

Work-Related Musculoskeletal Disorders in Croatian Nurses: A Cross-Sectional Study

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Abstract

Background: Work-related musculoskeletal disorders (WRMSDs) are the most prevalent group of health disorders related to work and working conditions, affecting more than half of all European workers. Nursing has previously been identified as an occupation with a high risk of developing WRMSDs, in which occupational physical static and dynamic strains seem to play a role.

Aim: This study aimed to assess the prevalence of WRMSD-related pain and common occupational physical strains associated with nursing, as well as examine their association with various occupational factors.

Methods: A self-report-based questionnaire was constructed and self-administered by hospital nurses in Croatian hospitals/hospital centers.

Results: A total of 116 nurses participated in this study. The results indicate a very high prevalence of WRMSD-related pain as well as static and dynamic loading among hospital nursing staff. Low back (87.93%), neck (84.48%) and shoulder (81.89%) pain were the most prevalent. Statistical analysis revealed strong associations of wrist/hand pain with applying manual force while performing tasks and assuming working in awkward/forced postures of the wrist and the fingers; association of low back pain with general force, and an association of ankle/foot pain with age and years of employment.

Conclusion: Our study confirmed some of the results of previous studies, suggesting a multifactorial etiology of WRMSD-related pain in hospital nursing staff, in which individual and occupational factors seem to play a role.

Keywords: musculoskeletal disorder, pain, workplace, physical work

Introduction

Work-related musculoskeletal disorders (WRMSDs) are the most prevalent group of health disorders related to work and working conditions. Research suggests that more than 58% of all European workers suffer from discomfort and/or pain in at least one body region (1), thereby affecting their physical and mental health, as well as productivity. According to the European Risk Observatory Report for WRMSDs, in 2015 three out of every five workers in the EU reported musculoskeletal discomfort in the back, upper limbs and/or lower limbs, with complaints regarding the back and upper limbs (43% and 41%, respectively) being the most commonly reported (1). Additionally, WRMSDs are the main cause of absenteeism, accounting for almost 53% of all reported cases (1).

WRMSDs are a large and heterogeneous group of functional disorders affecting the musculoskeletal and soft tissue structures associated (caused and/or aggravated) by work and/or working conditions. They comprise well-known inflammatory and degenerative clinical entities, such as carpal tunnel syndrome, medial/lateral epicondylitis or rotator cuff tendinopathy, as well as less clinically defined but more common painful syndromes, such as lumbago or cervicalgia (2,3). The etiology, pathophysiology and risk factors for the development and/or aggravation of WRMSDs are still not fully understood. Current research suggests a multifactorial etiology of most cases of WRMSDs, where intertwining occupational and individual factors increase susceptibility to musculoskeletal and soft tissue injury. Occupational factors shown to be associated with WRMSDs include physical (static and dynamic) (4), organizational/psychosocial (5) and environmental (6) factors. Occupational physical factors reported to be associated with WRMSDs include prolonged static (sitting, standing) (7,8) and dynamic loading (walking, bending, twisting) (9,10), repetitive movements (11), and having to apply force (handling loads, applying force with hands) (10,12) while performing tasks.

Research suggests that physical strains may account for the majority of the attributable risks for the development of WRMSDs. For example, manual application of force and repetitive movements comprise 93% of the attributable risks for the occurrence of upper extremity musculoskeletal disorders, while the manual handling of loads contributes to 66% of the risk for reporting low back pain (3). Organizational and psychosocial work factors, such as a heavy workload, fast-paced work, low task variety, low work autonomy, environmental discomfort arising from occupational noise or glare, as well as individual factors such as age, sex, health status, physical fitness and lifestyle, have also been previously shown to be related to musculoskeletal pain/discomfort (13).

