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Original

The Effect of Ergonomic Educational Intervention on Reducing Musculoskeletal Disorders among Nurses

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Abstract

Background: Nurses are subjected to musculoskeletal disorders for the reason of working situations and pressures, which any neglect of them causes a poor quality of hospital services provided to the patients. So, the present study was conducted to develop and evaluate the intervention based on the educational and reduction of musculoskeletal disorders among nurses of Khansar Fatemieh Hospital. **Methods**: This descriptive-analytical study was carried out on 74 nursing staffs of Fatemieh Hospital, Khansar, Iran, who were studied completely as the whole census. Inclusion criteria were nurses who were responsible for patient transmission, with more than one year of work experience and without a case history of musculoskeletal disorders. Exclusion criteria were surgery or accident while studying as well as disinclination to continue taking part in the study. Initially, the prevalence of musculoskeletal disorders was investigated by Nordic Questionnaire and Occupational Risk Factors by Rapid Body Assessment Technique (REBA). Evaluation criteria for the impact of training consisted of training such as film, pamphlets, handouts, informing in telegram channels, etc. Ultimately, after three months of training courses, the workstation was re-assessed through the above methods, and the data were analyzed through SPSS software version 16, Chi-square statistical tests, McNemar and Wilcoxon tests; then the effectiveness of the educational intervention was identified. **Results**: The mean age and work experience of the participants were 5.27 (32.83)and 4/55 (7.83) year respectively. The results illustrated that the highest rate of prevalence of musculoskeletal disorders was pertinent to the waist (64.90%) and knee (62.20%), wrist (50/00%) in order. The results obtained from the REBA technique indicated that 89.20% of participants were above the range of risk average. After the intervention, statistical tests exhibited a significant reduction in scores and level of risk achieved by the REBA technique (p-value<0/05). Also, the results stated that there was a significant reduction in musculoskeletal pains in the areas of the neck, shoulder, and knee after the intervention (*P*-value<0.05). But no perceptible change could be observed in the other kinesthetic organs of the body (*P*-value>0.05). No significant relationship could be seen between gender, work experience, BMI (Body Mass Index) and prevalence of musculoskeletal disorders (*P*-value>0.05) in this study, but the statistical tests indicated that there was a significant relationship between age and pain in wrist area (*P*-value<0.05). **Conclusion**: The results offer that if preventative ergonomic training is part of multidisciplinary interventions and is presented through training such as film, pamphlets, pamphlets, handouts, informing in telegram channels and etc., it may have more influence on the reduction of musculoskeletal disorders.

Keywords: Educational Intervention; Musculoskeletal Disorders; REBA,; Patient Transmission; Ergonomic

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Introduction

Work-Related Musculoskeletal Disorders (WMSDS) are considered as one of the major challenges in the health system as if about one-third of all healthcare costs are allocated to them and its prevalence in the workplace is increasing outstandingly.[1] Based on conducted investigations by World Health Organization and documentations presented by this organization in 2013 among occupational diseases, WMSDS are ranked as second one after occupational respiratory diseases.[2] Based on the OSHA (Occupational Safety and Health Administration) report, musculoskeletal disorders constitute more than half of the occupational diseases in the United States. [3] 48% of all work-related diseases and complications are constituted by CTDs (Cumulative Trauma Disorders) based on the NIOSH (National Institute for Occupational Safety and Health) report. Moreover, the conducted studies indicate that these disorders are in the first place in terms of prevalence of pain and suffer. For this end, many countries nowadays regard the WMSDs prevention as a national necessity and priority. [4] Now, MDSs are one of the notable factors concerning loss of work time, increase in cost and human damages of labor, absence, law quality and reduce in productivity. [5] The increase in prevalence of musculoskeletal disorders in the workplace has a direct connection with the ergonomic reasons of the workplace . [6] Also, epidemiologic studies illustrate a strong bond between manual handling of material, continuous bending and rotation, heavy physical work, vibration of all body with musculoskeletal disorders. [7] Concerning the definition, musculoskeletal disorders occur as a result of cumulative damage during the time[8] and take place due to physical activity during the time. [9]

