

## Work-Related Musculoskeletal Disorders among Nursing Staff of Tanta University Hospitals: Pattern, Risk Factors, and Coping Strategies

<sup>1</sup>Hanaa A. Zayed, <sup>2</sup>Shimaa M. Saied, <sup>1</sup>Rania M. El-sallamy, and <sup>2</sup>Walaa M. Shehata

<sup>1</sup>Department of Occupational Medicine, <sup>2</sup>Department of Public Health and Community Medicine, Tanta University, Egypt

Received: August, 2018 Accepted: October, 2018

### Abstract

**Background:** Work-related musculoskeletal disorders (WMSDs) represent a considerable occupational problem amongst nurses. **Objectives:** To determine the pattern, the associated job risk factors for the development of WMSDs and to identify the coping strategies for reducing the risk of WMSDs among Tanta University Hospitals` nursing staff. **Method:** A cross-sectional survey was conducted among the nurses at Tanta University Hospitals using a stratified random sampling method via a self-administered structured questionnaire. **Results:** Most of the studied nurses (92.3%) had WRMSDs in the past 12 months. The most frequently reported complaint was low back pain (56.6%), followed by neck pain in 51.5% and knee pain in 50.4% of them. The most frequently reported job risk factors were working in the same positions for long periods (90.8%), continuing to work while injured or hurt (90.7%), and bending or twisting your back in an awkward way (85.2%). Getting help in handling heavy patients (91.0%), modifying patient`s/nurse position (79.6%), and inadequate formal training on injury prevention (80.6%) were the top three coping strategies. **Conclusion:** Most of Tanta University Hospitals` nurses reported WMSDs at different body sites, where the low back being harmed most frequently. Training programmes on injury prevention are recommended to lower the rate of WMSDs and to encourage efficiency in patient care.

**Keywords:** *work-related musculoskeletal disorders (WMSDs), Nurses, Tanta, coping strategies, risk factors.*

**Correspondence to:** Rania M. El-sallamy Email: [rania.elsalamy@gmail.com](mailto:rania.elsalamy@gmail.com)

### Introduction

Work-related musculoskeletal disorders (WMSDs) are described as discomforts experienced by the worker on the musculoskeletal and neurovascular systems that are caused and get worse by the effect of work conditions.<sup>1,2</sup>

Epidemiological studies have demonstrated that WMSDs is a main occupational health problem among the nursing population that constitutes about 33% of the hospital workforce. The prevalence of MSDs always varies between 33.0% and 88.0% among nurses

all over the world. The frequency of disorders was found to be 84.0% and 76.2% in studies performed on nurses in Estonia and Taiwan respectively. In Turkey, the frequency of MSDs among nurses was 79.5%.<sup>3,4</sup> In studies performed in Egypt among hospital nurses in Mansoura and in Ismailia was 85.9% and 83.7% respectively.<sup>2,3</sup>

MSDs is a major cause of absenteeism, work restrictions, or even the need to change jobs, disability affecting performance at work, general well-being

and quality of life. It was estimated that 3.5% of nurses are leaving their profession due to back pain.<sup>1,5</sup>

According to the Bureau of Labour Statistics, nurses are in the 10 major occupations that have a high risk of work-related musculoskeletal disease<sup>(6)</sup>. The associated risk factors include Job risk factors, poor environmental conditions, and individual risk factors. Job risk factors as static posture (e.g. prolonged standing with trunk and neck flexion), repetitive movement, standing for long hours, bending positions as in (dress changing, injection postures, ...). Exhausting circumstances in their daily work environment, and physical force needed to perform certain tasks as, lifting patients, transferring patients out of bed, from the floor, and handling of patients after surgeries, these work tasks put nurses at high risk for acute, chronic and cumulative WMSDs.<sup>1</sup> One of the most common musculoskeletal complain among nurses is low back pain followed pain in (neck, shoulder/arm, wrist/hand, knees and ankles/feet).<sup>7</sup>

Further, personal risk factors as, reduced cardiovascular fitness, aging, poor back muscle endurance, physical inactivity, obesity; psychosocial stressors also play important roles and may aggravate the condition.<sup>5</sup>

