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The Impact of Lower Extremity Fatigue on Lower Quadrant Dysfunction and Health Profile in Hairdressers

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Key words: Lower Extremity Fatigue; Hairdressers; Lower Quadrant; Health Profile

Abstract

Background: *Although lower extremity pain and fatigue are important conditions for hairdressers, such occupational issues are poorly documented. This study aimed to determine lower extremity fatigue and related factors in hairdressers.* **Methods:** *The study population consisted of at least 18 years old individuals working as hairdressers. Lower Extremity Fatigue was assessed with 2 questions containing a 5-point Likert scale. A numerical fatigue rating scale was used to assess general fatigue level, a visual analog scale was used to assess occupational satisfaction, Nottingham Health Profile (NHP) was used to assess health profile, and Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was used to assess lower quadrant pain profile.* **Results:** *In the assessment of lower extremity pain, a statistically significant difference was found between Fatigue and Non-fatigue groups in the lower back (p=0.011), left knee (p=0.012), right (p=0.017) and left (p=0.012) lower leg parameters. In the lower extremity Weighted Scores, there was no significant difference between the fatigue and non-fatigue groups in the pelvis (p=0.365), right upper leg (p=0.153), left upper leg (p=0.156), right knee (p=0.054) but there were significant differences in the lower back (p=0.002), left knee (p=0.023), right lower leg (p=0.006) and left lower leg (p=0.017). The difference in the Energy, Pain, and Physical Mobility sub-dimensions of the Nottingham Health Profile of the hairdressers in the 'Fatigue Group' was at a significant level.* **Conclusions:** *In conclusion, the rate of lower extremity fatigue found in hairdressers in the present study was quite high, and lower extremity fatigue was associated with lower extremity pain and health profile.*

1. Introduction

Although hairdressing is a common profession worldwide, the activities of hairdressers in working life continue to be one of the least studied areas within the scope of occupational health [1]. When the daily workload of hairdressers is assessed, it is stated that it is at a high and severe level due to the lack of breaks [2]. Hairdressers usually carry out these workloads indoors and in standing positions for long periods of time. Therefore, hairdressing is one of the occupational groups in which physical force is highly needed. Conditions such as intensive use of awkward work postures, strenuous, excessive shoulder movements, physical force, mechanical loads on joints, repetitive motion, and long working hours may lead to poor performance in the long term and health problems in the future for people that work at hair salons [3, 4, 5].

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Compared to other occupational groups, work-related musculoskeletal diseases of hairdressers are quite frequent. It is stated that work-related musculoskeletal diseases are seen at a rate of approximately 75% in hairdressers in developed and developing countries. Circumstances that cause this are related to ergonomic problems due to working while standing with an inappropriate posture and features of inappropriate posture [6, 7, 8]. These complaints experienced in the working life negatively affect the employees' work efficiency and quality of life. It is stated that the effect of work-related musculoskeletal diseases with the psychosocial factors of the profession and work environment is increasing. Some studies have shown an association with occurrence of musculoskeletal disorders and lower job satisfaction. For example, those who enjoy their work almost all the time have been reported to be 2.5 times more likely to have back pain compared to those who almost never take pleasure in their work [9]. Decreases in job satisfaction are generally associated with physiological problems such as anger, tension, anxiety, and depression [8, 10].

Fatigue may occur in the lower extremity muscles following changes in neuromuscular control, and a decrease in voluntary muscle activation due to activity is defined as fatigue [11]. Occupational fatigue has been studied in many pieces of research in different occupational groups with concepts such as general fatigue, lower extremity fatigue, and fatigue with discomfort and pain [12]. Fatigue is also an important occupational condition for hairdressers. According to data from a study conducted in the USA, the prevalence of general body fatigue in hairdressers is 59% [13]. Studies examining the causes of occupational fatigue have concluded that prolonged standing is associated with general fatigue, especially in the lower extremities. It has been revealed that this is related to the limitation of blood circulation in the leg region and the muscles remaining in the static position [14, 15]. It has been reported that intervention studies such as wearing prophylactic compression stockings to reduce work-related venous pooling and edema yield positive results in reducing fatigue and pain and improving quality of life [16].

