Current Science International
ISSN: 2077-4435

Volume : 05 | Issue : 02 | April- June |2016
Pages: 215-222

Assessment of Work- related Musculoskeletal Symptoms in Operation Room Nurses

[1]Gehad Abo El Ata, [2]Soha El Desouky, [1]Marie Manawil and [1]Eman Khalifa

[1]Department of Occupational and Environmental Medicine, Cairo University, Egypt.
[2]Department of Rheumatology and Rehabilitation, Cairo University, Egypt.
[1]Occupational and Environmental Medicine, Faculty of Medicine, Cairo University, Egypt.

Received: 02 May 2016 / Accepted: 30 May 2016 / Publication date: 20 June 2016

ABSTRACT

Musculoskeletal disorders (MSDs) have become a growing problem among nursing personnel. They commonly develop musculoskeletal complaints that may cause nurse to leave their job. The operation room (OR) nurses are highly exposed to work related risk factors that contribute in musculoskeletal disorders. *Objectives:* The study aims to detect the prevalence of occupational musculoskeletal disorders (MSDs) among OR nurses at Cairo University hospitals and assessment of work related risk factors that contribute to the occurrence of these disorders. *Subjects and Methods:* A cross sectional study is performed on 184 OR nurses. Full history taking was done, including medical and occupational histories. The Standardized Nordic Questionnaire (SNQ) is used for detection and assessment of musculoskeletal symptoms. Clinical examination is performed with special emphasis on the locomotor system. *Results:* Lower back was the most commonly affected site in the past 12 months, prior to the study with prevalence of 76.1%. Many physical risk factors were detected among the studied nurses as neck bending, moving/ lifting, pushing/ pulling heavy objects, outreached arm and twisted wrist.These occupational risk factors were significantly associated with MSDs. Shift work is considered an occupational risk factor exerted on the study population and shows significant association with MSDs. *Conclusions:* MSDs represent a significant occupational health problem among OR nurses at Cairo University hospitals. Ergonomic programs are strongly recommended to control hazards and improve nurses' health.

Key words: Musculoskeletal disorders. Operation room nurses. Standardized Nordic Questionnaire. Physical risk factors. Shift work.

Introduction

Musculoskeletal disorders (MSDs) are considered a significant occupational disease all over the world and represent a major cause of work related injuries and disabilities (Menzel, 2004). Although so many articles were focused on work related musculoskeletal disorders (WMSDs), but most of them were based on populations in North America and Europe which can't be generalized to other developing populations due to differences in health care system, economic and social aspects (Lee *et al.,* 2005).

Musculoskeletal disorders are attributed to a number of risk factors implicated in their development (David, 2005).Nursing has been recognized as a physically demanding job and hospital nursing job is one of the high risky jobs that continuously facing hazards of MSDs (Sorour and Abd El-Maksoud, (2012). Low back pain/injury, neck and shoulder problems have been reported to be common MSDs among nursing personnel (Ando *et al.,* 2000).

Material handling taskse. g., lifting / moving and pushing/ pulling heavy objects among nurses are implicated in development and exacerbation of MSDs and these tasks are often associated with outstretched arms, bent and twisted trunk in awkward posture (Nelson, 2003). Because these handling tasks are performed manually without supporting of equipment, nurses are significantly exposed to physical (bodily) health hazards and eventually to high risk of injury (Nelson *et al.,* 2003).

Shift work at nursing job is accompanied by some health problems and leads to more accidents, injuries and disability among shift worker nurses. Working in shifts affects the physical and mental health causing errors and burnout (Caruso and Waters, 2008).

Operation room nurses are a specific group of nurses and are considered a high risky group. OR nurses are exposed to a variety of risk factors that are responsible for disorders of musculoskeletal system. These factors include static posture e.g., prolonged standing and trunk and neck flexion, also awkward posture of the trunk and manual handling e.g., lifting instruments and heavy objects, pulling/ pushing relatively heavy equipment and patients' trollies (Meijsen and Knibbe, 2007). Many studies have shown high prevalence of MSDs among

Corresponding Author: Eman Khalifa, Department of Occupational and Environmental Medicine, Faculty of Medicine, Cairo University
E-mail:emk_occ@yahoo.com

nurses that were attributed to work related physical risk factors (Anap *et al.,* 2013; Lipscomb *et al.,* 2004; Choobineh *et al.,* 2006).

