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CORRESPONDENCE

Investigation of physical activity, fear of falling, and functionality in individuals with lower extremity lymphedema

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Abstract

Purpose To investigate the fear of falling, physical activity, and functionality in patients with lymphedema in the lower extremities.

Methods Sixty-two patients who developed stage 2–3 lymphedema in the lower extremities due to primary or secondary causes (age: 56.03 ± 7.83 years) and 59 healthy controls (age: 54.61 ± 5.43 years) were included in the study. The sociodemographic and clinical characteristics of all individuals included in the study were recorded. In both groups, fear of falling was evaluated with the Tinetti Falls Efficacy Scale (TFES), lower extremity functionality with the Lower Extremity Functional Scale (LEFS), and physical activity with the International Physical Activity Questionnaire-Short Form (IPAQ-SF).

Results There was no statistically significant difference between the demographic characteristics of the groups ($p > 0.05$). The primary and secondary lymphedema groups had similar LEFS ($p = 0.207$, $d = 0.16$), IPAQ ($p = 0.782$, $d = 0.04$), and TFES ($p = 0.318$, $d = 0.92$) scores. However, the TFES score of the lymphedema group was significantly higher than that of the control group ($p < 0.01$, $d = 0.52$), while the LEFS ($p < 0.01$, $d = 0.77$) and IPAQ scores ($p = 0.001$, $d = 0.30$) were significantly higher in the latter. There was *a* negative correlation between LEFS and TFES ($r = -0.714$, $p < 0.001$) and between TFES and IPAQ ($r = -0.492$, $p < 0.001$). LEFS and IPAQ were positively correlated ($r = 0.619$, $p < 0.001$).

Conclusion It was determined that individuals with lymphedema developed a fear of falling, and their functionality was negatively affected. This negative effect on functionality can be attributed to reduced physical activity and an increased fear of falling.

Keywords Lymphedema · Physical activity · Functional status · Falling

Introduction

Lymphedema is a progressive disease that presents with edema due to the accumulation of protein-rich fluid in the interstitium as a result of inadequate drainage of lymphatic fluid and is later accompanied by chronic inflammation and reactive fibrosis in the affected tissues. It not only is usually characterized by unilateral edema of the extremities, but can also be seen in the genitals, trunk, head, and neck [1]. It may develop due to primary or secondary causes [2]. Primary lymphedema is congenital or hereditary and associated with dysplasia in the lymphatic system. It may develop due to hypoplasia, hyperplasia, or aplasia in lymphatic vessels. The causes of secondary lymphedema include cancer surgery and/or radiotherapy, infection, venous insufficiency, trauma, and lipedema [3]. Globally, more than 200 million people are affected by lymphedema, most commonly in the lower extremities [4]. Among the common symptoms of lower extremity lymphedema are pain, edema, decreased range of motion, fatigue, susceptibility to infection, sensory disturbances, cosmetic deformity, trunk asymmetry, and muscle weakness [5–7]. In addition, physical activity, balance, and functionality can be negatively affected by lymphedema in the lower extremities.

Most studies evaluating individuals with lymphedema have reported that physical activity produces positive results. Physical activity physiologically affects the musculoskeletal

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pump and increases venous and lymphatic return in the affected [8, 9]. However, physical activity levels in patients with lymphedema remain very low due to decreased joint movement sensation, musculoskeletal problems, feelings of heaviness and fullness, and kinesiophobia [10, 11].

Heaviness, tension, stiffness, and pain that occur in the extremities due to lymphedema can decrease mobility and cause dysfunction [12]. These changes in the extremities may adversely affect the spinal posture and overall body balance of individuals over time [13]. Considering the positive relationship between fear of falling and fear of balance and movement, reduced balance in individuals with lymphedema also increases fear of falling and kinesiophobia [14]. In addition, due to the complications of increased lower extremity volume, a feeling of heaviness in the extremity, and a feeling of fullness, the balance of individuals is adversely affected, which can also lead to an increased fear of falling [14].