To prevent (WMSDs) in hospital settings, it is necessary to conduct detailed job risk assessment first, to detect all risk factors, then design and implement a suitable intervention program that addresses all issues that may cause (WMSDs).<sup>8</sup> In addition, ergonomics awareness and application of ergonomics principals in work can achieve a balance between task demands and worker characteristics.<sup>9,10</sup> The National Institute for Occupational Safety and Health (NIOSH) has published documents and guidelines to prevent and reduce WRMSDs problems that must be

followed.<sup>4</sup> Prevention and early detection of WRMSDs can improve the working conditions and nurses` job satisfaction; and hence improvement of their performance for better patient care. This study aimed to estimate the prevalence and pattern of WRMSDs and its risk factors and coping strategies among nurses working in Tanta University Hospitals.

## Method

*Study design and setting:* The study was a cross-sectional one, conducted from January to June 2018 among the nurses who are active in service at Tanta University Hospitals; which incorporates seven hospitals; the main hospital, internal medicine hospital, ophthalmology hospital, pediatrics hospital, emergency hospital, students` hospital, and educational hospital. These hospitals receive different medical and surgical cases, injuries and road traffic accidents in Gharbia Governorate and nearby governorates of Delta region. The capacity of the hospitals includes 1967 beds, 1481 physicians, 4680 nurses and head nurses, and 400 services workers. The total number of patients in 2017 was 70,097 inpatients and 584,940 outpatients.

*Sample size and sampling technique:* The sample was calculated using Epi Info™ software created by WHO and CDC, Atlanta, Georgia, USA version 7.2.2.6. The estimated prevalence of WRMSDs among nurses was 75% with a margin of error of 2.5 and 95% confidence limit. The sample size was estimated as 925 and was increased to 1000 for better accuracy. The required sample was obtained via one stage stratified random sampling technique. The hospitals` departments were divided into two strata; a medical stratum and a surgical one, departments were randomly selected from each stratum, and then samples were proportionally allocated across the selected departments. *Inclusion criteria:* All nurses

who were in charge during the period of the study. **Exclusion criteria:** Nurses with work duration less than one year in the selected departments, and those who refused to participate in the study.

**Data collection methods and tools:**

A self-administered questionnaire was utilized as a data collection tool. It included four sections. Section (A): included the personal and socio-demographic data and occupational characteristics such as age, height, weight, duration of work, and work settings. The WHO international classification of adult underweight, overweight and obesity according to BMI was adopted, where: underweight <18.50, normal weight 18.50 - 24.99, overweight  $\geq 25.00$ , and obese  $\geq 30.00$ .<sup>11</sup>

Section (B): to detect the prevalence of WMSDs among the studied nurses in the last 12 months, it was a symptom survey tool prepared from Musculoskeletal Discomfort Form (Based on the Nordic Questionnaire).<sup>12</sup> It shows a body chart of nine anatomic areas which are the neck, upper back, lower back shoulders, elbows, wrists/hands, hips/thighs, knees, and ankles/feet and enquire about the existence of any troubles (pain and discomfort) during the last 12 months prior to the study. Section (C): included data related to job risk factors that might be a factor in the development of WMSDs, and Section (D): incorporated gathered data on coping strategies concerning lessening the risk of its development. The questionnaire validation and reliability testing were done and Cronbach's was 0.81. A total of 1000 questionnaires were distributed and 923 were completed and returned, giving 92.3% response rate. We excluded seventeen questionnaires due to incompleteness.

**Statistical analysis:**

The collected data were entered into Microsoft Excel spreadsheets, data

cleaning, and analysis was carried out via SPSS 25.0 software (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY). The level of significance was considered at p-value <0:05. For quantitative variables, data were expressed as means and standard deviations, and for qualitative ones, frequency and percentage were used. The comparison was done using the chi-square test and when it was not appropriate, the Monte Carlo exact test was used instead. Binary logistic regression analysis was done to detect the independent predictors of WRMSDs. Adjusted odd's ratios and their 95% CI were calculated.

