

Prevalence and Impacts of Upper Limb Morbidity after Treatment for Breast Cancer: A Cross-Sectional Study of Lymphedema and Function

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Abstract A cross-sectional study screened lymphedema, impaired upper limb function (ULF) and quality of life (QOL) in women post-breast cancer. Women attending review appointments who had completed surgery, chemotherapy and radiotherapy, were without recurrence, and could complete questionnaires in English were invited. Medical records were reviewed and questionnaires completed: the Morbidity Screening Tool (MST), Disability of the Arm, Shoulder and Hand questionnaire (DASH), and Functional Assessment of Cancer Therapy for breast cancer QOL questionnaire (FACTB+4). The vertical perometer (400T) measured percentage upper limb volume difference (%LVD), with 10% or greater difference diagnosed as lymphedema. Of 617 participants (mean age 62.3y, SD 10.0; mean time since treatment 63.0 months, SD 46.6), sufficient questionnaire data were available for 613 and perometry data for 417. Using the MST, 21.9% self-reported impaired ULF, 19.8% lymphedema, and 9.2% both. Based on %LVD, 26.5% had lymphedema. Histogram analysis for individuals in the first eight twelve-month intervals after treatment found impaired ULF prevalence peaked at three to five years and lymphedema at three years. Significantly worse function (DASH) and QOL (FACT B+4) resulted for those with morbidity ($p < 0.000$). This provides evidence that impaired ULF and lymphedema negatively affect QOL years after treatment and are not necessarily linked.

Keywords Lymphedema; Upper Limb Function; Prevalence; Quality of Life; Impacts

1. Introduction

Increasing survival rates after breast cancer have led to greater focus on improving functional outcomes, reducing

morbidity and improving quality of life. The necessary rigour of treatment can lead to long term morbidity, including impaired upper limb range of motion, strength and function, and swelling (lymphedema) that may develop immediately, or may emerge years later [1].

Lymphedema is an accumulation of interstitial fluid in the tissues due to interruption in the lymphatic system and can lead to skin fibrosis and cellulitis, as well as psychological sequelae. Prevalence estimates vary widely, from 2 to 86%, due to differences in study samples, measurement techniques, and diagnostic criteria [2]. Growing consensus indicates greater risk of lymphedema after axillary lymph node dissection (ALND), and radiotherapy to the axilla [3]. Previously, people have been recommended to avoid activity in the affected limb, with a link expected between treatment in the dominant limb and lymphedema, although this is unclear and requires further investigation [4]. Several studies have compared breast cancer survivors with and without lymphedema, finding greater psychological morbidity and poorer function and quality of life in the former [5].

Reduced mobility of the shoulder, reduced grip strength, and pain can also develop, affecting work and activities of daily living [3,6]. A systematic review looking at prevalence of upper limb morbidity found wide variation, but concluded that impaired upper limb function is a long-term problem after breast cancer treatment, affecting quality of life [7]. However, several authors highlight the lack of understanding of relationships between late morbidity and activities of daily living, occupation, and quality of life [3,6,8]. Thomas-MacLean and colleagues advocate for research into inter-relationships between forms of arm morbidity, such as lymphedema and impaired upper limb function [8].

Lymphedema measurement often focuses on limb volume, using volumetry (water displacement), or calculations from circumferential measurement of segments of the limb. Perometry (opto-electronic scanning) and multifrequency

bioelectrical impedance [1,9,10]. Lymphedema is frequently diagnosed through comparison of the affected and unaffected limbs, or within the same limb over time, most commonly specified as differences equal to or greater than 10%, 2cm, 5cm or 200ml in limb circumference or volume (as appropriate) [11]. A comparison study suggests that an increase in percentage limb volume of 10% or more is the most conservative classification, allowing for pre-existing bilateral limb volume differences [11]. Some evidence suggests that patient self-report provides an earlier and more sensitive diagnosis that does not rely on pre-operative limb volume measurements or expensive instrumentation and explores functional and psychosocial dimensions [1,4,11]. A combined approach is advocated by some [1]. Upper limb morbidity has been evaluated in various ways, including goniometry measurement of shoulder range of motion, dynamometry for grip strength, and self-report of pain and ability to perform activities of daily living [3].

