

# Ergonomic Relationship during Work in Nursing Staff of Intensive Care Unit with Operating Room

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## Abstract

**Background and Objectives:** High prevalence of work-related musculoskeletal disorders, especially in jobs such as nursing which covers tasks like patients' repositioning, has attracted great attentions from occupational healthcare experts to necessitate the knowledge of ergonomic science. Therefore, this study was performed aiming at ergonomic relationship during work in nursing staff of Intensive Care Unit (ICU) with operating room. **Materials and Methods:** In this descriptive-analytical study (cohort), fifty personnel of ICU staff and fifty of operating room staff were selected through a census method and were assessed using tools such as Nordic questionnaire and Rapid Entire Body Assessment (REBA) standards in terms of body posture ergonomics. The obtained data were analyzed by SPSS software and Chi-Square test after collection. **Results:** The most complaints were from the operating room group (68%) and ICU staff (60%) for the lumbar musculoskeletal system. There was a significant relationship between the total REBA scores of body, legs, neck, arm, force status, load fitting with hands and static or dynamic activities in the operating room and ICU staff groups ( $P < 0.05$ ). In operating room and ICU groups, most subjects obtained score 11–15 and very high-risk level. **Conclusion:** Nurses working at operating room and ICU ward are subjected to high-risk levels and occupational injuries which is dramatically resulted from inappropriate body posture or particular conditions of their works. As a result, taking corrective actions along with planning and identifying ways will help prohibiting the prevalence of disorders in the future.

**Keywords:** Ergonomics, Intensive Care Unit, nursing staff, occupational injuries, operating room ward

## INTRODUCTION

Work related musculoskeletal disorder (MSD) is considerable occupational health-care problem worldwide, both in advancing and industrial countries and the common reasons of which are non-ergonomic actions during lifting or pulling, repetitive tasks and stretching positions or doing tasks under stable and improper physical conditions. Health-care providing jobs are considered as high-risk MSD among others.<sup>[1]</sup> Fujishiro *et al.*, notes in his study that 12% of health-care providers in the U. S suffer from occupational injuries predominantly occur in their back or shoulders. These types of injuries have led to the loss of work time in more than 600 thousands staff per year and incurring 45–54 Billion dollars and consequently a reduction of workforce productivity.<sup>[2,3]</sup> Among health-care providing jobs, nursing is identified as a high-risk occupation for MSDs because of their intensive physical activities along with bending, turning, long time standing, patient transferring, and lifting heavy objects.<sup>[1]</sup> Hedge (2009) points out in his study that more than 40% of the injuries reported for nurses come

from patients transferring from which 75.9% have resulted in a backache.<sup>[4]</sup> De Castro *et al.*, have reported the incidence of backache in Philippine nurses about 80%. These authors have demonstrated that the increased incidence of backache or pain in legs are related to the nature of nursing career especially tasks like patient transferring, or handling, when getting the patients dressed or their repositioning.<sup>[5]</sup> Hegarty, *et al.* (2003), showed in ergonomic assessment of Intensive Care Unit (ICU) nursing stations in the U. S hospitals that patient handling obtained the highest score (10) in REBA tools which is a tool to evaluate the occupational status of health-care occupations such as nursing.<sup>[6]</sup> Therefore, this task is a high-risk task for nurses, and a prominent modification is necessary to change it. To reach this purpose, ergonomics

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is a helpful science. Ergonomics is the science of fitting the job to the worker, the practice of designing work tasks and equipment to conform to the worker's capabilities or adjusting the work environment or work practices to prevent injuries before occurring. Ergonomics purpose is to assure that the tasks, equipment and work environment mostly conform to the conditions of each worker.<sup>[4]</sup>

Patients are in a highly dependent on their nurses in ICU and also operating room tasks needs more assistance of nurses and working in these wards can lead to various injuries in nurses. Numerous studies have been conducted in other wards. The present study, however, attempts to provide an investigation on assessment of ergonomics of doing tasks in ICU and operating room wards and their comparison in hospitals under the cover of medical science and healthcare services of west Azerbaijan province to show the current status of these activities by risk level analysis and the relevant basic and necessary data. It is also expected that the results of the study could be useful in macro planning and training or executive strategies aiming at the reduction of the work leading to injuries and identification of the causes of musculoskeletal problems, accordingly.

