Vol. XXVII, Issue 2/ 2026

G Y M N A S I U M

Scientific Journal of Education, Sports, and Health

Original Article

The Role of Physical Exercise in Lymphedema Management and Quality of Life in Post-Mastectomy Patients

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DOI: 10.29081/gsjesh.2026.27.2.8

Keywords: *lymphedema, breast cancer, EORTC QLQ-C30, therapeutic exercise, quality of life*

Abstract

The aim of this study was to assess the relationship between lymphedema and quality of life in post-mastectomy patients who followed a supervised exercise program. The study included 30 post-mastectomy patients with a clinical diagnosis of stage II lymphedema. Participants underwent a supervised exercise program lasting 16 weeks, focusing on drainage stimulation. Quality of life was assessed with the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 before and after the intervention. Following the exercise program, the total score of the functional and symptom items improved significantly and the global health status score increased by 21.7 points on a 0–100 scale. This study highlights that structured exercise interventions are associated with a clinically relevant improvement in patient-reported quality of life, although controlled studies are needed to confirm these findings.

1. Introduction

Breast cancer is the most common malignancy among women worldwide. Advances in contemporary therapeutic management—including surgery,

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radiotherapy, chemotherapy, and hormonal or targeted therapies—have significantly improved long-term survival rates (Siegel et al., 2023). However, oncologic treatments may lead to late complications that impair quality of life, among which secondary post-treatment lymphedema is one of the most prevalent and functionally debilitating. Breast cancer-related lymphedema (BCRL) is characterized by the chronic accumulation of protein-rich fluid within the tissues of the upper limb, resulting in increased volume, impaired joint function, pain, sensations of heaviness, and limitations in daily activities (Ridner, 2012).

The incidence of lymphedema varies according to the type of surgical intervention performed (axillary lymph node dissection versus sentinel lymph node biopsy), radiotherapy, and individual risk factors such as body mass index and comorbidities (DiSipio et al., 2013). Patients undergoing unilateral mastectomy are at an elevated risk of developing lymphedema, particularly when the procedure includes axillary lymphadenectomy, which directly compromises the lymphatic drainage capacity of the upper limb (Gärtner et al., 2014). In such cases, both functional and aesthetic consequences are experienced physically and psychologically.

From a pathophysiological perspective, lymphedema arises as a result of reduced lymphatic transport capacity due to traumatic or fibrotic injury to lymphatic vessels and axillary lymph nodes. Lymph node resection and radiation therapy can induce progressive fibrosis of lymphatic structures, chronic inflammation, and increased adipose deposition, leading to permanent structural changes within soft tissues (Rockson, 2018; Greene et al., 2021). In stage II lymphedema, swelling becomes persistent and tissue consistency increases, reflecting fibrosis and tissue remodeling processes, which make therapeutic intervention more complex and prolonged (International Society of Lymphology, 2020).

In addition to functional impairment, unilateral mastectomy has a profound psychosocial impact. Loss of the breast may negatively influence body image, femininity, and interpersonal relationships, while the visible and persistent nature of lymphedema may exacerbate anxiety, social withdrawal, and feelings of stigmatization (Pusic et al., 2017; Fang et al., 2021). These dimensions are directly reflected in quality-of-life assessment instruments.

In this context, the EORTC QLQ-C30 (European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire – Core 30) is one of the most widely validated questionnaires for evaluating quality of life in oncology, incorporating physical, emotional, cognitive, and social functioning scales, as well as a global health status score. Interpretation of score changes is informed by minimally important differences (MID), where variations of approximately 5–10 points on functional scales are considered clinically meaningful for patients (Musoro et al., 2019).

Rehabilitation for secondary lymphedema is based on Complete Decongestive Therapy (CDT), an integrated therapeutic approach including manual lymphatic drainage (MLD), compression bandaging, therapeutic exercise, and patient education for self-management. Previous clinical studies have demonstrated that

CDT, particularly when delivered in structured programs lasting 8–16 weeks, can reduce limb volume, alleviate pain, and improve function and social participation (Cormier et al., 2010; Borman et al., 2022). However, the intensity, duration, and standardization of protocols vary considerably across studies, supporting the need for evaluating clearly defined rehabilitation programs.