Evidence suggests that when detected early, therapeutic intervention can lead to greater success in managing upper limb morbidity, with improved outcomes and quality of life [12], raising the importance of further investigation. A study was designed that screened for lymphedema and impaired arm function after breast cancer treatment, enabling investigation of the following research questions:

1. What are the prevalence rates of impaired upper limb function (ULF) and lymphedema in a cross-sectional sample of women who have completed treatment for breast cancer, and what is the relationship between the two?
2. How do the prevalence rates of impaired ULF and lymphedema differ between women who are at different time-points post-treatment in the sample?
3. To what extent do impaired ULF and lymphedema impact on quality of life, function and occupation of those within the sample, and do their impacts differ?
4. Does dominance of the treated limb affect prevalence of impaired ULF and lymphedema, and their impacts of morbidity on quality of life and function?

A further research question, relating to relationships between morbidity and treatment characteristics, will be dealt with elsewhere.

2. Material and Methods

2.1. Study Design

A cross-sectional study screened for impaired ULF and lymphedema in women who had completed treatment for breast cancer (surgery, chemotherapy and radiotherapy), between November 2009 and May 2010. The South East Scotland Research Ethics Committee classified this as service review and full ethical review was conducted within the Higher Education Institution.

2.2. Procedure and Measurement

Women awaiting review appointments at the Breast Clinic, who did not have recurrence, and who could complete questionnaires in English were provided with information and a consent form. If willing, they completed a questionnaire booklet, and participated in objective tests in a private clinic room, and medical records were reviewed.

The vertical perometer (400T) was used to objectively diagnose lymphedema where LVD was 10% or greater [11]. Evidence of validity and reliability exists in women post-breast cancer, and with lymphedema [13,14]. A previously developed protocol was used to standardise the limb proportion being measured, position within the measurement frame, and rest period prior to testing Bulley et al., in press, *European Journal of Physiotherapy*

Questionnaires included the DASH questionnaire [15]; the Functional Assessment of Cancer Therapy (FACTG) quality of life questionnaire with breast cancer sub-scale (FACTB) and additional questions relating to the upper limb (FACTB+4) [16]; and a Morbidity Screening Tool (MST) developed by the research group. The DASH Questionnaire focuses on day-to-day function of the upper limb and numerous studies support its psychometric properties in varied populations and translations [17]. Previous research supports the reliability, validity and practicality of the FACT B and FACT B+4 [18]. The MST requests participant characteristics such as handedness and changes in occupation and then focuses on impaired ULF and lymphedema. It first establishes whether or not the person perceives that there is a problem, and then explores its impacts on activities and participation, as recommended by the World Health Organization [19]. Its validity was studied by investigating relationships with established objective (n=434) and subjective measures (n=613) Bulley et al., in press, *Biomed Research International*. These included Perometry limb volume measurement [9], upper limb combined range of motion (ROM) [20], the DASH and FACT B+4 questionnaires. Results supported use of the MST; for example, self-reported ULF impairment differentiated significantly as expected in relation to 'hand-behind-back' range of motion (Mann Whitney $U=11784.5$; $p=0.001$), DASH scores ($u=7145.5$; $p<0.001$), and FACT G scores ($u=13891.5$; $p<0.001$). Self-reported lymphedema differentiated significantly as expected in relation to perometry percentage limb volume differences (%LVD) in those with unilateral treatment ($U=112128$; $p<0.001$), FACT G scores ($u=14617.0$; $p<0.001$), and the FACT B+4 arm-specific subscale ($u=9671.5$; $p<0.001$).

2.3. Analysis

Non-normal distributions (Shapiro-Wilk test: $p=0.000-0.004$) led to selection of non-parametric analysis (significance set at $p<0.05$), using the Mann-Whitney U test (two groups) and Kruskal Wallis H test (multiple groups) for between-group differences; post-hoc analysis used the

Mann-Whitney U test with Bonferroni corrections. Relationships were explored with the chi-square test for categorical variables.

3. Results

Of 617 women who participated (approximately 46.6% recruitment rate) 613 had sufficient subjective data for analysis and 417 had subjective and objective data. A different response rate results for each analysis, due to variable questionnaire completion.