Factors that lead to WMSDs consist of occupational activities such as heavy transmission, repetitive movements, inappropriate posture [10] as well as contextual factors such as age, weight, stress, smoking or the existence of musculoskeletal diseases in the prevalence of these diseases. [11, 12] The examinations also show that a significant connection can be observed between musculoskeletal disorders and individual activity in the workplace.[13] Due to work pressure facing with hospital staffs, healthcare personnel are known as the largest and most vulnerable group of practitioners at risk of musculoskeletal disorders.[14, 15] Following NIOSH studies, healthcare staffs such as nurses are at the exposure of high-risk factors for musculoskeletal disorders, such as shoulder and neck injuries. These disorders are mostly associated with the overload of patients' manual handling, using excessive force in pushing and pulling, inappropriate posture during healthcare activities, long working hours and shift work. No group of healthcare workers is immune from injury since all staff at healthcare units such as hospital personnel, nursing homes, emergency services, intensive care, operating rooms, orthopedics, and health homes are at risk for occupational factors. [16] Various factors contribute to the occurrence of musculoskeletal disorders among nurses.[17]

One of the most considerable factors in the high prevalence of musculoskeletal disorders among healthcare workers is patient transmission, which is one of the main tasks of the staff. Helping to disable patients and helping patients to move between beds and wheelchairs is one of the most important activities that exert considerable pressure on people's spinal column.[18] Therefore, to prevent musculoskeletal disorders caused by patients' handling, a precise assessment tool is recommended to identify risks accurately.[19] Among the observation methods MAPO (Movement and Assistance of Hospital Patient), REBA (Rapid Entire Body Assessment), DINO (Direct Instrument Nurse Observation), PTAI (Patient Transfer Assessment Instrument), OWAS (Ovako Working posture Analyzing System), can be mentioned.[20] These injuries are caused due to the most shares of duties in patient care during hospitalization in hospitals .[21] So, the physical and mental health of healthcare staff is remarkable in presenting high-quality healthcare. Inattentiveness to the physical health of nurses makes results in an increase in the loss of working days and a decrease in their work efficiency. Therefore, there must be special attention to these disorders , [22] and the rate of prevalence of musculoskeletal disorders in this population is high and considerable according to the previous studies.[18] Also, musculoskeletal disorders are regarded as a serious problem in this occupational group.[23]

Although, the chief task of patients cares during treatment is the responsibility of this group, which involves the works-related to treatment and regular works of patients. Most of the hospitalized patients required transmission during treatment time, which performed by healthcare personnel. Till now, in research and studies conducted in different parts of the world on musculoskeletal disorders of hospital staffs, especially nurses and based on the results obtained by Karahan's research, it was cleared that 7.85% of samples were

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affected by pain in the area of waist one year after nursing occupations.[24] Attempts for improving safety and reducing work-related injuries had a remarkable influence on the attraction of nurses and enhancement their satisfaction level. So, preventative interventions were necessary to control the risks pertinent to patients' transmission tasks.[25] Therefore, this study was carried out to determine the effect of training the ergonomic principles on musculoskeletal disorders and nurses' physical condition at work.

Methods

This descriptive-analytical study was carried out to determine the prevalence of musculoskeletal disorders on 74 nursing staffs of Fatemieh Hospital, Khansar, Iran, who were studied completely as the whole census. Inclusion criteria were nurses who were responsible for patient transmission, with more than one year of work experience and without a case history of musculoskeletal disorders. Exclusion criteria were surgery or accident while studying as well as disinclination to continue taking part in the study. Furthermore, all the participants in the study were warranted that the obtained information would be secured and they could be excluded from the research process at any time they desired. The required data of this study were gathered with the use of the Nordic Questionnaire (30) and ergonomic evaluation method with the use of the REBA method, which will be discussed in the following.

REBA Method

REBA method was a method applied to assess the likelihood of musculoskeletal disorders occurrence in occupations. The application of this method was taken place for the static, dynamic and the place in which many changes happened to the body during work time. [26] Since inappropriate posture was one of the most important risk factors of MSDs at work, posture analysis was considered as the fundamental of evaluation in many risk assessment methods for MSDs .[27] REBA (Rapid Entire Body Assessment) method was used to assess the working postures with movements. This method was a body condition assessment system which was sensitive to musculoskeletal risks in different tasks, especially for the assessment of working postures.[27] In this method, one analysis of the neck, torso and upper organs (arm, forearm, and wrist) and lower organs was performed. In this method, with the observation of any working condition on the head, torso, lower and upper organs were scored according to their orientation angles. Also, factors such as force, type of grip, and muscle activity were added to the scores and the final score was achieved, which was characterized by the proportion of risk that threatened an individual's musculoskeletal system. The risk level and priority of corrective posture action were separated into 5 categories: negligible group (final score of REBA was 1), low group (final score of REBA was 2-3), medium group (final score of REBA was 4-7), high group (final score of REBA was 8-10), and very high (final score of REBA was 11-15) (table 1, 28).

