Relationship between Knowledge of Ergonomics and Workplace Condition with Musculoskeletal Disorders among Nurses

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Abstract

Aims: Using ergonomics principles are effective on increasing production, job satisfaction productivity, and reducing medical and healing costs. This study investigated the relationship between nurses' knowledge of ergonomic principles with their musculoskeletal disorders (MSDs). **Materials and Methods:** This descriptive and analytical study was performed on 260 nurses working in selected hospital in Kashan/Iran, 2018. The nurses were randomly recruited to the study. Data were collected through personal profile questionnaires, knowledge of the ergonomics of the workplace, the questionnaire of the workplace ergonomics, and Nordic skeletal musculoskeletal questionnaire. Data were analyzed using the SPSS version 16 software. Descriptive statistics (frequency distribution, mean, and standard deviation) and inferential statistics (Chi-square, Fisher's exact, and Pearson's correlation coefficient) were used for data analysis. **Results:** The nursing staff had low level of knowledge with a mean score of (2.20 ± 0.68). The ergonomic condition of the nurses' work environment was weak (2.50 ± 0.76). About 77% of participants reported the MSD (neck 62.7% and shoulder pain 49.2%) and the least difficulty was in the elbow region (20.4%). There was a significant and negative correlation between knowledge of ergonomics principles ($r = -0.180$) and ergonomics condition of the workplace ($r = -0.160$) with musculoskeletal injuries. **Conclusion:** The study findings indicated low level of knowledge of the nurses regarding the ergonomics of workplace principles. Furthermore, results showed the ergonomics of the workplace was poor. The prevalence of MSD was high, which needs appropriate training and respecting ergonomics principles in the workplace.

Keywords: Musculoskeletal problems, nurses, workplace ergonomics

INTRODUCTION

Ergonomics is the science of work of the people who do it and the ways it is done; the tools and equipment they use, the places they work in, and the psychosocial aspects of the working situation.[1,2]

The objective of ergonomics is to obtain an effective match between the user and work station to improve working efficiency, health, safety, comfort, and easiness to the user. Neglect of ergonomics principles results in inefficiency and pain in the workplace.[3]

One of the striking topics in ergonomics is work-related musculoskeletal disorders (WMSDs). WMSDs is defined as abnormalities in muscles, bones, joints, nerves, and blood vessels.[4] MSDs are one of the most common causes of occupational injuries and disability that consist of 65% of occupational diseases.[5,6] Hence, many countries have considered the prevention of WMSDs as one of the national priorities and its control among the working populations, is one of the most important problems of ergonomics specialists worldwide.[7]

The MSDs are one of the most frequent health problems related directly to working conditions that occur in nurses.[8]

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MSDs among nurses worldwide have been reported to have a prevalence of between 40% and 90%.[9] In Iran, nurses compromise 80% of health-care staffs, and prevalence of these disorders has been reported to be 60%–80% among them.[10] MSDs among nurses, dentists, and physicians occur in different parts of the body, including neck, knees, ankles, and back such that low back pain is the most prevalent one.[11,12]

One of the factors which affect the occurrence of WMSDs is lack of ergonomics principles knowledge and not using it in the workplace. In fact, upgrading nurses' knowledge in the field of ergonomics, have had decreasing medical expenses, increasing efficiency, decreasing absenteeism pattern, decreasing the costs of WMSDs, and increasing the economic benefits.[10] Rahimi Moghadam *et al*.'s, in 2018, study showed that the relationship between knowledge of ergonomics and WMSDs among the physiotherapist is reverse and meaningful.[13] Findings in Zakeriyan *et al*., in Tehran, showed that the nurses' knowledge of ergonomics science was in an intermediate level and there was meaningful relationship between knowledge of ergonomics science and WMSDS, the more nurses knew workplace ergonomics principles, the less they had work-related injuries and problems.[14] However, the findings in Juibari *et al*. in 2010 study in Golestan province showed that knowledge of ergonomics among nurses was high, but there was no statistically significant relationship between these two variables.[15] Physical factors, such as manual handling, frequent bending and twisting, forceful movements, and awkward working postures, which has contributed to the problem of inadequate staffing, has been associated with WMSDs among nurses.[16,17] Considering these risk factors is important because ignoring ergonomic principles over time lead to the loss of time and workforce, early disability, and early fatigue of nurses.[18] On the other hand, the finding shows that respecting ergonomic principles in the workplace has a significant impact on reducing medical costs and psychological stresses, increase the production, job satisfaction, and performance and totally increase the national income.[15,19]

