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WORK-RELATED MUSCULOSKELETAL DISORDERS: AN ERGONOMIC INTERVENTION PROGRAM AMONG AL-AHRAR HOSPITAL INTENSIVE CARE UNITS NURSES

By

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Abstract

Introduction: Work-related Musculoskeletal Disorders are common among healthcare workers especially nurses, and because they are preventable, attention should be raised towards the importance of training as the first step for improving both health of nurses and quality of patient care thus decreasing both human and economic costs. **Aim of work:** This study was conducted to assess the prevalence of work-related musculoskeletal disorders, to implement an ergonomic training program and to evaluate the effect of ergonomic intervention program nurses' physical workload and work style. **Materials and methods:** intensive care units' nurses from two hospitals participated in the study and completed questionnaires including Nordic musculoskeletal questionnaire, physical work load questionnaire and Workstyle Short Form questionnaire. An intervention training program was conducted in one hospital on ergonomic principles, musculoskeletal disorders, patient manual-handling techniques, stretching and relaxation exercises for major body regions, other hospital regarded as control. Evaluation of the effect of the program was conducted after 6 months. **Results:** Low back pain was the commonest cause of job change among intervention and control hospitals nurses (11.9%, 13.0% respectively). Most of nurses reported a moderate physical workload. There was significant reduction in physical work load and improvement in the Work style after intervention ($p < 0.001$). **Conclusion:** Considering the fact of decreased resources needed to equip the Egyptian hospitals

with advanced patient handling equipment and as a glance of hope to improve nurses' health and safety while performing their job, our ergonomic training program showed significant improvement in nurses' activities that will help in reducing Work-related Musculoskeletal Disorders (WRMSDs) and thus improvement of their quality of life.
Key words: Musculoskeletal Disorders, An Intervention Program, Ergonomic, Intensive Care Units and Nurses.

Introduction

Work-related musculoskeletal disorders (WRMSDs) are grave and significant occupational health disorders among health care providers caused or aggravated by work. It is characterized by discomfort, persistent pain in the muscles, ligaments, tendons, bursa, joint capsules and bone lasting more than 3 days and may lead to impairment and disability (Ellapen TJ and Narsigan, 2014).

Nurses are known to have one of the highest rates of WRMSDs of any occupation; lower back pain and discomfort are reported as the most frequent symptoms with prevalence rates ranging from 32% to 90% (Reed et al., 2014). Intensive care units (ICUs) are reported as having the highest ergonomic risk so ICU nurses are more risky to have WRMSDs than nurses working in other units in the hospital. It is also reported that on having such disorders, many nurses have to leave their work (Habibi et al., 2015), and change their job (Kiekkas et al., 2008).

WRMSDs among nurses are of major concern and in a study done at El Mansoura hospitals they found that almost half of nurses (44%) experienced musculoskeletal pain, (6.5%) described pain as severe , additionally (91%) reported that pain was leading to sick leaves (Gabr and Mohamed, 2006).

One of the major problems in prevention of WRMSDs is their multifactorial nature that includes physical, organizational, psychosocial, personal, and cultural factors (Choobineh et al., 2010), so several researchers have reported that single intervention is not effective. Multifaceted intervention strategies are necessary to address all factors in the work of nurses that may have contributed to MSDs (Nelson et al., 2006). Multifaceted intervention strategies should include elements in engineering and administrative controls as well as training and education

(Nelson et al., 2006 and Szeto et al., 2013).

In every occupational setting, it is important to conduct a detailed job analysis first, to identify all risk factors, and then design a suitable intervention program to address all the issues that may contribute to work-related injuries (Szeto et al., 2013). Few developing countries have directed a lot of efforts for developing an ergonomic awareness among workers in different disciplines. Few researches discussed their success, however building ergonomic literacy is considered the first step for a successful process (Helali et al., 2008).

Aim of work

This study aims to assess the prevalence of work-related musculoskeletal disorders (WRMSDs) among intensive care units (ICUs) nurses, to implement an ergonomic training program and to evaluate its effect on physical workload and work style.

Materials and methods

Study design: An interventional study.

