

# Assessing the Risk of Manual Handling of Patients and Its Relationship with the Prevalence of Musculoskeletal Disorders Among Nursing Staff: Performance Evaluation of the MAPO and PTAI Methods

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## Abstract

**Background:** Manual handling of patients without using proper devices built for this purpose is the most important risk factor causing musculoskeletal disorders (MSDs) among nursing staff.

**Objectives:** The aim of the present study was to determine the prevalence of MSDs, assess the risk of manual handling of patients, and identify the risk factors related to the development of such disorders among nursing staff.

**Methods:** This cross-sectional study was conducted in 2015 and included 220 nurses from 24 wards who were working in Baqiyatallah hospital, Tehran, Iran; their duties mainly involved patient handling. The participants were selected based on the random stratified sampling method. In this study, the Nordic musculoskeletal questionnaire, demographic questionnaire, movimentazione and assistenza di pazienti ospedalizzati (MAPO), and patient transfer assessment instrument (PTAI) methods were applied as data collection tools. In addition, Spearman correlation coefficients and binary and multiple logistic regressions were used to determine the possible relationships between the variables.

**Results:** The prevalence of MSDs among the participants over the past 12 months was found to be 79.5%. The results for the risk factors showed that the lower back, neck, shoulders, and upper back were the most affected areas of the body. According to the MAPO and PTAI, 60% and 40% of the wards, respectively, are at risk of MSDs. A significant relationship between MAPO and PTAI was found, with a coefficient correlation of 0.252. Based on the statistical analysis, positively significant relationships were found between body mass index, gender, nurse-to-bed ratio, final PTAI and MAPO indices, and MSDs.

**Conclusions:** The prevalence of MSDs among the nurses was high, and the occurrence of such disorders was found to be related to the scores of MAPO and PTAI indices. Based on the results, these two indices can be used as appropriate tools to assess the risk of MSDs in patient handling by nursing staff. The risk of developing MSDs can be lowered through interventional programs, such as providing and equipping hospitals with the tools required for patient handling and educating staff on how to properly use such devices. In addition, increasing the nurse-to-bed ratio will lower the burden for the nurses in patient handling.

**Keywords:** Patient Transfer, Risk Assessment, Risk Factor, Low Back Pain, MAPO, PTAI

## 1. Background

Musculoskeletal disorders (MSDs) affect a significant proportion of the workforce and represent one of the main causes of work-related injuries among healthcare workers (1, 2). Nursing, which comprises the most populous health care-related occupational group, has attracted more research attention concerning such disorders compared with other types of occupations relating to health care (3, 4). Because of tasks like patient transfer, nurses and nursing assistants are at risk of developing MSDs (5, 6). The

issues of MSDs and their prevalence among nurses have been studied thoroughly in different countries around the world. For instance, in 2009, Karahan et al. (7) studied the prevalence of MSDs among Turkish nurses and nursing assistants; based on their results, the prevalence of this disorder was 77.1%. In a study in Norway, the prevalence of MSDs among nursing assistants was reported to be 89% (8), while the rate found among Japanese nursing assistants was 37%, which is considerably lower than that of Norway (9). For nurses and nursing assistants, MSDs represent one of the main reasons for lost workdays, absences

from work, increased limitations at work, changing and/or leaving the profession, lower quality of life, and developing specific disabilities (10, 11). From an economic point of view, these issues are all of high importance due to the burden each can have on an individual, organization, and/or society (12).

Based on a report by Bureau of Labor Statistics from 2009, MSDs resulting from patient handling account for 11.4% of the total claims for compensation (13). Determining the interaction between MSDs and nurses and nursing assistants requires assessment of the prevalence of pain, maintaining reports on injuries and disabilities, and knowing the potential risk factors for MSDs (14). The etiology of MSDs shows that complex, varied internal and external factors, including physical demands with a variety of psychological factors and personal characteristics, can result in the development of such disorders (3, 15). Nursing is known as an occupation with high physical demands; in other words, nurses' duties frequently include lifting and transporting patients, as well as transporting equipment (15). In fact, handling a patient generally means changing the position of the patient while he/she is on the bed, helping the patient to move on the bed, lifting the patient, and moving the patient from and to a wheelchair, bed, hoist, or trolley (7, 11). These tasks can increase the risk of developing back, neck, and shoulder pain among nurses (16).