It should be mentioned that the validity and reliability of the questionnaires applied in this study were approved by other studies.[29] The collected data were analyzed with the use of SPSS 16 software.

Intervention

After ergonomic evaluation of staff and workstations evaluation, the ergonomic intervention began to improve working posture. The ergonomic intervention included educational intervention implemented in the following manner.

Educational Intervention

These interventions were:

Providing and writing some ergonomic training pamphlets, such as administrative ergonomics, patient's proper transmission, and patient handling, and musculoskeletal disorders pamphlets distributed among staff.

Proving three posters of ergonomics training, administrative training and the proper manner of patients' transmission and the ergonomic related to the position of the patients installed in different parts of the hospital.

Holding two training sessions with the use of power point regarding patients' transmission ergonomic, administrative ergonomic, stretching movements during work and exercise, the proper manner of standing and sitting, and musculoskeletal disorders.

Table1. Final Score of REBA

Evaluation and Final Actions	The Value of Risk	Level of Corrective Action	Final score of Risk
Is not necessary	Very low	0	1
It may be necessary	Low	1	2-3
Necessary	medium	2	4-7
It will be necessary soon	high	3	8-10
It is necessary now	Very high	4	11-15

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Creating a telegram channel with the focus on training the principles of ergonomics on patients' transmission, films and animations related to the patient mobility and positioning, musculoskeletal disorders, warnings on the issue of ergonomic principles …

Delivering a booklet based on transmission principles and lifting the patients and injuries (Tabriz University of Medical Sciences Publications) to the Hospital Occupational Health Unit and reproducing the number of sections and placing in nurses' workstations

Also, after coordinating with the Hospital Training Unit and the Emergency Base Training Unit of Khansar, practical meetings were held for personnel on patients' transmission.

After accomplishing training and justifying the staff for the implementation of the trained principles, a three-month follow-up was performed to enable the staff to fulfill the trained principles.

Assessing the Effectiveness of Interventions

After fulfilling all the interventions, follow-up and periodic inspections for implementing the trained principles and the correct manner of doing a job, the risk factors of musculoskeletal disorders assessment were performed again after three months of follow-up to implement the ergonomic principles. After three months of implementing the ergonomic principles, posture assessment was evaluated by REBA and Nordic methods. The effectiveness of interventions at workstations and postures of staff at work was determined after the educational intervention and the data were compared with pre-intervention data.

Musculoskeletal Disorders Questionnaire (Nordic Musculoskeletal Questionnaire)

One of the tools used in this study was the Nordic Musculoskeletal Questionnaire which was one of the most comprehensive tools for assessing the prevalence of musculoskeletal disorders.[30] To this end, the Persian translation of the standard Nordic questionnaire was applied in this study.[31] In general, two main objectives were pursued in designing this questionnaire: A) as a tool for screening musculoskeletal disorders and (B) for occupational health services. These questionnaires could be applicable in measuring the results of epidemiological studies in the field of musculoskeletal disorders. Each questionnaire involved 12 questions related to individual, occupational, the prevalence of disorders in different parts of the body, severity, and duration of pain due to these disorders. This also included demographic information of individuals including age, weight, height, work experience and gender.[32] The validity and reliability of the Nordic questionnaire were approved in one study conducted by Choobineh.[33]

In the first part of the present study, demographic data of individuals including age, weight, height, work experience and gender were investigated. The second part examined the prevalence of musculoskeletal disorders in different areas of the body including pain in each of the organs of the neck, shoulder, elbow, wrist, waist, back, thigh, knee, and ankle. After presenting the required guidance for nurses, they were asked to respond to pain in each of the organs that existed in the questionnaire. Each questionnaire had 12 questions with "Yes" and "No" options, in which code 1 allocated to "Yes" and code 0 to "No". In this questionnaire, musculoskeletal disorders were assessed in the last 12 months and 7 days. The data for the last 12 months were applied to assess the prevalence of skeletal disorders and the data for the last 7 days to evaluate the impact of training on musculoskeletal disorders. Statistical tests were fulfilled using McNemar, Chi-square and Wilcoxon tests using SPSS 16 software. The Kolmogorov-Smirnov test deduced that there was no proof to admit the hypothesis of normality of the data obtained by the REBA method evaluation (p-value = 0.000). For this end, Wilcoxon test was used to compare pre- and post-intervention scores. McNemar test was used in this study to compare the ratio of skeletal disorders in each organ before and after the intervention due to correlation of samples.