Place and duration of the study: The study was conducted among nurses from 7 ICU wards (Internal ICU, Cardiac ICU, Open Heart ICU, Emergency ICU, Pediatrics ICU, Neonate ICU and Intermediate ICU) in 2 Hospitals, Al-Ahrar hospital in which the intervention was implemented and Zagazig University Hospital as control. Study was conducted from the 1st January 2015 till 30 April 2016.

Study sample: The total number of nurses who were eligible to participate at the period of this study was 310 nurses, 108 nurses from Al-Ahrar hospital compared to 202 nurses from Zagazig University Hospital. Sixty-two nurses didn't participate in the study, 6 nurses were in long legal leaves, 4 nurses were pregnant, 22 refused to participate due to personal reasons, and 30 of them participated in the pilot study (about 10% of the study sample) and were excluded, so only 90 nurses from Al-Ahrar hospital and 158 nurses from Zagazig University Hospital finally accepted to participate.

Study methods: Pilot study was done in both hospitals and conducted during January 2015 to test the response

to different items of the questionnaires, test the feasibility of the proposed main study and aid development of the data collection tools, ten nurses were enrolled in intervention program for one week and 20 nurses only subjected to questionnaires. After the pilot, modifications were done in the form of dividing filling of questionnaires in two days instead of one, using videos accompanied with simulation for patient handling, and dividing the training content into four sessions instead of two as they complained from condensed information in two training sessions.

Inclusion criteria included nurses who had been on the job for 6 months or more and are mostly involved in patient handling (physically assist patients in and out of bed, stretcher, wheel chair, perform bed baths, dressings and change patients' positions).

Exclusion criteria included nurses who had other injuries within the past 12 months for example sports injuries and motor vehicle accidents, being treated for other chronic musculoskeletal diseases, pregnant or have been pregnant within the past 12 months from the date of the study and nurses who had legal long leave.

Study used a **semi-structured questionnaire** including the following sections:

i. **Section one:** included information on demographic profile such as age, gender, medical history, family history and occupational history which included questions about work duration, work shifts, daily working hours and position, also work related risk factors guided by relevant literature.

ii. **Section two:** the Nordic Musculoskeletal Questionnaire (NMQ): which is the most currently used questionnaire to reveal the prevalence of musculoskeletal problems and their symptoms. It comprises questions about problems on the whole body and body parts (wrist, upper and lower arms, neck, trunk, and legs). A body "map" was also used to make it easier for nurses to pinpoint to their problems in each body area (Kuorinka et al., 1987).

iii. **Section three:** questionnaires on physical work load: the items of the questionnaire presented as pictograms. Five of the items described postures of the trunk, three

items for the positions of the arms, five items asked for positions of the legs; six items described the lifting of weights. Physical load index was classified as follows, Low (≤ 22.46 points) Middle (22.47–36.37 points) High (≥ 36.38 points) (Hollmann et al., 1999).

iv. **Section four:** the Workstyle Short Form questionnaire: including 32 items divided into two parts (Workstyle characteristic responses to the workplace - Workstyle reactivity to high work demands). It is subsequently divided into 8 subscales (working through pain, social reactivity, limited workplace support, deadlines/pressure, self-imposed workplace/workload, breaks, mood, and autonomic). Items in each subscale scored on a likert scale from 0 to 4 (almost never 0-almost always 4) or (Yes, No). A total score equal or higher than 28 was considered as high risk of adverse workstyle (Feuerstein and Nicholas, 2006).

Measurements of height and weight were done to all participant nurses and body mass index was calculated.

All questionnaires were translated into Arabic, validity test to the questionnaires was done for language clarity, content, relevancy, ease of understanding and time needed to answer. Reliability test was done by using the reliability coefficients (Cronbach's alpha) which was high for all questionnaires, and suitable for scientific purposes.

The study was conducted on three phases:

1. **Phase one:** A base line survey was conducted during the period of February 2015 using the four section questionnaire, also clinical examination to screen musculoskeletal disorders was done to all participant nurses in the form of inspection, palpation, range of motion and special tests to the region of complaint (e.g. for low back pain; straight leg raising test, femoral stretch test, local spinal and paraspinal tenderness for carpal tunnel syndrome; phalen's and tinel's test; for knee joint bulge test, cross fluctuation, tenderness and crepitus palpation for all joints range of motion; inspection of swelling, deformity and muscle wasting).

