

THE ASSOCIATIONS OF WORK STYLE AND PHYSICAL EXERCISE WITH THE RISK OF WORK-RELATED MUSCULOSKELETAL DISORDERS IN NURSES

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Abstract

Objectives: This study aimed to investigate the prevalence of work-related musculoskeletal disorders (WMSD) in nurses, and to explore the association of work style and physical exercise with WMSD in this professional group. **Material and Methods:** In this study, a cross-sectional survey design was applied. A questionnaire survey was conducted on 692 nurses in 5 municipal hospitals, in the period August–October 2015. The survey included personal information, lifestyle, physical exercise and symptoms of WMSD. Chi² test and logistic regression were used to identify the risk factors of WMSD. **Results:** The prevalence of WMSD was 84% in all parts of the body in the previous year, with the highest prevalence in the neck (68.2%), followed by waist (67.6%) and shoulder (54.6%). Both univariate and multivariate analyses showed that physical exercise, night shifts and staying up late were associated with WMSD in nurses. The lack of exercise, night shifts and a tendency to stay up significantly increased the risk of WMSD ($p < 0.05$). **Conclusions:** The prevalence of musculoskeletal disorders among the municipal hospital nursing staff is high. An elevated risk of WMSD is observed in nurses who do not do exercises, work shifts and stay up late. *Int J Occup Med Environ Health.* 2019;32(1):15–24

Key words:

risk factors, nurses, physical exercise, work-related musculoskeletal disorders, work style, staying up

INTRODUCTION

A work-related musculoskeletal disorder (WMSD) is an injury of the muscles, tendons, ligaments, nerves, joints, cartilage, bones or blood vessels in the arms, legs, head, neck or back, which is caused or aggravated by work tasks

such as lifting, pushing and pulling. Its symptoms include pain, stiffness, swelling, numbness and tingling [1]. David's 5-year study of 12 426 participants representing 47 different occupations in 18 countries showed that occupational groups (such as civilian workers, food processors, nurses,

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operators, etc.) had a higher prevalence of WMSD, especially nurses [2]. The research in various countries and regions also showed that nursing staff had a high prevalence of WMSD, e.g., 70% in Estonia [3] and 85% in the Kingdom of Saudi Arabia [4].

A work-related musculoskeletal disorder not only brings great harm to people's health, but also causes serious absenteeism and economic losses. In addition, more than 3 million days of absence from work in 2010 could be attributed to lower limb pain in the European Union [5]. Official data from the U.S. suggest that WMSD represents 40% of the amount of compensation for work-related illnesses, with annual costs higher than USD 50 billion [6], and 19 360 days of absence from work ranked U.S. nurses second in all industries in 2015 [7].

Factors that are mainly related to WMSD in nursing staff include handling, lifting a patient, prolonged bad posture, etc. [8–10]. Nurses frequently have bad posture, including standing for a long time, remaining bent over, or bowing. Specific performance is required, such as bending for intramuscular or intravenous injections, making beds, helping patients go to and get out of their bed, turning over, or knocking back expectoration, and performing other basic procedures. In addition, nurses usually have a 3-shift work system, and those on night shifts have to stay up all night. This day and night shift work system greatly affects the health of nurses and their working conditions, contributing to the frequent occurrence of WMSD. Moreover, due to heavy workloads and family responsibilities, less time is left for nurses to do physical exercise. Previous studies have shown that age, gender, psychosocial factors, workload and the mode of operation are important risk factors in musculoskeletal disorders [11–13]. However, how physical exercise and work style affect WMSD in nurses is yet to be characterized. Therefore, the purpose of this study was to investigate the relationship between physical exercise, work style and musculoskeletal disorders in nurses.

MATERIAL AND METHODS

Study population

Convenience sampling of registered nurses from 5 municipal hospitals of Zhengzhou, Henan Province, China, was conducted in the period from August till October 2015. All the respondents were informed on the survey and their formal consent was obtained. The inclusion criteria included: age ≥ 18 years, the licensed practical nurses with work experience of > 12 months in a permanent position, and no obvious physical and mental illness. Of the 800 distributed questionnaires, 692 (86.5%) were collected and considered valid.

Data collection

A nominated survey coordinator at each hospital distributed the revised questionnaires, based on both the Nordic and the Dutch questionnaires, among nurses in August–October 2015.