Results

The results of the present study illustrated that the mean age of the participants were 5.27 (32.83) years, denoting that the participants were almost young. [35] (47.30%) of participants were men and 39 (52.70%) of them were women. The mean for work experience was 4.55(7.83) years. BMI in the population under study indicated that 1/40% of participants were thin, 52.70% of them had normal weight, 44.60% of them were overweight and 1.40% of them were involved in obesity. Figure 1 exhibited a frequency percentage of musculoskeletal disorders in various organs over the past year in the population under study. The obtained results of the Nordic questionnaire indicated that pain in waist, knee, wrist and ankle areas constituted the most percent of disorders for nurses in the past year.

The results of the table2 dedicated a significant

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relationship between age and pain in the area of the wrist. But there was no relation between demographic variables with the prevalence of skeletal disorders in organs (all quantitative variables were categorized and shifted to qualitative variables).

The frequency percentage of musculoskeletal disorders before and after the educational intervention in the study population was presented in table 3. As you can observe in this table, the frequency percentage of musculoskeletal disorders in kinesthetic organs was decreased after the intervention. The results of pre- and post-intervention showed that there was a significant decrease in neck, shoulder and knee pain after implementing the educational intervention (*P*-value<0.05), and this reduction displayed the impact of training on staff.

The results obtained from the evaluation with the REBA method before the intervention showed that 10/80% of working postures were at the medium risk level and 89.20% of them were at the high-risk levels. Having implemented the educational intervention, a significant decrease was observed in scores and REBA risk levels. Table 2 showed the frequency percentage of risk levels before and after the intervention with the use of the REBA method. There was a significant decrease in this graph among the risk levels obtained from the REBA technique.

Besides, there was a significant reduction in the average score of REBA with implementing the intervention (*P*-value<0.05). The results obtained from table 4 exhibited the comparison of REBA method evaluation before and after the intervention. The average score of REBA was decreased with performing the educational intervention.

Table 5 illustrates the results obtained from determination of the relation between the risk level of REBA method and the prevalence of pre-intervention musculoskeletal disorders. Based on data of this table, there was no significant relation between the rate of musculoskeletal disorders and REBA risk levels.

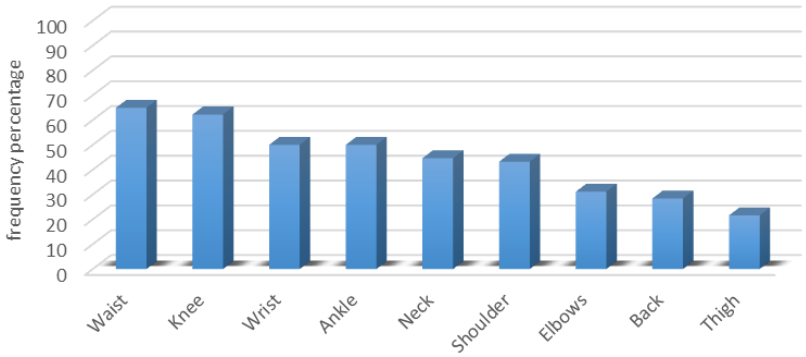

Figure 1. Frequency Percentage of Musculoskeletal Disorders over the past year

Table2. Examination of the Relation between the Prevalence of Musculoskeletal Disorders in organs with Demographic Variables

Variable	*P_Value								
	Neck	Shoulder	Wrist	Elbows	Back	Waist	Thigh	Knee	Ankles
Age(Year)	0.443	0.748	0.933	0.033	0.060	0.077	0.520	0.229	0.183
Gender	0.222	0.684	0.286	0.103	0.318	0.071	0.130	0.718	0.816
Work experience(Year)	0.758	0.096	0.618	0.483	0.300	0.139	0.756	0.086	0.246
BMI (Kg/cm^2)	0.609	0.422	0.408	0.334	0.837	0.189	0.156	0.735	0.248