The weight of the burdens, along with their unpredictable form and size, significantly influences the prevalence of MSDs. In addition to lifting patients, carrying them involves a mixture of inappropriate movements and postures, as well as mechanical exposure to factors related to the development of MSDs, including bending, rotating, poorly coupling the hands, unpredictable environments (7), repetitive movements, sudden movements in abnormal postures, walking quickly, and applying excessive force to the spine in transferring, adjusting, or changing the position of the patients (17). These excessive forces can increase shear force and pressure to the spine and other soft tissue structures (18). Considering the duties of nurses mentioned above, these professionals are at a high risk of developing cumulative and acute MSDs (19). So far, MSD risk management has focused on lowering nurses' exposure to physical hazards relating to patient handling through different programs like the "No Lifting Program" (20).

Continuing lifting activities at work without using mechanical aids can contribute to the development or intensification of MSDs (11). To prevent problems caused by patient handling and identify related risk factors, assessment tools with acceptable precision are needed. Initially, general methods can be applied as the assessment tools, such as the rapid entire body assessment (21); this can serve to

identify the risk factors or proper techniques that can be taken into account when patient handling. However, there is no such method available at present. Thus, the description and validity of methods of assessing the risk of patient handling have been the main issue in previously conducted works (22-24). Although each method mentioned above has its own advantages and disadvantages, overall, these methods are useful in preventing staff from developing specific MSDs (10).

A few studies have investigated risk assessment methods related to patient handling, as well as the association of individual and organizational risk factors with the prevalence of MSDs among nurse assistants. However, the results of the studies have been variable (10, 25, 26).

## 2. Objectives

The aim of the present study was to determine the prevalence of MSDs, the risk of developing the through patient handling, and other risk factors related to the occurrence of such disorders. The results of identifying and assessing the risk factors for MSDs can be used as a guideline for determining ergonomic interventions to improve staff work conditions.

## 3. Methods

The present study reports on cross-sectional research conducted in 2015; the study was carried out by interviewing staff and directly observing how they carried the patients, equipment, and medical tools in different sections of the hospital. The group under study was selected based on the random stratified sampling method. The work focused on hospital nursing staff in 24 different sections of the Baqiyatallah Subspecialty hospital in Tehran, Iran, which has 700 beds. This hospital is one of the largest hospitals in Tehran, and it is regarded as the teaching hospital of Baqiyatallah University of Medical Sciences.

### 3.1. The Participants and Sample Size

The participants in this study included nursing staff (i.e., nurses, nurse assistants, and nurse co-assistants) whose duty was patient handling. The inclusion criteria were as follows: being full-time staff members, having more than a year of work experience, and having no disease or injury from an accident that could interfere with the study. It is noteworthy that the sections of the hospitals in which there were no patient handling duties were excluded from the study. Considering this, paraclinical sections were not considered.

The required sample size was calculated as 220 participants, considering a significance level of 0.05, of 0.05, and power of 0.8 for the inclusion of independent variables. The questionnaire was completed by each participant. It should be noted that the aim of administering the questionnaire was to gather demographical, organizational, and health-related data. The questions included in the questionnaire were related to gender, age, weight, the hospital section in which each participant worked, work experience in relation to nursing, and issues related to MSDs in different parts of the body. The reliability and validity of the questionnaire applied in this study were evaluated in both the Farsi language and others (27, 28). Nine parts of the body, namely the neck, shoulder, wrist/hand, elbow, upper back, lower back, hip, knee, and ankle/leg, had been assessed in the previous 12 months to identify any pain or problems relating to the participants' work.

To present their pain experience, the nursing personnel gave "yes or no" answers for each question on the body parts. After a total of 235 questionnaires were handed out, considering wastage rates, 231 questionnaires were collected. It should be noted that those who did not fill the questionnaire completely were removed from the study and replaced with new participants. Following the inclusion criteria, a total of 220 questionnaires were used for analysis and 11 participants were excluded.