Recent literature, including meta-analyses and prospective trials, reinforces the benefits of supervised exercise programs and combined therapy approaches on upper limb function and quality of life in women undergoing breast cancer surgery. Nevertheless, many studies are limited by small sample sizes, short intervention periods, or heterogeneity in assessment tools, making generalization difficult and highlighting the need for well-designed studies employing standardized protocols (e.g., interventions lasting 12–16 weeks) and consistent use of the EORTC QLQ-C30 for comparability (Xue et al., 2025).

Given these considerations, the present study aims to evaluate the changes in quality of life, measured using the EORTC QLQ-C30, associated with a 16-week exercise-based rehabilitation program, in a cohort of 30 patients with stage II lymphedema following unilateral mastectomy, with emphasis on the relationship between lymphedema and quality of life. Analysis of pre- and post-intervention changes allows assessment of both statistical significance and clinical relevance of the outcomes.

2. Material and methods

Subjects

The study was conducted at Sfantul Nectarie Oncology Center in Craiova over a period of 16 weeks, involving a cohort of 30 female patients (mean age 57.90 ± 6.4 years) diagnosed with breast cancer who had undergone unilateral mastectomy. Following surgical treatment, all participants were diagnosed with stage II secondary lymphedema.

All patients provided written informed consent, and the study was carried out in accordance with the principles of the Declaration of Helsinki (2013 revision).

Inclusion criteria: Patients diagnosed with stage II secondary lymphedema.

Exclusion criteria: Patients presenting postoperative complications, metastatic disease, or medical contraindications to physical exercise.

Lymphedema was staged according to the International Society of Lymphology criteria (International Society of Lymphology, 2020), based on clinical examination (persistent swelling that does not resolve with limb elevation, pitting and early signs of tissue fibrosis) and on circumferential measurements of both upper limbs. In this study, lymphedema stage was used as an inclusion criterion and as the clinical background of the quality-of-life analysis; it was not analysed as a separate outcome.

Assessment: Patients were assessed prior to the initiation of the rehabilitation program to determine lymphedema staging and to individually tailor exercise dosage according to the FITT principles (Frequency, Intensity, Time, Type). *The evaluation included*:

- Measurement of heart rate and blood pressure
- Functional assessment and quality of life evaluation using the EORTC QLQ-C30 questionnaire at baseline (T1) and after completion of the 16-week intervention (T2).

The EORTC QLQ-C30 (version 3.0) contains 30 items. Items 1–28 are rated on a 4-point scale (1 = "not at all" to 4 = "very much") and form five functional scales (physical, role, emotional, cognitive and social functioning), three symptom scales (fatigue, nausea and vomiting, pain) and six single items (dyspnoea, insomnia, appetite loss, constipation, diarrhoea and financial difficulties). Items 29–30 are rated on a 7-point scale and form the global health status/quality of life scale (Aaronson et al., 1993). In this study, two indicators were used: (1) the total score of items 1–28 (range 28–112; lower values indicate better functioning and fewer symptoms) and (2) the global health status/quality of life score, expressed as the sum of items 29–30 (range 2–14) and, in addition, linearly transformed to a 0–100 scale according to the EORTC scoring manual (Fayers et al., 2001).

The therapeutic approach was implemented over 16 weeks. Each participant engaged in a structured, individualized physical rehabilitation program consisting of supervised exercise sessions (examples from individual sessions are presented in Figure 1).

Program objectives

- Restoring range of motion
- Lymphedema management
- Recovery of functional independence
- Improving quality of life

Therapeutic exercise protocol

Participants attended individual exercise sessions 3 times per week. Exercise intensity was maintained at a moderate level (60–75% of maximum heart rate), with each session lasting 50 minutes. The exercise program emphasized mobility exercises aiming to increase joint range of motion but also isometric contractions intended to facilitate lymphatic decongestion and improve upper limb function .

