12)	22.7 (17)	34.0 (16)
Every one to two years	19.6 (11)	17.3 (13)	8.5 (4)
Every two years or more	17.9 (10)	8.0 (6)	10.6 (5)
Missing	28.6 (16)	22.7 (17)	10.6 (5)

*some selected multiple options

garments were more likely to be worn by women with severe lymphoedema (61.7%).

Compression garments were prescribed by a range of health practitioners, including physiotherapists (*n* = 113), occupation therapists (*n* = 39), medical doctors (*n* = 11), massage therapists (*n* = 21) and nurses (*n* = 6). Twelve percent of participants had been prescribed compression garments by more than one type of health practitioner over the past 5 years. The most common combinations were prescriptions by a physiotherapist as well as an occupational therapist (*n* = 6), physiotherapist and medical doctor (*n* = 5) and occupational therapist and nurse (*n* = 5). Instructions given by clinicians to patients on their garment use varied both between and within severity of lymphoedema (Fig. 1). For example, while 44.5%

of women with mild lymphoedema were advised to use their garment only during at-risk activities, 21.3% of those with moderate lymphoedema were given similar recommendations ($\chi^2 = 9.1$; $P = 0.002$). In contrast, 61.7% of those with severe lymphoedema were advised to wear their garment during waking hours, compared to 30.4% of women with mild lymphoedema ($\chi^2 = 9.5$; $P = 0.002$). Overall, 74.6% followed the instructions given regarding use of their garment.

Beliefs that drive use of compression

Factor analysis identified two factors, perceived efficacy of compression garments managing lymphoedema and the participants’ fear of lymphoedema worsening (Table 3), which

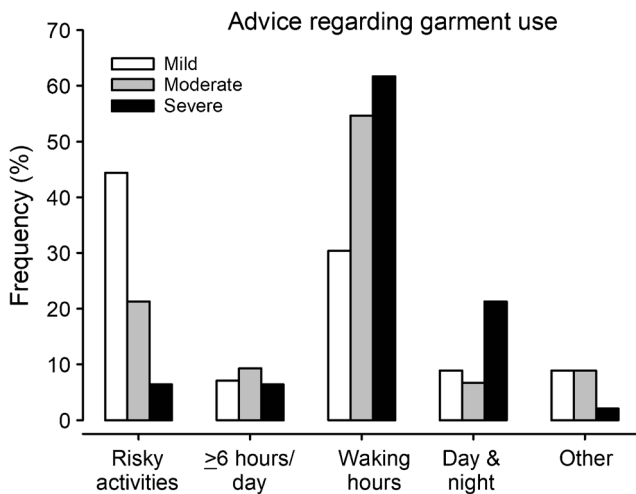


Fig. 1 Advice regarding garment use, accounting for severity of lymphoedema. Women with mild lymphoedema were commonly instructed to use compression garments during high-risk activities; in contrast, women with moderate to severe lymphoedema were commonly told to use compression garments at least during the waking hours

accounted for 60% of the variance in the responses to survey statements on the beliefs that drive use of compression garments.

Perceived efficacy of the compression garments in managing lymphoedema: Five survey statements included in this component (Fig. 2a) referred to participants' perceptions about the efficacy of compression garments to alleviate or prevent swelling and their own ability to use a compression garment (Cronbach's alpha = 0.83). Women who perceived that compression garments were effective in managing their lymphoedema also agreed that compression garments were easy to use and vice-versa. These survey statements had factor loading between 0.66 and 0.84, with the statement 'wearing a compression garment is an easy routine for me to follow' having the lowest loading, indicating that among these statements, this was the one with the least agreement among the cohort.

Perceived vulnerability to worsening of lymphoedema: Four survey statements included in this component referred to participants' fear of lymphoedema developing or worsening and the perceived physical and psychological consequences of lymphoedema (Fig. 2b; Cronbach's alpha = 0.70). Thus, if

women perceived that lymphoedema was a major side effect, they also perceived that women living with it suffered greatly, that it looked unattractive and they were concerned that it would worsen. These survey statements had factor loadings from 0.63 to 0.81, with the statement that 'lymphoedema was a major side effect' having the lowest loading.

The derived regression scores from the factor analysis were used to determine if the perceived ability to cope and perceived threat of lymphoedema were related to severity of disease. Coping ability did not differ significantly depending on severity of lymphoedema, although there was a trend towards significance ($F = 2.6_2, 152; P = 0.08$). In contrast, the perceived threat of lymphoedema was significantly related to severity of disease ($F = 4.3_2, 152; P = 0.02$). Post hoc analyses revealed that the scores of women with moderate severity lymphoedema were not significantly different to those either with severe or mild lymphoedema; however, scores from women with mild lymphoedema were significantly different to those with severe lymphoedema. Other variables such as age, body weight, BMI and duration of living with lymphoedema were not related to either of the derived regression scores for either variable.