2. **Phase two** (interventional training program): A health education training program was carried out on 90 nurses from Al-Ahrar hospital on 12 sessions (8 sessions for nurses during morning shift, 4 session for nurses during afternoon) each session lasted for about 1 hour, number of nurses in each session ranged from 27-35 nurse, each group attended 4 sessions focusing on:

2.1. Introductory lecture: Ergonomic principles, evaluation and control of work place conditions that influence the occurrence of musculoskeletal disorders were explained.

2.2. Musculoskeletal disorders: Describing different musculoskeletal disorders and attributed risk factors with focusing on low back pain and red flag signs.

2.3. Patient manual-handling techniques: Nurses were instructed about the methods for patient handling according to the different ways of performing them (Manual Transfer methods, Transfer methods using small patient handling aids, Transfer methods using large patient handling aids) as recommended by OSHA (2009), with stressing on Manual Transfer methods as the most feasible method available.

Stretching and relaxation exercises program for major body regions: Nurses were encouraged to do stretching exercises to improve the range of motion of the joints. Nine exercises for major body regions such as the neck, shoulders and lower limbs were illustrated using videos and demonstrated by the lecturer during training. Nurses were instructed to hold a stretch the joint for about 20 seconds, and then switch sides.

At every training session different educational tools were used including posters, videos, simulation and booklets. Motivational methods including appraisal and simple bags containing educational material of the program were introduced to nurses. Posters about ergonomic principles, musculoskeletal disorders, patient handling, and stretching and relaxation exercises were designed and left hanged at the site of work.

Zagazig University Hospital nurses (control group) received no intervention only base line survey and clinical examination was done on 158 ICUs nurses.

Phase three: After 6 months evaluation of the effectiveness of the

health education program was done through dissemination of questionnaires similar to the base line survey questionnaires and nurses' satisfaction questionnaire to evaluate the perceived usefulness of the training program from nursing point of views after program implementation. It included (6) different aspects related the content of the program, the methods of training, and overall usefulness of the program in reducing WRMSDs. They were asked to rate their perceptions on the usefulness of the program components on a 6-point Likert scale ranging from 'not useful at all' (0) to 'very useful' (5).

Consent

An informed consent was obtained from all participants of this study. The component of the tools were explained to the participants and they were reassured that the information collected would be used for the scientific research only.

Ethical approval

The Institutional Review Board (IRB) of the Faculty of Medicine approved the study protocol (IRB #2634). A formal letter from the hospital manager was taken to get their permission to collect data from the hospital then distributing the questionnaires to the study participants. Permission to conduct training sessions was obtained and supervised by Hospitals Training Management Department.

Data management

The collected data were computerized and statistically analyzed using SPSS program version 19.0. For the statistical calculations Data coding was done, Qualitative data were presented as frequencies, Quantitative data were presented by mean and standard deviation comparison between groups means were done using Student's t test and Mann-Whitney test, comparison between categorical variables was done by chi-squared test and mcnemar test. The test results were considered significant when p-value < 0.05.

Results

The majority of nurses are females (96.7% in intervention hospital and 93.0% in control hospital) and their age ranged from 20 to 34 years. Most of them (more than 50%) in both groups graduated from Nursing Institute.

Table 1: Frequency distribution of study participants by Physical Profile and Occupational History.

Socio-demographic characteristics	Intervention Hospital (No =90) No (%)	Control Hospital (No =158) No (%)	p value
Physical profile			
- Height (cm)	163.9 ± 6.21	165.1 ± 5.37	>0.05#
- Weight (kg)	67.96 ± 10.13	69.03 ± 9.85	>0.05#
- BMI (kg/m^2)	23.67 ± 3.22	24.58 ± 4.13	>0.05#
Work Department			
- Cardio-thoracic unit	9 (10.0)	18 (11.4)	
- Intermediate care unit	22 (24.4)	32 (20.3)	
- Internal medicine unit	15 (16.7)	29 (18.4)	
- Emergency unit	14 (15.6)	26 (16.5)	>0.05##
- Pediatric unit	19 (21.1)	33 (20.9)	
- Cardiology unit	11 (12.2)	20 (12.7)	
Years of Experience:			
- Mean ± SD	7.16 ± 2.08	6.82 ± 1.96	>0.05#
- Range	1.0 - 8.0	1.0 - 12.0	
Working hours/ day			
- Mean ± SD	8.46 ± 2.58	9.02 ± 2.77	>0.05#
- Range	2.0 - 12.0	4.0 - 12.0	
Case load per day			
Mean ± SD	13.44 ± 4.32	14.36 ± 4.58	>0.05#
Range	4.0 – 20.0	2.0 – 20.0	