In the literature, work-related musculoskeletal disorders are mostly seen in the upper extremities in hairdressers, so the studies in this area mostly research the upper extremity [17,18]. There is no study examining the lower extremity fatigue of hairdressers. In addition, the number of studies on lower extremity pain and health profile in hairdressers is not sufficient. The purpose of this study was to examine the relationship between lower extremity fatigue, and lower extremity pain and health profile in hairdressers.

2. Methods

The study population consisted of at least 18 years old individuals working as hairdressers in the city center of Isparta. Participants without any known neurological, orthopedic or cardiopulmonary disease, history of accident or injury requiring surgical operation in the last 2 years, and symptoms or signs of venous insufficiency (CEAP class C0 and C1) were included in the study. Pregnant women and those who did not meet the inclusion criteria were excluded from the study. After obtaining the information of the participants with the descriptive data form, the following assessment tools were applied to those who volunteered to participate in the research by experienced researchers in a face-to-face environment.

- Lower extremity fatigue: Participants' lower extremity fatigue was assessed with 2 questions containing a 5-point Likert scale. In the first question, lower extremity fatigue at the end of a typical working day was graded from "strongly agree" to "strongly disagree". In the second question, the effect of lower extremity fatigue on activities outside of work was graded between "strongly agree (5 points)" and "strongly disagree (1 point)" [12].
- Persons who declared that they "strongly agree (5 points)" or "agree (4 points)" that they experienced lower extremity fatigue were called "Fatigue Group" during the statistical analysis of the study.
- Numerical fatigue rating scale: The overall fatigue rating was graded in the range of 0 points: not fatigued at all to 10 points: extremely fatigued with the help of a visual analogue scale [19].

- Occupational satisfaction: Occupational satisfaction level was graded between 0 points: not satisfied at all and 10 points: very satisfied with the help of visual analogue scale [20].
- Nottingham Health Profile (NHP): Developed by Hunt et al., this tool provided a simple and quick way to assess people's health-related problems. The assessment tool consisted of a total of 38 "yes/no" questions and 6 different sub-dimensions. As sub-dimensions, Energy, Pain, Emotional Reactions, Sleep, Social Isolation and Physical Mobility were examined. In this tool, which can be scored between 0-100 in each sub-dimension, the increase in the score indicated the increase in the severity of health-related problems [21]. The Turkish adaptation of this tool was carried out by Küçükdeveci et al. [22]. Cronbach's alfa coefficients for the NHP ranged between 0.56 and 0.83 [22].
- Cornell Musculoskeletal Discomfort Questionnaire (CMDQ): In the present study, lower extremity parameters of CMDQ were used to assess lower extremity pain. This assessment tool examined the discomfort's frequency, severity and its effect on work performance in 11 different body parts during the last 1 week. The weighted score of the complaint in the body regions was calculated. The higher the score was, the higher the discomfort in the musculoskeletal system became. The Turkish language adaptation of the scale was made by Erdinç et al. [23]. Test-retest reliability of the T-CMDQ was satisfactory; Kappa coefficients, which ranged between 0.56-0.97 across the three scales, indicated moderate to almost perfect agreement between test-retest responses across body parts [23].

2.1. Power Analysis and Ethical Aspects of Research

In the sample that was accepted as the universe of the study (population size n=374), when the type 1 error was considered to be 0.05 and the type 2 error was considered to be 95% (GPower v.3.1), the number of people to be reached was determined as at least n=194. The study was approved by Süleyman Demirel University, Faculty of Medicine, Clinical Research Ethics Committee (72867572-050.01.04-218131).