Overall, participants were a mean age of 62.3 (complete data: $n=595$; SD 10.0; range 31-90 years) and completed treatment (surgery and any chemotherapy or radiotherapy) 63.0 months (mean) previously ($n=593$; SD 46.6, range 0-360 months). Of 596 with data, 7% ($n=44$) had bilateral breast cancer; of those with unilateral treatment, 25.5% received mastectomy and 73.6% wide local excision (WLE). Of 91.1% with unilateral axillary surgery 35.0% had full clearance, while 56.2% received either 4-node axillary sampling or sentinel lymph node biopsy (SLNB). Of 596 with data, 82.2% received breast radiotherapy, and 24.0% axillary. Out of 512, 40.2% received chemotherapy, and 75.2% received, or were still receiving, hormone therapy.

3.1 Prevalence of Impaired ULF, Lymphedema and Both

As summarised in Table 1, approximately one fifth of participants self-reported impaired ULF, and one fifth lymphedema. Using perometry, 26.5% of 434 participants with unilateral treatment had lymphedema. Almost a tenth reported co-existence of impaired ULF and lymphedema. Table 1 provides participant characteristics for each of these categories and summarises inferential analysis: no significant differences in age were found between those self-reporting impaired upper limb function or not, lymphedema or not, and for those with both types of morbidity or not.

3.2. Differences in Morbidity Prevalence with Time since Treatment

Table 1 summarises descriptive and inferential analysis comparing months since treatment according to morbidity category; no statistically significant differences were found for participants with self-reported impaired upper limb function and those without, for those with lymphedema and those without and for those with both types of morbidity and those with either type or neither. Histogram analysis explored differences in prevalence of morbidity in participants who were in the first to eighth 12-month time interval categories post-treatment, where $n>30$ for each. For impaired ULF,

from a median of 63.5 participants in each category, over the categories 21.6% impairment was reported (median no impairment = 49.5; impairment = 10.5). For lymphedema, there were 64.5 participants per category (median), with 22.8% impairment reported over the categories (median: no impairment = 51.5; impairment = 12.0). Figures 1 and 2 illustrate the differences in percentage impairment reported over each of the eight years; prevalence of impaired ULF in the sample peaked in the groups who were three to five years post-treatment, while prevalence of lymphedema was greatest year three, and then remained fairly static.

3.3. Impacts of Morbidity

Comparison of DASH and FACT B subscale scores was undertaken for those responding they had impaired ULF, lymphedema, both, and neither ($n=473$), summarised in Table 2. The Kruskal Wallis H test found significant differences between the four groups. Post hoc analysis (Mann-Whitney U test; Bonferroni correction requiring $p<0.008$) found significant differences ($p<0.007$) in all groups for all variables, with the exceptions of comparisons between those with only impaired ULF and those with only lymphedema (DASH: $U=1298.4$, $p=0.117$; FACTB: $U=1499.0$, $p=0.690$; Breast cancer subscale: $U=1205.0$, $p=0.035$; Arm subscale: $U=1248.5$, $p=0.061$), and between those with neither type of morbidity and those with impaired ULF: for the Breast cancer subscale score only ($U=7156.5$, $p=0.009$).

Lastly, relationships between morbidity and occupational status categories were explored (Table 3). χ^2 results were statistically significant for both impaired ULF and lymphedema, supporting the negative impacts of morbidity. Descriptively, 14.4% of people with impaired ULF and 15.5% with lymphedema self-reported that they had stopped working since their breast cancer treatment, compared with 5.8% and 6.1% of those without impairment. Upper limb morbidity appears to be associated with negative changes in occupational status.

3.4. Relationships between Morbidity and Dominance of the Limb Treated

Table 4 demonstrates that for those with self-reported impaired ULF and lymphedema, proportions of people treated on their dominant and non-dominant sides are approximately equal, with no significant difference in the impacts of treatment according to DASH and FACT B (and subscale) scores. The only borderline statistically significant result was that higher quality of life scores relating to breast cancer symptoms were found in those with impaired ULF who were not treated in their dominant limb.