**Ethical consideration:**

The study was approved by Tanta Faculty of Medicine Research Ethics Committee (REC). Informed consent was obtained for participation in the research after the explanation of its aim and clarification that the data will be used for scientific research only. Confidentiality of personal information was guaranteed and the questionnaires were filled anonymously.

**Results**

Our study included 906 participants, 880 of them (97.1%) were females and 26 (2.9%) were males, with a mean age as  $34.88 \pm 10.25$  years. The majority of them (84.2%) were graduated from nursing school, their means of work experience, daily working hours, and BMI were  $14.02 \pm 10.62$  years,  $7.27 \pm 1.45$  hours, and  $29.79 \pm 5.5\%$ , respectively. Most of them were married (87%).

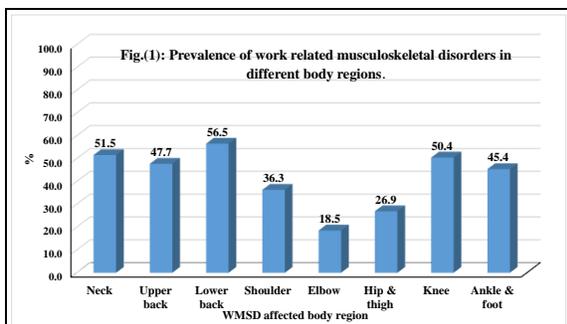
On analysis, we found the last 12- months` prevalence of work-related musculoskeletal pain or discomfort as 92.73%, and most of the oldest age (97.6%) group had WRMSDs with a statically significant difference. The highest percentage (37.9%) of nurses who had WRMSDs were working at the emergency hospital. Nearly half of them

**Table (1): Socio-demographic and occupational characteristics of the studied nurses in relation to their WRMSDs status**

Socio-demographic & Occupational characters	Having WRMSDs (n=836)		Not having WRMSDs (n=70)		$\chi^2$ p
	No.	%	No.	%	
<b>Age (Years)</b>					
19–	346	88.7	44	11.3	13.17 0.004*
30–	213	94.7	12	5.3	
40–	195	94.2	12	5.8	
50–59	82	97.6	2	2.4	
<b>Marital status</b>					
Unmarried <sup>a</sup>	109	84.5	20	15.5	12.76
Married	727	93.6	50	6.4	0.000*
<b>Education</b>					
Bachelor degree	183	92.9	14	7.1	2.72 0.436
Health technical Institute	25	86.2	4	13.8	
Nursing school	617	92.5	50	7.5	
Post graduate	11	84.6	2	15.4	
<b>Duration of work (Years)</b>					
1–10ys	393	88.9	49	11.1	13.97 0.003*
11–20ys	155	95.1	8	4.9	
21–30ys	221	95.3	11	4.7	
31–40ys	67	97.1	2	2.9	
<b>Department of work</b>					
Medical	302	91.5	28	8.5	0.494 0.781
Surgical	217	92.3	18	7.7	
Emergency	317	93.0	24	7.0	
<b>Work shifts</b>					
One shift	121	14.5	9	12.9	3.19 0.363
Two shifts	260	31.1	29	41.4	
Three shifts	414	49.5	29	41.4	
Night shift only	41	4.9	3	4.3	
<b>Daily working hours</b>					
≤ 8 Hrs	490	58.6	34	48.6	2.68
> 8 to ≤12 Hrs	195	23.3	20	28.6	0.262
> 12 Hrs	151	18.1	16	22.9	
<b>Having Extra (side) work</b>					
Yes	81	9.7	8	11.4	0.222
No	755	90.3	62	88.6	0.639
<b>Practicing physical exercises regularly</b>					
Yes	138	16.5	15	21.4	1.11
No	698	83.5	55	78.6	0.291
<b>BMI</b>					
Underweight	8	1.0	0	0.0	MCET# 0.009
Normal	153	18.3	24	34.3	
Overweight	293	35.0	28	40.0	
Obese	382	45.7	18	27.5	

#MCET = Monte Carlo exact test \*Statistically significant

<sup>a</sup> Unmarried=Single, divorced & widowed



(48.6%) had three-shift work schedule, more than half (54.4%) were working for more than 8 hours per day. Most of our participants who had experienced work-related musculoskeletal pain or discomfort were overweight and obese (82.2%) with a significant difference between them and those who did not have work-related musculoskeletal complaints (p=0.003) (Table 1).