## MATERIALS AND METHODS

This is a descriptive-cross sectional study which ergonomic relationship during work in nursing staff of ICU with operating room wards in the studied hospitals in 2015. The study population was selected by means of a census method from all the nurses working at ICU and operating room ward of the hospitals covered by medical science and health-care service university in southern regions of west Azerbaijan province of Iran (100 nurses) if qualified the specifications of the study conditions for the mentioned wards.

The predefined characteristics to qualify the study participation were: Having at least a relevant academic associate degree, full time employment, lack of developing MSDs, hearing the study subject words, lack of a surgery operation for MSD disorders, loss of vision or audience problems affecting the individual's tasks according to the subject statements, participation in patient repositioning in ICU or operating room wards and consent to take part in the study. The study environment included ICU and operating room of the hospitals covered by the medical science and health-care services university in southern regions of west Azerbaijan province. Data collection tools of the study included: an author-designed questionnaire in the field of the subject demographic information (age, gender, work experience, qualifications, height and weight), Rapid Entire Body Assessment (REBA) and Nordic questionnaire. The demographic information data were completed by the studied nurses through self-performance method. Body mass index (BMI) was measured by the authors and data relating to the posture of different parts of the nurses' bodies when repositioning the patients from one side to another were gathered by the authors from nurses working at ICU and operating room wards under three different conditions during

each work shift and were recorded on REBA, accordingly. Given that the type of activity varies in each ward and in ICU, patients are highly dependent on nurses and surgical operations in the operating room require some patients, and the work of nurses in both wards creates various injuries, the type of damage and its amount is unknown, using the REBA tool can be effective.

REBA is comprised of a particular coding for movement range of each part of human body which is scored according to the different standing and dynamic movements, quick movements and unstable status. According to the tool guideline, the author can determine the risk incurred to each part with different ranges of risk level including negligible, no need to change the current position (score 1), low risk level in which position change may be required (score 2-3), moderate risk level in which quick change in position is required (score 8-10) and high risk level in which a shocked change in position is required (score 11-15) after the scores record of each movement in REBA tool and computing the total score (ranged 1-15).

Finally, referring to the small size of the study population divided by the mentioned ergonomic rates, the risk level results were categorized into two groups of low-risk level (score 1-3) and moderate risk level (score 4-15) and the author has ergonomically considered the low-risk level as desired and moderate and higher risk levels as undesired results.

In REBA, organs are divided into two groups: A (trunk, neck and legs) and group B (arms, forearms, and wrists). In this method, the author and an expert choose the worst position during work in addition to capturing photos and REBA will analyze them, accordingly.

A Nordic questionnaire contains two sub-questionnaires: General questionnaires including demographic information (age, gender, job type, job satisfaction, status of employment, and work experience) and special questionnaire including the profound analysis of disorders as well as pain, anesthesia (shoulder, waist, back, elbow, wrist and hand, knee, tarsus, thigh and hip) during the last 12 months. A Nordic questionnaire follow-ups two goals:

- Screening MSDs
- Measuring the results of epidemiologic researches in the field of MSDs.

The validity and stability of the tools were measured and confirmed. The study tools were applied after gaining the relevant permits and introduction letters and presenting to the nursing officials of the health-care centers.

Data were collected from the first part of the questionnaire after obtaining consent from the studied subjects in a self-performance manner except items 8 and 9 which were considered in measuring BMI.

The second part of the tool was completed through observing by the author. To control the intervention factors, first, the

questionnaires were distributed among the subjects satisfied to participate in the study (through census method), completed and the ergonomic postures were separately examined for each individual in operating room and ICU wards by the author within three times (during early, middle and end of the work shifts). The study data were analyzed by descriptive (average and standard deviation) and deductive (Chi-square and *t*-test) tests in SPSS software.

## RESULTS

The study findings revealed that women obtained the highest gender frequency in operating room group with 34 nurses (68%) and ICU for with 35 nurses (70%). In operating room group, most subjects aged 25–29 (56%) and in ICU group they were 20–24 years old (69%). The study nurses obtained predominantly a normal BMI both in operating room (74%) and ICU groups (70%) ranged 18.5–25 (normal range of weight). In operating room group, 28 staff had associate’s degree (56%), and in ICU group, 45 subjects had bachelor’s degree (90%). The number of married nurses in the operating room and ICU obtained 30 (60%) and in 32 (64%), respectively. The longest work experience years obtained 1–5 (53%) and 5–10 (66%) years for operating room and ICU group, respectively. 85% of the studied nurses in operating room and 90% in ICU group stated that they had not taken any posture training course, yet and 55% of the subjects in operating room and 57% in ICU group were not aware of their job risks.