In the literature, it has been reported that the increase in lower extremity volume due to edema and the feeling of heaviness in the affected extremity make it difficult for patients to walk and perform daily living activities and decrease their functionality [5, 7]. Currently, fear of movement and related problems have started to attract the attention of researchers. Individuals with lymphedema have been reported to have kinesiophobia and often show avoidance of activity in the case of the worsening or emergence of symptoms, which can adversely affect their functionality [14, 15].

In the light of literature findings on problems experienced by individuals with lymphedema, it is very important to investigate their physical activity, fear of falling, and functionality. Although there are studies evaluating these parameters in patients with lymphedema, we found no research comparing the findings with those of healthy individuals. With the hypothesis that there would be differences between these two groups, the current study aimed to compare the level of physical activity, fear of falling, and functionality between individuals with lower extremity lymphedema and healthy individuals.

Methods

This study was conducted with volunteer patients (age: 56.03 ± 7.83 years) diagnosed with secondary and/or primary lymphedema by a specialist physician in the lymphedema polyclinic of Ankara City Hospital between October and December 2022 and healthy controls (age: 54.61 ± 5.43 years).

The inclusion criteria for the lymphedema group were as follows: being women, having unilateral lymphedema, and having stage 2–3 primary or secondary lymphedema in the lower extremities according to the International Lymphedema Association guidelines [16], being aged 18–65 years, having no orthopedic disorder that would prevent walking, having no previous history of falling, having no neurological disorder that could affect balance, having no cooperation problem, and agreeing to participate in the study. Excluded from this group were patients who did not provide consent for participation in the study, having conservative or surgical treatment during the study, those with mental or cognitive problems or active metastasis, those who had completed adjuvant therapy within the past 6 months, and those with a history of orthopedic surgery in the lower extremity, active thrombosis, active infection, an open skin wound, pain complaints in the lower extremity, or a history of falling. For the control group, the inclusion criteria were being women, an age range of 18–65 years, and the absence of a lymphedema diagnosis, history of orthopedic surgery in the lower extremity, neurological problem, or balance coordination therapy. Those who did not volunteer to participate in the study and those with mental or cognitive problems, a history of orthopedic surgery in the lower extremities, a history of falling, sensory problems, peripheral vascular disease, or complaints of pain in the lower extremities were excluded from the study. Prior to the study, approval was obtained from the Ethics Committee on Clinical Trials using Non-Pharmaceutical and Medical Devices at KTO Karatay University Faculty of Medicine (number: 2022/023), and the individuals were informed as necessary. The study complied with the tenets of the Declaration of Helsinki.

G*Power software package (G*Power, Version 3.0.10, Franz Faul, Universität Kiel, Germany) was used to calculate the sample size. Ten participants from each group were randomly recruited for the pilot study. The effect size corresponding to this value was 0.534. It was calculated that in order to achieve 80% power with $\alpha = 0.05$ type I error, 57 patients were required for each group.

Outcome measures

The sociodemographic and clinical characteristics of all individuals included in the study were evaluated. In this context, age, height, weight, and body mass index (BMI) were recorded, and the lymphedema stages of the patients in the lymphedema group were also noted. Questionnaires were evaluated to patients face to face.

In both groups, fear of falling was evaluated with the Tinetti Falls Efficacy Scale (TFES), lower extremity functionality with the Lower Extremity Functional Scale (LEFS), and physical activity level with the International Physical Activity Questionnaire-Short Form (IPAQ-SF).

Tinetti Falls Efficacy Scale

TFES was developed by Tinetti et al. to measure fear of falling while performing activities of daily living (taking

a bath, walking, personal care, etc.). The scale consists of 10 items, each scored by the individual from 1 (I am very confident) to 10 (I have no confidence) points. The total score is obtained by adding the scores given to each item. The minimum score is 0 points, and the maximum score is 100 points, with a higher score indicating a higher level of fear of falling [17, 18].

