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WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG UPHOLSTERERS IN POLAND

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: The number of individuals with work-related musculoskeletal disorders is increasing in Poland.

Aim of the study: This study aimed to analyze and evaluate pain symptoms among upholsterers and compare these ailments with a group of employees who do not perform physical work. It also examined the associations between pain intensity and frequency with age, length of employment, and somatic characteristics in both research groups.

Material and methods: Ninety-four men were examined, including 50 upholsterers and 44 non-physical workers, who were the control group. Pain location was assessed using the Nordic Musculoskeletal Questionnaire, pain intensity in the lower back was measured using a Visual Analog Scale (VAS), and the frequency of lower back pain was determined using the Jackson-Moskowitz Scale. Participants also provided information relating to age, length of employment, and education. Body mass and height were measured.

Results: Among the study participants, 94% of the upholsterers and 73% of the control group experienced pain in at least one area of the body. The largest percentage of the study participants from both groups reported pain in the lower back. Upholsterers experienced pain in their elbow joints and hands/wrists significantly more often than the control group. The control group experienced pain in the upper back, neck, and hip joints significantly more often than upholsters. Significant positive correlations were found between age and length of employment and the VAS and Jackson-Moskowitz Scale results in both groups.

Conclusions: The locations of pain complaints in the group of upholsterers and in the group of employees who did not perform physical work differed. In both groups, lower back pain predominated. Working as an upholsterer promoted pain in the elbow joints and wrists/hands. Performing mental and mixed work was associated with neck, upper back, and hip/thigh pain. Future studies should aim to assess the prevalence and analyze the risk factors for work-related musculoskeletal disorders.

KEYWORDS: work-related musculoskeletal disorders, pain, occupational health, physical workers, NMQ, ergonomics

Background

The number of individuals in Poland with work-related musculoskeletal disorders is increasing. Factors contributing to pain and musculoskeletal complaints include the type of occupational work and lifestyle [1–3]. Performing repetitive motions for extended periods, assuming specific positions, and engaging the same muscle groups can lead to pathological changes in the musculoskeletal system [4].

Work-related musculoskeletal disorders are becoming a common cause of work absences and medical leave. According to the Social Insurance Institution (ZUS) sickness absence report in 2020, 16.1% of physically active workers took sick leave due to musculoskeletal disorders of the skeletal, muscular, and connective tissues [5].

A significant proportion of musculoskeletal disorders among occupational workers are located in the lumbar spine region, with a smaller percentage affecting the cervical spine, upper limbs, knee joints, and hip joints [4,6,7]. The location and type of complaints depend on the nature of the work performed, body posture, external forces acting on the body, and the duration of musculoskeletal strain [1,4]. Additionally, increased stress experienced by many individuals leads to increased muscle tension, exacerbating existing pain [8].

In physical work, direct overload factors include task intensity and duration. The body position, organization of the workplace – according to occupational health and safety requirements, and individual characteristics of the workers also play a significant role. Lifting, pushing, pulling, precise hand movements, and assuming uncomfortable and/or forced body positions are considered the most common problems [4,6,9]. Physical work often leads to chronic fatigue and exhaustion due to excessive energy expenditure during duties. The most common musculoskeletal dysfunctions among physical workers involve the lumbar spine region [2,4,6,9–12].

One of the fastest-growing branches of industry in Poland, employing over 205,000 people, is the furniture industry, with upholstered furniture having the largest market share [13]. Analysis of the work characteristics of employees in the upholstery industry suggests that cumulative strain syndrome may occur particularly frequently within this professional group. Hazards for upholsterers are associated with tasks such as lifting and carrying heavy loads, climbing, manipulating sharp tools with delicate components, and working in uncomfortable positions (e.g., bending forward, squatting, or kneeling) [14].

There are numerous studies on musculoskeletal dysfunctions among physical workers in the scientific literature, but no studies specifically addressing the complaints experienced by upholsterers were found. The first objective of the work is to analyze and evaluate pain complaints in upholsterers and compare them with complaints occurring in employees who do not perform physical work. The second objective is to analyze the relationships between the intensity and frequency of pain and age, somatic features, and work experience in both research groups.

The following research questions were formulated:

1) what are the most common locations of pain complaints occurring in upholsterers,

2) do these locations differ in comparison to the group of employees who do not perform physical work,

3) is there a relationship between age, work experience, somatic features, and the intensity and frequency of pain in both research groups?