The intensity and type of occupational physical strains differ among occupations, primarily due to the variability of the tasks performed. The Occupational Safety and Health Administration (OSHA) has identified sectors with a high risk of WRMSDs due to occupational physical strains, one of which being healthcare (14). The prevalence of WRMSDs among healthcare workers ranges from 13% to 96%, with a higher prevalence reported among nurses and nursing aids (15). Previous research shows a general prevalence of musculoskeletal pain in nurses ranging from 70.8% to 89.0% (16,17), and is considered the most prevalent occupation-related health problem (1). The reason for the higher prevalence of WRMSDs in nurses is believed to be related to risk factors arising from the manual handling of patients (e.g., lifting, moving, repositioning), working in awkward postures, applying excessive manual force, strenuous physical working conditions and long working shifts (18) associated with patient care, as well as psychosocial/organizational and individual factors such as age, sex and previous musculoskeletal injury (15). To examine the relationship between occupational physical strains and WRMSD-related pain in nurses, numerous studies have been conducted in different countries and different occupational settings, with no available research on Croatian nurses. To address the aforementioned, this study was conducted to examine the prevalence

of WRMSD-related pain and occupational physical strains among nurses in Croatia as well as their association with various occupational factors.

Materials and methods

Study design

This was a cross-sectional study.

Ethics

This study was not subjected to research ethics evaluation due to the use of anonymous information that had no associated identifiers and a low probability that the participants would be identified.

Participants

The participants were nurses employed at five Croatian medical institutions: Osijek University Hospital Center, Special Hospital for Children with Neurodevelopmental and Motor Disorders, Srebrnjak Children's Hospital, Children's Hospital Zagreb and Jordanovac Clinic for Lung Diseases.

Data collection and study tool

Participation in the study was voluntary and anonymous. The study was conducted from February 2014 to June 2014 using a self-report-based questionnaire. Previous research has suggested that the results obtained by self-report are in good correlation with the results obtained by more objective methods (19,20). The questionnaires were delivered to the aforementioned institutions and distributed in medical wards, along with a ballot box for the anonymous submission of filled-out questionnaires. The questionnaire was self-administered, giving the respondents the choice of opting in or out of the study. Only formally educated nurses were eligible to participate in the study. Nursing aids and assistants, as well as interns, were excluded.

The questionnaire was constructed using a standardized version of the Nordic Musculoskeletal Questionnaire (NMQ-E) (21) and the results of previous research on physical strains and WRMSDs among nurses, comprising questions regarding the

following domains: individual and work-related factors (age, height, weight, education, years of employment, years in current position, working hours), musculoskeletal health (musculoskeletal complaints in the last 12 months) and physical strains (static and dynamic). Based on self-reported weight and height, the Body Mass Index (BMI) was calculated and categorized according to the World Health Organization (WHO) classification: underweight (<18.5), normal (18.5–24.9), overweight (25–29.9) and obese (30 and above). The level of professional education was classified according to the Croatian Qualifications Framework. The prevalence of musculoskeletal complaints was examined for 9 different body regions using a standardized extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E) (21).

Occupational static and dynamic strains were assessed as follows. The amount of force required to perform tasks at work was examined using Likert-based scaling (very small, small, moderate, large, very large). Awkward and/or forced postures for the trunk and upper extremities were examined using time spent in a particular position (not at all, < than half of the shift, > half of the shift) as an indicator of the quantity of the physical strain: neck (flexion/extension, lateral flexion, rotation), lower back (flexion, extension, lateral flexion), shoulders (abduction/adduction, elevation) and wrist (internal/external rotation). Repetitive movements were evaluated only for the upper extremities (shoulders, elbows, wrists, fingers) using the number of repetitions per minute and the number of hours spent performing repetitive work during an 8-hour working shift.

Statistical analysis

Data were analyzed using the SPSS Statistics for Windows, version 22.0. Descriptive analysis was used for demographic variables, musculoskeletal complaints, and static and dynamic occupational loads. A correlation analysis (using the Spearman and rank-biserial correlation coefficient), performed to determine the relationship between demographic and work-related variables,

reported static and dynamic loads, as well as WRMSD-related pain. To determine whether static and dynamic strains predict musculoskeletal pain in different body sites, multiple regression analysis was performed.