Study instruments

Socio-demographic characteristics

The information in the questionnaire included:

- demographics, including gender and age,
- work-related factors, such as working department, physical exercise, work style, shift (day or night) work, and the frequency of night shifts.

Work-related musculoskeletal disorders

The following regions of the body were included in the survey: back, shoulder, neck, elbow, lower back, hand/wrist, hip, knee, and ankle/foot. The symptoms included in the questionnaire were as follows: tendon inflammations and related conditions (tenosynovitis, epicondylitis, bursitis), nerve compression disorders (carpal tunnel syndrome, sciatica) and osteoarthritis, as well as less standardized conditions such as myalgia, low back pain and other regional pain syndromes, not attributable to any known pathology [14]. Symptom presence was defined as having experienced work-related discomfort, numbness, pain or restricted

movement in any part of the body, and its duration for more than a day, along with failure to recover after rest. This was determined with yes/no responses to the Chinese version of the musculoskeletal questionnaire which was used to identify the symptoms occurring in the previous 12 months [15].

Data analysis

Data were recorded and analyzed using EpiData3.1 and SAS (9.4) software. The qualitative data were descriptively analyzed by calculating percentage rates or frequencies, and the quantitative data were presented as mean \pm standard deviation ($M \pm SD$). Chi² test and unconditional logistic regression analyses were used to analyze the association between the risk factors and WMSD. A *p* value < 0.05 was considered statistically significant.

RESULTS

The characteristics of the surveyed nurses are shown in Table 1. Out of 692 participants, 37 were men and 655 women. The average age of the participants was 28.9 ($SD = 5.6$ with the range of 18–53). The average length of their work experience was 7.6 years ($SD = 6.2$ years), with the range of 1–33 years.

The prevalence of WMSD

The prevalence of WMSD in working year 1 and in the previous 12 months was 89.6% and 84%, respectively. The most commonly affected regions were the neck, waist and shoulder, with the annual prevalence of 68.2%, 67.6% and 54.6%, respectively. The lowest prevalence was recorded for the elbow (17.3%) (Figure 1). In view of the prevalence rates, the authors decided to focus on the top 3 body regions with the high prevalence of WMSD in the analysis of risk factors.

The association between individual risk factors and WMSD in the neck, waist and shoulder

To investigate the association between individual risk factors and WMSD, the authors first performed univariate analyses,

Table 1. Characteristics of the participants in the questionnaire survey conducted among nurses in 5 municipal hospitals in China, in August–October 2015

Variable	Respondents (N = 692)	
	n	%
Age		
18–24	142	20.5
25–29	288	41.6
30–34	171	24.7
≥ 35	91	13.2
Gender		
male	37	5.3
female	655	94.7
Length of service		
1–5 years	327	47.3
6–10 years	191	27.6
≥ 11 years	174	25.1
Department		
emergency	69	10.0
surgical	157	22.7
pediatric	35	5.1
obstetrics and gynecology	86	12.4
internal medicine	184	26.6
other	161	23.3

the results of which are shown in Table 2. Physical exercise, night shifts and staying up were significantly associated with both neck and waist pain ($p < 0.05$). The working department, night shifts and staying up were associated with shoulder pain ($p < 0.05$). The prevalence of WMSD of the neck in nurses who exercised 1–2 times/week (30–60 min/time) was lower. The prevalence of WMSD of the waist in nurses who exercised 3–4 times/week was also lower. The prevalence of WMSD in nurses with irregular work styles was the highest, rising with regular shift work and staying up. The prevalence of WMSD of the shoulder in nurses employed in pediatric departments was the highest (Table 2).

Table 3 shows the multivariate analysis results, in which such factors as the working department, physical exercise, night shifts and staying up were included in an un-