2.2. Statistical Analysis

Data were summarized by descriptive statistics, as appropriate depending on the Shapiro-Wilk test, used to assess the normality of data distribution. The Mann-Whitney U test and Chi-square test were used to assess the differences between the groups. Binary logistic regression analysis was used to determine the factors associated with lower extremity fatigue. The regression model was examined with the Hosmer-Lemeshow goodness of fit test. Data were presented as frequency (n), percentage (%), and mean ± standard deviation. The p value was considered significant at the 0.05 level. SPSS v.23 package program was used for the analysis.

3. Results

A total of 249 hairdressers, 69 (27.7%) women and 180 (72.3%) men, participated in the present study. While 108 participants (43.4%) stated that they did not exercise at all, 91 (36.5%) stated that they exercised sometimes, and 50 (20.1%) that they exercised at least once a week. As many as 26 hairdressers (10.4%) declared not to take a break during the day. One hundred and sixty participants (64.3%) were smokers (Table 1).

It was determined that 214 (85.9%) of 249 hairdressers in the present study experienced lower extremity fatigue (Table 1). It was determined that 48.6% (n=121) of the hairdressers that were deemed "strongly agreed" and 36.1% (n=90) of them "agreed" that they experienced lower extremity fatigue.

When the effect of lower extremity fatigue on life in general was questioned, 21.7% (n=54) stated that they "strongly agreed" and 29.3% (n=73) stated that they "agreed". While 23.3% (n=58) of the hairdressers reported that they had days where they could not go to work due to lower extremity fatigue, the rate of those who were applicated to the outpatient clinic due to this complaint was 30.9% (n=77) (Table 1).

Table 1. Descriptive results.

	All (n=249)	Fatigue (n=214)	Non-fatigue (n=35)	*p*
Gender	69 (27.7)	66 (30.8)	3 (8.6)	**0.004***
F, n (%)	180 (72.3)	148 (69.2)	32 (91.4)	
M, n (%)				
Age, y (mean+SD)	28.28±8.81	28.39±9.06	27.60±7.19	0.979
BMI, kg/m^2(mean+SD)	23.66±3.93	23.54±3.86	24.39±4.36	0.335
Job duration, y (mean+SD)	3.79±0.56	3.77±0.59	3.91±0.28	0.258
Working time, h/week (mean+SD)	68.32±11.83	68.95±11.49	64.45±13.26	0.063
Exercise				0.669
Not exercise, n (%)	108 (43.4)	95 (44.4)	13 (37.1)	
Sometimes, n (%)	91 (36.5)	76 (35.5)	15 (42.9)	
Least once a week, n (%)	50 (20.1)	43 (20.1)	7 (20.0)	
Smoking				0.625
None, n (%)	89 (35.7)	79 (36.9)	10 (28.6)	
Sometimes, n (%)	45 (18.1)	38 (17.8)	7 (20.0)	
Often, n (%)	115 (46.2)	97 (45.3)	18 (51.4)	
Took a break, n (%)	223 (89.6)	191 (89.3)	32 (91.4)	0.689
Fatigue rating scale (0-10)	5.08±2.45	5.27±2.39	3.88±2.46	**0.004***
Occupational satisfaction (0-10)	7.78±2.44	7.67±2.43	8.43±2.43	**0.030***
Absenteeism, n (%)	56 (22.5)	49 (22.9)	7 (20.0)	0.871
Day of absence from work, n	0.85±2.93	0.94±3.14	0.34±0.73	0.636
Outpatient clinic application, n (%)	77 (30.9)	74 (34.6)	3 (8.6)	**0.004***

*F, M: Female, Male. BMI: Body mass index * p< 0.05 in the Independent-sample Mann-Whitney U and Chi-Square test.*

When the participants were divided into groups according to their fatigue in the lower extremities, the groups showed difference in terms of gender, numerical fatigue rating scale, occupational satisfaction and the presence of outpatient clinic application (Table 1).