As shown in the figure 1, prevalence rates of Work-related musculoskeletal pain or discomfort was highest in the low back (56.5%), followed by the neck (51.5%), knee (50.4%), upper back (47.7%), ankle and feet (45.4%), shoulder (36.3%), hip and thigh (26.9%) and the lowest percentage was for elbow region (18.5%).

Regarding job risk factors, nurses suffering from WRMSDs have reported that working in the same positions for long periods (90.8%), continuing to work while injured or hurt (90.7%), bending or twisting their back in an awkward way (85.2%), treating an excessive number of patients in one day (84.7%), inadequate formal training on injury prevention (80.6%), performing the same task over and over (80.3%), working with confused or agitated patients (69.7%), no enough rest breaks or pauses during the workday (66.1%), work scheduling problems (65%), lifting or transferring dependent patients (61.7%), and carrying, lifting or moving heavy material or equipment (43.5%) were the most perceived job risk factors precipitating WRMSDs during their hospital duties (Table 2).

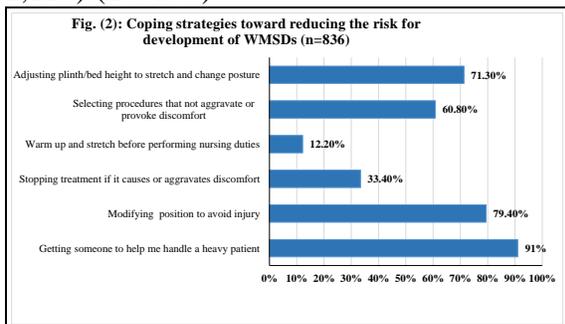
**Table (2): Self-reported job risk factor percentage among the studied nurses**

Risk factors (n=836)	No.	%
1. Working in the same positions for long periods (Standing, bend over, sitting, kneeling)	759	90.8
2. Bending or twisting your back in an awkward way	712	85.2
3. Lifting or transferring dependent patients	516	61.7
4. Treating an excessive number of patients in one day	708	84.7
5. Working with confused or agitated patients	583	69.7
6. Performing the same task over and over	671	80.3
7. Carrying, lifting, or moving heavy materials or equipment	364	43.5
8. Not enough rest breaks or pauses during the workday	553	66.1
9. Work scheduling (overtime, irregular shifts, length of the workday)	543	65.0
10. Continuing to work while injured or hurt	758	90.7
11. Inadequate formal training on injury prevention	674	80.6

Concerning coping strategies, priority was given to getting help to handle heavy patients (91%), nursing procedure modification in order to avoid stress injury (79.4%), adjustment of plinths and/or bed heights (71.3%), and selection of techniques and/or procedures that will not aggravate or provoke their discomfort (60.8%) as strategies for reducing the risk of development of WRMSDs. Less commonly used strategies were stopping treatment if it causes or aggravate their discomfort (33.4%) and warming up and stretching before performing their nursing duties (12.2%) (Figure 2).

Binary logistic regression analysis showed that the significant independent predictors

of WRMSDs among nurses were: Bending or twisting the back in an awkward way (OR: 0.448, CI: 0.241 - 0.833), lifting or transferring dependent patients (OR: 0.561, CI: 0.322 - 0.978), and duration of work in years (OR: 1.54, CI: 1,107 - 2,129) (Table 3).



Among our complaining respondents, nearly half (52.5%) received treatment, in the form of conservative medical treatment either via self-medication (40.54%) or prescribed by a specialist (50.8%), and 8.66% of them underwent surgical intervention. The majority of complaining nurses (79.8%) were generally satisfied (very satisfied and satisfied) with their job, and their injury did not hinder them from working (Table 4).