P value >0.05 is non-significant # t-test ## chi-square test

Table 1 shows that there were no statistical significant differences between both intervention and control hospital nurses regarding their physical profile and occupational history ($p \geq 0.05$).

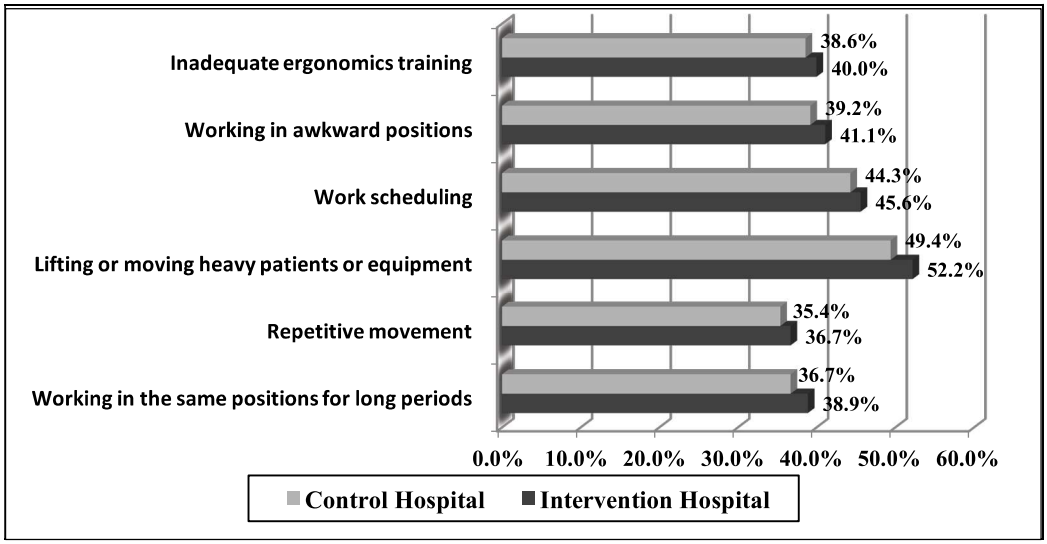

Fig 1: Percentage indicating nurses' perceptions of job risk factors that may contribute to development of WRMSDs.

Figure 1 shows no statistical significant differences between both intervention and control hospital nurses regarding perceptions of job risk factors that may contribute to development of work related musculoskeletal disorders (WRMSDs) ($p \geq 0.05$).

Table 2: Baseline characteristics of MSDs in different body regions among the intervention and control groups adopted from the Standardized Nordic Questionnaire (n1 (No. of nurses in intervention hospital)= 64, n2 (No. of nurses in control hospital) =122).