The status of associating the lower extremity fatigue felt by the hairdressers with their profession was at the level of "completely" in 31.3% (n=78) and "partially" in 36.1% (n=90) of the participants. The effect levels of the fatigue felt while doing their job were observed as follows: For 0.8% (n=2), it was "inhibiting the job", for 5.2% (n=13) "effective on daily life", for 14.5% (n=36) "effective on work performance", for 43.0% (n=107) "mild" and for 36.5% (n=91) "no effect". Due to this effect, 22.5% (n=56) of the hairdressers reported that they had absent days (mean 0.85±2.93) in the last 1 year, while 30.9% (n=77) reported that they were applicated to the outpatient clinic with complaints. While there was no difference between the groups in terms of not going to work (p=0.871) and number of days absent from work (p=0.636), there was a difference in terms of outpatient clinic application (p=0.004) (Table 1).

Gender and outpatient clinic application were found to be risk factors for lower extremity fatigue (Table 2).

In the assessment of lower extremity pain, all hairdressers participating in the study reported the most pain after lower back pain (53.0%, n=132) at right lower leg (36.9%, n=92), left lower leg (32.5%, n=81), right knee (24.5%, n=61) and left knee (22.1%, n=55). The regions reported as least painful were hip-pelvis (12.0%, n=30), left upper leg

Table 2. Variables associated with lower extremity fatigue.

	Odd Ratio	95% CI		*p*
		Lower	Upper	
Female gender	8.550	0.020	0.673	**0.016***
Outpatient clinic application	1.670	1.011	27.912	**0.049***

**:The p value is less than 0.05 in the binary logistic regression analysis tests.*

Table 3. Cornell Musculoskeletal Discomfort Questionnaire (CMDQ): Frequency of lower extremity pain.

	All (n=249)	Fatigue (n=214)	Non-fatigue (n=35)	*p*
Lower back	53.0%, n=132	56.4%, n=120	34.2%, n=12	**0.011***
Pelvis	12.0%, n=30	12.8%, n=27	7.9%, n=3	0.370
Right upper leg	21.7%, n=54	23.2%, n=49	13.2%, n=5	0.146
Left upper leg	18.9%, n=47	20.4%, n=43	10.5%, n=4	0.130
Right knee	24.5%, n=61	26.5%, n=56	13.2%, n=5	0.062
Left knee	22.1%, n=55	24.6%, n=52	7.9%, n=3	**0.012***
Right lower leg	36.9%, n=92	40.3%, n=85	18.4%, n=7	**0.017***
Left lower leg	32.5%, n=81	35.5%, n=75	15.8%, n=6	**0.012***

**p-value < 0.05 in the Chi-Square tests. Note: The number of 'n' exceeds the sample size.*

(18.9%, n=47), and right upper leg (21.7%, n=54). Statistically significant difference was found between Fatigue and Non-fatigue groups in lower back (p=0.011), left knee (p=0.012), right (p=0.017) and left (p=0.012) lower leg parameters (Table 3).

In the lower extremity Weighted Scores, there was no significant difference between the fatigue and non-fatigue groups in pelvis (p=0.365), right upper leg (p=0.153), left upper leg (p=0.156), right knee (p=0.054) but there were significant differences in lower back (p=0.002), left knee (p=0.023), right lower leg (p=0.006) and left lower leg (p=0.017) (Table 4).

In assessing the general health profile, a difference was observed in the participants' results who were grouped according to their fatigue in the lower extremities. The difference in the Energy, Pain, and Physical Mobility sub-dimensions of the Nottingham Health Profile of the hairdressers in the "Fatigue Group" was significant (Table 5).

4. Discussion

To our knowledge, this is the first study on lower extremity fatigue in hairdressers. The rate of lower extremity fatigue was 85.9%: female gender and outpatient clinic application were found to be risk factors for lower extremity fatigue.