**Discussion:**

Amongst all healthcare workers, nurses show the peak prevalence of work-related musculoskeletal disorders.<sup>13</sup> These disorders are multifactorial as many of the work-related risk factors are implicated in their promotion and progression.<sup>10,14</sup> They considerably disturb the quality of life, lead to increased absenteeism and may cause disability that may oblige move to another job.<sup>15</sup> The results of the present study showed a high prevalence (92.73%) of work-related musculoskeletal disorders among the nurses working in Tanta University Hospitals, which strongly agree with results of Smith et al. 2003, a study done in rural Japan that reported a 12-months prevalence of WRMSDs as 91.9%.<sup>16</sup> Both

results showed slightly higher prevalence rates than that reported by Ribeiro et al., 2017, Elsherbeny et al., 2018, Tinubu et al., 2010, and Amer, 2018 (89.0%, 85.9%, 84.4%, and 83.7% respectively).<sup>2,3,15,17</sup>

On the other hand, a study was done by Nkhata et al., 2015 in Zambia found a prevalence of 68.9%, which was much lower than our results. These differences in the prevalence may be due to the inclusion of emergency hospital nurses in our study who face too much occupational risk factors related to their stressful heavy work that make them at higher risk to develop WRMSDs than nurses working in other departments.<sup>18</sup>

Regarding age, we found that the prevalence of WRMSDs complaints was statistically higher in the younger age groups especially those aged from 19 years old to less than 30 years old (41.4%) (346 out of 836), and the prevalence decrease with increasing age to be the lowest at those nurses aged from 50 to 59 years old (9.8%) (82 out of 836). This can be explained by the fact that the heavier manual tasks may be more referred to younger nurses. Our results were in accordance with Elsherbeny et al. 2018 results who found that the nurses aged from 20 to 29 years showed higher prevalence of WRMSDs (91.2%) than older age groups and, also with Attarchi et al., 2014 who found that the prevalence was higher among those aged less than 30 years than more than 30 years.<sup>2,19</sup> This was in contrast to results of Ribeiro et al., 2017 who found that the higher prevalence was in the age group between 31 and 40 years (35.7%) and from 41 to 50 years (35.9%).<sup>17</sup> This difference may be attributed to variation in nursing tasks and procedures in different countries.

The present study found that the higher percentage of nurses experiencing WRMSDs were graduated from nursing school (73.8%), while 21.9% of them were

**Table (3): Logistic regression of factors affecting the presence of WRMSDs among the studied nurses**

Factors	Coefficient	OR	95% CI	P
Working in the same positions for long periods	-0.49825	0.6076	0.2837 -, 13,015	0.1999
Bending or twisting in an awkward way	-0.80310	0.4479	0.2409 - 0.8331	0.0112*
Lifting or transferring dependent patients	-0.57798	0.5610	0.3220 - 0.9775	0.0413*
Treating an excessive number of patients/day	0.20044	12,219	0.5832 -, 25,603	0.5953
Working with confused or agitated patients	-0.48889	0.6133	0.3482 -, 10,802	0.0905
Performing the same task over and over	0.21226	12,365	0.6065 -, 25,208	0.5592
Carrying, lifting, or moving heavy materials	0.071738	10,744	0.6134 -, 18,817	0.8019
Not enough rest breaks or pauses during the day	0.22463	12,519	0.7086 -, 22,115	0.4391
Work scheduling	-0.085904	0.9177	0.5324 -, 15,817	0.7571
Continuing - work while injured or hurt	-0.20463	0.8149	0.3575 -, 18,579	0.6265
Inadequate formal training on injury prevention	0.078106	10,812	0.5349 -, 21,854	0.8278
BMI	0.28120	13,247	0.9969 -, 17,603	0.0525
Department	0.013310	10,134	0.7450 -, 13,784	0.9324
Daily working hours	-0.26544	0.7669	0.5346 -, 11,001	0.1494
Work shifts	0.23414	12,638	0.8878 -, 17,992	0.1938
Duration of work (Years)	0.42872	15,353	11,074 -, 21,285	0.0101*

OR: Odds Ratio, \* Statistically significant

with a bachelor degree and only 1.3% received post-graduate education. Elsherbeny et al., 2018 and Alexopoulos et al. 2006 agreed with our results as they also found that nurses with lower educational levels experienced WRMSDs symptoms more than those with higher educational levels. This may be explained as tasks which require high physical load are usually done by lower educated nurses and by less awareness regarding ergonomics principals and correct procedures on doing work tasks.<sup>2,20</sup>