Variables associated with the discontinued use of compression garments

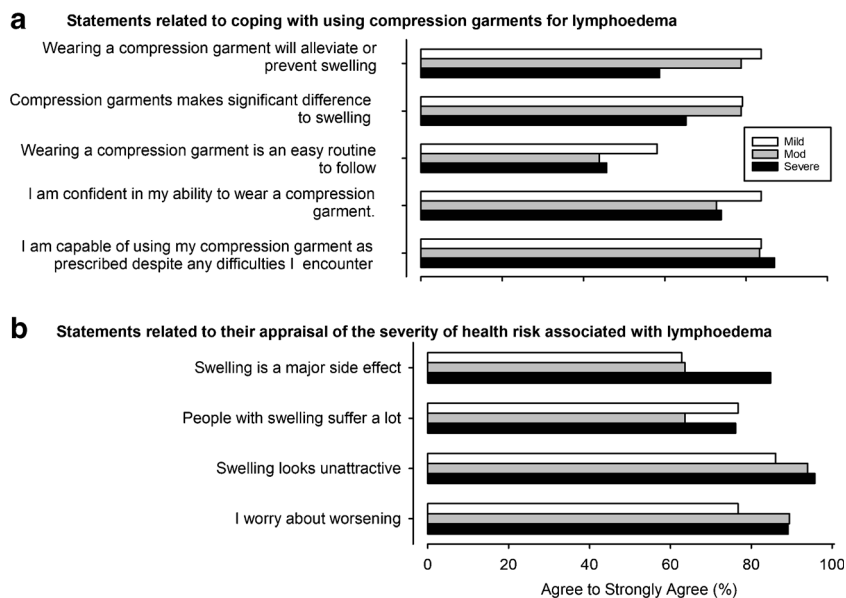
Compression garments had been discontinued by 37 (21%) women. The most common reasons reported for discontinued use of compression garments were '[garment] felt uncomfortable' ($n = 16$), 'lymphoedema stable' ($n = 12$), did not like the look of it ($n = 10$) and made no difference ($n = 10$). Six women had discontinued use of compression garments as the swelling had resolved.

Unadjusted odds ratios identified three participant characteristics ($OR > 2.0$ or $P < 0.1$) that were significantly different between participants who did and did not continue to use their compression garments. The three variables were duration of living with lymphoedema (< 5 versus ≥ 5 years), severity of disease (mild-moderate versus severe) and beliefs about the efficacy of compression garments in management of lymphoedema (effective versus not effective). These variables were entered sequentially into a multivariable logistic

Table 3 Independent risk factors for discontinued use of compression garments

		Discontinued use of compression (%)	Odd ratio	95% Confidence Intervals	
Perceive benefit of compression	>.559	37.8	4.5	1.9 to 10.5	<0.01
	<.559	15.2			
Severity of lymphoedema	Mild-mod	24.6	4.7	1.6 to 14.2	<0.01
	Severe	10.6			
Duration of swelling (years)	>5	29.0	2.2	1.0 to 4.8	0.05
	<5	15.7			

Fig. 2 Statements comprising the factors related to **a** compression use and **b** severity of health risk associated with lymphoedema, stratified by perceived severity of swelling



regression model, and all were retained as independent variables (Table 3). Participants were therefore more likely to discontinue use of their compression garments if they (i) perceived that the garments were not effective in managing their condition, (ii) experienced mild-moderate swelling and/or (iii) had experienced swelling for greater than 5 years. Seventy-one percent of participants who discontinued use of their compression garments and in whom the swelling had not resolved could be described by two or more of these variables. Age, BMI, dominant side affected and beliefs about lymphoedema did not contribute significantly as to whether or not women discontinued use of compression garments.

Discussion

Although regularly worn compression garments are considered to be central to the long-term management of secondary upper limb lymphoedema [5], we found little agreement on what patients report their clinicians recommended for wear time, particularly for those with mild lymphoedema. Large variability was also reported with respect to the types of garments prescribed as well as the frequency of replacement. Exploration of women's beliefs regarding use of compression garments identified two factors related that influenced their beliefs around use of compression: (i) their perception around the efficacy of compression garments in managing their condition and (ii) their perceived threat of worsening lymphoedema. Interestingly, only the perceived threat of worsening lymphoedema was related to the severity of lymphoedema, with those with severe disease more likely to perceive the threat of worsening. While most women believed that compression was an effective way to manage their lymphoedema, a minority of women from across the spectrum

of severity of lymphoedema chose to discontinue use of their compression garments.