Nurses are an efficient and effective part of any health system, so investigating their knowledge of ergonomic principles and MSDs related to work in nurses are important.[14] Few researches have been done on the musculoskeletal problems of nurses and their relation with working conditions and the nurses' awareness of ergonomic principles with outright findings.[14,15] This study is aimed to evaluate the relation between the nurses' awareness of ergonomic principles and workplace conditions with WMSDs in Shahid Beheshti Hospital, Kashan University of Medical Science in 2018.

MATERIALS AND METHODS

Study setting and design

This descriptive-analytical research was performed on all of the nursing personnel working in Shahid Beheshti Hospital affiliated with Kashan University of Medical Science, in 2018. Hospital is the largest hospital in the city with more than 600 beds serving more than 500,000 people.

Sampling and sample size

For calculating sample size, the amount of correlation coefficient between the nurses' awareness of ergonomics principles and skeletal injuries was estimated to be 0.18 and with the confidence interval of 95% and test power of 80% and using the following formula, the minimum sample size was calculated at 240 persons considering a study conducted by Zakeriyan *et al*.,[14] at the end with a 10% drop, 260 individuals were recruited to the study.

$$n = \left(\frac{Z_{1-\frac{\alpha}{2}} + Z_{1-b}}{0.5 ln\left(\frac{1+r}{1+r}\right)} \right)^2 + 3 = \left(\frac{1.96 + 0.84}{0.5 ln\left(\frac{1+0.18}{1-0.18}\right)} \right)^2 + 3 = 240$$

The participants were selected randomly from the provided list. Inclusion criteria were willingness to participate in the study, having BSc or higher degree in nursing, having worked as a clinical nurse for at least 1 year. Nurses with a history of MSDs caused by nonwork-related diseases or trauma were excluded from the study and nurses who met the criteria of the study were identified and all eligible participants were informed and invited to participate.

Measurement and data gathering

Besides demographic information including sex, age, marital status, education, and work experience, three questionnaires were used in this study:

- The Nordic questionnaire of musculoskeletal symptoms: Rate of MSDs was measured by the Nordic questionnaire of musculoskeletal symptoms.[20] This questionnaire is a standard and valid tool that has been developed by professional health institute of Nordic countries. The questionnaire composed of two parts as follows: (a) general and (b) specific questionnaires. The first part was questioned by the general objective of the symptoms of the entire body disorder, whereas the second part deeply analyzed symptoms in a specific region such as waist, neck, and shoulders. The answers to the Nordic questionnaire were rated zero or 1, and the frequency of answers is important.[21,22] Validity and reliability of the questionnaire were certified in Mossadeghrad's study in 2004.[23] Reliability was checked by examining internal consistency (Cronbach's alpha coefficient) was 0.85 and 0.82, respectively. Validity and reliability of the above-mentioned questionnaire to evaluate MSDs, especially related to work-related injuries were certified in Pugh *et al*. and reported as good.[22] This instrument was also translated and localized to the Persian version by Mokhtarinia *et al*. in 2015. The face validity of the Persian version was examined and re-examined and was more than 0.7. The Kappa coefficient was also used to measure the

inter-rater agreement for nominal variable and calculated as 0.78[20]

- Questionnaire to measure knowledge of a nurse regarding ergonomic principles in the workplace including 13 closed questions in a Likert scale.