Musculoskeletal disorders (MSDs) are related to high repetitive work processes and working in bad postures. Therefore, effective application of ergonomics in work place design can produce a balance between worker anthropometric characteristics and task demands, which can provide worker safety, physical and mental well-being and worker productivity (Shikdar and Al-Hadhrami, 2005).

Osteoarthritis (OA) is one of the lower limbs MSDs and is considered the most common joint disorder that is characterized by cartilage destruction due to imbalance between articular cartilage synthesis and degradation. OA is exacerbated by a number of occupational risk factors e.g., kneeling or squatting, carrying and lifting heavy objects (Klubmann *et al.,* 2008).

Although several authors have reported the prevalence of WMSDs among nurses in the developed countries (Yip, 2001; Alexopoulos *et al.,* 2003), yet, Egypt data on prevalence of WMSDs is limited for reference. This study believed to determine the prevalence of WMSDs, as well as the associated job risk factors among OR nurses at Cairo University hospitals.

Aim of the study:

The aim of this study is to detect work- related musculoskeletal disorders among operation room nurses at Cairo University hospitals and to assess the occupational factors that contribute to occurrence of these disorders.

Subjects and Methods:

Subjects:

The study is a cross sectional and was conducted on 184 operation room (OR) nurses at Cairo University hospitals. The study was conducted in the period from January to April 2014.

The studied group includes 29 male and 155 female OR nurses. Ages of studied group ranged from 20 to 50 years, duration of work ranged from2 to 35 years, with Body Mass Index (BMI)< 30 kg/m^2. They represent 52.6% of the total nurses at operation rooms at Cairo University hospitals.

Methods:

The studied group was subjected to questionnaire which was implemented through face to face interview and it was performed by occupational medicine specialist. Personal data including age, gender, weight, and height, as well as body mass index was obtained. Occupational history including duration of employment per years, daily working hours, number of working days per week, working schedule, specialty, additional job, is retrieved together with medical history of any locomotor system troubles. Clinical examination was performed with special emphasis on the locomotor system as regard joint mobility, presence of effusion, tenderness. The Standardized Nordic Questionnaire- SNQ of musculoskeletal disorders was used to detect and assess the extent of musculoskeletal complaints among nurses. It divides the body into nine regions from the neck to the ankles and ask about presence of any musculoskeletal troubles in each of the body areas during the last year and past seven days, prior to the interview. It also ask about presence of any musculoskeletal problem during the last twelve months, prior to the interview to assess the severity and extent of the symptoms that preventing normal activity at home or at work.

Statistical analysis:

Data are statistically described in terms of frequency, i.e. number and percentages. For comparing categorical data, Chi square (χ^2) test is performed to assess association between MSDs and occupational risk factors. *p* value less than 0.05 was considered statistically significant. All statistical calculations were done using computer program Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

Results

Table 1 shows that the most commonly affected body part among operation room nurses during the last 12 months, prior to the interview, is lower back (76.1%), followed by knees (67.9%), shoulders/ arms and ankles/ feet (60.9%) and neck (57.1%) . Other regions with less prevalent symptoms are hips (46.7%), upper back (37%) and elbow (23.9%).

The most prevalent affected body part during the last 7 days, prior to the interview, is knees (47.3%) followed by lower back (46.2%), ankles/feet (39.7%), neck (30.4%), shoulders/arm (27.7%), hips (24.5%), wrist/hands (15.2%), elbows (4.9%), and lastly the upper back (3.8%).

The most prevalent affected body part that preventing performance of normal work is lower back (22.3%), followed by neck and shoulders/ arms (17.4%). Knees and wrists/ hands are the fourth prevalent one (10.9%), then hips (10.3%), ankles/ feet (9.8%) and upper back symptoms represent (3.8%). The least affected part is elbows (3.3%).

Table 1: Prevalence of musculoskeletal symptoms in different body parts among the studied population during the last 12 months and the last 7 days, prior to the interview, using the Standardized Nordic Questionnaire–SNQ

Body parts affected in symptomatized OR nurses [a]	Symptoms during the last 12 months		Symptoms during the last 7 days		Symptoms during the last 12 months prevent normal work performance	
	Number	percentage	Number	percentage	Number	percentage
Neck	105	57.1	56	30.4	32	17.4
Shoulders/Arms	112	60.9	51	27.7	32	17.4
Elbows	44	23.9	9	4.9	6	3.3
Wrists/hands	96	52.2	28	15.2	20	10.9
Upper back	68	37	7	3.8	7	3.8
Lower back	140	76.1	85	46.2	41	22.3
Hips	86	46.7	45	24.5	19	10.3
Knees	125	67.9	87	47.3	20	10.9
Ankles/feet	112	60.9	73	39.7	18	9.8