Question	Shoulder		Lower back		Neck		Knee		Elbow	
	IH (n_1=51) No %	CH (n_2=101) No %	IH (n_1=42) No %	CH (n_2=92) No %	IH (n_1=36) No %	CH (n_2=64) No %	IH (n_1=38) No %	CH (n_2=55) No %	IH (n_1=21) No %	CH (n_2=42) No %
■ **Duration of discomfort in last 12 months**										
- < 1 day	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.1)	1 (4.8)	0 (0.0)
- 1-7 days	14(27.5)	30(29.7)	17(40.5)	45(48.9)	10(27.8)	26(40.6)	6 (15.8)	9 (16.4)	6(28.6)	15(35.7)
- 8 – 30 days	19(37.3)	46(45.5)	15(35.7)	30(32.6)	15(41.7)	16(25.0)	18(47.4)	28(50.9)	8(38.1)	12(28.6)
- > 30 days	12(23.5)	20(19.8)	6 (14.3)	9 (9.8)	10(27.8)	16(25.0)	12(31.6)	10(18.2)	6(28.6)	12(28.6)
- everyday	6 (11.8)	5 (4.9)	4 (9.5)	7 (7.6)	1 (2.8)	6 (9.4)	2 (5.3)	7 (12.7)	0 (0.0)	3 (7.1)
■ **Reduced work activities**	28(54.9)	46(45.5)	35(83.3)	72(78.3)	19(52.8)	26(40.6)	24(63.2)	30(54.5)	4(19.1)	10(23.8)
■ **Reduced leisure activities**	27(52.9)	42(41.6)	36(85.7)	75(81.5)	19(52.8)	26(40.6)	18(47.4)	30(54.5)	5(23.8)	8(19.0)
■ **Change job or job nature**	2 (3.9)	1 (0.99)	5 (11.9)	12(13.0)	1 (2.8)	3 (4.7)	2 (5.3)	5 (9.1)	0 (0)	2 (4.8)
■ **Received medical treatment in past 12 months**	15(29.4)	35(34.7)	26(61.9)	70(96.1)	11(30.6)	22(34.4)	15(39.5)	19(34.5)	5(23.8)	12(28.6)
■ **Discomfort in past 7 days**	28(54.9)	30(29.7)	28(66.7)	43(46.7)	20(55.6)	23(35.9)	24(63.2)	22(40.0)	6(28.6)	12(28.6)
■ **Onset of discomfort:**										
- < 1 month	5 (9.8)	14(13.9)	2 (4.8)	9 (9.8)	1 (2.8)	6 (9.4)	2 (5.3)	5 (9.1)	0 (0.0)	2 (4.8)
- 1 – 6 months	9 (17.6)	20(19.8)	9 (21.4)	30(32.6)	15(41.7)	30(46.9)	12(31.6)	18(32.7)	1 (4.8)	12(28.6)
- 7 – 11 months	17(33.3)	33(32.7)	19(45.2)	35(38.0)	10(27.8)	16(25.0)	12(31.6)	15(27.3)	8(38.1)	15(35.7)
- 1 – 2 years	16(31.4)	24(23.8)	7 (16.7)	12(13.0)	5 (13.9)	8 (12.5)	10(26.3)	12(21.8)	8(38.1)	8 (19.0)
- 3 – 4 years	4 (7.8)	10 (9.9)	5 (11.9)	6 (6.5)	5 (13.9)	4 (6.3)	2 (5.3)	5 (9.1)	4(19.1)	5 (11.9)
- > 5 years	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
■ **Related to job**	48(94.1)	98(97.0)	40(95.2)	75(81.5)	33(91.7)	60(93.8)	37(97.4)	54(98.2)	20(95.2)	37(88.1)

IH= Intervention Hospital CH= Control Hospital

Table 2 shows that the duration of discomfort in the last 12 months was mostly between 8-30 days among almost all types of MSDs disorders and feeling of pain was related to job by most of participants.

Table 3: Physical workload index among the study participants.

Evaluation	Intervention Hospital (No=90)		Control Hospital (No=158)		p value	
	Pre-test No (%)	Post-test No (%)	Pre-test No (%)	Post-test No (%)	Pre vs. pre #	Post vs. post#
Physical work load index						
Low (≤ 22.46)	10 (11)	22 (24)	21 (13)	19 (12)	>0.05	<0.05*
Moderate(22.47-36.37)	74 (82)	65 (72)	123 (77)	126 (79)		
High (≥ 36.38)	6 (6)	3 (3)	14 (8)	13 (8)		

*: Significant # chi-square test

Table 3 shows that there was a significant reduction on physical work-load index among nurses in intervention hospital after intervention ($p < 0.05$).