As shown in Table 1, the maximum rate of complaint percentage about musculoskeletal system in operating room group was related to the back (68%), neck (44%) and knee (40%) and the minimum rate was observed for wrist (8%). Furthermore, the highest rate of complaint percentage about musculoskeletal system in ICU group was obtained in back (60%), upper back (48%), and shoulder (46%) and the minimum rate observed in elbow (8%).

The results also demonstrated that the operating room staff group most frequently referred to the occupational health-care centers for neck ache with 10 subjects (20%), however, no one referred for pain in knee and wrist, 4 (8%) referred to physiotherapy centers because of neck complaint, 1 (2%) for complaint of elbow and thigh which was the minimum rate.

In ICU group, the most frequent reference to the occupational healthcare centers occurred for pain in the waist for 4 subjects (8%) and the least one reported for elbow pain with 0 subject. In this group, 4 subjects (8%) referred for MSDs of knee and 1 (2%) for elbow and wrist pains, respectively.

The comparison between the scores obtained for group A and B for variables such as body, energy level, hand fitting to the load and standing and dynamic activities and REBA total scores in two groups of ICU and operating room demonstrated that there was a significant relationship between body, legs, neck, arm, energy level, hand fitting to the load, and standing and dynamic activities with REBA total score in both groups ( $P < 0.05$ ) [Table 2].

In ICU and operating room groups, hand fitting to the load status was appropriate, with the highest frequency value of 41 (82%) and 30 subjects (60%), respectively [Table 3].

The activity status showed that in operating room group, 29 subjects (58%) postured in a standing status and 5 (50%) performed repetitive tasks with a shorter range of movement [Table 4].

Analysis results from comparing demographic factors and REBA total scores in operating room and ICU groups showed that there was no significant relationship between REBA

**Table 1: Distribution of complaints percentage related to musculoskeletal system during the past 12 months of the study in operating room and Intensive Care Unit groups**

Body parts	Number of staff (%)	
	Operating room group	ICU group
Neck	22 (44)	18 (36)
Shoulder	15 (30)	23 (46)
Elbow	4 (8)	4 (8)
Wrist	5 (10)	6 (12)
Upper back	13 (26)	24 (48)
Lower back	25 (50)	30 (60)
Thigh	11 (22)	18 (36)
Knee	20 (40)	21 (42)
Tarsus	15 (30)	15 (30)

ICU: Intensive Care Unit

**Table 2: Analysis results of the scores obtained from Groups A and B for body, energy level, hand fitting to the load and standing and dynamic activities variables compared with Rapid Entire Body Assessment total scores earned for Intensive Care Unit and operating room groups**

Variables	Total REBA score	Each part score	P	Statistic test
Group A body parts	Trunk	283	0.001	$\chi^2$
	Leg	195	0.006	$\chi^2$
	Neck	205	0.012	$\chi^2$
Group B body parts	Forearm	141	0.000	$\chi^2$
	Arm	275	0.021	$\chi^2$
	Wrist	243	0.005	$\chi^2$
Energy exertion status		179	0.003	$\chi^2$
Hand fitting to the loads		133	0.000	$\chi^2$
Standing or dynamic status		175	0.014	$\chi^2$

$\chi^2$ : Chi-square test. REBA: Rapid Entire Body Assessment

**Table 3: Hand fitting to the load status in Intensive Care Unit and operating room groups**

Activity status	Operating room	ICU
Good	30	41
Relatively good	6	6
Bad	11	3
Relatively bad	3	0

ICU: Intensive Care Unit

total score and education level ( $P > 0.05$ ), while there was a significant relationship between REBA total scores and age, work experience, BMI, and gender ( $P < 0.05$ ).

In operating room and ICU groups, most studied personnel scored 11–15 and obtained very high-risk level which needed emergency actions to correct the conditions [Table 5]. In addition, the results showed that there was a significant relationship between risk level and total score in ICU and operating room groups ( $P < 0.05$ ).