Material and methods

Study design and settings

The research was conducted in Poland in May and November 2021. Research on upholsterers was conducted in the districts of Wieruszów (Łódź Voivodeship) and Kępno (Greater Poland Voivodeship). These districts have a significant number of furniture manufacturing facilities. The study of the control group was carried out in the Opole Voivodeship.

Participants

Ninety-four men were examined. The study group consisted of fifty randomly selected male upholsterers working in multiple furniture manufacturing facilities. The control group consisted of forty-four employees who did not perform physical work but did mental or mixed work. The inclusion criteria for participants in both groups were a minimum employment experience of 1 year and providing written consent to participate in the study. The exclusion criteria were acute injuries and infections, exacerbation of chronic disease, previous injury potentially associated with pain, work experience of less than one year, and lack of written consent to participate in the study.

The upholsterers surveyed most often performed their work in a standing, kneeling, and forward-leaning position. A frequent and repetitive movement was assembling furniture and screwing furniture parts together. In addition, the upholsterers lifted and carried heavy furniture parts. Respondents in the control group mostly assumed sitting and standing positions in their work.

Research tools

The Nordic Musculoskeletal Questionnaire (NMQ) was used to assess the location and frequency of pain. The questionnaire includes questions regarding the presence of symptoms within the last seven days and twelve months, as well as the specific body areas where the pain occurred (neck, upper back, lower back, shoulders, elbows, wrists/hands, hips/thighs, knees, ankles/feet) [15].

The Visual Analogue Scale (VAS) was used to assess lumbar spine pain. The VAS visualizes pain intensity on a scale from 0 to 10, where 0 represents no pain, and 10 represents unbearable maximum pain [16].

The Jackson-Moskowitz Scale was used to assess the frequency of lower back pain and its impact on daily functioning [17]. The scale distinguishes six levels of pain perception:

- Level 0: no pain symptoms
- Level 1: sporadic pain occurring several times a year, mainly after exertion, not limiting the participant's daily activities
- Level 2: periodic pain occurring several times a month, mainly after exertion, not limiting the participant's daily activities
- Level 3: frequent pain occurring several times a week, limiting the participant's daily activities
- Level 4: very frequent pain occurring daily, significantly limiting the participant's activities, requiring medical visits, pharmacotherapy, and work absences
- Level 5: continuous pain completely limiting the participant's functionality.

Participants also answered questions regarding age, place of residence, length of employment, daily working hours, and education. Body mass and height were measured, and the Body Mass Index (BMI) was calculated.

Statistical methods

Descriptive statistical methods were applied. The mean (M), standard deviation (SD), median (Me), lower quartile (Q1), and upper quartile (Q3) were calculated. The distribution of the variables was assessed in terms of normality using the Shapiro-Wilk test. A parametric test – the Student's t-test – was used only to assess the significance of differences in body height. The Mann-Whitney U-test was used to assess the significance of differences in the study groups regarding other variables. Spearman's rank correlation was used to evaluate the relationships between pain intensity and frequency with somatic characteristics, length of employment, and daily working hours. A significance level of $p \leq 0.05$ was adopted to assign statistical significance. The calculations were performed using Microsoft Excel and Statistica 13.3 (TIBCO Inc., Tulsa, United States).

Ethics consideration

The research was conducted in accordance with the guidelines of the Declaration of Helsinki and Good Clinical Practice. It received approval from the Bioethical Commission at the Opole Medical School (permission no. KB/240/FI/2020). The study followed the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology).

Results

Descriptive data

The mean age of the upholsterers was 29.5 years, and that of the control group was 29.02 years. The studied groups did not differ significantly in age, somatic features, or the number of years of work. The group of upholsterers differed significantly from the control group in terms of education. Vocational education dominated among upholsterers, while secondary education dominated in the control group (Table 1).

Main results

Among the participants, 94% of people in the upholstery group and 73% in the control group experienced pain symptoms in at least one body region. The highest percentage of respondents from both groups

Table 1. Descriptive statistics of age and somatic and demographic variables in the study group.