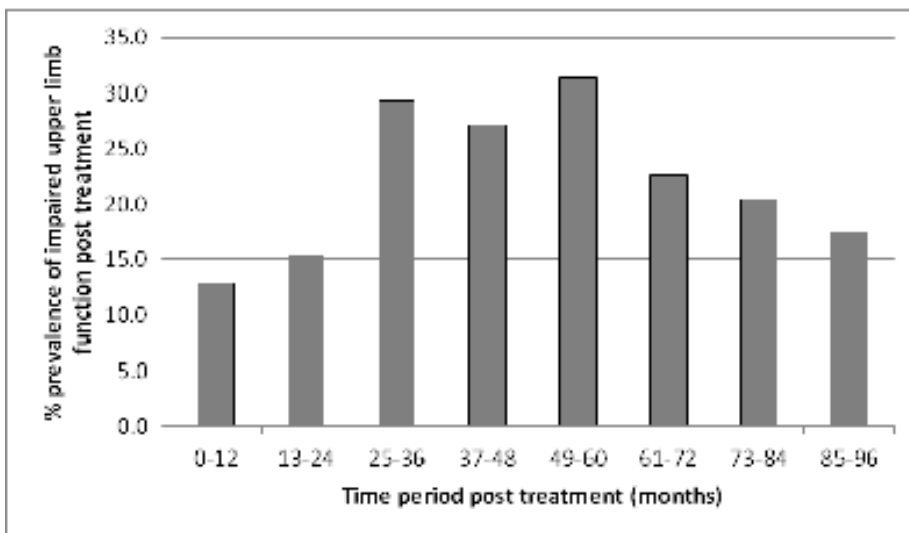


Figure 1. Percentage prevalence of impaired upper limb function during the first eight years post-treatment

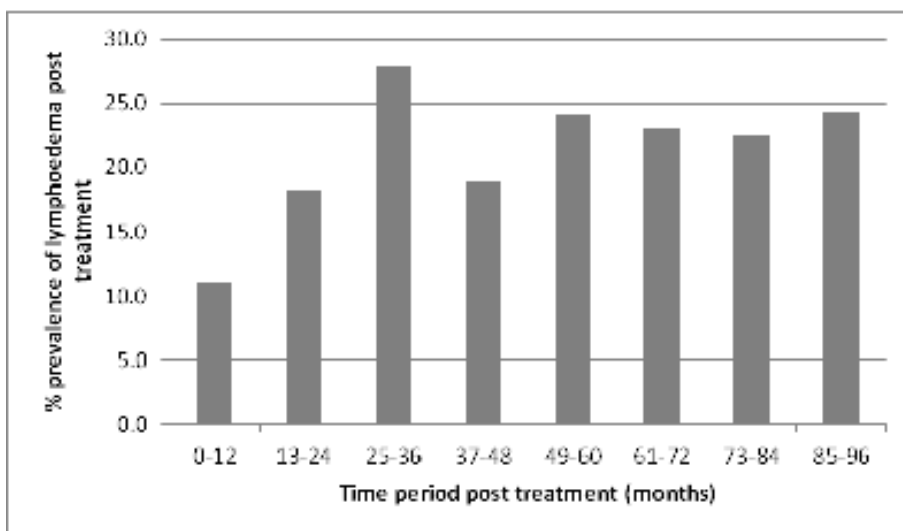


Figure 2. Percentage prevalence of lymphoedema during the first eight years post-treatment

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Table 1. Perceived morbidity prevalence according to the Morbidity Screening Tool and participant characteristics