In our study, we found that nurses with the least years of experience showed the higher prevalence of WRMSDs (47.0%) while those with 31-40 years of experience showed the least prevalence (8.0%) with statistically significant association, while Tinubu et al., 2010 found no significant association between years of experience and WRMSDs prevalence.<sup>15</sup>

Our results are not similar to Attarchi et al. 2014 ones, which showed that nurses with higher work experiences were more

affected by WRMSDs especially low back disorders.<sup>19</sup>

Our results revealed that nearly half of nurses with WRMSDs symptoms (48.6%) worked three shifts but only 14.8% of them worked only one shift. This is in accordance with Yasobant and Rajkumar, 2014 and with Shafiezadeh et al., 2011 who found that nurses who worked three shifts show a greater chance of developing WRMSDs when compared to those working for a single shift. This finding can be explained that increasing working hours are usually associated with an increased physical load on nurses.<sup>21,22</sup>

Concerning body weight, our study revealed that 82.2% of the complaining nurses were overweight and obese with a statistically significant association between body weight and complaining from WRMSDs' symptoms. Yasobant and Rajkumar (2014) in their study in India and Mohsen et al., 2017 in Egypt agreed with our findings.<sup>22,23</sup> This may be explained by the presence of an extra load

on the different body parts and joints due to overweight and obesity, which may lead to earlier development or aggravation of WRMSDs.

**Table (4): Effect of WMSD on nurses` occupational life**

Effects (n=836)	No.	%
<b>Had you received treatment for your injury?</b>		
• No, I didn't receive any treatment	397	47.5
• Yes, I did	439	52.5
<b>Type of treatment received:</b>		
Self-medication	322	38.5
Prescribed by specialist	352	42.1
Surgical intervention	49	5.9
<b>Degree of job satisfaction after injury</b>		
Very satisfied	241	28.8
Satisfied	426	51.0
Not satisfied	169	20.2
<b>Did your injury hinder you from working?</b>		
Yes	169	20.2
No	667	79.8

As regards the site of Work-related musculoskeletal pain or discomfort, the present research showed that the low back was the most affected site (56.5%), followed by the neck (51.5) and the least affected site was the elbow region (18.5%). Amer, 2018 agreed with our findings as he reported that the low back is the most prevalent site as it was affected in 79.3% of nurses, followed by the neck while the least affected site was the ankle and the elbow (8.6% for each).<sup>3</sup>

This was in accordance with Tinubu et al., 2010 and Sorour and Abd El-Maksoud, 2012 studies which reported that low back was the most affected site, followed by the neck<sup>14,24</sup> and with Abo El Ata et al., 2016 results which found that the low back was affected in more than three quarters of their patients but followed by knee.<sup>13</sup>

Moreover, Anap et al., 2013 study results in India are similar to ours as they found that the most affected site was the low back (48.2%) and followed by the shoulder (34.6%) while elbow and hip were the least affected sites (1.88% and 1.6% respectively).<sup>1</sup>

In contrast with all these results, the low back was found the least site in studies done by Elsherbeny et al., 2018, Smith et al., 2003 and Niedhammer et al., 1994. These differences may be attributed to the different tasks, procedures, and activities done by nurses in the hospitals included in these studies.<sup>2,25</sup>

Regarding the WRMSDs risk factors, the present research reported that the most prevalent risk factor is working in the same positions for long periods (90.8%) followed by continuing to work while injured or hurt (90.7%). Studies were done by Gopal et al., 2012 and Tinubu et al., 2010 reported similar results as they also found that working in the same positions for long periods was the most perceived job risk factors (87.3% and 55.1% respectively).<sup>14,26</sup> On the other hand, the most prevalent risk factor was working in awkward or cramped position (63.9%) as reported by Yasobant et al. (2014)<sup>22</sup> and was managing large numbers of patients in one day as recorded by Mohsen et al., 2017 (63%)<sup>23</sup>, while it was lifting or transferring dependent patients (52.4%) as recorded by Anap et al. (2013) in their study.<sup>1</sup>

The least prevalent risk factor was carrying, lifting or moving heavy material or equipment (43.5%) according to the current research, while it was working with confused or agitated patients (10%) as reported by Anap et al. (2013)<sup>1</sup> and was assisting patients during gait activities (12.7%) in a study performed by Tinubu et al. (2010).<sup>15</sup> The differences found in the prevalence of work-related risk factors among those studies may be attributed to the differences in the working conditions and tasks required from nurses in different hospitals and in different countries.