Static and prolonged standing causes fatigue, especially in the lower extremities and lower back. Circulation decreases due to decreased muscle contractions in static standing or inactive posture. While this situation negatively affects the nutrition and oxygenation of the muscles, it also causes a decrease in the removal of metabolic waste products from the system, resulting in fatigue [24]. In the study of Gell et al., in which they examined the risk factors that cause lower extremity fatigue in assembly workers, it was stated that high-risk factors included smoking, rheumatoid arthritis, unsuitable shoes, and prolonged standing, weekly working hours, and high BMI [12]. In their study, Heather et al. found that lower extremity fatigue decreased vastus lateralis activation in young, healthy women, and knee joint loads decreased simultaneously with this deterioration in quadriceps activation [25]. In the present study, the variables related to lower extremity fatigue included female gender and outpatient clinic application. The higher lower extremity

Table 4. Cornell Musculoskeletal Discomfort Questionnaire (CMDQ): Lower extremity weighted scores.

	All (n=249)	Fatigue (n=214)	Non-fatigue (n=35)	*p*
Lower back	6.60±13.88	7.47±14.81	1.73±4.03	**0.002***
Pelvis	1.07±6.55	1.23±7.10	0.21±0.76	0.365
Right upper leg	2.46±9.49	2.77±10.24	0.77±2.40	0.153
Left upper leg	2.46±9.80	2.77±10.57	0.72±2.30	0.156
Right knee	2.93±9.78	3.39±10.55	0.39±1.13	0.054
Left knee	3.18±11.30	3.70 ±12.20	0.31±1.11	**0.023***
Right lower leg	4.79±12.64	5.43±13.54	1.26±3.96	**0.006***
Left lower leg	4.46±12.28	5.03±13.15	1.31±4.02	**0.017***

**p-value < 0.05 in the Independent-sample Mann-Whitney U.*

Table 5. General health profile assessment results.

	All (n=249)	Fatigue (n=214)	Non-fatigue (n=35)	*p*
Nottingham Health Profile				
Energy	24.09±29.32	26.32±29.91	10.47±21.04	**0.002***
Pain	18.47±23.19	19.39±22.99	12.86±23.96	**0.009***
Emotional reactions	32.44±28.06	33.43±28.34	26.35±25.86	0.187
Sleep	28.11±24.23	28.69±24.23	24.57±24.29	0.270
Social isolation	15.50±23.74	16.07±24.04	12.00±21.80	0.378
Physical mobility	14.81±17.49	15.42±16.83	11.07±20.95	**0.008***

**p-value < 0.05 in the Independent-sample Mann-Whitney U.*

fatigue in females might stem from the fact that females are a disadvantaged group in terms of muscular strength and endurance due to the lower testosterone hormone and muscle volume compared to males [26, 27]. There was no significant difference between the "fatigue" and "non-fatigue" groups regarding BMI. This can be attributed to the fact that the BMI values of the hairdressers participating in the present study were between 18.5 and 24.9 in both groups. Long working hours are the most frequently mentioned variable in the literature for both lower extremity pain and lower extremity fatigue. In addition to circulatory causes, fatigue is thought to occur due to a decrease in the efficiency and force-generating capacity of the muscles after prolonged exposure to the activity.

Lower quadrant pains are complaints that cause many occupational groups such as teachers and health workers to go to the hospital frequently. They constitute an important source of medical expenditure. These medical conditions are usually recurrent and progressive and significantly decrease quality of life [28,29,30]. Studies assessing pain in hairdressers reported that neck, lower back, and upper extremity pain were the most frequent types [7, 17,18, 31-33]. In addition, in a study conducted in India, 49.5% of hairdressers reported knee and foot pain [4]. In another study conducted in Taiwan, it was reported that the presence of leg pain was as high as 71.1% [17]. In the study conducted by Hassan et al. to collect information about the prevalence of musculoskeletal pain in hairdressers in the last 12 months, lower extremity pain in hairdressers came after upper extremity and waist-neck pain. However, the assessment of chronic pain found that lower back and knee pain had the highest rate. In addition, in that study, it was stated that lower extremity pain was more common in hairdressers with a high BMI value, while it was stated that standing for a long time and inappropriate back posture was significantly associated with lower extremity pain. However, there was no significant difference in average weekly working hours between hairdressers who reported and did not report symptoms [1]. In the present study, regarding pain frequency in hairdressers, the most affected area after the lower back was the lower leg, then the knee and the least affected area was the upper leg and the pelvis. Pain reporting was higher in the "fatigue" group than in the "non-fatigue" group in all assessed regions. The difference was significant in the lower back, left knee, and right and left lower leg. According to the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) of the lower extremity Weighted Scores results, there was a significant difference between the "fatigue" and "non-fatigue" groups in the same regions.