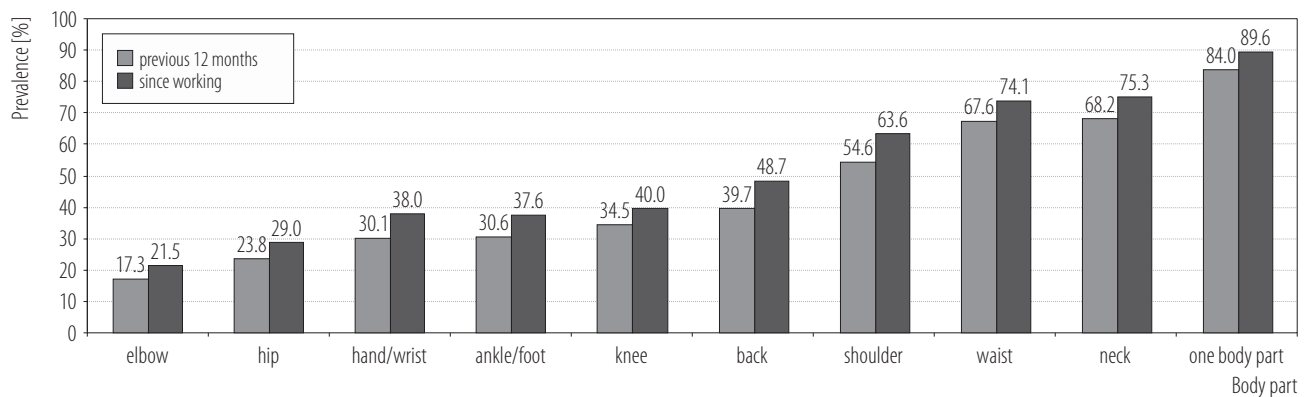


Figure 1. The prevalence of work-related musculoskeletal disorders (WMSDs) in various parts of the body, based on the questionnaires survey conducted among nurses in 5 municipal hospitals in China, in August–October 2015

conditional logistical model. The results showed that the surgical and internal medicine departments, the lack of exercise, always working night shifts and staying up significantly increased the risk of WMSD.

Neck pain had statistically significant associations with the following responses: surgical department (OR = 2.14, 95% CI: 1.08–4.24), internal medicine department (OR = 2.34, 95% CI: 1.29–4.27), seldom exercise (OR = 2.53, 95% CI: 1.41–4.54), seldom staying up (OR = 4.14, 95% CI: 1.57–10.97), and sometimes staying up (OR = 2.84, 95% CI: 1.18–6.82), respectively.

Waist pain had statistically significant associations with the following responses: surgical department (OR = 2.32, 95% CI: 1.20–4.48), exercise 1–2 times/week (OR = 2.84, 95% CI: 1.44–5.60), seldom exercise (OR=1.96, 95% CI: 1.08–3.54), never exercise (OR = 1.60, 95% CI: 1.10–2.35), seldom staying up (OR = 3.67, 95% CI: 1.41–9.56), and sometimes staying up (OR = 2.45, 95% CI: 1.04–5.81), respectively. Shoulder pain had statistical significant associations with the following responses: obstetrics and gynecology department (OR = 0.40, 95% CI: 0.17–0.94), internal medicine department (OR = 1.99, 95% CI: 1.13–3.51), seldom exercise (OR = 2.07, 95% CI: 1.17–3.68), never exercise (OR = 1.44, 95% CI: 1.01–2.05), always night shift (OR = 1.76, 95% CI: 1.01–3.06), and seldom staying up (OR = 2.55, 95% CI: 1.01–6.45), respectively.

DISCUSSION

Nurses are susceptible to cumulative work-related musculoskeletal disorders. This study showed that the general prevalence of WMSD among nurses in the previous 12 months was 82.1%, which was similar to the prevalence of 82.38% reported by Tang et al. [16], whereas it was lower than that of 91.4% reported in a previous study [17], and higher than that of 70% reported for Estonia [3]. The differences in the prevalence of WMSD between various countries and regions may be due to different the commencement of work conditions. In China, the population is much larger compared to other countries. The increasing health requirements, particularly with the development of the economy, and the relative shortage of nursing staff lead to heavier workloads for nurses. The Ministry of Health recommends a general nurse-patient ratio of 1:8 [18], which is much higher than the ratios of 1:5 in California and 1:4 in Australia [19,20]. However, the authors could not rule out the possibility that the difference in the incidence of WMSD was due to the lack of uniform diagnostic criteria and clinical examinations about WMSD [21].