Results

Demographic characteristics

In total, 116 questionnaires were submitted. All the participants were women with the demographic characteristics presented in Table 1. The average age of the participants was 40.36 (± 10.737) years. More than two-thirds of the nurses who reported their weight and height for the purpose of BMI calculation were of normal weight (N=58, 53.2%) or overweight (N=31, 28.4%). In total, 3 nurses (2.8%) were classified as underweight and 17 (15.6%) as obese.

The majority of the participants (N=78, 67.2%) had earned a diploma, while 38 (32.7%) had a degree in nursing with, an average of 20

years of work experience and 9.8 working hours per day.

Musculoskeletal complaints

In total, 113 nurses (97.4%) reported having musculoskeletal pain/discomfort in at least one anatomical body site. The self-reported prevalence rates of musculoskeletal pain/discomfort for different body regions in the last 12 months are shown in Table 2. Low back pain/discomfort was the most frequently reported complaint (N=102, 87.93%), followed by neck (N=98, 84.48%) and shoulders (N=95, 81.89%). The least frequently reported sites of complaints were elbows (N=67, 57.75%), hips (N=70, 60.43%) and ankles/feet (N=74, 63.79%).

Static and dynamic occupational loads

In total, 109 (93.96%) of the nurses reported that they had to apply manual force to perform daily tasks at work. The self-reported intensity of the general and manual force required to perform such tasks is presented in Table 3.

Table 1. The demographic characteristics of the participants

Variables	Mean (\pm SD)	Median	Range
Age	40.36 (± 10.737)	38.0	21–62
Height	165.10 (± 6.92)	165.00	152–190
Weight	69.45 (± 13.46)	67.50	48–127
BMI	25.07 (± 4.78)	24.38	17.96–49
Years of employment	20.168 (± 11.26)	19.00	1–43
Years in current position	15.11 (± 10.71)	11.50	0–43
Working hours per day	9.807 (± 2.43)	8.12	7–24

Table 2. Site-specific prevalence of reported WRMSD-related pain

Body region	Frequency (N)	Percentage (%)	Proportion confidence interval (95% CI)
Neck	98	84.48	0.75–0.90
Upper back	86	74.13	0.68–0.85
Lower back	102	87.93	0.80–0.94
Shoulder	95	81.89	0.70–0.87
Elbow	67	57.75	0.48–0.68
Wrist/hand	83	71.55	0.61–0.80
Hip	70	60.43	0.50–0.70
Knee	76	65.51	0.57–0.76
Ankle/foot	74	63.79	0.57–0.78

In total, 78 nurses (67.24%) reported manually lifting patients. All the nurses (N=116, 100%) reported having to assume awkward/forced postures of the back, 113 (97.41%) awkward/forced postures of the neck, while 83 nurses (71.55%) reported awkward/forced postures of the wrist/hand. Working with prolonged shoulder abduction/adduction was reported by 113 nurses (97.41%), while 89 (76.72%) reported working with elevated arms. The self-reported working time spent in each position is shown in Table 3.

In total, 61 nurses (52.5%) reported that they were required to perform repetitive movements of the shoulders, elbows and

fingers, while 64 (55.2%) reported having to perform repetitive wrist/hand movements. The mean, median, and range of the repetitive movements reported are shown in Table 4.