There are few studies describing hairdressers' working conditions and occupational health problems. The most common work-related health problems in hairdressers are respiratory problems, skin and allergic diseases, and musculoskeletal disorders. According to the hairdressers' statements, the causes of musculoskeletal disorders are as follows: repetitive manual work, tiring upper extremity movements, inappropriate posture, and prolonged standing [1, 34]. A study conducted in Turkey revealed that female hairdressers experienced the most ergonomic health problems related to the load. These problems were followed by respiratory, eye, and skin complaints due to the chemicals they used. It was observed that people who work in hair salons are mainly exposed to chemical, ergonomic and psychosocial hazards and experience problems such as musculoskeletal system problems and stress [35]. Loughlin et al. stated that working as a hairdresser negatively affects one's health and found that especially young hairdressers were at risk of poor health in general. In addition, in the results of this study, while young hairdressers reported a higher prevalence of common health problems compared to the general population group, middle-aged and older hairdressers were generally as healthy as the general population. This result was attributed to the "healthy worker effect," in which individuals with poorer health caused by health problems retire from the profession [36]. Another study reported that hairdressers, especially older ones, were more likely to report symptoms due to longer working hours [1]. In assessing the general health profile in the present study, there was a difference in the Energy, Pain, and Physical Mobility sub-dimensions of the Nottingham Health Profile of the hairdressers in the "Fatigue Group". The Deschamps et al. study showed that female hairdressers were more likely to seek health services than men [37]. In the present study, the application rate to the outpatient clinic was significantly higher in the group with lower extremity fatigue, regardless of gender. In this case, it can be said that lower extremity fatigue negatively affects health by increasing outpatient clinic applications.

When Tsegay et al. examined the situations that cause lower back pain in hairdressers, they stated that occupational stress and satisfaction were among the core reasons. They suggested that ergonomic arrangements and psychosocial approaches should be emphasized in coping with lower back pain [31]. Similarly, Gell et al. stated that lack of occupational satisfaction was among the risk factors that cause lower extremity fatigue [12]. Page et al., in their study on hairdressers in Australia in 2021, reported that they felt insignificant and emotionally exhausted and needed support. However, they had a high rate of job satisfaction [38]. It was observed that the hairdressers who participated in the present study had a high rate of associating lower extremity fatigue with their profession. In contrast, the rate of preventing them from doing their jobs was low. When their occupational satisfaction was questioned, it was found that they generally had high occupational satisfaction. However, there was a significant difference between the "fatigue" and "non-fatigue" groups regarding lower extremity fatigue.

5. Conclusions

In conclusion, the rate of lower extremity fatigue found in hairdressers in the present study was relatively high, and fatigue prevention is an important issue that needs to be studied. Protective approaches such as making ergonomic arrangements, training hairdressers on correct working procedures, and reducing working hours are recommended in studies performed with hairdressers [39, 40]. In addition, lower extremity fatigue is associated with lower extremity pain, health, and occupational satisfaction. Therefore, future studies need to identify the factors that cause lower extremity fatigue and design effective treatment and preventive strategies to prevent fatigue so that hairdressers can improve their work efficiency and well-being.

Several limitations must be considered when interpreting these findings. First, the sample was self-selected and based only upon data collected in one country and may not apply to other countries with different regulatory regimes, levels of training, or cultural differences. Thus, these findings can be strengthened by further qualitative, quantitative, and mixed-methods research across various participants and contexts. On the other hand, reaching the targeted sample size as a result of power analysis makes the obtained data reliable.

Declaration of Interest: The authors declare that they have no conflict of interest.

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