[a]*For the total number and percentage of OR nurses with MSDs 180 subjects (97.8%)*

Table 2 revealed that standing posture in about 81% of the study group sustained ≥ 4 hours. Neck bending is prevalent among (95.1%) of the study group, followed by awkward posture (90.2%), repetitive movement of wrist and hand and twisted wrist and hand (84.8%), unfit seat (84.2%), repetitive movement of shoulder and arm (83.7%). Manual handling in the form of moving/lifting and pushing/ pulling heavy objects represent 64.7% and 64.1% respectively, while the least prevalent risk is outreached arm among 26.1% of the study group.

Table 2: Occupational risk factors elicited among the studied OR nurses by history

Occupational physical factors	Number	Percentage
Standing hours: < 4hs	35	19.02
≥ 4hs	149	80.97
Awkward posture	166	90.2
Moving and lifting heavy objects	119	64.7
Pushing and pulling heavy objects	118	64.1
Repetitive movement of shoulder and arm	154	83.7
Repetitive movement of wrist and hand	156	84.8
Outreached arm	48	26.1
Twisted wrist and hand	156	84.8
Neck bending	175	95.1

Table 3 shows that there is statistically significant association between moving/lifting heavy objects and musculoskeletal symptoms at neck, hips and ankles/feet. There is statistically significant association between pushing/pulling heavy objects and symptoms at neck, ankles/ feet. There is statistically significant association between outreached arm and symptoms at shoulders/arms and wrists/ hands. There is statistically significant association between twisted wrist and symptoms at neck, hips and ankles/ feet. There is statistically significant association between neck bending and neck symptoms. The association between standing hours per shift and any of the musculoskeletal symptoms, proved to be statistically insignificant.

Table 3: Association between physical risk factors and musculoskeletal symptoms during the last 12 months, prior to the interview, with statistical significance using Chi square- χ^2 test

Body parts affected	Standing hours		Moving heavy objects (N:119)		Push and pull heavy objects (N:118)		Outreached arm (N:48)		Twisted wrist (N:156)		Neck bending (N:175)	
	%	*P*	%	*p*	%	*P*	%	*p*	%	*p*	%	*P*
Neck	57	0.356	65.5	0.002	65.3	0.003	62.5	0.376	60.9	0.013	58.9	0.030
Shoulders/Arms	60.8	0.772	67.2	0.075	67.7	0.054	79.1	0.024	63.4	0.216	62.2	0.273
Elbows	23.9	0.863	25.2	0.394	24.5	0.564	31.2	0.559	24.3	0.532	24.5	0.329
Wrists/Hands	52.1	0.623	54.6	0.775	52.5	0.884	62.5	0.008	54.4	0.361	53.1	0.578
Upper back	36.9	0.633	39.5	0.334	39	0.446	37.5	0.928	37.2	0.882	37.1	0.817
Lower back	76	0.365	79	0.211	74.6	0.521	77.1	0.851	77.6	0.268	77.1	0.139
Hips	45.6	0.525	47.8	0.010	47.4	0.100	47.9	0.747	46.7	0.034	46.8	0.895
Knees	67.9	0.179	67.2	0.100	70.3	0.384	66.6	0.707	68.5	0.381	69.1	0.456
Ankles/Feet	60.8	0.294	63.9	0.024	62.7	0.042	58.3	0.556	61.5	0.001	62.8	0.051

Highlighted figures denote statistical significance at p<0.05

Table 4 shows the effect of shift work schedule on the prevalence of musculoskeletal symptoms. There is a statistically significant difference between nurse with shift work and nurses with normal day work as regard musculoskeletal symptoms at low back and hips ($p < 0.05$).

Table 4: Prevalence of musculoskeletal symptoms during the last 12 months among the OR nurses participated in the study according to shift work arrangement

Body parts affected	Shift work (N: 132)		No shift work (N:52)		Statistical significance	
	Number	Percentage	Number	Percentage	$\chi 2$	*p- value*
Neck	79	59.8	26	50	3.599	0.165
Shoulders/Arms	83	62.8	29	55.7	4.232	0.645
Elbows	29	21.9	15	28.8	3.367	0.762
Wrists/hands	67	50.7	29	55.7	7.995	0.238
Upper back	54	40.9	14	26.9	3.607	0.165
Lower back	103	78.03	37	71.1	6.757	0.034
Hips	61	46.2	25	48.07	14.445	0.025
Knees	88	66.7	37	71.1	7.391	0.286
Ankles/feet	81	61.3	31	59.6	3.201	0.525

Highlighted figures denote statistical significance at p <0.05

Table 5 shows statistically significant positive correlations between BMI and hips and knees symptoms, duration of employment and neck, knees symptoms ($p < 0.05$).