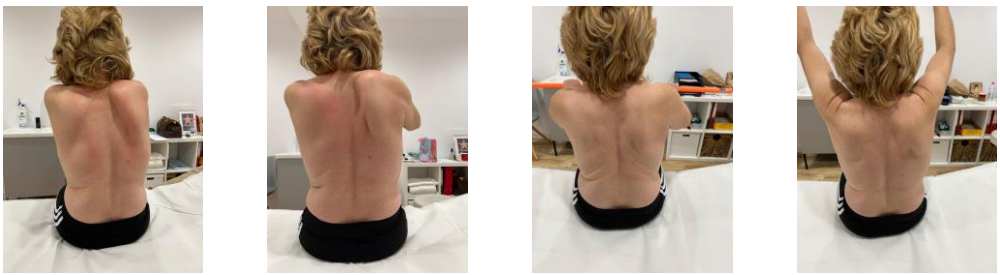
Structure and type of exercises. Each session included three parts: (1) warm-up (about 10 minutes) – diaphragmatic breathing exercises and active-assisted (autopassive) mobilisations of the shoulder girdle, performed in the supine position with the affected limb elevated; (2) main part (about 30 minutes) – active free exercises and exercises with objects (wand, soft ball, light elastic band), performed in the supine, sitting and standing positions; (3) cool-down (about 10 minutes) – relaxation and breathing exercises with the limb elevated, together with self-care instructions.

Movements and muscle groups. Mobility exercises targeted the joints of the affected upper limb: shoulder flexion, abduction, external and internal rotation, elbow flexion–extension, forearm pronation–supination, and wrist and finger flexion–extension. Movements were initially performed in gravity-eliminated positions (supine, limb supported), then against gravity and, later, against light resistance (elastic band or manual resistance applied by the physiotherapist).

Isometric contractions were performed for the deltoid, pectoralis major, biceps and triceps brachii and forearm flexors (squeezing a soft ball), held for 5–6 seconds and followed by 10 seconds of relaxation, in order to activate the muscle pump and facilitate lymphatic return.

Dosage and progression. Exercises were performed in 2–3 sets of 8–12 repetitions. The program progressed every four weeks: weeks 1–4, gravity-eliminated and active-assisted exercises; weeks 5–8, active free exercises against gravity; weeks 9–12, exercises with objects and light resistance; weeks 13–16, combined exercises and functional tasks of daily living. The load was increased only when the current level was performed completely and without pain, when no increase in limb swelling or heaviness was reported after the session, and when heart rate remained within the target zone.

Methodological instructions. Patients wore their compression sleeve during the sessions. Movements were slow and rhythmic, synchronised with breathing and performed without breath-holding, within the pain-free range of motion, progressing from the proximal to the distal segments; rest intervals of 30–60 seconds were allowed between sets. Heart rate and blood pressure were measured before and after each session. Pain, fatigue and shortness of breath were monitored at every session based on the patients' reports: when any of these occurred, the number of repetitions or the resistance was reduced, rest intervals were extended and the exercise was replaced with an easier variant (active-assisted, in a gravity-eliminated position), while diaphragmatic breathing was used both to support lymphatic drainage and to reduce dyspnoea. All 30 patients completed the 16-week program and were included in the final analysis.



A **B** **C** **D**

A, B – range of motion of the affected upper limb during the first two physiotherapy sessions;
C, D – range of motion after 10 sessions of individualized therapeutic exercise

Figure 1. *The progression of upper limb mobility over the course of the rehabilitation program*

Statistical analysis. Data are presented as mean ± standard deviation. The normality of the T1–T2 differences was checked with the Shapiro–Wilk test. Differences between T1 and T2 were analysed with the two-tailed paired-sample t-test; as the differences for items 29–30 were not normally distributed, this result was confirmed with the non-parametric Wilcoxon signed-rank test. Effect size was

expressed as Cohen's d, calculated as the mean T1–T2 difference divided by the pooled standard deviation of the two assessments, $SD_{pooled} = \sqrt{[(SD\_T1^2 + SD\_T2^2)/2]}$ (Cohen, 1988). The significance level was set at $p < 0.05$. The calculations were performed using the SciPy library for Python (Virtanen et al., 2020).

3. Results and Discussions

3.1. Anthropometric results

The analysis conducted on the cohort of 30 patients revealed the anthropometric characteristics presented in Table 1. The mean age of the participants was 57.90 years, the mean height was 162.87 cm, and the mean body weight was 63.20 kg.