### 3.2. Assessing the Risk of Patient Handling

Determination of the risk of MSDs caused by patient handling was performed using the movimentazione and assistenza di pazienti ospedalizzati (MAPO) and patient transfer assessment instrument (PTAI) methods. The MAPO method is capable of assessing the risk of transferring patients in hospitals, home nurses, and hospice services (22). This method was designed to assess patient handling and consisted of two parts. The first part comprises interviews with the head of each hospital ward regarding how the duty of each nursing staff member is organized and an assessment of the section in terms of devices and educational plans. The second part of this method is completed by an observer whose duty is to assess the devices and the environment (i.e., the quality and quantity of mechanical devices needed to carry a patient) (29). The final MAPO is defined with three possible levels of exposure. The green level (range, 0 to 1.5) denotes negligible risk, which means that the prevalence of MSDs is identical to that of the general population; the yellow level (range, from 1.51 to 5) represents a 2.5 times greater chance of developing MSDs compared to green level; and the red level, (range, 5 and above), denotes an occurrence of back pain that is 5.6 times greater than that of the previous levels (30).

The PTAI method can be used to assess the burden resulting from patient handling per unit of assessment; therefore, it can be used to assess the ergonomic working postures and staff dexterity during the time of patient handling. The usability and repeatability of this method in assessing the burden from patient handling were determined through application of the PTAI in four surgical wards of a healthcare center in Finland (31). Applying this method, 15 factors can be assessed; 9 factors can be investigated through observing the subjects carrying out their tasks, and the other 6 factors can be assessed by interviewing nursing staff. Indexes lower than 60%, between 60% and 80%, and higher than 80%, denote the red, yellow, and green levels, respectively (10).

### 3.3. Statistical Analysis

In this study, the chi-square test, Spearman correlation coefficient, and simple and multiple logistic regressions were used to investigate possible relationships between the variables. To assess the normality and equality of variance, the Kolmogorov-Smirnov (K-S) and Levene tests were applied. SPSS v. 23 was used to carry out all of the statistical analyses applied here. In this work, 0.05 was set to show the significance of the data.

### 3.4. Ethical Considerations

Ethical approval for the research was obtained from Baqiyatallah University of Medical Sciences (No. 133, 10/27/2015), a nursing faculty in Tehran, Iran. After sending a recommendation letter to enhance cooperation in each section of the hospital with the researchers of this study and receiving verbal agreement from each participant, the questionnaires were given to nursing staff. The questionnaire explained the purpose of the study and stated the participant's rights; it also clarified that collected data would not be used for anything other than the study purpose and that the data would be handled anonymously.

## 4. Results

Table 1 shows the demographic and organizational variables of the participants based on the prevalence of reported MSDs for the past 12 months in at least one part of the body. A total of 55.9% of the respondents were male, and their average age was 34.69 years (6.69). Most of the participants were married (90.5%). In terms of work position, most were nurses (44.5%), and 53.2% worked shift duty.

Based on the results, it was found that nearly 80% of the participants had suffered from pain in at least one part of their bodies, indicating the high prevalence of MSDs