Table 5: Correlation between musculoskeletal symptoms during the last 12 months, and various personal and occupational variables

Body parts affected	BMI Mean ± SD(26.93±2.56)		Duration of employment Mean ± SD(17.32± 8.08)	
	r	*P*	r	*P*
Neck	0.121	0.101	0.221	0.003
Shoulders/Arms	0.019	0.799	0.092	0.214
Elbows	0.057	0.443	0.095	0.202
Wrists/Hands	-0.032	0.664	0.021	0.774
Upper back	0.005	0.944	-0.108	0.146
Lower back	0.093	0.210	0.048	0.522
Hips	0.153	0.038	-0.004	0.953
Knees	0.178	0.015	0.214	0.004
Ankles/Feet	0.121	0.101	0.119	0.109

Highlighted figures denote statistical significance at p <0.05

Discussion

There is high prevalence of work related musculoskeletal disorders (WMSDs) during the past twelve months prior to interview among the studied OR nurses (97.8%). In the current study, it is found that the lower back is the most affected site according to twelve months prevalence of musculoskeletal symptoms elicited by the Standardized Nordic Questionnaire- SNQ (76.1%). Low back pain is also the most common symptoms resulting in affection of work ability and performance of normal work activity. This is followed by knees 67.9%, shoulders/ arms 60.9%, ankles/feet 60.9%, neck 57.1% then wrists/hands 52.17%.Other regions with less prevalence are hips 46.7%, upper back 37% and the least common site is elbows 23.9%. These results are similar to those of Smedly and coworkers who found that a high prevalence of MSDs reported by operation room (OR) nurses were in the lumbar spine, knees, ankles/ feet and shoulders (Smedley *et al.,* 2003).

The prevalence of the last seven days musculoskeletal symptoms, prior to the interview, elicited by applying the SNQ is high at knees 47.3% followed by low back 46.2% and ankles/ feet 39.7%. Neck and shoulders symptoms are the second common MSDs affecting the work ability of OR nurses elicited by applying the SNQ and representing 17.4% of symptoms. The current study results are in relative resemblance to results of a study performed by Sorour and AbdEl-Maksoud, (2012), who documented high prevalence of MSDs among emergency nurses at Zagazig University Hospital and Al- Ahrar Hospital in Zagazig- Sharkia governorate of Egypt. The commonest site affected, in their series was the lower back 72.4%, followed by neck 67.2% and shoulders 65.5%. In addition, the current study results are concomitant to the study conducted among rural hospital nurses in India and it was found that the highest prevalent MSDs was in the low back 48.2%, followed by the shoulder 34.6%, neck 33.1% and knee 29%. Other regions with less prevalence were thoracic spine 10.5%, feet and ankle 7.6%, elbow 1.88% and hip 1.6% (Anap *et al.,* 2013).

In another study, the 12-month prevalence of MSDs among OR Iranian nurses in Shiraz city school was 85.7% which is less than what is found in the current study. Low back symptoms were the most prevalent MSDs in the Iranian study, the same as in the current study (Choobineh *et al.,* 2010). The results of the present study

are in accordance with another study in which the most frequent complaint was low back pain among hospital nurses due to workloads (Ono *et al.,* 2000).

In resemblance to the present study, as regard affection of work activity of the study population due to low back symptoms in 22.3% of OR nurses. Many investigators have found that there's prevalence of reduced activities due to low back symptoms in their study (Widanarko *et al.,* 2012; Palliser *et al.,* 2005).

The second commonly affected site by WMSDs is knee in 67.9% of OR nurses according to the past twelvemonths' symptoms by SNQ. These findings are in agreement with a study conducted among nurses in South-West Greece and revealed that knee pain was the second common reported symptoms 23% after low back pain 51% of the studied subjects (Alexopoulos *et al.,* 2011).

The prevalence of musculoskeletal symptoms of pain and discomfort among the present study sample population can be explained by the nature of nursing job in operation rooms which requires prolonged static posture such as prolonged standing with trunk and neck flexion. All those are considered as physical risk factors associated with nursing job. In the present study population, about 81% of the studied nurses revealed that they are standing more than four hours a day which exceeds the ergonomic guidelines for standing that should not be more than one hour of continuous standing and not more than four hours in total per day (Meijsenand Knibbe, 2007).