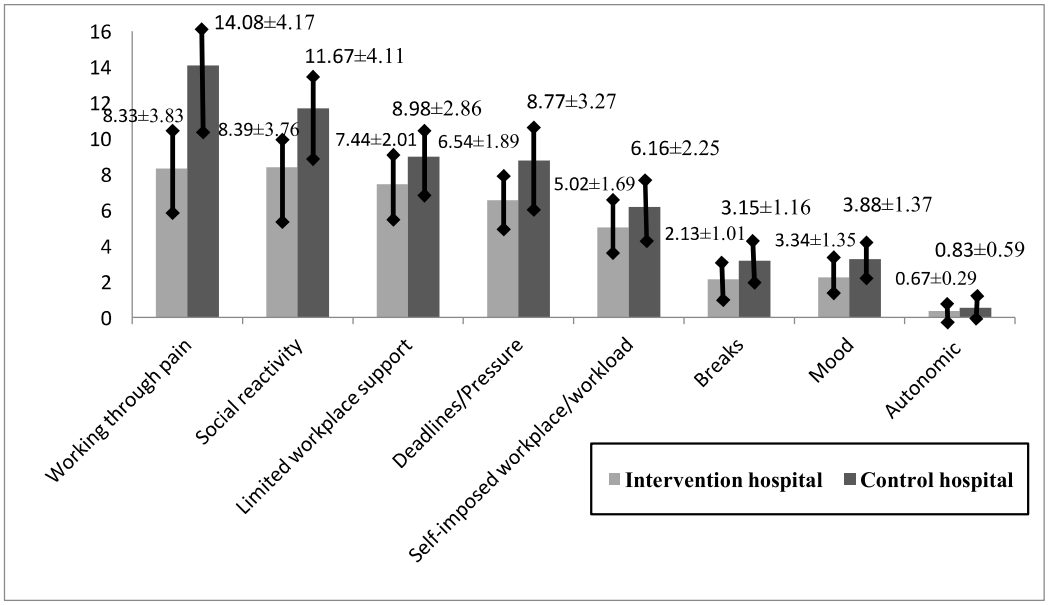

Fig 2: Mean score for workstyle subscales between intervention and control groups after applying the training program.

Figure 2 shows that the mean score for Workstyle subscales was significantly decreased after intervention compared to control hospital nurses ($p < 0.01$).

There was a highly significant reduction ($p < 0.01$) of risk of adverse work style (≥28) after intervention among intervention hospital nurses (97.0% to 74.0%) compared to the control hospital nurses (98.0 % with no change in the follow up).

Results of this study showed that the higher levels of satisfaction were reported for videos (4.33 ± 0.43), exercise program (4.12 ± 0.62), and manuals (4.05 ± 0.54).

Discussion

In an effort to elucidate the prevalence of work related musculoskeletal disorders, its risk factors and evaluating the effect of ergonomic intervention program on ICU nurses regarding WRMSDs. An intervention study was carried out in 7 ICU units of two hospitals divided as case and control groups. There was no difference as regards socio-demographic and occupational criteria between both groups.

Nurses in both groups identified dealing with heavy equipments, unhealthy work schedule, improper back bending or twisting and assisting patients during gait activities as the main job risk factors predisposing to the occurrence of WRMSD (Figure 1). If we look carefully to these factors it represents every day and the most common activities nurses do at ICUs. Moreover, due to shortage in nursing number usually work schedule is overwhelming regarding the time and number of shifts. In agreement with these results previous studies (Telaprolu and Anne, 2014; Mirtaghi et al., 2015 and Sezgin and Esin, 2015) reported that the main work related risk factors of MSDs are physical work efforts as transferring and turning the patient, applying pressure with hands/fingers and awkward posture. In addition, a study conducted in Egypt (Abou El-Soud et al., 2014) found that the most frequent risk factors for MSDS especially low back pain were lifting heavy loads, followed by twisting, prolonged standing, prolonged sitting, walking for long distances, and bending forward. In contrast, other studies (Geiger-Brown and Trinkoff, 2010; Suzan, 2014) identified working more than 10 hours as the main risk factor of MSDs.

As nurses in both groups almost work under the same conditions and had the same socio-demographic criteria, the pattern of MSDs was the same. Most of the nurses felt discomfort due to pain at different body parts for an average period from 8-30days. However everyday pain was mostly due to pain in the shoulders and lower back. This may be explained by the nature of work in ICU from dealing with unconscious patients who need frequent change of position and repeated handling. Lower

back pain was the most incriminated in reduced work and leisure activities, change job nature, received medical treatment and feeling discomfort in the last 7 days (Table 2). This may be explained by the fact that most of nurses spent most of their times at work with different stressors involved in it. Consistently with these results Christiana and Eunice (2012) named low back pain as the most common cause for restricting and limiting activities for the day, taking many days off and thoughts of career shifting. Additionally, Adhikari and Dhakal (2014) clarified that due to LBP; most of nurses were unable to perform their job effectively, became less productive and had restriction in their work duties.