The circadian clock plays an important role for human health [22]. Its disruption is associated with lots of adverse health effects [23]. The night-shift system of hospital work leads to interrupting the nurses' circadian clock, thereby affecting their sleep, diet, family life, social activities and so on, and altering the endocrine system. These changes

Table 2. Univariate analysis of the risk factors of work-related musculoskeletal disorders (WMSD) of the neck, waist and shoulder, based on the questionnaire survey conducted among nurses in 5 municipal hospitals in China, in August–October 2015

Variable	Anatomical region of WMSD															
	Participants			neck			waist			shoulder						
	n	n	%	n	%	χ^2	p	n	%	χ^2	p	n	%	χ^2	p	
Age																
18–24	142	92	64.8	87	61.3	4.35	> 0.05	87	61.3	4.31	> 0.05	74	52.1	0.56	> 0.05	
25–29	288	209	72.6	205	71.2			205	71.2			161	55.9			
30–34	171	112	65.5	115	67.3			115	67.3			93	54.4			
≥ 35	91	59	64.8	61	67.0			61	67.0			50	54.9			
Length of service																
1–5 years	327	224	68.5	219	67.0	0.58	> 0.05	219	67.0	0.06	> 0.05	173	52.9	0.11	> 0.05	
6–10 years	191	136	71.2	136	71.2			136	71.2			112	58.6			
≥ 11 years	174	112	64.4	113	64.9			113	64.9			93	53.4			
Gender																
male	37	24	64.9	24	64.9	0.2	> 0.05	24	64.9	0.14	> 0.05	19	51.4	0.17	> 0.05	
female	655	488	68.4	444	67.8			444	67.8			359	54.8			
Department																
emergency	69	47	68.1	42	60.9	4.66	> 0.05	42	60.9	6.26	> 0.05	35	50.7	14.5	< 0.05	
surgical	157	103	65.6	103	65.6			103	65.6			78	49.7			
pediatric	35	26	74.3	23	65.7			23	65.7			26	74.3			
obstetrics and gynecology	86	52	60.5	55	64.0			55	64.0			39	45.3			
internal medicine	184	132	71.7	137	74.5			137	74.5			114	62.0			
other	161	112	69.6	108	67.1			108	67.1			86	53.4			
Exercise																
≥ 5 times/week	21	13	61.9	14	66.7	8.32	< 0.01	14	66.7	10.92	0.001	12	57.1	3.54	> 0.05	
3–4 times/week	43	26	60.5	22	51.2			22	51.2			22	51.2			
1–2 times/week	64	34	53.1	39	60.9			39	60.9			28	43.8			
seldom	290	197	67.9	186	64.1			186	64.1			150	51.7			
never	274	202	73.7	207	75.5			207	75.5			166	60.6			

Table 2. Univariate analysis of the risk factors of work-related musculoskeletal disorders (WMSD) of the neck, waist and shoulder, based on the questionnaire survey conducted among nurses in 5 municipal hospitals in China, in August–October 2015 – cont.

Variable	Anatomical region of WMSD												
	Participants			neck			waist			shoulder			
	n	n	%	n	%	χ^2	n	%	χ^2	n	%	χ^2	p
Night shift													
never	182	106	58.2	106	58.2	18.22	106	58.2	11.13	86	47.3	8.18	< 0.01
seldom	86	54	62.8	58	67.4		58	67.4		46	53.5		
sometimes	109	75	68.8	75	68.8		75	68.8		60	55.0		
frequently	168	121	72.0	118	70.2		118	70.2		91	54.2		
always	147	116	78.9	111	75.5		111	75.5		95	64.6		
Stay up													
never	52	25	48.1	25	48.1	25.26	25	48.1	20.65	16	30.8	12.99	< 0.001
seldom	104	59	56.7	61	58.7		61	58.7		48	46.2		
sometimes	185	126	68.1	121	65.4		121	65.4		109	58.9		
frequently	233	166	71.2	170	73.0		170	73.0		133	57.1		
always	118	96	81.4	91	77.1		91	77.1		72	61.0		

Table 3. Logistic regression analysis of the risk factors of work-related musculoskeletal disorders (WMSD) of the neck, waist and shoulder, based on the questionnaire survey conducted among nurses in 5 municipal hospitals in China, in August–October 2015