Due to presence of several risk factors in a combined manner responsible for WMSDs, there is a need to measure the level of exposure and the potential risk for incidence of WMSDs and to determine to what extent the measured risk exposure can represent a true level of WMSDs outcome. For these reasons, there is a need to evaluate MSDs and relevant risk factor by a help of certain evaluation methods. In the present study, evaluation of work place situation, assessing, observing and measuring physical ergonomic stressors in the workplace was performed.

In the present results, the ergonomic problems for WMSDS are manual material handling for back, posture (outreached arm) for arms, posture (twisted wrists and hands) for wrists/hands and posture (neck bending) for neck.

Prolonged standing nursing activities without seated break is considered a potential risk for back causing spinal loading and spinal shrinkage with time (Beynon and Reilly, 2001). These results are in contrary to the present study results.

Awkward posture of OR nurses during surgical operation often consists of forward bending of head, neck and bent twisted trunk and outreached arm in which hands and arms are present above shoulders. Also there is awkward posture of wrist in which wrist and hand become flexed and twisted. Working in unfavorable posture demands high muscle force, overloading, exhaustion and fatigue of the muscle. This posture puts muscle in strain which results in ischemia and pain in the muscle (Hegazy *et al.,* 2009).

The present study results show that neck flexion and neck bending which is adopted by OR nurses during surgical operations is the highest physical job risk factor among the studied population representing 95.1%.Twisted wrist and hand during manipulation in operations represents high prevalence 84.8% of the studied OR nurses and this is because demands of surgical procedure which require twisting of wrist for long period during traction upon the surgical site and during handling maneuver of surgical instruments and maintaining field sterilization. Outreached arm with arms above the shoulder represents 26.1% of the present study population, as during preparation and manipulation of fluids used for washing in urology operations, and during applying of traction upon the fractured limbs during orthopedic operations.

Also, manual handling is one of the physical risk factors facing OR nurses who sometimes due to limited number of workers have to perform a lot of manual tasks which are implicated in variety of occupational musculoskeletal symptoms. From the present study, manual task activities performed by OR nurses includes moving and lifting heavy objects like boxes or trays of instruments and equipment needed during surgery, carrying and lifting and repositioning of patients64.7%, and there are pushing and pulling heavy objects 64.1% like patients beds and trollies. All the seexert severe stress on the musculoskeletal system and especially on the axial skeleton. Also, during patient transfers, there is possibility of flexion and rotation movements which may increase the risk of back injury (Engkvist *et al.,* 1998).

The present study results are consistent with those of Andersen and coworkers who studied the effect of manual handling performance among healthcare workers on musculoskeletal symptoms. They found that patient-handling such as moving, turning, lifting, and repositioning involves high biomechanical loadings of the neck/shoulder muscles during healthcare work (Andersen, 2012).

These physical risk factors show a statistically significant association with multiple WMSDs among OR nurses in the present study. Neck flexion is significantly associated with neck WMSDs. There is statistically significant association between outreached arm position and shoulder/ arm WMSDs and wrist/ hands WMSDs. This is because such maneuver of awkward posture with the arm above the shoulder can affect the whole upper limb. The statistically significant association between twisted wrist/ hand and neck, hips, and ankles/feet, that can be explained by the nature and demands of surgical procedure in which twisting of wrist is accompanied by neck flexion and also hips and ankles/feet become affected by prolonged static posture. There is a statistically

significant association between moving and lifting heavy objects and WMSDs at neck, hips and ankles/ feet. Also there is statistically significant association between pushing and pulling heavy objects and WMSDs at neck, and ankles/ feet. This significant association attributed to neck flexion position which occurs during lifting and pushing procedure.

In the present study results, pushing and pulling heavy objects are associated with ankles/feet symptoms as well as neck symptoms. These results are in accordance with a study in which pushing and pulling heavy weight were resulting in hips, knees, and ankles/ feet symptoms (McBeth *et al.,* 2003).

The present study results are in accordance with a study in which activities among OR nurses that require reaching or working away from the body (outreached) representing41.2% from the study population and contributing to WMSDs at shoulder region (Anap *et al.,* 2013) .In another study awkward posture of neck was associated with neck musculoskeletal symptoms which are similar to the current study results (Choobineh *et al.,* 2006).

Shift work is considered a psychosocial risk factors, nurses working in a sift work schedule were more prone to burnout, emotional instability and emotional exhaustion and had a sense of less personal accomplishment (Kawakami and Fujigaki, 1996; Koda *et al.,* 1989).