*Chi-Square Test (at the 0.05 significance level)

Table3. Frequency Percentage of Musculoskeletal Disorders in Organs before and after the Educational Intervention

Percentage (%)	Organs								
	Neck	Shoulder	Wrist	Elbows	Back	waist	Thigh	Knee	Ankles
Before	40.50	41.90	31.10	24.30	9.50	51.40	18.90	52.70	24.30
After	25.70	23.00	24.30	17.60	16.20	36.50	17.60	36.50	21.60
*P-Value	0.033	0.015	0.300	0.424	0.167	0.055	0.798	0.045	0.686

*McNemar Test (at the 0/05 significance level)

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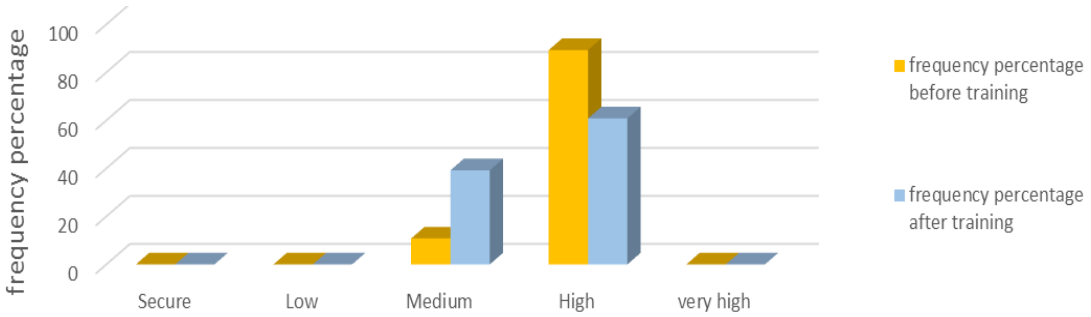

Figure 2. Frequency Percentage of Risk Levels with the REBA Method

Table4. Results Obtained from Comparison of Evaluation with REBA Method before and after the Intervention, Respectively

Group	Number	Average Score of REBA (Standard Deviation)		*P-value
		Before Intervention	After Intervention	
Intervention	74	8.40 (0.89)	7.67 (0.72)	0.001

* Wilcoxon test (at the 0.05 Significance Level)

Table5. The Results Obtained from Determination of the Relation between the Risk Level of REBA Method and the Prevalence of Musculoskeletal Disorders before the Intervention

Frequency	Organs								
	Neck	Shoulder	Wrist	Elbows	Back	Waist	Thigh	Knee	Ankles
*P-Value	0.281	0.270	0.229	0.134	0.822	0.086	0.259	0.400	1.00

*Chi-Square Test (at the 0.05 Significance Level)

Discussion

The results of the present study declared that the prevalence of musculoskeletal disorders in the waist, knee, wrist and ankle muscles were the highest frequent, respectively, and this study was consistent with the study conducted by Sharifnia et al., in which nurses were complaining of the pain in the waist, knee, and neck areas; So these two studies were common in terms of pain in the waist and knee area. [34] Magnago and et al, (2010) carried out a cross-sectional study in Brazil with the use of a Nordic questionnaire on 491 nurses. They reported the prevalence range of musculoskeletal disorders in the waist area as 71.5% in the 12 last months . [35] Also, in a cross-sectional study by Choobineh et al, (2007) on 642 nurses from 46 different sections of 12 hospitals, it was concluded that the prevalence of back pain as 54.9% in the last 12 months.[36] Also, another study conducted by Choobineh et al, (2010) on nurses in the operating room reported that the prevalence of back pain was 60/6. [37] In the study carried out by Smith et al. (2006) the prevalence of musculoskeletal disorders in the waist area for 844 participants was reported as 71.3% , [38] indicating the pain in the nurses' back area. In the study conducted by Abedini et al., it was observed that the pain in the waist legs, hands, and wrist area had the highest frequency.[39] In the conducted study, back pain had the highest frequency that may be for the reason of nurses' work nature during doing tasks such as patients' transmission. This matter was due to the necessity of sudden movements, back rotation and bending, and improper physical posture.[40]