Variable	Upholsters		Control group		p
	M±SD	Me (Q1–Q3)	M±SD	Me (Q1–Q3)	
Age [years]	29.50±7.87	28 (23–34)	29.02±10.95	23 (21–35)	0.102
Body height [cm]	183.54±6.82	182.5 (170–190)	180.46±5.24	180 (178–184)	0.055
Body mass [kg]	83.82±9.09	83.5 (78–90)	80.90±11.60	80 (73–88)	0.132
BMI [kg/m^2]	24.86±2.20	24.74 (23.67–25.46)	24.81±3.19	24.5 (22.53–27.73)	0.768
Employment experience [years]	6.06±5.56	4 (2–9)	7.06± 8.13	3 (1–12)	0.395
Education N (%)	Vocational Secondary Higher	25 (50%) 23 (46%) 2 (4%)	Vocational Secondary Higher	1 (2%) 26 (58%) 18 (40%)	Chi^2 Chi^2=40.02 p<0.001***

Note: M – mean; SD – standard deviation; Me – median, Q1 – lower quartile, Q3 – upper quartile, p***<0.001.

reported pain symptoms in the lower back. In addition, the upholsterers reported pain symptoms in the elbow joints, hands and wrists, and knee joints. In the control group, the next most common locations of indicated pain were the neck, shoulders, and hip and knee joints. Upholsterers experienced pain in their elbow joints and hands/wrists significantly more often than the control group. The control group experienced pain in the upper back, neck, and hip joints significantly more often than upholsters (Table 2).

Table 2. Results of the NMQ scale

Body parts	Symptoms in the last 12 months N (%)		Chi²	Symptoms in the last 7 days N (%)		Chi²
	Upholsters	Control group		Upholsters	Control group	
Neck	5 (10%)	20 (44.5%)	Chi^2=14.49 p<0.001***	2 (4%)	10 (22%)	Chi^2=7.12 p<0.001**
Shoulders	4 (8%)	6 (13.5%)	Chi^2=0.71 p=0.397	0 (0%)	4 (9%)	Chi^2=4.63 p=0.031*
Upper back	0 (0%)	4 (9%)	Chi^2=4.63 p=0.031**	0 (0%)	1 (2%)	Chi^2=1.12 p=0.289
Elbows	17 (34%)	3 (6.5%)	Chi^2=10.64 p=0.001**	5 (10%)	0 (0%)	Chi^2=4.75 p=0.029*
Wrists/hands	14 (28%)	5 (11%)	Chi^2=4.22 p=0.039*	7 (14%)	1 (2%)	Chi^2=4.26 p=0.039*
Lower back	28 (56%)	21 (46.5%)	Chi^2=0.82 p=0.363	16 (32%)	13 (29%)	Chi^2=0.10 p=0.742
Hips/thighs	0 (0%)	6 (13.5%)	Chi^2=7.11 p=0.007**	0 (0%)	3 (6.5%)	Chi^2=3.44 p=0.063*
Knees	9 (18%)	7 (15.5%)	Chi^2=0.10 p=0.750	4 (8%)	5 (11%)	Chi^2=2.30 p=0.315
Ankles / feet	3 (6%)	1 (2%)	Chi^2=0.83 p=0.359	0 (0%)	0 (0%)	—

Note: p*<0.05, p**<0.01, p***<0.001.

The intensity of pain in the lower back measured using the VAS scale differed significantly between the two groups. Upholsterers experienced significantly more pain compared to non-physical workers. The mean VAS score indicated moderate pain in the upholstery group and mild pain in the control group. The mean Jackson-Moskowitz scale score was not significantly different between the two groups and indicated pain bordering on sporadic and periodic. The study groups differed significantly in terms of pain levels. No lumbar spine pain was noted in 44% of the upholsterer group and 49% of the control group. The largest percentage of the upholsterers in the study reported periodic pain, while in the control group, sporadic pain. In the control group, none of the workers in the study reported very frequent or continuous pain (Table 3).