Correlation between the reported static and dynamic strains and WRMSD-related pain

Correlations between reported pain in nine different body regions and individual and static/dynamic strains are shown in Table 5. Significant correlations with a p level of 0.01 have been shown for elbow and wrist pain with manual force; wrist pain and awkward/forced postures of the wrist; wrist pain and awkward/forced postures of the fingers;

Table 3. Prevalence of reported forceful movements and awkward/forced postures

Variables	Frequency (N)	Percentage (%)
Force		
General force needed to perform tasks		
very small	14	13.08
small	35	32.71
moderate	27	25.23
large	22	20.56
very large	9	8.41
Manual force needed to perform tasks		
very small	11	10.09
small	8	7.34
moderate	36	33.02
large	42	38.53
very large	12	11.01
Awkward/forced postures		
Back		
< ½ working hours	34	29.31
> ½ working hours	82	70.69
Neck		
< ½ working hours	29	25.66
> ½ working hours	84	74.34
Shoulder (abduction/adduction)		
< ½ working hours	40	35.4
> ½ working hours	73	64.6
Shoulder (elevation)		
< ½ working hours	71	79.77
> ½ working hours	18	20.23
Wrist		
< ½ working hours	63	75.90
> ½ working hours	20	24.10

Table 4. Characteristics of reported repetitive movements

Body region	Mean (\pm SD)	Median	Range
Shoulder			
Per minute	20.46 (\pm 25.97)	10.00	1–130
Hours per day	6.39 (\pm 4.99)	6.00	1–34
Elbow			
Per minute	21.77 (\pm 21.18)	15.00	2–100
Hours per day	6.57 (\pm 5.36)	6.00	1–34
Wrist			
Per minute	35.36 (\pm 54.34)	22.50	5–340
Hours per day	6.57 (\pm 4.35)	6.00	2–24
Fingers			
Per minute	42.62 (\pm 70.91)	20.00	5–400
Hours per day	7.60 (\pm 9.23)	6.00	1–66

Table 5. Correlation coefficients for the correlation calculations of individual and physical factors with site-specific pain

Variables	NE	UB	SH	EL	WR	LB	HI	KN	AN
Age	-.010	.159	.212*	.197*	.148	-.010	.092	.202*	.265**
Height	-.073	-.232*	-.108	.010	.000	-.037	.066	-.091	-.120
Weight	-.086	-.069	.112	.056	.065	-.050	.070	.046	.082
BMI	-.069	.030	.143	.063	.046	-.063	.060	.127	.140
Working years	-.010	.126	.226*	.185*	.141	-.021	.081	.195*	.259**
Working years/current	.061	.154	.235*	.156	.178	-.055	.055	.109	.225**
Working hours	.008	-.071	.019	-.114	-.192*	.016	-.188	.148	.108
Force									
General force	.130	.060	.030	.146	.207*	.249**	.116	.180	.107
Manual force			.179	.281**	.255**				
Postures									
Back		.134				-.008			
Neck	.152	.193*							
Shoulder (AA)			.051						
Shoulder (E)			.098						
Wrist					.342**				
Repetition									
Shoulder									
Per minute			.111						
Hours per day			-.088						
Elbows									
Per minute				.060					
Hours per day				-.216					
Wrist/hand									
Per minute					-.024				
Hours per day					-.431				
Fingers									
Per minute					-.094				
Hours per day					-.351				

NE - neck; UB - upper back; SH - shoulders, EL - elbows; WR - wrist/hand; LB - lower back; HI - hips; KN - knees; AN - ankle/foot; * - correlation is significant at 0.05 level; ** - correlation is significant at 0.01 level

low back pain and general force; ankle/foot pain and age, ankle/foot pain and years of employment, ankle/foot pain and years in their current position. No significant correlations of individual or occupational factors with neck pain and hip pain were demonstrated. Significant correlations with a p level of 0.05 have been shown, as follows: upper back pain and height; upper back pain and awkward/forced postures of the neck; shoulder pain and age, shoulder pain and years of employment; shoulder pain and years in their current position; elbow pain and age, elbow pain and years of employment; wrist/hand pain and working hours; wrist/hand pain and the amount of general force; wrist/hand pain and repetitive movements of the fingers; wrist/hand pain and repetitive movements of the wrists; knee pain and age; knee pain and years of employment.