Variable	Anatomical region of WMSD					
	neck		waist		shoulder	
	OR	95% CI	OR	95% CI	OR	95% CI
Department						
emergency	1.00		1.00		1.00	
surgical	2.14	1.08–4.24*	2.32	1.20–4.48*	1.69	0.90–3.16
pediatric	1.58	0.95–2.61	1.41	0.86–2.32	1.46	0.92–2.33
obstetrics and gynecology	0.83	0.35–1.97	1.11	0.49–2.50	0.40	0.17–0.94*
internal medicine	2.34	1.29–4.27**	1.73	0.95–3.13	1.99	1.13–3.51*
other	1.54	0.92–2.59	1.11	0.66–1.85	1.01	0.63–1.62
Exercise						
≥ 5 times/week	1.00		1.00		1.00	
3–4 times/week	1.28	0.50–3.33	1.16	0.44–3.09	0.94	0.37–2.39
1–2 times/week	1.75	0.87–3.49	2.84	1.44–5.60**	1.54	0.78–3.02
seldom	2.53	1.41–4.54**	1.96	1.08–3.54*	2.07	1.17–3.68*
never	1.25	0.86–1.84	1.60	1.10–2.35*	1.44	1.01–2.05*
Night shift						
never	1.00		1.00		1.00	
seldom	1.68	0.79–3.54	1.26	0.60–2.65	1.86	0.93–3.71
sometimes	1.23	0.55–2.77	0.80	0.35–1.82	1.49	0.70–3.18
frequently	1.32	0.62–2.81	1.01	0.47–2.14	1.94	0.97–3.86
always	1.14	0.62–2.13	1.14	0.62–2.09	1.76	1.01–3.06*
Stay up						
never	1.00		1.00		1.00	
seldom	4.14	1.57–10.97**	3.67	1.41–9.56**	2.55	1.01–6.45*
sometimes	2.84	1.18–6.82*	2.45	1.04–5.81*	1.27	0.57–2.81
frequently	1.70	0.78–3.72	1.80	0.84–3.85	0.67	0.34–1.35
always	1.56	0.81–3.02	1.14	0.61–2.16	0.77	0.43–1.36

** $p < 0.01$, * $p < 0.05$.

have been shown in association with WMSD in nursing staff [24,25]. At the same time, the lack of sleep during night shifts leads to an increased incidence of WMSD [26]. Staying up causes a variety of damages to the body, entailing a series of symptoms such as fatigue, lack of energy and an impaired immune system. Further symptoms of involuntary neurosis, such as cold, gastrointestinal infections and allergies, are also likely to occur. Staying up late

for prolonged periods induces insomnia, forgetfulness, irritability, anxiety, and other nervous and mental symptoms. This study shows that the prevalence of WMSD in nurses with irregular working styles, regular night-shifts or a tendency to stay up was the highest. Compared to nurses who neither worked at night nor stayed up, the risk of WMSD for those who stayed up and worked night shifts was significantly higher.

Physical exercise can improve the body's sensitivity and coordination of muscles, and the response speed and effective action of human brain. It can also effectively delay the age-related decline in muscle strength. Proper physical exercise can effectively reduce the prevalence of low back pain (LBP) in handling workers and acts as a protective factor for LBP [27]. This study shows that the prevalence of WMSD is lower in nurses who regularly do physical exercise than in those who lack exercise.

The nurse-patient and doctor-nurse ratios in various departments may result in differences in their workloads. This discrepancy may explain the difference in the prevalence of musculoskeletal disorders in nurses employed in different departments. The results of this study show that the prevalence of WMSD of the shoulder in pediatric nurses was the highest. Since the number of pediatric nurses is usually much lower while pediatric patients are difficult to communicate with and manage, pediatric nurses spend more time and efforts, and hence the increased risk of WMSD.

This study did not find a correlation between WMSD and age, and only the prevalence of WMSD of the waist in the nursing staff with work experience of 6–15 years was the highest. This is consistent with the findings by Cheng [17], but not with the results of other studies [28,29]. This inconsistency might have resulted from different age structures of nurses employed in these studies.

Study limitations

The measurement and symptoms of WMSD were self-reported and might therefore, exhibit self-report bias. The participants may have underestimated or overestimated their levels of WMSD.

CONCLUSIONS

This study shows a high prevalence of WMSD in nurses, with the highest prevalence of neck pain, followed by waist and shoulder pain, whereas the prevalence of cervical pain

is the lowest. The authors also found that the lack of exercise, regular night shifts and staying up significantly increased the risk of WMSD. Relevant policies and measures are urgently needed to reduce the impact of WMSD on nurses, for example, reducing the frequency of night shifts, enhancing the program of regular exercises or relaxation practice during breaks, and educating nurses on how to do exercise in a limited area and at short intervals. Future studies should focus on how to reduce the need to stay up and improve exercise programs to effectively reduce the prevalence of musculoskeletal disorders in nurses.

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