Table 3. Results of the VAS scale and Jackson-Moskowitz scale

Variable	Upholsters		Control group		p
	M±SD	Me (Q1–Q3)	M±SD	Me (Q1–Q3)	
VAS scale	3.22±3.23	3.5 (0–5)	1.62±2.03	1 (0–3)	0.043*
Jackson-Moskowitz scale	1.34±1.40	1 (0–2)	0.86±1.05	1 (0–1)	0.178
Levels of the Jackson-Moskowitz scale	**N (%)**		**N (%)**		**Chi²**
Level 0	22 (44%)		22 (49%)		Chi^2=44.46 p<0.001***
Level 1	4 (8%)		13 (29%)		
Level 2	14 (28%)		4 (9%)		
Level 3	6 (12%)		6 (13%)		
Level 4	3 (6%)		0 (0%)		
Level 5	1 (2%)		0 (0%)		

Note: M – mean; SD – standard deviation; Me – median, Q1 – lower quartile, Q3 – upper quartile, p*<0.05, p***<0.001.

In both groups, significant positive correlations were found between age and work experience and the results of the VAS scale and the Jackson-Moskowitz scale. It can be stated that the older the age and the longer the work experience, the more intense and frequent the pain in the lower back was. In the group of upholsterers, an additional significant positive correlation was found between the BMI index and the results of the VAS and Jackson-Moskowitz scales. The higher the BMI index, the stronger and more frequent the lower back pain was (Table 4).

Table 4. Spearman's rank correlation between the measured data

Variable	Upholsters	
	VAS scale	Jackson-Moskowitz scale
Age	0.315*	0.292*
Body height	0.003	0.001
Body mass	0.246	0.217
BMI	0.282*	0.284*
Employment experience	0.356*	0.311*
	Control group	
Age	0.534*	0.480*
Body height	0.068	0.090
Body mass	0.080	0.072
BMI	0.029	0.019
Employment experience	0.532*	0.475*

Note: $p^{*}<0.05$.

Discussion

The study's first objective was to analyze and assess the pain complaints among the employees. The highest percentage of employees in both groups declared lower back pain. Among upholsterers, more than half of the respondents had experienced lower back pain in the past 12 months. Lifting heavy objects and maintaining a forced or uncomfortable body position for a long time was found to be the cause of lumbar spine pain among physical workers [4,6,9]. In our study, upholsterers also experienced significantly more intense lower back pain than non-physical workers, measured using the VAS scale. During their work, upholsterers lift and carry heavy furniture components and often work in uncomfortable positions, such as forward bending. These movements and forced postures can lead to pain in the lumbar spine region.

Research results confirm the frequent occurrence of lower back pain among physical workers. No studies specifically addressing pain complaints among upholsterers were found in the literature. Therefore, the results of our research were compared to studies conducted on other physical workers. The prevalence of low back pain among wind farm operation and maintenance personnel was reported to be 88.74% [11]; among fishermen, 82.9% [18]; among male commercial kitchen workers, 65.8% [12]; among agricultural workers, 59.3% [10]; among bakery workers, 48.2% [19]; among flower farm workers, 38.1% [20]; and among loggers, 34% [21]. The lower back region was also found to be the most affected area among aircraft maintenance workers [22] and rubber industry workers [23]. Unbalanced muscle loading in brush cutter operators may contribute to low back pain [24].

The next most common areas where pain occurred among upholsterers were the elbow joints, wrists, and hands. Pain complaints related to the elbow joints, wrists, and hands were observed among physical workers who lifted and moved heavy objects and performed manipulative tasks. Frequently lifting and carrying heavy objects and performing manual activities by upholsterers, such as handling sharp tools with small elements, may overload the elbow joints, wrists, and hands, causing pain. Results from other studies confirm our research. The prevalence of hand and wrist complaints ranged from 12.65% to 70%, while complaints related to the elbow joint ranged from 11% to 28.9% among bakery workers, fishermen, flower farm workers, vehicle repairers, and cleaning workers [18–20,25,26].

In the control group, the most common locations of pain were the lower back and neck. These are common pain locations among employees, including those who do not perform physical work [6,7,27]. Among non-physical workers, the cause of neck and lower back pain may be due to a poorly designed workstation that does not meet ergonomic principles and the worker maintaining a sitting position for a long time [27]. Assuming a forced position for an extended period of time is often the cause of back pain. Even if the working positions are similar in terms of body layout, they are highly individually differentiated in terms of quantitative working parameters – combinations of repetition of specific settings, directions, and ranges of movement within individual spinal segments. These, in turn, can be determined not only by the activities and forced positions performed but also by the individually varying functional status of the individuals under study, which the presence of pain can also influence. Most often, pain, acting in a vicious circle, is only one link in a complex causal chain of dysfunction that exacerbates over time. In order to avoid pain, a person reflexively adopts a position that is as painless as possible and performs daily activities in this position. Over time, however, this position can become a new cause of overload and further discomfort, and in the case of chronic pain, it can even lead to the development and consolidation of the habit of adopting a pain-free but incorrect body position [27].