According to the current study, getting help to handle heavy patients (91%), nursing procedure modification in order to avoid stress injury (79.4%) and adjustment

of plinths and/or bed height (71.3%) were the top three coping strategies in reducing the risk of developing WRMSDS. Similar coping strategies were reported by Anap et al., 2013 in India and Tinubu et al., 2010 among Nigerian nurses.<sup>1,15</sup>

On the other hand, Mohsen et al., 2017 found that modifying patient's position/nurse position was the most common coping strategy (70.3%), followed by getting someone to help me handle a heavy patient (59.5%) and adjusting bed height (55.5%).<sup>23</sup> Their findings were also supported by Gopal et al., 2012 study done on nurses in Ajman.<sup>26</sup> The differences in the coping strategies may be attributed to the different facilities that can be offered to nurses in their working place to reduce the risk to develop WRMSDS in different countries and in different types of hospitals included in these studies.

### Conclusion and Recommendations

The present study showed a high prevalence of WMSDs among participant nurses working in different departments of Tanta University Hospitals at different body sites. It is recommended to conduct ongoing ergonomics educational programs on right working postures and application of ergonomics principals at work to achieve a balance between work demands and worker characteristics, and adherence to National Institute for Occupational Safety and Health (NIOSH) guidelines to prevent and reduce MSDs problems, in order to promote efficiency in patient care. Also, it is of ultimate importance to perform job risk assessment first, to detect all risk factors related to WMSDs.

### Study Limitations

This main limitation of our study that the data was self-reported, and therefore exposed to recall bias as the researchers cannot ensure the validity of self-reported

data. In addition, it was a cross-sectional study so the risk factors couldn't be precisely determined as in case-control studies.

### Conflicts of interest

Authors declare no conflicts of interest

### Acknowledgment

The authors want to thank all female nurses who participated in this study for their cooperation

### References

1. Anap DB, Iyer C and Rao K: Work related musculoskeletal disorders among hospital nurses in rural Maharashtra, India: a multi centre survey. *Int J Res Med Sci*, 2013; 1 (2):101–107.
2. Elsherbeny EE, Elhadidy SS, El-Masry R, and El-Bahnasawy AS: Prevalence and associated factors of musculoskeletal complaints among nurses of Mansoura University children hospital. *Egyptian Journal of Occupational Medicine*, 2018; 42 (2): 151–166.
3. Amer SA: Work-related musculoskeletal symptoms among nurse staff in Ismailia, Egypt. *Egyptian Journal of Occupational Medicine*, 2018; 42 (1): 61–78.
4. Pinar S and Ali O: Evaluation of the prevalence of musculoskeletal disorders in nurses: A systematic review. *Med Science*, 2018. Available online at [www.medicinescience.org](http://www.medicinescience.org), DOI: 105,455/medscience.2017.06.8747 *Med Science*.
5. Moussa M, El-Ezaby H H and El-Mowafy RI(2015): Low back pain and coping strategies' among nurses in Port Said City, Egypt. *Journal of Nursing Education and Practice*, 2015; 5 (7):55–62.
6. Bureau of Labour Statistic: Non-fatal occupational injuries and illness requiring days away from work: [<http://www.bls.gov/news.release/pdf/osh2.pdf>], 2013.
7. Kumaraguruparan G, Merlin T and Jayadevan S: Work-related musculoskeletal disorders (WMSD) in hospital nurses: Prevalence and coping strategies. *GMJ, 4th Annual Scientific Meeting of Gulf Medical University. GMJ*, 2012; 1 (S1): 159–163.