Compression garments are most often used in the long-term management of lymphoedema, regardless of what other conservative treatments are also used [5]. Theoretically, compression garments increase interstitial tissue pressure, thereby reducing capillary filtration and production of lymph [5, 21]. Due to the graduated pressure, compression garments are also believed to shift fluid from the compressed region to that which is not compressed [24]. Other benefits attributed to compression garments include (i) improved lymphatic functioning and softening of tissue [5, 24]. The evidence supporting these mechanisms is, for the most part, theoretical. New imaging techniques, such as the use of ICG, may provide additional evidence in humans to support the role of compression.

In addition to little evidence underpinning the physiological basis for use of compression garments, there is also little evidence, or expert consensus, to support even basic prescription details for upper limb lymphoedema [25]. As a consequence, and as shown in the current study, a wide range of prescriptive approaches are being implemented. The lack of expert consensus is not surprising given the wide range of variables to consider in prescription of garments. Such variables may include those related to the garment itself such as whether it is custom-made or off the shelf, flat or circular knit, the compression class used and which additional features to include with the garment, e.g. gauntlet, silicon top band. Additional patient variables to consider include severity of lymphoedema, which regions are affected by lymphoedema, the underlying skin condition and ability to don and doff the garment. The International Lymphoedema Framework [8] advocates use of low compression for mild upper limb lymphoedema that has minimal limb volume change and still

presents with pitting (e.g. 15–21 mmHg), moderate compression for limbs in which the region is no longer pitting and significant volume changes has occurred (23–32 mmHg) and high pressure (34–46 mmHg) for those patients in whom the lymphoedema is excessive, significant tissue change has occurred and the lymphoedema spans multiple joints. This is however, based on little evidence, and beyond the guidance on level of compression, there are few recommendations offered.

Another aspect which needs to be addressed is in relation to when compression garments should be used. This lack of knowledge may contribute to the conservative recommendations of life-long requirements of wear and use of compression garments placing a possibly unnecessarily heavy burden on patients [14]. While there is evidence to suggest that use of a compression garment may result in the stabilisation of or a reduction in limb volume [1, 10], particularly in the earliest presentations of lymphoedema [6], it is unknown if continued wear is required to maintain reductions for all individuals and, if so, how many hours per day or week continued wear is required. Preliminary data from women with very mild swelling suggest that if compression is used when slight swelling is identified, it may stave off long-term use of compression [31]. However, this has yet to be confirmed. In the current study, 30% of women did not follow the advice given to them regarding wearing the garments, with a minority of women discontinuing their use. It is unknown whether they are worse off because of their approach to use of compression garments. While the most common reason women gave for discontinuing them in the current study was discomfort, some did note that their swelling had either stabilized or resolved [15].

To determine the extent to which women are likely to be compliant, it is important to understand their perceptions related to the likelihood of their lymphoedema worsening and their beliefs in the role of compression in managing any possible worsening. The majority of women did agree or strongly agree that compression garments were beneficial. Similarly, they perceived that they were at risk of their swelling worsening. Of the small percentage who had discontinued the use of their garments, it was related to their perception around lack of efficacy of their garment in controlling their lymphoedema, as well as having the condition for >5 years, and having mild to moderate lymphoedema. It is unknown whether discontinuance is associated with any worsening of the condition as there has been surprisingly little research into either the short- or long-term use of compression garments for the treatment of upper limb lymphoedema [15].

Our samples were drawn from women who were part of the BCNA Survey and Review group. The response rate for the current study was low; however, the e-mail which was forwarded to the group on our behalf indicated that the study was about the use of compression garments for treatment of lymphoedema. As a previous study conducted through this group achieved 59% response rate [29, 30], we hypothesize that

the low response may reflect the lack of participation of women who did not have lymphoedema and other members of the group who may not have had breast cancer. The women who did participate, due to the need for computer literacy, tend to have higher than average education levels as well as access to private healthcare [9]. In addition, they may be better informed and or more motivated to engage with their own healthcare than the general population of women with lymphoedema secondary to breast cancer because of their ongoing association with BCNA. These factors may have influenced the treatment and compliance with treatment that these women receive. However, this limitation needs to be balanced against the representation these women provide, being drawn from all states in Australia and from both rural and urban settings. The other issue to address is potential bias in the sample.

Conclusion

In conclusion, the use of compression garments by women with lymphoedema secondary to breast cancer is highly varied in terms of what garments are prescribed and advice regarding use, even when controlling for severity of swelling. The majority of women continued to use their garment as they perceived they were vulnerable to progression of this disease, and compression mediated this risk. However, for some, this may be an unnecessary burden. What is lacking is an evidence-based approach to inform prescription of garments, both in terms of what type of garment is required, based on underlying pathology, as well as in terms of how long and often to wear the garments.

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Compliance with ethical standards

Ethical approval All procedures performed were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Statement of originality This manuscript reports original data. The authors have full control of all primary data and agree to allow the journal to review the data if requested.

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