Lower Extremity Functional Scale

LEFS contains 20 items to evaluate the functional status of individuals with lower extremity disturbances. Each item is scored from 0 (extreme difficulty) to 4 (no difficulty). The total score is obtained by summing the scores of each item. A minimum of 0 and a maximum of 80 points can be obtained on this scale. A lower score represents worse functionality [19, 20].

International Physical Activity Questionnaire-Short Form

The physical activity levels of the individuals were evaluated with IPAQ-SF, which consists of seven questions that elicit information on the number of days an individual has been engaging in high-, moderate-, and low-intensity activities within the past week, the time allocated for these activities, and the time spent sedentary. A criterion in this evaluation is that each activity should be performed for at least 10 min in order to be included in scoring. Minutes and days are multiplied by the metabolic equivalent of task (MET) value, and the result is expressed as MET-minutes/week. A lower value indicates a lower physical activity level [21, 22].

Statistical analysis

IBM SPSS Statistics v. 25.0 (IBM Corp. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) was used for data analyses. The normality of the distributions of the variables was tested using visual (histograms) and analytical (Kolmogorov-Smirnov test) methods. Descriptive statistics were calculated for all variables, and the normally distributed data were presented as mean ± standard deviation, the non-normally distributed data as median (interquartile range), and the ordinal variables as frequency (n) and percentage (%) values. The independent-samples t-test and Mann-Whitney U test were utilized to test the differences between the groups. The relationship between function, drop efficiency, and physical activity was analyzed with Spearman's correlation test. The effect size was calculated using the equation proposed for Cohen's d, and $p < 0.05$ was accepted as statistically significant.

Table 1 Demographic characteristics of the participants

	Lymphedema ($n = 62$) Mean ± SD	Control ($n = 59$) Mean ± SD	p-value*
Age (year)	56.03 ± 7.83	54.61 ± 5.43	0.250
BMI (kg/m^2)	35.06 ± 8.19	33.05 ± 3.14	0.080

n number, *SD* standard deviation, *BMI* body mass index

*Independent-samples t-test, $p < 0.05$

Table 2 Demographic characteristics and functionality, fear of falling, and physical activity scores of the patients with lymphedema

	Primer lymphedema ($n = 33$) Mean ± SD	Seconder lymphedema ($n = 29$) Mean ± SD	p-value*
Age (year)	54.51 ± 8.66	57.76 ± 6.49	0.104
BMI (kg/m^2)	33.71 ± 8.07	36.60 ± 8.19	0.168
Lymphedema duration (month)	110.54 ± 83.89	64.27 ± 48.09	**0.011**
LEFS	40.81 ± 19.65	35.00 ± 13.48	0.185
TFES	25.21 ± 21.65	33.83 ± 26.66	0.166
IPAQ	1098.64 ± 1673.37	609.95 ± 531.91	0.137

n number, *SD* standard deviation, *BMI* body mass index, *LEFS* Lower Extremity Functional Scale, *TFES* Tinetti Falls Efficacy Scale, *IPAQ* International Physical Activity Questionnaire

*Independent-samples t-test, $p < 0.05$

Results

The sample of the study included 121 participants aged 36–65 (55.34 ± 6.78) years, consisting of 62 patients with lymphedema and 59 healthy controls. In the lymphedema group, 33 (53.23%) patients had primary lymphedema and 29 (46.77%) had secondary lymphedema. There was no statistically significant difference between the demographic characteristics of the lymphedema and control groups ($p > 0.05$) (Table 1).

Table 2 presents the demographic characteristics of the patients with primary and secondary lymphedema. Of the patients with lymphedema, 33 (53.23%) had primary lymphedema and 29 (46.77%) had secondary lymphedema. The primary and secondary lymphedema groups had similar LEFS ($p = 0.207$, $d = 0.16$), IPAQ ($p = 0.782$, $d = 0.04$), and TFES ($p = 0.318$, $d = 0.92$) scores (Table 2).