The Nursing Worker's Questionnaire including 16 closed questions on the Likert scale used by Zakerian *et al.*[24]

The answers to second and third questionnaires were rated from zero to five (never = 0, rare = 1, low = 2, medium = 3, high = 4, and very high = 5). Then, the average score of each three parts was calculated. The average rate of nurses' awareness from ergonomic principles, work conditions, and work-related injuries categorized as follows:

- Score <2: very weak (very low for the third part of the questionnaire)
- 2–2.75: weak (low for the third part of the questionnaire)
- 2.76–3.5: medium
- 3.51–4.25: good (much for the third part of questionnaire) and
- 4.26–5: very much (very good for the third part of questionnaire).

Ethical considerations

The research was approved by the ethics committee in the research of Kashan University of Medical Science with the ethical code: (No. IR.KAUMS.NUHEPM.REC.1397.004). Questionnaires were provided to participants when the research objectives were described, and they were announced that their participation and withdrawal were optional, their identity was remained confidential, and the written informed consent was signed by all the participants.

Data analysis

Data were analyzed using the SPSS Software version 16 (IBM Co.,USA). Descriptive statistics (consist of frequencies and mean [standard deviation]) and inferential statistics (consist of Chi-square test, Fisher's exact test, and two-string spatial correlation) were analyzed.

RESULTS

Result of our study show that the number of female participants (62.3%) was more than men and the number of married nurses (57.3%) was more than singles. Most of nurses were also in the age group of 36–40 (41.5%) years and the age group of 31–35 (25.4%) years old was in the next rank. The education of majority (90.4%) of nurses was Bachelor of Science and their work experience between 5 and 10 years, shows the most frequencies (35.4%) [Table 1].

The result shows that the knowledge of ergonomic principles is low (41.2%) among most of the nurses and the obtained average (2.20 ± 0.68) also shows low knowledge of participants of the principles of ergonomics. Most of the understudy nurses (34.7%) announced that the ergonomics conditions of their workplace was weak which the obtained average also

Table 1: Frequencies of demographic information of the nurses

Variable	Frequency (%)
Gender	
Female	162 (62.3)
Male	98 (37.7)
Marital status	
Single	111 (42.7)
Married	149 (57.3)
Age	
25-30	50 (19.2)
31-35	66 (25.4)
36-40	108 (41.5)
41-45	28 (10.8)
46-50	8 (3.1)
Education	
Bachelor of science	235 (90.4)
Master of science	25 (9.6)
Work experience (years)	
<5	70 (27)
5-10	92 (35.4)
11-15	60 (23)
>15	38 (14.6)

Table 2: Rate of frequencies of descriptive indices related to knowledge of ergonomics principles and workplace ergonomics conditions variables

Variable	Frequencies (%)
Knowledge of ergonomics principles	
Very low (<2)	94 (36.1)
Low (2-2.75)	107 (41.2)
Medium (2.76-3.5)	59 (22.7)
2.20±0.68	
Workplace ergonomics conditions	
Very weak (<2)	69 (26.5)
Weak (2-2.75)	90 (34.7)
Medium (2.76-3.5)	73 (28.1)
Good (3.51-4.25)	24 (9.2)
Very good (>4.25)	4 (1.5)
2.50±0.76	

shows the weakness (2.50 ± 0.76) of ergonomics conditions of their workplace [Table 2].

Results of Table 3 show that neck problem (62.7%) has the highest prevalence among the participants and shoulders, waist, back, knee, wrist and hand, feet and ankles, and hips and thighs with 49.3%, 48.8%, 42.7%, 40.8%, 40%, 38.8%, and 27.7% are in the next rank, respectively. Elbow problem (20.4%) has the least prevalence among the participants [Table 3].

As it is shown in Table 4, there is a meaningful and negative relationship between the variable of knowledge of ergonomics principles ($r = -0.180$) and workplace ergonomics conditions ($r = -0.160$) ($P < 0.05$) [Table 4].