Table 1. *Anthropometric parameters and EORTC QLQ-C30 scores of the study group at T1 and T2*

Patient	Age [years]	Height [cm]	Weight [kg]	BMI [kg/m²]	Items 1–28 T1*	Items 1–28 T2*	Items 29–30 T1**	Items 29–30 T2**
P1	50	163	58	21.83	73	65	7	9
P2	60	156	62	25.48	68	60	8	10
P3	53	160	55	21.48	71	59	7	9
P4	57	168	53	18.78	79	62	6	9
P5	61	158	52	20.83	81	62	6	9
P6	63	162	62	23.62	77	64	7	10
P7	51	171	65	22.23	79	68	6	8
P8	52	168	67	23.74	82	70	6	9
P9	64	162	59	22.48	67	54	7	10
P10	59	163	62	23.34	59	54	10	12
P11	48	157	70	28.40	78	69	6	9
P12	53	160	68	26.56	79	58	7	10
P13	55	158	66	26.44	84	68	6	10
P14	67	161	64	24.69	68	54	8	11
P15	58	172	70	23.66	77	68	7	9
P16	60	161	69	26.62	68	58	8	10
P17	62	170	66	22.84	59	54	10	12
P18	53	158	69	27.64	58	53	10	12
P19	55	160	63	24.61	65	52	9	10
P20	58	165	63	23.14	79	68	6	9
P21	59	165	70	25.71	76	68	6	9
P22	68	170	68	23.53	82	72	6	10
P23	43	160	57	22.27	77	59	6	9
P24	57	158	66	26.44	73	61	7	10
P25	63	160	54	21.09	68	57	7	10
P26	58	163	69	25.97	69	63	9	11
P27	53	167	59	21.16	74	64	7	10
P28	71	160	70	27.34	75	59	6	9
P29	69	162	58	22.10	79	63	7	9
P30	57	168	62	21.97	69	54	9	11
Mean	57.90	162.87	63.20	23.87	73.1	61.3	7.2	9.8
SD	6.40	4.52	5.54	2.37	7.11	5.83	1.33	1.02

SD – standard deviation; * items 1–28 are scored 1–4 (total score range 28–112): 1 indicates independence and perceived well-being, while 4 indicates functional dependence and reduced perceived well-being; ** items 29–30 are scored 1–7 (sum range 2–14): higher values indicate better global health status/quality of life

For each patient included in the study, the Body Mass Index (BMI) was calculated. BMI was recorded because a high BMI is a recognised risk factor for the onset and severity of breast cancer-related lymphedema and may also influence exercise tolerance and quality of life (DiSipio et al., 2013).

In the present sample, the mean BMI was 23.87 kg/m², corresponding to the normal weight category. Twenty patients had a normal BMI and ten were overweight (BMI 25.0–28.4 kg/m²); none was obese, which limits the possible influence of excess body weight on the quality-of-life results.

3.2. Functional assessment and quality of life

Responses to items 1–28 (these items cover the functional scales and the symptom scales/items of the questionnaire; lower total scores indicate better functioning and fewer symptoms). The distribution of responses for these items at T1 and T2 is presented in Table 1.

Responses to the last 2 questions (which assess the overall quality of life of the patient over the past week) are detailed in Table 1

Transformed to the 0–100 scale according to the EORTC scoring manual (Fayers et al., 2001), the global health status/quality of life score increased from 43.6 ± 11.1 points at T1 to 65.3 ± 8.5 points at T2, a mean increase of 21.7 points (95% CI: 19.6–23.8). An increase of at least 10 points, considered clinically meaningful (Musoro et al., 2019), was recorded in 29 of the 30 patients.

3.3. Variation in scores obtained for the first 28 questions of the EORTC QLQ-C30 questionnaire

Table 2 presents the statistical indicators of the variation in scores obtained for the first 28 questions of the EORTC QLQ-C30 questionnaire for the cohort of 30 patients.

Table 2. *Statistical indicators of the variation in scores obtained for the first 28 questions of the EORTC QLQ-C30 questionnaire (n = 30)*

Mean difference (T1–T2)	95% confidence interval	Effect size (Cohen's d)	t	df	p*
11.76	10.19 – 13.34	1.81	15.26	29	<0.001

*significance level p=0.05; exact $p = 2.2 \times 10^{-15}$

Statistical analysis was performed using the paired-sample t-test. For the first 28 questions, the mean value decreased from 73.1 to 61.33, and the standard deviation decreased from 7.11 to 5.84, indicating an increase in independence; that is, the scores approached the maximum independence values with lower dispersion. The effect size was large (Cohen's d = 1.81, above the 0.8 threshold; Cohen, 1988).