The lymphedema group had a significantly higher TFES score than the control group ($p < 0.01$, $d = 0.52$), while the control group had significantly higher LEFS ($p < 0.01$, $d = 0.77$) and IPAQ ($p = 0.001$, $d = 0.30$) scores (Table 3).

Among the patients with lymphedema, there was a negative correlation between LEFS and TFES ($r = -0.714$, $p < 0.001$) and between TFES and IPAQ ($r = -0.492$, $p < 0.001$). LEFS and IPAQ were positively correlated ($r = 0.619$, $p < 0.001$) (Table 4).

Table 4 Correlation between functionality, fear of falling, and physical activity in the lymphedema group

	LEFS	TFES	IPAQ
LEFS	1		
TFES	**−0.714***	1	
IPAQ	**0.619***	**−0.492***	1

LEFS Lower Extremity Functional Scale, *TFES* Tinetti Falls Efficacy Scale, *IPAQ* International Physical Activity Questionnaire

*Spearman correlation test, $p < 0.01$

Discussion

This study investigated the effects of lymphedema on physical activity, fear of falling, and functionality. The results revealed that lymphedema led to a significantly lower level of functionality and increased fear of falling when compared to healthy individuals. Physical activity was found to be lower in the healthy individuals but this not reach a statistically significant level. Also, physical activity was found to be lower in secondary lymphedema than primary lymphedema. Also, this difference did not reach a statically significant level.

Studies show that lymphedema negatively affects dynamic balance and requires more energy consumption for postural control [23]. Increased extremity volume changes load transmission by preventing bilateral symmetry. This impaired balance and asymmetry in the legs can trigger a fear of falling in these patients [14, 24]. Although the fear of falling depends on the psychological tendency of the patient, the biological basis is that increased edema in the deep tissue of the lower extremities and around the joint creates capsular tension. This tension in the joint capsule further increases with the sliding movement of the tendons during movement, creating a feeling of insecurity [25]. It is also known that a BMI of >30 (obesity) has an increasing effect on the fear of falling [26]. Considering the effect of weight gain caused by lymphedema on joints, patients' fear of falling may become inevitable. In the current study, when the patients with lymphedema were compared with the healthy individuals, it was observed that they had similar BMI values. Therefore, it can be considered that even if BMI is not taken into account, the fear of falling caused by lymphedema is almost twice as high when compared to healthy individuals.

Due to the fear of falling, patients with lymphedema may become more cautious in performing daily activities and begin to avoid physical activity. Fu and Rosedale reported that patients with secondary lymphedema suffered from "losing pre-lymphedema being" and "feeling handicapped" symptoms [27], which is related to these patients no longer having the physical and mental comfort they experienced in the pre-lymphedema period. This may be due to these patients experiencing a period of physical and mental comfort before lymphedema. In our study, although the exposure times of the patients to primary and secondary lymphedema were different, they were similarly physically restricted, and their fear of falling reduced their physical activity levels. Sander et al. (2011) reported that the lack of knowledge about lymphedema negatively affected physical activity and behaviors in lymphedema patients [28]. Similarly, Karadibak et al. [11] determined that increasing lymphedema severity caused a fear of movement, which, in turn, increased inadequacy in performing physical activities. On completion of our study, we observed that physical activity was higher in the patients with primary lymphedema, suggesting that the ability of these patients to live and adapt to their anatomical structure or congenital disease was better when compared to those with secondary lymphedema. Even if the level of physical activity did not significantly differ between the primary and secondary lymphedema groups, it was twice as high in the former. Therefore, consistent with the literature, we also observed that the patients with secondary lymphedema tended to suffer from "losing pre-lymphedema being" and thus limited

Table 3 Comparison of functionality, fear of falling, and physical activity levels between the lymphedema and control groups