Table 3: Frequency of musculoskeletal disorders in nurses based on existence/nonexistence of injuries in 9 regions

Problem	Frequency (%)
Neck	
Yes	163 (62.7)
No	97 (37.3)
Shoulders	
Yes	128 (49.2)
No	132 (50.8)
Elbow	
Yes	53 (20.4)
No	207 (79.6)
Wrist/hand	
Yes	104 (40)
No	156 (60)
Back	
Yes	111 (42.7)
No	149 (57.3)
Waist	
Yes	127 (48.8)
No	133 (51.2)
Hips and thighs	
Yes	72 (27.7)
No	188 (72.3)
Knee	
Yes	106 (40.8)
No	154 (59.2)
Feet and ankles	
Yes	101 (38.8)
No	159 (61.2)

Table 4: Obtained results of relationship between knowledge of ergonomics principles with workplace ergonomics conditions and musculoskeletal disorders among the nurses

	Muscular	
Variable	**Musculoskeletal disorders**	
	Correlation coefficient	***P***
Knowledge of ergonomics principles	−0.180	0.005
Workplace ergonomics conditions	−0.160	0.012

Result shows that the frequency of musculoskeletal problems with demographic variables. There was a significant relationship between MSDs among the nurses and their age and work experience ($P < 0.05$), but there was no significant relationship between musculoskeletal problems and the variables of gender, marital status, and their education ($P > 0.05$) [Table 5].

The nurses with one of the problems in one of the nine regions are considered as nurses who have MSD, and the other who had no problem in none of the nine regions are considered

as nurses without MSD to determine the variable of MSDs generally.

DISCUSSION

The present study investigated the relationship between knowledge of ergonomics principles and workplace ergonomics conditions and MSDs among the nurses. In accordance with the obtained average scores, nurses' knowledge about working ergonomics conditions was low. In this regard, average scores of nurses' awareness of ergonomic principles were reported mediocre in accordance with Zakeriyan *et al.* study.[14] Mosadeghrad was also announced the nurses' knowledge of ergonomic was low.[23] However, Juibari *et al*., reported the nurses' knowledge of ergonomics principles were high.[15] The reason for such a difference can be the differences between statistical society and the differences between the participants. Sawyer studied the computer users in Vayala, South Australia, they reported that the participants had no knowledge of ergonomic principles that relate to computer use.[25] One of the possible reasons associated with the low level of nurses' awareness of ergonomic principles, is management and care system's lack of attention to the importance of educational issues related to the principles of ergonomics in the workplace. In fact, the focus of the care system on care and health of the patient is greater than on the safety of the workplace. Besides the lack of training courses related to principles of occupational safety and health and workplace, ergonomic conditions can be effective in this regard.

Findings in this study showed the average of workplace ergonomic conditions was weak. In this regard, the average of workplace conditions of the nurses was reported mediocre by Zakeriyan *et al*.,[14] and was reported weak by Rokni *et al*.[26] Khoshbakht, also were studied on 91 nursing personnel and reported that most nurses' workplace ergonomic conditions were mediocre.[27] In studies performed by Mosadeghrad, nurses' workplace ergonomic conditions (consist of lighting, ventilation, heating, cooling, relaxation, equipment, work environment, protective equipment and …) evaluated weak.[23] In the context of this finding, it can be inferred that the term ergonomic status of work environment is not limited to a single dimension and consists a range of issues such as lighting and temperature of the work environment, using sound and standard equipment, principles of transport and right way of moving things, facing sharp, winning or contaminated equipment, rest during work time, using of protective mechanism for working with chemical material. On the other hand, nursing profession is related to different aspects of ergonomic conditions and it seems that in this study, nurses were involved with various problems and stresses, such as poor lighting, poorly ventilation of workplace, lack of sound equipment, inappropriate method of patient transfer and facing with sharp and contaminated equipment, lack of use of protective mechanisms associated with drugs and blood products for reasons such as lack of knowledge of

Table 5: Frequency of nurses based on existence/ nonexistence of musculoskeletal problems by demographic