The p-value was below the significance threshold ($t(29) = 15.26$, $p < 0.001$), allowing us to conclude that there are statistically significant differences in the responses provided by the patients after completing the exercise program, reflected in the reduction of the mean values (mean difference = 11.76), thereby rejecting the null hypothesis (H_0: the means are equal). The Shapiro–Wilk test confirmed the normal distribution of the differences ($W = 0.973$, $p = 0.633$).

3.4. Variation in scores obtained for the last 2 questions of the EORTC QLQ-C30 questionnaire

Table 3 presents the statistical indicators of the variation in scores obtained for the last 2 questions of the EORTC QLQ-C30 questionnaire for the cohort of 30 patients.

Table 3. *Statistical indicators of the variation in scores obtained for the last 2 questions of the EORTC QLQ-C30 questionnaire (n = 30)*

Mean difference (T1–T2)	95% confidence interval	Effect size (Cohen's d)	t	df	p*
−2.60	−2.85 – −2.34	2.19	−21.11	29	<0.001

* significance level p=0.05; exact $p = 3.8 \times 10^{-19}$

Statistical analysis was performed using the paired-sample t-test. For the last two questions, the mean value increased from 7.23 to 9.83, and the standard deviation decreased from 1.33 to 1.02, indicating an improvement in quality of life through higher values; that is, the scores approached the maximum functionality values with low dispersion. The effect size was large, with Cohen's $d = 2.19$ (above 0.8). The p-value was below the significance threshold ($t(29) = -21.11$, $p < 0.001$), allowing us to conclude that there are statistically significant differences in the responses provided by the patients after completing the exercise program, reflected in the increase in mean scores (mean difference = -2.6), thereby rejecting the null hypothesis (H_0: the means are equal). Because the differences were not normally distributed (Shapiro–Wilk $W = 0.820$, $p < 0.001$), the result was confirmed with the Wilcoxon signed-rank test ($p < 0.001$).

Discussions

The findings of this study indicate that the 16-week rehabilitation program was associated with significant improvements in the quality of life of patients with stage II post-mastectomy lymphedema, as assessed using the EORTC QLQ-C30 questionnaire. The decrease in the total score of items 1–28, which cover physical, role, emotional, cognitive and social functioning as well as symptoms such as pain and fatigue, together with the increase of more than 20 points in the global health status score, suggests a clinically meaningful change in functional capacity and participation in daily activities.

The relationship between the exercises applied and the questionnaire parameters can be explained by the specific effect of each component of the program. Mobility exercises for the shoulder, elbow, wrist and fingers target the movements required in the activities assessed by items 1–7 (carrying objects, walking, self-care, work and leisure activities), which are the activities most limited by a swollen, heavy and stiff upper limb. Isometric contractions and rhythmic movements activate the muscle pump and favour lymphatic return, which may reduce the sensation of heaviness, pain and fatigue (items 9, 10, 12, 18 and 19). Diaphragmatic breathing supports thoracic lymphatic flow and may reduce dyspnoea (item 8), while the individual, supervised sessions and the gradual regaining of control over the affected limb may positively influence the emotional and social items (items 21–24 and 26–27). Conversely, the pain, fatigue and dyspnoea reported by the patients were used to adjust the exercise dosage, so that the program and the questionnaire parameters influenced each other. These observations support the view that, in stage II lymphedema, quality of life is closely linked to the functional status of the affected limb.

Our results are consistent with those reported by McNeely et al., who demonstrated that supervised therapeutic exercise programs can be safely implemented in patients with lymphedema and lead to improved upper limb function, reduced discomfort, and enhanced quality of life. (McNeely et al., 2010) Similarly, Cheville et al., reported that integrated rehabilitation interventions—including active exercises, compression therapy, and self-management education—resulted in reduced symptoms and increased functional independence (Cheville et al., 2003).