	Perceived impaired upper limb function		Perceived lymphedema		Both impaired upper limb function and lymphedema	
	Yes	No	Yes	No	Yes	No
Perceived morbidity - n (% ₁): (response=580 ₂ ; 595 ₃ ; 575 ₄)	127 (21.9%)	453 (78.1%)	118 (19.8%)	477 (80.2%)	53 (9.2%)	522 (90.8%)
Age (years): median (range) (response=580 ₂ ; 595 ₃ ; 575 ₄)	62.00 (38.00-85.00)	61.00 (31.00-90.00)	61.00 (41.00-87.00)	62.00 (31.00-90.00)	61.00 (42.00-82.00)	62.00 (31.00-90.00)
Mann-Whitney U Test	U=28093, Z=-0.401, p=.69		U=26168.5, Z=-1.18, p=.24		U=13516.5, Z=-0.28, p=.78	
Monthsince treatment: median (range) (response=575 ₁ ; 590 ₂ ; 570 ₃)	51.00 (5.00-240.00)	55.00 (0.00-360.00)	57.00 (4.00-360.00)	53.00 (0.00-317.00)	51.00 (5.00-144.00)	55.00 (0.00-360.00)
Mann-Whitney U Test	U=27949, Z=-0.21, p=.84		U=27768, Z=-0.48, p=.96		U=13022.5, Z=-0.59, p=.55	
Unilateral cancer - n (% ₁): (response=558 ₂ ; 571 ₃ ; 555 ₄)	111 (91.74)	406 (92.91)	104 (91.23)	424 (92.78)	49 (92.45)	465 (92.63)
Mastectomy - n (% ₁): (response=555 ₂ ; 569 ₃ ; 550 ₄)	39 (32.23)	114 (26.27)	42 (36.21)	118 (26.05)	21 (40.38)	132 (26.51%)
Wide Local Excision - n (% ₁): (response=557 ₂ ; 571 ₃ ; 552 ₄)	83 (68.60)	326 (74.77)	75 (64.66)	341 (74.95)	31 (59.62)	373 (74.60)
Axillary full node clearance - n (% ₁): (response=556 ₂ ; 570 ₃ ; 551 ₄)	49 (40.50)	149 (34.25)	70 (59.83)	137 (30.24)	29 (55.77)	169 (33.87)
Axillary sampling / SLNB ₅ - n (% ₁): (response=556 ₂ ; 570 ₃ ; 551 ₄)	66 (54.55)	259 (59.54)	47 (40.17)	282 (62.25)	23 (44.23)	298 (59.72)
Radiotherapy to the breast - n (% ₁): (response=561 ₂ ; 576 ₃ ; 556 ₄)	100 (81.97)	364 (82.92)	95 (80.51)	380 (82.97)	41 (77.36)	418 (83.10)
Radiotherapy to the axilla - n (% ₁): (response=560 ₂ ; 575 ₃ ; 555 ₄)	35 (28.69)	104 (23.74)	37 (31.36)	104 (22.76)	15 (28.30)	122 (24.30)
Chemotherapy - n (% ₁): (response=486 ₂ ; 496 ₃ ; 486 ₄)	44 (42.31)	151 (39.53)	53 (53.54)	147 (37.03)	17 (41.46)	177 (39.78)

1. % of respondents with relevant treatment who do / do not self-report morbidity
2. Perceived impaired upper limb function: response rate for item
3. Perceived lymphedema: response rate for item
4. Perceived impaired upper limb function and lymphedema: response rate for item
5. Four-node axillary sampling or sentinel lymph node biopsy

Table 2. Comparison of DASH and FACT B scores for those with impaired upper limb function, with lymphedema, with both, and with neither: descriptive and inferential analysis

People who perceive themselves (MST ₁) to have:	Neither impaired upper limb function / lymphoedema	Impaired upper limb function only	Lymphoedema only	Both impaired upper limb function and lymphoedema
N (%)	321 (67.9)	57 (12.1)	55 (11.6)	40 (8.5)
Median (range) DASH ₂ score	2.6 (0.0-52.6)	12.5 (0.0-78.4)	8.3 (0.0-67.5)	25.0 (2.5-77.6)
Kruskal Wallis H Test	Chi ² =125.0; p=0.000			
Median (range) FACTB ₃ score	125.0 (55.3-144.0)	115.0 (51.6-143.0)	118.0 (64.6-139.0)	97.4 (51.8-132.0)
Kruskal Wallis H Test	Chi ² =59.0; p=0.000			
Median (range) breast cancer subscale score	29.0 (12.0-36.0)	27.0 (9.5-36.0)	25.0 (9.0-33.0)	22.0 (3.0-33.1)
Kruskal Wallis H Test	Chi ² =65.7; p=0.000			
Median (range) arm subscale score	20.0 (6.0-20.0)	17.0 (6.0-20.0)	16.0 (2.0-20.0)	13.1 (0.0-20.0)
Kruskal Wallis H Test	Chi ² =156.5; p=0.000			

1. MST: Morbidity Screening Tool;
2. DASH: Disability of the Arm, Shoulder and Hand questionnaire;
3. FACT-B: Functional Assessment of Cancer Therapy – Breast Cancer specific quality of life questionnaire.