Variables with associated test		
Demographic variable	Musculoskeletal prolems, frequency (%)	Statistics (*P*)
	Yes	No
Gender		
Male	100 (62.1)	62 (62.6)	0.140
Female	61 (37.9)	37 (37.4)	
Marital status		
Single	75 (38.9)	36 (53.7)	0.083
Married	118 (61.1)	31 (46.3)	
Age		
25-30	40 (18.5)	10 (22.7)	0.004
31-35	50 (22.1)	16 (36.4)	
36-40	90 (41.7)	18 (40.9)	
41-45	28 (13.0)	0 (0.0)	
46-50	8 (3.7)	0 (0.0)	
Education		
Bachelor of science	200 (90.9)	35 (87.5)	0.087
Master of science	20 (9.1)	5 (12.5)	
Work experience (years)		
<5	35 (18)	35 (53)	0.000
5-10	76 (39.2)	16 (24)	
11-15	45 (23.2)	15 (23)	
>15	38 (19.6)	0 (0.0)	

ergonomic principles and lack of nursing assistant, lack of rest during work time, multiple work shifts, which all affecting the workplace ergonomics conditions.

According to findings, 77% of people suffered from musculoskeletal problems; mostly in the neck (62.7%) and shoulders (49.2%) and least in elbow (20.4%). This finding is in line with the results of the study by Zakeriyan *et al*.,[14] Dehdashti *et al*., Nasiry Zarrin Ghabaee *et al*.,[28] and Rad.[23] Along with this finding, Maul *et al*. found that the most common injuries in nursing care include low back pain, neck, shoulder problems, arm injuries, wrist, and knee.[29]

Tinubu *et al*. reported the highest prevalence of MSDs among nursing of Southwestern Nigeria in the past 12 months include the back, neck, and knee, respectively.[16] Adjibas also had the highest MSDs in the waist area and the least damage to the elbow region reported.[30] Findings from Dadarkhah *et al*.,[31] Ando *et al*.,[32] and Smith *et al*.[33] studies showed the highest prevalence of MSDs was in the lumbar region. In explaining this finding, it can be stated that caring for people frequently involves the transfer of patients from the bed to the stretcher, sitting and long standing, bending and twisting, pushing or lifting awkward loads and therefore is one of the main causes of MSDs for nurses.

MSDs were also significantly higher among older nurses with more work experience, but there was no significant relationship between gender, marital status, and education level. Together with this finding, Juibari *et al*.,[15] Mohseni-Bandpei *et al*.,[34] Maroufi *et al*.,[35] Polanyi *et al*.[36] and Omokhodion *et al*.[37] found that there is a significant relationship between age and work experience and the prevalence of low back pain among nurses. Since the proper education of body mechanics during work is not complete and trainings during academic courses are forgotten, thus this shortage of awareness can lead to increasing age-related MSDs. It should not be forgotten that the aging process is naturally accompanied by a physical capacity weakness and movement function of the individual, which can result in weaker work techniques and therefore, a greater prevalence of pain due to MSDs.

According to the results of this study, there is a reverse and significant relationship between knowledge of ergonomic principles and the level of workplace ergonomics with the level of musculoskeletal problems in nurses. This finding is consistent with the results of Zakeriyan *et al*.[14] and Rad.[23] The findings of numerous studies also showed that using appropriate equipment significantly decrease the prevalence of musculoskeletal disorders.[19,38-40] In confirmation, findings of Lagerström *et al*. approved that the use of new techniques for nursing for transporting the patient has reduced the symptoms of pain in the waist and pelvis.[41] Aung study findings also showed that the use of auxiliary equipment, such as a crane for transporting patients and training nurses on ergonomic principles, has led to a reduction in musculoskeletal injuries in nurses.[39] In accordance with the above findings, it was concluded that nurses' training related to the correct way of doing work, the importance of resting and interrupting to do things that take a long time, and the use of equipment and facilities available play a significant role to prevent occupational injuries and increase productivity.

Conclusion

It can be concluded that the occurrence of musculoskeletal problems and the lack of knowledge and awareness among nurses in relation to ergonomic principles are common. Therefore, preparation and development of a comprehensive and continuous training program to increase nurses' knowledge of ergonomic principles, their familiarity with proper working methods, how to use therapeutic equipment, methods for managing stress, and providing an appropriate ergonomic work environment can play a significant role in reducing musculoskeletal problems among nurses. In order to achieve the following goals, all round planning is highly felt by health policy-makers in the health system.

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