**Table 1.** Descriptive Statistics of the Study Population (n = 220)

| Variables                          | Mean (SD) or No. (%) | Range       |
|------------------------------------|----------------------|-------------|
| Age, y                             | 34.69 (6.69)         | 22 - 56     |
| Height, cm                         | 171.59 (8.89)        | 150 - 190   |
| Weight, kg                         | 74.56 (10.47)        | 45 - 105    |
| Body mass index, kg/m <sup>2</sup> | 21.74 (2.95)         | 14 - 30     |
| Clinical experience, y             | 10.72 (6.09)         | 2 - 33      |
| Nurse-to-bed ratio                 | 0.59 (0.29)          | 0.21 - 1.25 |
| <b>Gender</b>                      |                      |             |
| Male                               | 123 (55.9)           |             |
| Female                             | 97 (44.1)            |             |
| <b>Marital status</b>              |                      |             |
| Married                            | 199 (90.5)           |             |
| Single                             | 21 (9.5)             |             |
| <b>Shift work</b>                  |                      |             |
| Rotate                             | 117 (53.2)           |             |
| Fix                                | 103 (46.8)           |             |
| <b>Job title</b>                   |                      |             |
| Nurse                              | 98 (44.5)            |             |
| Nurse assistant                    | 52 (23.6)            |             |
| Nurse co-assistant                 | 70 (31.8)            |             |
| <b>Educational status</b>          |                      |             |
| High school degree and diploma     | 132 (60)             |             |
| Associate's degree                 | 45 (20.5)            |             |
| Graduate school                    | 43 (19.5)            |             |
| <b>Musculoskeletal disorders</b>   |                      |             |
| Yes                                | 175 (79.5)           |             |
| No                                 | 45 (20.5)            |             |

among the participants here. [Table 2](#) shows the results for the MSD questionnaire. Among the MSDs, back pain (69.1%) was found to have the highest frequency, as more than one-third of the participants reported having or experiencing it. In contrast, the ankle (29%) and elbow (31.8%) represented the types of pain least reported by the nursing staff.

Considering the risk assessment related to patient handling, the MAPO method showed that 60% of the participants had a high risk of developing MSDs; while the PTAI method only indicated that 30% of the participants had a high level of risk. The results regarding the use of these two methods are shown in [Table 3](#). In the wards where patients do not cooperate during transportation (e.g., the intensive care unit [ICU], critical care unit [CCU], and surgery wards),

**Table 2.** Prevalence of Musculoskeletal Disorders in Nursing Staffs Over the Past 12 Months

| Body Part  | Number (%) | Confidence Interval (95%) |
|------------|------------|---------------------------|
| Lower back | 152 (69.1) | 63 - 75.2                 |
| Neck       | 110 (50)   | 43.4 - 56.6               |
| Shoulder   | 99 (45)    | 38.4 - 51.6               |
| Upper back | 94 (42.7)  | 36.2 - 49.2               |
| Knee       | 94 (42.7)  | 36.2 - 49.2               |
| Wrist/hand | 84 (38.2)  | 31.8 - 44.6               |
| Hip        | 72 (32.7)  | 26.5 - 38.9               |
| Elbow      | 70 (31.8)  | 25.6 - 37.9               |
| Ankle      | 64 (29)    | 23 - 35                   |

the results risk assessment using both methods showed the highest frequency of high risk (red level). Based on the results, it can be stated there was a significant difference in the risk level obtained using the MAPO and PTAI methods for different wards ( $P < 0.05$ ). The Chi-square test showed a significant relationship between these two methods, with a Spearman correlation coefficient of 0.252.

Since the incidence of MSDs results from patient handling, as well as the staff's demographic and organizational characteristics, predictable variables and their effects on the incidence of MSDs were also studied, as shown in [Table 4](#). The K-S test was used to investigate the data normality before analysis. According to this test, the data were normally distributed. Based on the statistical analysis conducted on those participants with and without MSDs, it was found that for the variables of age, gender, shifts at work, nurse-to-bed ratio, the MAPO and PTAI indices, and body mass index, the P value is less than 0.25. These data were then entered into the regression model. Based on the final model, body mass index, nurse-to-bed ratio, gender, and the PTAI and MAPO indices were found to have significant relationships with the incidence of MSDs,  $P < 0.05$ .

## 5. Discussion

The aim of the present study was to determine the incidence of MSDs, assess the risk associated with patient handling, and identify the factors related to the incidence of such disorders in different parts of the body. Based on the results, the incidence of MSDs among the nursing staff of the hospital was high; nearly 80% of the participants had experienced at least one form of MSDs over the past 12 months. In previously conducted studies by Tinubu et al. (2010) and Abedini et al. (2012) (19, 32), the incidence levels of MSDs among the nursing staff were reported to be