In the present study results, 132 (71.7%) of OR nurses are working in shifts either rotating or night shifts. Shift work shows a statistically significant positive association with musculoskeletal symptoms at lower back and hips. These results are in agreement with a study suggesting that shift working may be associated with increased prevalence of low back symptoms among nursing personnel (Attarchi *et al.,* 2014).

The present study results are in relative resemblance to a study conducted upon Iranian OR nurses and it revealed that shift working was associated with MSDs at neck, upper back and knees ((Choobineh *et al.,* 2010) .

Normal working hours mean working at day time, while night time is for rest. Working at any time other than normal daylight hours is considered as shift work (Harrington, 2001).

Many studies investigated the association between rotating shift and abnormal work schedule and prevalence of MSDs and it showed high incidence of musculoskeletal disorders among those working in rotating shifts (Sveinsdóttir, 2006) and night shifts (Horwitz and McCall, 2004).

Shift work may affect physical and mental well-being which results in possibility of injuries and accidents. Different types of shift work were implicated in prevalence of injuries e.g., blood and body fluid exposure, including rotating shift (Smith *et al.,* 2006; Guastello *et al.,* 1999), and night shifts (Parks *et al.,* 2000; Neuberger *et al.,* 1984).

The statistical analysis in the present study reveals that mean value of the duration of employment per years of the OR nurses is17.32±8.08 years and there is a statistically significant positive correlation between duration of employment and MSDs at neck and knees. This is explained by that the more the duration of employment, the more the exposure to stressors an frisk factors. Accumulation of exposure causes chronic health problems of the musculoskeletal system.

The present study results are in agreement with a study in which duration of employment (> 20 years) was significantly associated with prevalence of knee disorders (Lemasters *et al.,* 1998).

These results are similar to a study that found significant association between duration of employment and neck MSDs at male nurses from different hospitals (Corona *et al.,* 2004).

The present study findings also agreed with a study in which a significant high prevalence of lower limb disorders among workers who had spent more than 5 years in their present job (Chee *et al.,* 2004).

In the present study, the mean body mass index (BMI) of the study group is 26.93±2.56Kg/m^2 .

The results reveal that body mass index BMI is significant risk factor for MSDs and there is a significant positive correlation between BMI and MSDs at hips and knees. The results can be explained by the increasing loading of the lower limb joints by the overweight person than in normal subjects.

Several studies indicate that BMI (> 25Kg/ m^2) was a significant risk factor to knee OA (Dawson *et al.,* 2003) , and hip pain (Sobti *et al.,* 1997) .These results are in agreement with those reached by Lagerstrom *et al.* (1995) who found that high BMI among nursing personnel was associated with knees MSDs.

Conclusion and Recommendations

In conclusion, the results of the present study reveal high prevalence of musculoskeletal disorders among the OR nurses which are attributed to various work related risk factors. An interventional ergonomic program for preventing and reducing MSDs among OR nurses is recommended and it should focus on reducing physical demands, particularly excessive manual handling demand. The use of technical aids, improving working methods, better ergonomic design of work equipment and tools can greatly reduce physical load and increase productivity. Proper planning and regulation of working hours and prevention of extended work shifts to reduce musculoskeletal symptoms.

All procedures of the study were approved by the ethical committee of Occupational and Environmental Medicine Department, Cairo University. All subjects included in the study were treated according to the

Helsinki Declaration of biomedical ethics (World Medical Association Declaration, 2000). Informed consent was obtained from all OR nurses participated in the study after proper explanation regarding the objectives of the study and the data confidentiality.

References

Alexopoulos, E.C., A. Burdorf, A. Kalokerinou, 2003. Risk factors for musculoskeletal disorders among nursing personnel in Greek hospitals. Int Arch Occup Environ Health, 76: 289-94.

Alexopoulos, E.C., D. Tanagra, I. Detorakis, P. Gatsi, A. Goroyia, M. Michalopoulou, E. Jelastopulu, 2011. Knee and low back complaints in professional hospital nurses: occurrence, chronicity, care seeking and absenteeism. Work., 38(4): 329-35.

Anap, D.B., C. Iyer, K. Rao, 2013. Work related musculoskeletal disorders among hospital nurses in rural Maharashtra, India: a multi centre survey. Int J Res Med Sci., 1(2): 101-107.