Multivariate analysis

Multivariate analysis showed that static and dynamic strains significantly predict hand/wrist pain ($F=5.272$, $P<0.05$). The model indicates that general and manual force, as well as wrist posture, explain 14.8% of the variance in wrist/hand pain ($R=0.385$, $R^2=0.148$). Multivariate analysis did not significantly predict pain in any other anatomical site.

Discussion

This study was conducted with the aim of examining the prevalence rates of WRMSD-related pain and common static and dynamic strains associated with nursing in Croatian hospital/hospital center nurses and their association with occupational factors. The Occupational Safety and Health Agency has previously classified nursing as one of the 15 occupations with a high risk of developing WRMSD due to occupational hazards (14), where lifting heavy objects, prolonged standing and working in awkward/forced postures, repetitive movements of the trunk and upper extremities, as well as forceful movements of the upper extremities (22) contribute to musculoskeletal pain. Many studies have previously examined the

relationship between musculoskeletal pain/discomfort and occupational physical strains, but case differences in relation to WRMSDs and physical strains, differences in the recall period, and the predominant cross-sectional design of the studies made a comparing the given results and drawing definitive conclusions on the association of WRMSDs and occupational physical strains difficult.

In the present study, the prevalence of WRMSD-related pain and physical strains was shown to be very high. The general 12-month prevalence of musculoskeletal pain in our study was 97.4%, which is higher than previously reported. Previous research for the same recall period reported a prevalence of musculoskeletal pain ranging from 70.8% to 89.0% (16, 17). Similarly, higher prevalence rates were observed for all individual body regions as well: neck 84.48% vs 33.3%–62.7% (16, 23), upper back 74.13% vs 40.9%–45.79% (17, 24), shoulders 81.89% vs 22.0%–74.5% (5, 23), elbows 57.75% vs 5.5%–7.49% (12, 16), wrist/hand 71.55% vs 17.5%–29.7% (16, 24), low back 87.93% vs. 48.8%–72.4% (12, 5), hips 60.43% vs 8.9%–19.5% (11, 24), knees 65.51% vs 21.7%–52.1% (23, 24), ankle/foot 63.79% vs 14.9%–41.5% (16, 25), respectively. Both the high general and site-specific prevalence could indicate insufficient occupational safety measures aimed at preserving and promoting musculoskeletal health, but also a sampling bias where nurses with ongoing pain at the time of the study showed a greater inclination to participate in the study compared to those who did not experience pain. The latter may be probable, considering the self-administration of the questionnaire, which meant that not all the nurses participated in the study but only those who chose to do so (based on their will and motivation).

Low back pain is the most prevalent complaint, as consistent with previous research (18, 24–28). Previous research suggested that nursing tasks that require awkward/forced postures of the back while performing tasks and heavy physical exertion are the most common causes of back pain among nursing staff (29). Correlations of reported low back pain with awkward postures of the back and lifting patients in the present study did not meet

statistical significance but have significance regarding the reported general force needed to perform tasks. A positive correlation of low back pain with the general force needed to perform tasks at work suggests that heavy physical exertion may be associated with low back musculoskeletal pain and may be of concern regarding nursing tasks that require pushing and/or pulling (patients, machines etc.).

The general force needed to perform work-related tasks was also significantly correlated with the reported elbow and wrist/hand pain, without a significant correlation with lifting patients, suggesting that the aforementioned pushing and/or pulling affects the forearm and wrist as well, aligning with previous research that associates heavy physical exertion with elbow and wrist/hand pain (4). Furthermore, a strong association was found between self-reported applied manual force and wrist/hand pain, indicating that holding and gripping equipment and medical devices, as well as the fine movements and pinch gripping required in everyday nursing practice, may be considered as risk-increasing activities for wrist and/or hand pain and overuse injuries as previously reported by Thomsen et al. (29). Furthermore, an association of awkward postures of the wrist with reported wrist/hand pain was found as well, suggesting that typing, charting, preparing and administering medication as well as wound care, all common everyday nursing activities, may also pose a risk for wrist/hand pain and overuse injuries. Multivariate analysis showed that general and manual force along with awkward/forceful postures of the wrist/hand could explain 14.8% of the variance in wrist/hand pain, suggesting a multifactorial etiology of musculoskeletal pain. It should be noted that wrist/hand WRMSDs cause the longest absences from work, compared to WRMSDs in other sites (30). However, although associated with significant functional impairment in occupations such as nursing, where manual handling and fine movements are of essential importance, pain associated with wrist or hand WRMSDs rarely receives as much consideration as pain related to WRMSDs at