## DISCUSSION

In the present study, the assessment of prevalence of MSDs in two studied groups of operating room and ICU revealed that the most frequent disorder was observed for waist or back the results of which were inconsistent with the those obtained Khosroabadi *et al.*, which approved the prevalence of backache up to 57.8% and obtained the highest score among MSDs.<sup>[7]</sup> In addition, in a study conducted by Tinubu *et al.*, the results demonstrated that within the past 12 months of the study the prevalent MSD was observed in back (44.1%).

Back or waist injuries and the consequent pains occur when the functional unit tissues are suffered. Functional unit tissues make an individual do bending, turning, and twisting. Moreover, it makes the spine bear the total body weight easily.<sup>[8]</sup> It seems that the tissue injury in nurses (nurses working in ICU and operating room) is resulted from hard working conditions, twisting movements in spine, inappropriate physical postures (over twisting or turning), patients repositioning, and prolonged bending.<sup>[9]</sup>

According to Munabi *et al.*, study which was carried out on 880 nursing staff, prolonged or over bending, handling or pushing heavy loads were the key reasons for waist injuries.<sup>[10]</sup> In a study of Nabirye *et al.*, it was revealed that pushing or pulling loads exceeding 20 kg, prolonged bending or twisting

were the key causes for MSDs.<sup>[11]</sup> In another study, it was demonstrated that nursing especial tasks related to patients repositioning or handling required sudden movements, bending, turning, lifting, and abnormal postures.<sup>[12]</sup>

According to Smith *et al.*, a 1-year MSD prevalence of 85.5% was reported for nurses.<sup>[13]</sup> In study of Lorusso *et al.* (2007), pain in shoulders, neck, upper body and lower body, was reported 49%, 36%, 31% and 54%, respectively. Pompeii *et al.*, in his study also stressed that one-third of his nursing staff of the study population developed MSDs 83% of which were caused by nursing works.<sup>[14]</sup>

In the present study, a significant relationship was seen between total REBA score and the corpus, forearm, arm, energy level, hand fitting to loads and dynamic/standing tasks ( $P < 0.05$ ) both in ICU and operating room groups. Over bending and stretching of body drastically recorded for ICU and operating room nursing staff. For instance, a nurse should turn on both sides with a torsion of 20–60 degrees or bear weight on one foot and make a bending over 20 degrees in neck, bend arms lower than 60 degrees or over 100 degrees and bend or stretch 45°–90° in arms. For nurses working at other wards and operating room, the amount of applied force, energy and workload to do the duties or tasks were not equal.

For hand fitting to loads variable, a significant relationship was reported between the two groups ( $P < 0.05$ ). Comparing the two groups showed that the hand fitting to loads status in operating room group was moderately resulted from working with handle assistant tools, in spite of good score of this status, while ICU group workers frequently faced with patients or objects handled with no handle assistant tools. In operating room group, tasks were often performed statically, and the body could be retained for 1 min, while in ICU group the staff movements repeated often more than 4 times/minute. Comparing the two above mentioned expressions, one can conclude that activity status was in a higher range of movement and they had more side activities than those working at operating room group. Therefore, there was a significant relationship between the two groups in standing and dynamic status.

The study results revealed that a backache was highly developed by increasing the age in both groups. Kjellberg *et al.* concluded that younger individuals adapted to the safe work techniques more rapidly and comfortably than the older did.<sup>[15]</sup> Since no comprehensive orderly training course was hold for the proper usage of body mechanics during

**Table 4: Standing activities status in operating room and Intensive Care Unit groups**

Activity status	Operating room group	ICU group
Standing body posture	29	9
Repetitive tasks with short range of movement	8	25
Drastic posture change	13	16

ICU: Intensive Care Unit

**Table 5: Comparison between Rapid Entire Body Assessment total score status and risk level in Intensive Care Unit and operating room groups**

Group	REBA score				Total (%)
	Low (2-3)	Medium (4-7)	High (8-10)	Very high (11-15)	
ICU personnel (%)	4 (8)	10 (20)	17 (34)	19 (38)	50 (100)
Operating room personnel (%)	2 (4)	11 (22)	14 (28)	23 (46)	50 (100)
Total (%)	6 (6)	21 (21)	31 (31)	42 (42)	100 (100)