Andersen, L.L., T. Clausen, R. Persson, A. Holtermann, 2012. Perceived physical exertion during healthcare work and prognosis for recovery from long-term pain in different body regions: Prospective cohort study. BMC Musculoskeletal Disorders. 13: 253.

Ando, S., O. Yuichiro, M. Shimaoka, S. Hattori, F. Hori, Y. Takeuchi, 2000. Associations of self- estimated workloads with musculoskeletal symptoms among hospital nurses. Occup Environ Med., 57: 211-6.

Attarchi, M., S. Raeisi, M. Namvar, M. Golabadi, 2014. Association between shift working and musculoskeletal symptoms among nursing personnel. Iran J Nurs Midwifery Res., 19(3): 309-14.

Beynon, C and T. Reilly, 2001. Spinal shrinkage during a seated break and standing break during simulated nursing tasks. ApplErgon, 32(6): 617-22.

Caruso, C.C., R. Waters, 2008. A review of work schedule issues and musculoskeletal disorders with an emphasis on the healthcare sector. Ind Health, 46: 523-34.

Chee, H., K.G. Rampal and A. Chandrasakaran, 2004. Ergonomic risk factors of work processes in the semiconductor industry in peninsular Malaysia. Industrial Health, 42: 373-81.

Choobineh, A., M. Movahed, S.H. Tabatabaie, M. Kumashiro, 2010. Perceived Demands and Musculoskeletal Disorders in Operating Room Nurses of Shiraz City Hospitals. Industrial Health, 48: 74-84.

Choobineh, A.R., A. Rajaeefard, M. Neghab, 2006. Association between perceived demands and musculoskeletal disorders among hospital nurses of Shiraz University of Medical Sciences: a questionnaire survey. JOSE. 2: 347-54.

Corona, G., G. Monduzzi, M. Minerva, F. Amedei and G. Franco, 2004. Individual, ergonomic and psychosocial risk factors affect musculoskeletal disorders in nurses, physiotherapists and VDU users. G Ital Med Lav Erg., 26: 201-2.

David, G.C., 2005. Ergonomic methods for assessing exposure to risk factors for work related musculoskeletal disorders. Occup Med (Lond). 55(3): 190-9.

Dawson, J., E. Juszczak, M. Thorogood, S.A. Marks, C. Dodd and R. Fitzpatrick, 2003. An investigation of risk factors for symptomatic osteoarthritis of the knee in women. J Epidemiol Community Health, 57: 823-30.

Engkvist, I., M. Hagberg, E. Hjelm, E. Menckel, L. Ekenvall, 1998. The accident process preceding overexertion back injuries in nursing personnel. Scand J Work Environ Health, 24: 367-75.

Guastello, S.J., R.R.M. Gershon, L.R. Murphy, 1999. Catastrophe model for the exposure to blood-borne pathogens and other accidents in health care settings. Accident; Analysis and Prevention, 31(6): 739-49.

Harrington, J.M., 2001. Health effects of shift work and extended hours of work. Occup Environ Med., 58 (1) :68-72 .

Hegazy, A.A., N.J. Awadalla, N.S. Shenouda, 2009. Prevalence of musculoskeletal complaints among dentists in some Egyptian cities. Egyptian Journal of Occupational Medicine, 33(1): 55-71.

Horwitz, I.B. and B.P. McCall, 2004. The impact of shift work on the risk and severity of injuries for hospital employees: an analysis using Oregon workers' compensation data. Occupational Medicine, 54(8): 556-63.

Kawakami, N., Y. Fujigaki, 1996. Reliability and validity of the Japanese version of Job Content Questionnaire; Replication and extension in computer company employees. Ind Health, 34: 295-306.

Klubmann, A., H. Gebhardt, F. Liebers L.V. Engelhardt, A. Dávid, B. Bouillon, M.A. Rieger, 2008. Individual and occupational risk factors for knee osteoarthritis – Study protocol of a case control study. BMC Musculoskeletal Disorders. 9: 26.

Koda, S., A. Hisashige, T. Ogawa, H. Aoyama, N. Kurumatani, S. Nakagiri, 1989. A study of burnout among hospital nurses. J UOEH, 11: 604-608.

Lagerstrom, M., M. Wenemark, M. Hagberg and E.W. Hjelm, 1995. Occupational and individual factors related to musculoskeletal symptoms in 5 body regions among Swedish nursing personnel. International Archives of Occupational and Environmental Health, 68(1): 27-35.

Lee, H.Y., Y.Y. Wen, C.W. Chun, J.D. Wang, 2005. Prevalence and psychosocial risk factors of upper extremity musculoskeletal painin industries of Taiwan: A Nationwide study. J.Occup. Health, 47: 311-18.