In contrast Lloyd et al. (2014) found that foot/ankle MSDs were the most prevalent conditions experienced by nurses during the preceding seven days, the second and the third most prevalent MSDs to impair physical activity were low-back pain and neck problems during the past 12 months.

High workload in (ICUs) has been identified as a major problem that affects patient safety and worker's heath. Kiekkas et al. (2008) identified workload especially physical as the most important health hazard among ICU nurses. Moderate workload was the commonest among both studied groups (Table 3). This was explained by nurses themselves due to their cooperation in work especially in difficult handling of patients that makes workload milder than supposed to be. In other words, it may be referred to the presence of male workers with more physical endurance than females and helping them in patients handling. In contrast to these results other studies (Queijo et al., 2013 and De Souza Nogueira et al., 2014) identified only high workload index among ICU nurses in comparison to other wards and they explained that by many risk factors as workplace conditions, tools and equipments, the relationship between employees and information exchange, transporting the patient in the hospital and helping colleagues.

As a result of intervention, among the intervention group, low workload was increased and high workload was decreased. This may be explained by the success of intervention in increasing

nurses' attention towards the concept of workload and how to use what they learned in the training about correct body postures and ideal ways for weight lifting. Previous studies (Young et al., 2008 and Weydt, 2009) noted that decreasing workload among nurses is a key to improve quality of work, and increasing their perception towards this important issue through education programs may be the front door in actual reduction of either physical or mental workload.

Work style describes how nurses can ameliorate high workload. Significant reduction in the total score of risky work style was noticed among intervention group as well as significant reduction in risky responses to the workplace and reactivity to high work demands (Figure 2). Study findings showed that the prevalence of adverse Workstyle in almost all of the participants in the pre-test which may be attributed to lack of needed equipments, unsuitable work environment and absence of suitable training which was reflected on nurses' workstyle. These findings are in consistence with that of a recent interventional study among nurses at Hong Kong (Szeto et al., 2013) as there was a statistically significant reduction of the Work style score among the intervention group after implementing of a multifaceted ergonomic program.

Post-intervention satisfaction survey on perceived usefulness of the training program was done. The highest level of satisfaction was about manuals, videos and exercise program, which can be explained by that the practical training and simulation of reality is more interesting than theoretical. Aebersold et al. (2012) demonstrated simulation as an effective method to train practicing nurses for proper positions and handling of patients.

In summary, the present study noted MSDs at different body regions however low back pain was the most disorders intervene with work and everyday activities. Moreover, everyday ICU activities as patient handling were the most common risk factor identified by nurses. Good intervention programs can decrease WRMSDs and how nurses by simple ways can overcome it.

This study was one of little studies that introduced an actual training program with audio- visual and

simulation aids in order to increase awareness about MSDs. Also, the current study focused on different body parts not only one as other studies. Additionally, intervention in this study focused on two fundamental items; patient manual-handling techniques and stretching and relaxation exercises for major body regions. Finally, high response rate (the nurses were most willing to contribute to the study) was one of the most important strengths in this study.

Limitations of the study were in the form of busy work schedule of nurses make it difficult in many situations to complete the sessions. Limited funding made it difficult to introduce patient handling equipments that could help in decreasing WRMSDs among ICUs nurses.

Conclusion

In conclusion, most of nurses reported a positive history of MSDs mainly low back pain which affected their work performance. This study introduced a training program; not just a health education for better change of the nurses' knowledge and faulty practices making them at risk for WRMSDs, but these training programs should be mandatory, a requirement for the nurse qualification and a part of routine hospital policy. Attention should be also drawn to the nursing community needs for supplying patient with lifting and transferring equipments along with regular well designed ergonomic training programs.

Conflict of Interest

Authors have declared that no conflict of interests exists. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for sectors.

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