ICU: Intensive Care Unit, REBA: Rapid Entire Body Assessment

work, forgetting academic courses and lack of their review and also repeated routine tasks could also increase MSDs development by age increase. However, it should be noted in mind that age increase process is normally correspondent with the loss of motor function or physical potentials of an individual body which leads to apply insufficient or weaker techniques and finally prevalence of intensive pains derived from MSDs.<sup>[15]</sup>

Referring the obtained results from the present study, doing regular exercises in both groups reduced the development or experience of a backache. Numerous studies have revealed that backache is dramatically less developed in individuals who regularly exercise. Daily exercise can boost and protect the back muscles to get better compatible with sudden loads or shocks, hence reduction of frequency and intensity of backaches against abnormal loads or forces.<sup>[16]</sup>

The present study findings showed that women staff experienced higher risks of inappropriate ergonomic status in both groups which highlighted a higher risk taking level in women toward MSDs, as numerous studies confirm the high level of these disorders in women against men as well as the study of Comerino *et al.*, in which prevalence of backache was found considerably in women among all the studied groups.<sup>[17]</sup>

Furthermore, Nicot revealed in his study that MSDs increased from 25.7% to 58% during 2003–2008 worldwide, according to the comparative data published by the French International Statics Institute.<sup>[18]</sup> The highest prevalence of these disorders among women probably depends on factors such as pregnancy and delivery experience in women which requires more research. On the other hand, men nurses apply more secure techniques once handling patients from bed to wheelchairs.<sup>[15]</sup>

Mandel *et al.*, study was also conducted to assess the relationship between high-risk nursing care service tasks and MSDs among nurses in the U. S which demonstrated that moderate or high prevalence of the disorder was significantly seen in women (66%) than in men (31%) for at least one part of the body during 7 days before completion of the questionnaires.<sup>[16]</sup>

As for gender distribution inequity in both groups of the present study operating room and ICU, most subjects were young with a few work experience years which confirmed their physical power to face with factors enabling MSDs. Moreover, nurses hardly performed ergonomic standards in ICU and operating room for their work background knowledge; thereby their ergonomic status was evaluated undesired comparing with those experiencing fewer years of work. This might be resulted from increased work experience years and following that, the long gap between academic formal and clinical courses and information in the field of ergonomic principles against those with fewer years of work experience which could lead to the risk of MSDs development in both groups.

There was a significant relationship between BMI and REBA total score in both groups ( $P < 0.05$ ) more than the normal level which was in consistent with Hosseini *et al.*, study

results.<sup>[19]</sup> Lorusso *et al.* explained in his study that BMI could prone the individuals to the MSDs.<sup>[20]</sup> Karahan and Bayraktar, highlighted the role of obesity on backache which could result in a reduction of abdominal muscles stretching or lumbar lordosis increment.<sup>[21]</sup> Alexopoulos *et al.* concluded in his study that a high BMI was in a significant relationship with chronic back pains, absence from work or pain in shoulders.<sup>[22]</sup>

In this study, a significant relationship was observed between the risk level and REBA score in both groups ( $P < 0.05$ ). The subjects had different education degrees and were not equally aware of their occupational risks and the higher educated staff could perform more tasks and duties rather than those with lower levels.

There was a significant relationship between risk level and REBA scores in the two groups, and the obtained risk level was very high and high in the operation room and ICU groups, respectively. The risk of the body part hurt was existed which required emergency initiations. In the study of Hosseini *et al.*, conducted by means of REBA method, 71% of the nurses were subjected to a moderate level of risk.<sup>[19]</sup> In the study of Dias *et al.*, performed on different techniques of nursing tasks, the risk level was reported moderate.<sup>[23]</sup> In work of Abdalla *et al.*, conducted by REBA method for different nursing techniques, the risk level was obtained high and very high.<sup>[24]</sup>

## CONCLUSION

Health-care service jobs are needed to be basically trained in terms of relevant tasks, risks and their control methods. Nurses working in operating rooms and ICU ward are subjected to a high-risk level principally originated from incorrect body postures and special conditions of working. Therefore, corrective actions along with preventive planning are to be performed to avoid disorders in the future and the formation of training classes, periodic visits to wards, periodic examinations, rest periods and leave for staff it is suggested.

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## Conflicts of interest

There are no conflicts of interest.

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