Lemasters, G.K., M.R. Atterbury, A.D. Booth-Jones, A. Bhattacharya, N. Ollila-Glenn, C. Forrester and C. Frost et al., 1998. Prevalence of work related musculoskeletal disorders in active union carpenters. Occupational and Environmental Medicine, 55: 421-27.

Lipscomb, J., A. Trinkoff, B. Brady, J. Geiger-Brown, 2004. Health care system changes and reported musculoskeletal disorders among registered nurses. Am J Public Health, 94(8): 1431-5.

McBeth, J., E.F. Harkness, A.J. Silman, G.J. Macfarlane, 2003. The role of workplace low-level mechanical trauma, posture and environment in the onset of chronic widespread pain. Rheumatology (Oxford). 42: 1486-94.

Meijsen, P., H.J. Knibbe, 2007. Prolonged standing in the OR: a Dutch research study. AORN J.86(3): 399-414.

Menzel, N.N., 2004. Back pain prevalence in nursing personnel: measurement issues. AAOHN. 52(2): 54-65.

Nelson, A., G. Fragala, N. Menzel, 2003. Myths and facts about back injuries in nursing. American Journal of Nursing, 103(2): 32-40.

Nelson, A., 2003.State of the science in patient care ergonomics: Lessons learned and gaps in knowledge. Presented at the Third Annual Safe Patient Handling and Movement Conference: March 5, 2003; Clearwater Beach, FL.

Neuberger, J.S., J. Harris, W.D. Kundin, A. Bischone, T.D. Chin, 1984. Incidence of needlestick injuries in hospital personnel: implications for prevention. American Journal of Infection Control., 12(3): 171-176.

Ono, Y., M. Shimaoka, S. Hiruta, Y. Hattori, F. Hori, 2000. Associations of self-estimated workloads with musculoskeletal symptoms among hospital nurses. Occup Environ Med., 57(3): 211-16.

Palliser, C.R., H.M. Firth, A.M. Feyer, S.M. Paulin, 2005. Musculoskeletal discomfort and work-related stress in New Zealand dentists. Work & Stress. 19: 351-59.

Parks, D.K., R.J. Yetman, M.C. McNesse, K. Burau, M.H. Smolensky, 2000. Day night pattern in accidental exposures to blood borne pathogens among medical students and residents. Chronobiology International, 17(1): 61-70.

Shikdar, AA and M.A. Al-Hadhrami, 2005. Operator performance and satisfaction in an ergonomically designed assembly workstation' The Journal of Engineering Research, 2(1): 69-76.

Smedley, J., H. Inskip, F. Trevelyan, P. Buckle, C. Cooper, D. Coggon, 2003. Risk factors for incident neck and shoulder pain in hospital nurses. Occup Environ Med., 60(11): 864-69.

Smith, D.R., M. Mihashi, Y. Adachi, Y. Nakashima, T. Ishitake, 2006. Epidemiology of needle stick and sharps injuries among nurses in a Japaneses teaching hospital. The Journal of Hospital Infection, 64(1): 44-49.

Sobti, A., C. Cooper, H. Inskip, S. Searle and D. Coggon, 1997. Occupational physical activity and long-term risk of musculoskeletal symptoms: A national survey of post office pensioners. American Journal of Industrial Medicine, 32: 76-83.

Sorour, A.M., M.M. Abd El-Maksoud, 2012. Relationship between musculoskeletal disorders, job demands, and burnout among emergency nurses. Adv Emerg Nurs J. 34(3): 272-82.

Sveinsdóttir, H., 2006. Self-assessed quality of sleep, occupational health, working environment, illness experience and job satisfaction of female nurses working different combination of shifts. Scandinavian Journal of Caring Science, 20(3): 229-237.

Widanarko, B., S. Legg, M. Stevenson, J. Devereux, A. Eng, A. Mannetje, S. Cheng, N. Pearce, 2012. Prevalence and work-related risk factors for reduced activities and absenteeism due to low back symptoms. Applied Ergonomics. 43: 727-37.

World Medical Association Declaration of Helsinki, 2000. Ethical Principles for Medical Research Involving Human Subjects. Revised by the 52nd WMA General Assembly, Edinburgh, Scotland. http://www.wma.net/e/policy/b3.htm.

Yip, Y.B., 2001. A study of work stress, patient handling activities and the risk of low back pain among nurses in Hong Kong. Journal of Advanced Nursing, 36: 794-804.