Table 3. Cross-tabulation of upper limb impairment and lymphedema with occupational status since breast cancer treatment (frequency)

Self-report (MST ₁)	Upper limb impairment		Lymphedema	
	No	Yes	No	Yes
Employment ceased: n (%)	24 (57.1)	18 (42.9)	26 (60.5)	17 (39.5)
Reduced hours of employment: n (%)	23 (85.2)	4 (14.8)	20 (74.1)	7 (25.9)
No change in hours of employment: n (%)	199 (82.6)	42 (17.4)	198 (82.5)	42 (17.5)
Increased hours of employment: n (%)	2 (50.0)	2 (50.0)	3 (75.0)	1 (25.0)
Not applicable ₂ : n (%)	165 (73.7)	59 (26.3)	181 (80.8)	43 (19.2)
Total: n	413	125	428	110
Chi ² with 4 degrees of freedom	17.514, p=0.002		11.678, p=0.020	

1. MST: Morbidity Screening Tool;
2. Not applicable, for example, retired from employment before treatment for breast cancer

Table 4. Analysis of the differences in DASH and FACT B subscale scores according to treatment in the dominant or non-dominant limb for those with self-reported impaired upper limb function and lymphedema

	Those with impaired ULF (MST ₁): treated in the dominant limb (n=97)		Those with lymphedema (MST ₁): treated in the dominant limb (n=94)	
	Yes	No	Yes	No
N (%)	48 (49.5)	49 (50.5)	47 (50)	47 (50)
Median (range) DASH ₂ score	18.1 (0.0-77.5)	17.5 (0.0-78.4)	15.8 (0.0-69.8)	15.2 (0.0-77.6)
Mann-Whitney U Test	U=1163.5; p=0.928		U=1059.0; p=0.731	
Median (range) FACT-B ₃ subscale score	104.5 (53.5-143.0)	112.0 (51.6-140.0)	113.8 (67.5-133.0)	104.0 (51.8-139.0)
Mann-Whitney U Test	U=949.0; p=0.102		U=1068.0; p=0.783	
Median (range) breast cancer subscale score	22.5 (6.0-36.0)	26.0 (3.0-36.0)	23.9 (6.0-33.0)	24.0 (3.0-33.1)
Mann-Whitney U Test	U=904.5; p=0.050		U=1055.0; p=0.708	
Median (range) arm subscale score	16.0 (0.0-20.0)	16.0 (0.0-20.0)	16.0 (0.0-20.0)	15.0 (0.0-20.0)
Mann-Whitney U Test	U=1157.0; p=0.890		U=1025.5; p=0.549	

1. MST: Morbidity Screening Tool;

2. DASH: Disability of the Arm, Shoulder and Hand questionnaire;

3. FACT-B: Functional Assessment of Cancer Therapy – Breast Cancer specific quality of life questionnaire.

4. Discussion

Some interesting insights into upper limb morbidity have been found and are discussed in turn. When comparing participant characteristics with one UK and one US study published in the previous six years [21,22], variations are not substantial considering such a heterogeneous population.

4.1. Prevalence of Impaired Upper Limb Function and Lymphedema and Relationships with Dominance of the Limb Treated

The current study found similar proportions of about one fifth of participants self-reporting impaired ULF and lymphedema, but under a tenth self-reported both, suggesting that they are not frequently linked. Fewer studies have looked at the prevalence of impaired ULF than lymphedema, but one recent systematic review included 32 longitudinal or cross-sectional studies and found decreased shoulder ROM varied from 1% to 67% prevalence (7

studies), and arm weakness, 9 to 28% (3 studies) [7]. Incidence rates were lowest when estimated by clinicians rather than from objective measurement or participant self-report; the latter was used by the current study, possibly explaining the prevalence estimate being at the mid-to-high end of the estimate range [7].

The current study's prevalence estimate for lymphedema is again at the higher end of the range found in the previously mentioned systematic review, 0-34% [7]. In the ALMANAC trial, at eighteen months from baseline, 8.4% of ALND patients and 3.8% with SLNB self-reported swollen or tender arms using the FACT B+4 arm subscale [21]. A recent study of incidence and course of lymphedema (circumferential measurement) six-to-twelve months post-surgery in 347 women found incidence rates of 9-16% depending on the criterion used, averaging 12%⁸. Current findings are higher than both studies, possibly reflecting the high upper range of time since treatment, as evidence suggests incidence or prevalence estimates increase with

longer follow-up [3]. The previously mentioned study [8] also investigated shoulder abduction and external rotation (10% difference indicated deficit); impairments were found in 41% and 28% respectively. Although both are greater than prevalence of impaired ULF in the current study a very similar result of under 10% of participants reporting both lymphedema and impaired ULF was found, supporting the finding that they are not related in the majority of participants.