more common sites (e.g., low back, neck and shoulder). Therefore, a comprehensive risk assessment of manual nursing tasks should be performed, with preventive measures tailored accordingly.

Our study showed that age can play a role in the onset or aggravation of musculoskeletal pain. Pain reported in several anatomical sites, shoulders, elbows, knees and ankles/feet, was shown to be associated with age, further accentuating the multifactorial etiology of musculoskeletal pain. Both younger and older ages have previously been associated with musculoskeletal pain, depending on the anatomical site (4). However, in our study, the positive correlation observed suggests that older age is a possible contributing factor to reported pain, which is consistent with previous research showing a steady increase in the general prevalence of occupation-related musculoskeletal pain with age (31). Cardoso et al. hypothesized that the positive correlations observed between musculoskeletal pain and older age may be related to natural wear of the body and merely aggravated by the working conditions and working environment (32).

A similar explanation may be given for the observed association of years of employment and reported pain in the shoulder, elbow, knee and ankle/foot. WRMSDs usually develop over a prolonged period due to continuous exposure to occupational physical strains, where the accumulation of the effects of each occupational activity performed by workers results in the wear of the affected tissues (33). In our study, the nurses had been working for an average of 20 years at the time of the survey was conducted, which is concerning when taking into account the high general and site-specific prevalence of reported musculoskeletal pain and the number of remaining years of employment until retirement. A study conducted with Indonesian fishermen showed a 1.2 times greater risk of experiencing lower back pain in workers who had performed the same work for 20 years or more (34).

Our study has several limitations. The most important drawback has shown to be using self-reporting as a means to measure static

and dynamic strains, which seem to be overestimated and overreported, especially with regard to awkward/forced postures and repetitive movements. Previous research suggested that overestimation and overreporting of occupational strains as well as musculoskeletal pain could be associated with the pain status of participants at the time of filling out the questionnaire, as well as specific knowledge and beliefs about workplace hazards and strains (35). Therefore, although self-reporting is a reliable research method when it comes to pain, future research should consider measuring occupational physical strains using more objective methods. Second, the self-administration of the questionnaire potentially selected nurses experiencing pain at the time of the filling out of the questionnaire and/or nurses who had perceived high static and dynamic strains and could be especially motivated to participate in the study, making the prevalence of reported musculoskeletal pain, as well as static and dynamic strains higher. The aforementioned may be of even greater importance considering the relatively small sample size. Overreporting of physical strains as well as a small sample size further affected statistical analysis and correlation calculations, suggesting the need for caution in the interpretation of the results. On the other hand, the design of the cross-sectional study makes it impossible to draw conclusions about the causality between physical strains and reported pain related to WRMSDs.

Conclusion

Musculoskeletal pain is a complex multifactorial condition in which individual and occupational factors seem to play a role. However, the precise association and interaction of the aforementioned factors have yet to be determined by high-quality research. Considering that chronic musculoskeletal pain can greatly affect the quality of nurses' professional and private lives, causing work restrictions, absenteeism, and presentism, as well as their increasingly frequent desire to leave the nursing profession, it is of essential

importance to identify the individual and occupational factors that contribute to the development or aggravation of pain.

Declarations

Authors' contributions

All the authors have contributed equally to this work and have read and approved the final version of the manuscript.

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Competing interests

We declare no conflicts of interest.

Data sharing statement

Data available on request from the authors.

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