The results achieved by this study displayed that there was no significant relationship between independent variables of work experience and BMI with the prevalence of musculoskeletal disorders, which was consistent with the study conducted by Dehdashti. [40] Also, the study by Askarpour et al. indicated that work experience and BMI did not affect the prevalence of musculoskeletal disorders.[41] However the results of the present study stated that there was a significant relationship between age and back pain, there was this relation on 110 nurses in Rokni's study. [42] A significant relation was cleared between age and pain in the ankle area in Dadarkhah's study. [43] This discrepancy in results was due to differences in the sample size, or the mean age of participants. This study indicated that there was no significant relationship between gender and prevalence of

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musculoskeletal disorders, [42] which was in line with the study by Askarpour et al.[41] This study found out that there was a significant decrease in musculoskeletal disorders of the neck, shoulder, and knee with educational intervention. The study conducted by Saremi et al. on dentists concluded that there was a significant decrease in musculoskeletal disorders of neck, shoulder and back area with performing the educational intervention,[44] which was consistent with the present study in terms of results of the neck and shoulder pain. The study by Farahani et al. declared that the training program was effective in reducing the frequency distribution of musculoskeletal disorders in the ankle area.[45]

A study conducted by Shirdelzadeh et al. on 50 personnel with transmission duty at Gonabad Hospital understood that only the musculoskeletal disorders of elbow and ankle decreased significantly with performing the intervention.[46] The study carried out by Motamedzadeh et al. on 46 staff in different sections of Nahavand hospital indicated that training alone had little impact on the reduction of musculoskeletal disorders in the therapeutic milieu. [47] The results of Motamedzadeh's study were not in line with the results of the present study and it was due to differences in sample size, differences in duration of training courses and type of prepared training. Therefore, concerning the present study and the last study, it can be deduced that lack of proper training of patients' transmission can result in musculoskeletal disorders in individuals.[48, 49] The results of data analysis obtained from this study concluded that no significant relationship observed between risk levels of REBA technique and musculoskeletal disorders reported by nurses for one year. The study conducted by Daneshmandi et al. in the midwifery community declared that there was no significant statistical difference between the prevalence of musculoskeletal disorders and the level of risk obtained with the use of the REBA method.[50] In the research conducted by Amini et al. on dentists, it was cleared that there was no significant relation between scores earned by the REBA method and musculoskeletal pain, which was consistent with the present study.[51]

In this study, the assessment results with the use of the pre-intervention REBA checklist stated that 89/30% of the participants were at high-risk level, but this risk level was decreased to 60.8% after the intervention, which was denoted the effect of educational intervention on the nurses' posture. The significance differences, which were achieved after the implementation of the educational intervention at-risk levels of risk assessment by the REBA method, exhibited that educational intervention was effective on the correctness of nurses' working posture. The study conducted by Saremiet al. on the dental society deduced that a significant difference was observed between final scores and risk levels achieved by the risk level after the implementation of the educational intervention.[44] Significance difference between the mean scores of REBA before and after the ergonomic intervention was also the other result of this study, which meant the effectiveness of the trained principles on the nurses' posture. In the study carried out by Arsalani et al. on 20 nurses, a significant statistical difference was taken into consideration between mean scores obtained from the PTAI method before and after the ergonomic intervention . [48] Farhadi et al.'s study on 57 dental students indicated that the mean score of pre-training REBA was significantly different with a mean score of post-training REBA, and it became clear that it was consistent with the present study.[52] According to the results of this study and the task of transmission and patients' positioning, it is suggested to use firstly modern equipment and advanced mechanical devices for transmission of patients. But work techniques training and ergonomic principles training can enhance the working performance of nursing personnel, since performing the educational intervention improves physical condition and decreases musculoskeletal disorders. Consequently, it is recommended to offer sessions to re-train this subject, while teaching the principles and ergonomics issues to employees in this organizational position.

Conclusion

The findings and results of the present study illustrated that musculoskeletal disorders were highly prevalent in nurses, and poor and unsuitable postures at work were one of the chief causes of these disorders. It appeared that training program for proper patients' transmission techniques and ergonomic principles training were main issues in protecting the nursing society, since performing the educational intervention program resulted in reducing musculoskeletal disorders and correction of the physical condition while working in the population under study.

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