**Table 3.** The MAPO and PTAI Indexes in Hospital Wards

| Ward                       | MAPO Index       |                  |              | PTAI Index     |                    |                |
|----------------------------|------------------|------------------|--------------|----------------|--------------------|----------------|
|                            | Level 1: 0 - 1.5 | Level 2: 1.5 - 5 | Level 3: 5 < | Level 1: > 80% | Level 2: 60% - 80% | Level 3: < 60% |
| Cardiology (n = 13)        | 0                | 6 (46.2)         | 7 (53.8)     | 0              | 8 (61.5)           | 5 (38.5)       |
| Internal medicine (n = 23) | 0                | 11 (47.8)        | 12 (52.2)    | 1 (1.3)        | 14 (60.9)          | 8 (34.8)       |
| Orthopedics (n = 20)       | 7 (35)           | 13 (65)          | 0            | 6 (30)         | 8 (40)             | 6 (30)         |
| Surgery (n = 26)           | 0                | 0                | 26 (100)     | 0              | 19 (73.1)          | 7 (26.9)       |
| Urology (n = 27)           | 0                | 27 (100)         | 0            | 3 (11.1)       | 18 (66.7)          | 6 (22.2)       |
| ICU (n = 35)               | 0                | 0                | 35 (100)     | 0 (0%)         | 19 (54.3)          | 16 (45.7)      |
| CCU (n = 28)               | 0                | 0                | 28 (100)     | 0 (0)          | 9 (32.1)           | 19 (67.9)      |
| Other (n = 48)             | 0                | 24 (50)          | 24 (50)      | 1 (2)          | 26 (54.2)          | 21 (43.8)      |
| Total (n = 220)            | 7 (3.2)          | 81 (36.8)        | 132 (60)     | 11 (5)         | 121 (55)           | 88 (40)        |
| P value <sup>a</sup>       | 0.001 >          | 0.001 >          | 0.001 >      | 0.001          | 0.001              | 0.001          |

<sup>a</sup>Chi-square.**Table 4.** Binary and Multiple Logistic Regression Indicating Factors Influencing the Occurrence of Musculoskeletal Disorders (MSDs) Among Nursing Staffs

| Variable           | Binary Logistic Regression |               |       | Multiple Logistic Regression |             |       |
|--------------------|----------------------------|---------------|-------|------------------------------|-------------|-------|
| Age                | 1.043                      | 1.001 - 1.088 | 0.057 | -                            | -           | -     |
| BMI                | 0.7                        | 0.61 - 0.8    | 0.001 | 0.71                         | 0.62 - 0.81 | 0.001 |
| Nurse-to-bed ratio | 3.76                       | 1.43 - 9.9    | 0.007 | 3.38                         | 1.15 - 9.93 | 0.027 |
| <b>Gender</b>      |                            |               |       |                              |             |       |
| Male               | ref                        | ref           | ref   | -                            | -           | -     |
| Female             | 2.23                       | 1.22 - 4.09   | 0.009 | 3.35                         | 1.62 - 6.92 | 0.001 |
| <b>Shift work</b>  |                            |               |       |                              |             |       |
| Rotating           | ref                        | ref           | ref   | -                            | -           | -     |
| Fixed              | 0.7                        | 0.29 - 1.24   | 0.22  | -                            | -           | -     |
| PTAI index         | 0.97                       | 0.95 - 1.016  | 0.21  | 0.95                         | 0.92 - 0.99 | 0.014 |
| MAPO index         | 0.89                       | 0.82 - 0.98   | 0.017 | 0.87                         | 0.78 - 0.97 | 0.011 |

78% and 88%, respectively. MSDs were mostly found to affect the lower back, neck, shoulder, knee, and upper back. The results showed that more than half of the individuals who carried patients suffered from MSDs in lower back and neck regions. In a review study conducted by Davis and Kotoski in 2015 (14), 132 articles on MSDs among nurses and nurse assistants were reviewed; based on the findings of this study, the lower back, shoulder, and neck were found to be the most reported regions for MSDs. The present study showed that 37.27% of the participants were under treatment for pain from MSDs. The corresponding amount reported in previous work by Tinpubu et al. (2010) (19) was 30.3%.