The current study found perometry measurement estimated lymphedema prevalence 7% higher than self-report; lower estimates from self-report were also found in a study of 211 women 2.5 years post-treatment: 41% compared with 45% (perometry: 10% change pre-to-post treatment) [22]. An earlier study of 176 women found the opposite, 27.8% from self-report and 11.9%, 0.6% and 11.4% found by objective criteria (summed arm circumferences: difference >5cm or >10%; multifrequency bioimpedance: 3+SD above reference score) [23]. Therefore, the relationship between subjective and objective prevalence estimation is unclear.

The large number of participants in the current study enabled comparisons of prevalence in women at different time-points post-treatment, finding that impaired ULF was highest at three to five years post-treatment, while lymphedema peaked at 28% at three years. Prospective studies of lymphedema incidence have found similar results, for example, incidence increased from 20% at six months, to 32% with persistent swelling at three years (n=622) [24]. Although investigated less in relation to ULF, one study of impaired arm movement found some reduction over four years from 37 to 26% prevalence [25]. The persistence of arm problems over time in some women supports the current study findings.

The current study found no evidence that prevalence and impacts of morbidity are greater when treated in the dominant limb. Evidence increasingly suggests that greater use of the dominant treated limb is beneficial; one study found 80% greater risk of lymphedema with treatment in the non-dominant limb [23].

4.2. Impacts of Impaired Upper Limb Function and Lymphedema

The current study found that for those self-reporting impaired ULF, and those with lymphedema, significantly poorer function and quality of life resulted, and co-existence of both provided significantly worse scores than either. A review of the literature on health-related quality of life found poorer psychological well-being in those with lymphedema than the general population. Qualitative literature highlights contributions from fear, frustration, and poor body image [5] and significantly worse FACT B scores have been found in women with lymphedema than matched controls [24]. A change of at least five points in the FACT B has been stated to be clinically relevant [21]. Score differences in the current

study were well above this threshold: between those with no impairment and those with impaired ULF (10 points), lymphedema (7 points), and both (28 points).

The current study also provided evidence that UL morbidity can be associated with negative occupational changes. One recent study found between 11-44% of 3253 women, depending on treatment group, gave up activities after breast cancer treatment, and over a third of those working felt that this had been affected [2].

These data further support the increasing trend towards avoiding over-treatment of the axilla [3]. Although it is positive to note the increasing consensus regarding reduced risk of arm morbidity following SLNB, risk of morbidity remains, as the long-term effects are not yet known and a proportion of women will still require more extensive axillary surgery. There is evidence that earlier detection and management are most likely to be successful [12]. Therefore timely screening for morbidity should be part of follow-up care [8] and management of upper limb morbidity is important to improve function and quality of life after breast cancer treatment.

4.3. Study Considerations

The current study is cross-sectional, and some women may have returned to clinic review sessions after longer periods post-treatment due to upper limb morbidity, rather than other concerns. Treatment protocols are likely to have developed over the time period, which could have increased morbidity prevalence in those with a longer time since treatment. However, the lack of significant differences in time since treatment among those who did or did not self-report impairment does not support these suggestions.

5. Conclusion

To conclude, the current study findings found approximately a fifth of the study sample to have lymphedema, a fifth to have impaired upper limb function, and only 9% to have symptoms of both. Prevalence of impaired ULF appeared to be greatest among women who were three to five years post treatment, and prevalence of lymphedema peaked at three years, suggesting that upper limb morbidity is an ongoing problem after treatment for breast cancer. Statistically significant reductions in daily function and quality of life were evident in those with morbidity supported by negative impacts on occupational status. These insights into prevalence and impacts of upper limb morbidity expand our current understanding of the relationships between lymphedema and other forms of upper limb function, and their differential impacts on activities, participation in occupational roles and general quality of life, as well as providing further support for the chronicity of morbidity. The results support the need for timely screening as part of follow-up care and early management to improve function and quality of life after breast cancer treatment.

Ongoing prospective investigation of these issues will be important as treatment protocols for breast cancer continue to develop, and further development and evaluation of screening and management strategies will be valuable.

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