	Lymphedema ($n = 62$)		Control ($n = 59$)		p-value*
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
LEFS	38.09 ± 17.16	71.00 (23.75–49.00)	69.76 ± 8.08	59.00 (66.00–76.00)	**<0.001**
TFES	29.24 ± 24.31	34.50 (22.75–49.25)	21.92 ± 17.04	16.00 (11.00–24.00)	**<0.001**
IPAQ	870.06 ± 1288.12	490.00 (113.75–1102.50)	843.31 ± 555.60	845.00 (630.00–1020.00)	**0.001**

SD standard deviation, *n* number, *IQR* interquartile range, *LEFS* Lower Extremity Functional Scale, *TFES* Tinetti Falls Efficacy Scale, *IPAQ* International Physical Activity Questionnaire

*Mann-Whitney *U* test, $p < 0.01$

their physical activities. Our findings also showed that the control group was less active than the lymphedema group, which may be due to the patients with lymphedema engaging in regular exercise depending on their treatment conditions. Nonetheless, all the groups had low levels of physical activity (600–3000 MET-minutes/week) [22].

Dunberger et al. [29] reported that weight gain and pain caused by lymphedema, combined with physical activity that decreased over time, would negatively affect functionality by reducing muscle strength. Physical activity reduced by lymphedema may also limit the ability to perform daily activities. Therefore, the volume of lymphedema and its effect on tissues are very important. Considering treatment, it should be determined whether the benefits for the patient outweigh the burden [30]. For example, in patients receiving complex decongestive therapy, the obligation to wear special garments for life may be one of the factors that negatively affect their functionality. In this regard, clothing pressure measurements are also important, and pressure on the joints should only target lymphedema and not affect movement [31]. In the study of Hammer et al. in 213 women with uterine cancer, it was determined that 53% of the women had functional and physical disorders. In addition, it was determined that 36.2% of women had the most functional loss in the lower extremities [32]. In another study of women who developed lymphedema in the lower extremities after endometrial cancer, it was reported that 35% of women had inadequate physical function [33]. In our study, the patients with lymphedema were determined to have significantly reduced functionality compared to the healthy group. In addition, we found that the secondary lymphedema group had a lower functionality score than the primary lymphedema group. Both cancer surgery, chemotherapy, and radiotherapy applications can cause people to be adversely affected physically and emotionally. In a study, patients who developed lymphedema in the lower extremities were divided into two groups as primary and secondary. As a result of the comparison, lower extremity functionality of those with secondary lymphedema was found to be lower than those with primary lymphedema. These findings support the literature [34].

To the best of our knowledge, this is the first study in the literature to evaluate physical activity, fear of falling, and functionality together in patients with lower extremity lymphedema. The results showed that lower extremity lymphedema decreased functionality by increasing their fear of falling. Although the lymphedema group had a relatively higher physical activity level than the healthy group with comparable body volumes, both groups had insufficient levels of physical activity. With the subsequent onset of secondary lymphedema, these patients' functionality was impaired to a greater extent due to a further increase in their fear of falling and a further reduction in their physical activity.

Limitations

This study was conducted only with female patients. Therefore, future studies should investigate whether gender has an effect on the fear of falling in individuals with lymphedema. Furthermore, we did not question whether the patients had previously received treatment or disease education for lymphedema, which could increase their awareness and knowledge of the difficulties associated with lymphedema development. Another limitation concerns the single-center design. The quality of the study can be improved by including patients from different populations in multiple centers.

In conclusion, the results of our study showed that the individuals with lymphedema experienced an increased fear of falling and impaired functionality. This negative impact on functionality was related to reduced physical activity levels and increased fear of falling.

Author contributions Cansu Sahbaz Pirincci and Emine Cihan contributed to conceptualization, methodology, data collection, writing original draft, writing review, and editing.

Bayram Sonmez Unuvar and Hasan Gercek contributed to analysis, editing, and writing.

Aydan Aytar and Pınar Borman contributed to reviewing and editing.

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Code availability Not applicable.

Declarations

Ethics approval Not applicable.

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Conflict of interest The authors declare no competing interests.

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