Furthermore, the outcomes of the present study align with the findings of (Zimmermann et al., 2022), whose meta-analysis showed that complex decongestive therapy (CDT), when applied over the medium term, yields significant reductions in limb volume as well as consistent improvements in standardized quality of life scores. Likewise, Devoogdt et al., demonstrated that patient training in self-management techniques, including self-administered manual lymph drainage and progressive exercise, contributes to long-term maintenance of therapeutic gains and reduces anxiety related to disease progression. (Devoogdt et al., 2011)

Another relevant aspect of our study is the possible contribution of emotional and social functioning (included in the total score of items 1–28) to the overall improvement, suggesting that the intervention addressed not only physical impairment but also psychosocial adaptation. This observation is supported by Fu et al., who showed that active participation in rehabilitation and self-management programs enhances sense of personal control, reduces anxiety, and contributes to re-establishing a positive relationship with one’s body after mastectomy. (Fu et al., 2020)

In a clinical study involving patients with secondary lymphedema, (Wang et al., 2019) reported that a progressive exercise program combined with manual lymphatic drainage resulted in significant improvements in EORTC QLQ-C30 scores, particularly in physical functioning, social functioning, and pain. The authors highlighted that questionnaire score improvements were directly associated with

reductions in affected limb volume, suggesting that enhanced functional status directly influences perceived quality of life.

Similarly, Ferreira et al., compared supervised rehabilitation programs with unsupervised exercise and found that patients who received guided therapeutic intervention achieved significantly greater improvements in EORTC QLQ-C30 scores, emphasizing the importance of professional monitoring in functional re-education and symptom management. This finding aligns with the outcomes of our study, where the structured 16-week supervised intervention was associated with consistent improvements in questionnaire scores.(Ferreira et al., 2020)

Additionally, Paluch-Shimon et al. examined quality of life among breast cancer survivors and identified lymphedema as a key predictor of decreased functional scores on the EORTC QLQ-C30, particularly in the domains of mobility and social participation. The authors emphasize the necessity of long-term rehabilitation interventions integrated within the standard therapeutic pathway to prevent progressive quality-of-life decline—an observation consistent with our results. (Paluch-Shimon et al., 2021)

However, the present study has several limitations. The main one is the absence of a control group: the single-group pre–post design allows the observation of changes over time but does not demonstrate that they are exclusively the result of the exercise program, as they may also have been influenced by the natural course of the condition, other therapeutic interventions or a placebo effect; therefore, the results should be interpreted as associations rather than causal effects. In addition, the EORTC QLQ-C30 results were analysed as aggregated scores (items 1–28 and global health status), as the available dataset did not allow the calculation of the individual functional and symptom scales, which limits comparability with other studies. Other limitations are the relatively small sample size, the absence of objective quantitative measurements of lymphedema at the end of the program and the lack of long-term follow-up. Future research should include a control group, scale-level analysis of the EORTC QLQ-C30, objective limb volume measurements and follow-up intervals of 6–12 months to assess the durability of outcomes and to identify predictors of therapeutic response.

Personal contributions and novelty. The contribution of this study consists in linking a clearly described, individualised and progressive exercise protocol, adapted to stage II lymphedema, to the changes in patient-reported quality of life. Unlike many studies that focus mainly on limb volume, our research emphasised the relationship between lymphedema and quality of life as perceived by the patients. In addition, the study provides data from a Romanian population of post-mastectomy patients, which is less represented in the international literature, and proposes a practical protocol that can be applied in outpatient oncology rehabilitation.

4. Conclusions

The results of the present study show that the implementation of a structured 16-week rehabilitation program in patients diagnosed with breast cancer treated by unilateral mastectomy and stage II lymphedema was associated with significant

improvements in quality of life, as assessed by the EORTC QLQ-C30 questionnaire. The results revealed a significant decrease in the total score of the functional and symptom items and a clinically relevant increase in the global health status score, indicating a positive change not only on physical status but also on psychosocial adaptation.

In conclusion, the rehabilitation program applied in this study was associated with an improvement in the quality of life of patients with post-mastectomy lymphedema, highlighting the close link between lymphedema and quality of life and reinforcing the importance of integrating rehabilitation as a continuous and essential component of the therapeutic pathway for breast cancer survivors.

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