8. Bolbol SA, El-Shafie DA, Abdelsalam AE, Abdelsalam NM, and Alian SM: Work-related musculoskeletal disorders: an ergonomic intervention program among Al-Azhar hospital intensive care units nurses, *ejom*, 2017; 41 (3): 429–446.
9. Seyedtaghi M, Jamshid Y, Syavash E, and Hanyeh A: A cross-sectional study on work-related musculoskeletal disorders and associated risk factors among hospital health care's. 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences. *Procedia Manufacturing*, 2015; 3:4528 – 4534.
10. Abo El Ata G, Khalifa E, El Desouky S, Sabry D, and Manawil M: Occupational Risk Factors for Musculoskeletal Disorders among Operation Room Nurses at Cairo University Hospitals. *BJMMR*, 2016; 14 (9): 1–11.
11. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, and Jørgensen K: Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied ergonomics*, 1987; 18 (3):233-7.
12. 1998 Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults--The Evidence Report. National Institutes of Health. *Obes Res* 6 Suppl 2:51S-209S
13. Ali HA and Abdel-Hakeim EH: The Effect of Ergonomics Program on Nurses' Knowledge and Practice in Operating Room. *Journal of Nursing and Health Science (IOSR-JNHS)*, 2018; 7 (1): 6–15.
14. Abo El Ata G, El Desouky S, Manawil M, and Khalifa E: Assessment of work-related musculoskeletal symptoms in operation room nurses. *Curr Sci Int*, 2016; 5 (2):215-22.
15. Tinubu BM, Mbada CE, Oyeyemi AL, and Fabunmi AA: Work-related musculoskeletal disorders among nurses in Ibadan, South-West Nigeria: A cross-sectional survey. *BMC Musculoskeletal Disord*, 2010; 11:12.
16. Smith DR, Choi JW, Ki M, Kim JY and Yamagata Z: Musculoskeletal disorders among staff in South Korea's largest nursing home. *Environmental Health and Preventive Medicine*, 2003; 8 (1): 23–28.
17. Ribeiro T, Serranheira F, and Loureiro H: Work related musculoskeletal disorders in primary health care nurses. *Applied Nursing Research*, 2017; 33: 72–77.
18. Nkhata LA, Esterhuizen TM, Siziya S, Phiri PD, Nkandu EM, and ShulaH: The Prevalence and Perceived Contributing Factors for Work-Related Musculoskeletal Disorders Among Nurses at the University Teaching Hospital in Lusaka, Zambia. *Science Journal of Public Health*, 2015; 3 (4): 508–513.
19. Attarchi M, Raeisi S, Namvar M, and Golabadi M: Association between shift working and musculoskeletal symptoms among nursing personnel. *Iranian Journal of Nursing and Midwifery Research*, 2014; 19 (3): 309.
20. Alexopoulos EC, Burdorf A, and Kalokerinou A: A comparative analysis on musculoskeletal disorders between Greek and Dutch nursing personnel. *International Archives of Occupational and Environmental Health*, 2006; 79 (1): 82–88.
21. Shafiezadeh KR: Prevalence of Musculoskeletal Disorders among Paramedics Working in a Large Hospital in Ahwaz, Southwestern Iran. *IJOEM*, 2011; 2:3.
22. Yasobant S and Rajkumar P: Work-related musculoskeletal disorders among health care professionals: A cross-sectional assessment of risk factors in a tertiary hospital, India. *Indian Journal of Occupational and Environmental Medicine*, 2014; 18 (2):75–81.
23. Mohsen MM, El-Abbassy AA, and Hassan SS: Work-Related Musculoskeletal Occupational Hazards among Nurses. *International Journal of Novel Research in Healthcare and Nursing*, 2017; 4 (1): 69–81.
24. Sorour AM and Abd El-Maksoud MM: Relationship between musculoskeletal disorders, job demands, and burnout among emergency nurses. *Adv Emerg Nurs J*, 2012; 34 (3):272-82.
25. Niedhammer I, Lert F and Marne MJ: Back pain and associated factors in French nurses. *International Archives of Occupational and Environmental Health*, 1994; 66 (5):349–357.
26. Gopal K, Thomas M, and Sreedharan J: Work-related musculoskeletal disorders

(WMSD) in hospital nurses: Prevalence and coping strategies. GMJ, 2012; 1 (S1): S159-S163.