The study's second objective was to analyze the associations between pain intensity and frequency of lower back pain with age, length of employment, daily working hours, and somatic characteristics. Positive significant correlations were observed between age, length of employment, BMI index, and the intensity and frequency of pain in upholsterers. Thus, it can be concluded that older age, longer tenure as an upholsterer, and higher BMI are associated with higher pain intensity and a greater frequency of lower back pain. Similar relationships between age and work experience and the intensity and frequency of pain were found in the control group.

Other authors have also observed similar associations between age, length of employment, and BMI with musculoskeletal pain. Studies on shellfish gatherers, factory and industrial workers, flower farm workers, garment industry workers, bakery workers, porcelain factory workers, petrochemical industry workers, and musicians confirmed the positive impact of age and length of employment on the occurrence of lower back pain [19,20,23–26,28–32]. It is worth noting the relatively young age of the upholsterers in our study, with a mean of 29.5±7.87 years, and the short length of employment, an average of 6±5.56 years. Even at such a young age and with a short length of employment, a high prevalence of pain complaints was observed among the participants. These complaints will likely intensify with further years of work. In our research, individuals with higher BMI experienced more intense and frequent pain. Greater body mass translates to increased musculoskeletal strain and higher intensity and frequency of pain. Similar observations were made by Baretto et al. (2019), where a BMI above 25 was found to be a risk factor for musculoskeletal pain among shellfish gatherers [9].

Since full-time work takes about eight hours a day, sometimes even more, and the length of service increases with age, it is worth paying attention to compliance with occupational health and safety regulations and work ergonomics. Employees who worked long hours in factories where occupational health and safety regulations were not observed were more susceptible to musculoskeletal disorders. Employees who work long hours in factories with poor compliance with occupational health and safety regulations have a higher burden of musculoskeletal disorders. Enforcing minimum occupational health and safety standards and improving working conditions would help improve workers' health [30]. Ergonomic interventions could also help reduce the high prevalence of pain complaints in upholsterers. The introduction of robotic assistance in the packaging process in the furniture industry eliminated torso twisting during work and consequently reduced the associated risk of work-related musculoskeletal disorders [33].

Strengths of the study

The study focused on a group of upholsterers, and no previous research on work-related musculoskeletal disorders among this professional group has been found in the literature. Given the large number of upholsterers in Poland and the rapidly growing furniture industry, it is essential to understand, analyze, and identify risk factors for musculoskeletal dysfunction among upholsterers. Standardized questionnaires were used in order to compare research results from multiple countries and among individuals representing different occupations.

Limitations

The study also has limitations. It involved a relatively small number of individuals from furniture factories in two provinces in Poland. Therefore, when interpreting the results, it is important to remember that they only provide an approximation of the situation concerning upholsterers in Poland. Additionally, the study analyzed only a few risk factors for musculoskeletal disorders among upholsterers. Further research incorporating a significantly larger number of upholsterers from various regions in Poland and addressing other risk factors such as body posture during work, work-related stress, workplace ergonomics, and lifestyle factors would be valuable.

Future studies on the epidemiology of musculoskeletal disorders among upholsterers should focus on related risk factors and preventive measures for work-related issues.

Conclusions

Musculoskeletal disorders among upholsterers are common. The locations of pain complaints in the group of upholsterers and in the group of employees who do not perform physical work differ. In both groups, lower back pain predominates. Working as an upholsterer promotes pain in the elbow joints and wrists/hands. Performing mental and mixed work is associated with neck, upper back, and hip/thigh pain.

In both groups, there is a relationship between pain complaints, older age, and longer work experience. In the group of upholsterers, pain complaints are also associated with a higher BMI.

Future studies among upholsterers should aim to assess the prevalence and analyze the risk factors for work-related musculoskeletal disorders. This knowledge can guide the development of appropriate preventive measures, such as physical training programs,

educational programs, and workplace ergonomics, to prevent the development, prolonged duration, and severity of work-related musculoskeletal disorders among upholsterers.

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