Using the MAPO index in different wards of the hospi-

tal showed that 96.8% of the participants were at risk of developing MSDs, among which 60% were at high risk. However, in the study conducted by Abedini et al., 83.5% of the study participants were at risk of developing MSDs, among which 20.5% were at high risk; in addition, Bettavi et al. (22, 32) reported that 85.5% of the participants in their study were at risk of developing MSDs, among which 41.5% were at high risk of developing at least one form of such disorders. This difference could be due to the difference in the study groups participating in these studies, as well as the sample sizes of these two studies, which were larger than that of the present study. The MAPO index score in a study conducted by Samaei et al. (2015) (26) showed that 87.8% of the study participants were at risk of developing MSDs,

among 39.7% were at high risk.

In terms of the PTAI index, it was found that 95% of the study participants were at risk of developing MSDs, among which 40% had a high risk in this regard (i.e., the index score was less than 60%). In a study conducted by Abedini et al. (2012)(32), 87.5% of the participants were at high risk of developing MSDs; this conflicted with the results of the present study. It should be mentioned that 400 nurses participated in that study, among which 105 were nurse assistants and nurse co-assistants whose main duty was patient handling. Based on the results, it was found that the highest frequency of a high risk of developing MSDs was related to those working in wards where they had to carry patients without any assistant from them, such as the ICU, CCU, and surgery wards. Abedini et al. (33) also used the MAPO index to assess the study group in this regard; they showed that the highest frequency of high risk was related to the orthopedic, emergency, and neurology wards. The MAPO method was applied to assess the devices and tools used to carry patients; this could be why the results of the present study are different from those reported by Abedini et al.

The results showed a significant relationship between the MAPO and PTAI, with a correlation coefficient of 0.252. The results of the study conducted by Abedini et al. (25) showed that there is a significant relationship between the incidence of MSDs and the MAPO/PTAI; however, they found no significant relationship between the two methods of the MAPO and PTAI. In a study conducted by Villarroya et al. (2016) (10), it was reported that the MAPO, PTAI, and care thermometer have a mild approach toward the variables of patient handling. Based on the results of multiple logistic regressions, it was found that the occurrence of MSDs is related to the individual's body mass, the nurse-to-bed ratio, gender, and the MAPO and PTAI indexes, even when the number of potential confounder variables was lowered. Based on the regression model, there is a significant relationship between the body mass index and the incidence of MSDs. This is in line with the reports by Moreira-Silva et al. (2013) and Mozafari et al. (2014) (34, 35). It is also noteworthy that some studies have reported no significant relationship between the body mass index and the incidence of MSDs (33, 36). In their study, Lorusso et al. (2007) (37) mentioned that the body mass index could make an individual susceptible to developing MSDs. Based on the results, the possibility of having an incidence of MSDs in the wards with a low nurse-to-bed ratio was high (3.38, 1.15 - 9.93). In a study conducted by Abedini et al. (33), a significant relationship between MSDs and the nurse-to-bed ratio was reported. Increasing this ratio could be a way to reduce the incidence of MSDs, since a low nurse-to-bed ratio increases the load on nurses caused by patient handling.

The results of the present study also showed that there

is a significant relationship between MSDs and the gender of nursing staff. In this regard, it was found that females had a higher likelihood of developing MSDs than males. In a review study conducted by Lorusso et al. (37) on the prevalence of back pain among the Italian nurses, all 22 of the studies they reviewed reported a significant relationship between the prevalence of back pain and gender in the study groups. Based on the results, an increase in the possibility of developing MSDs could cause an increase in the scores of the MAPO and PTAI indices. This is in line with results of previous studies (26, 33). However, in a study conducted by Samaei et al. (26), the PTAI index stayed in the regression model, while the MAPO index was removed; this may have been due to differences in the devices and tools related to patient handling, since these were the variables of MAPO index. It should be noted that the incidence of MSDs among the nurses may have resulted from various factors, such as management, organization, and the environment. In this regard, such variations may be responsible for the differences of the results in the present study compared to those obtained in some previous works.

A key point of this study was that it used a new method, which was also include in the "ISO/TR 12296:2012 Ergonomics Standard," for the identification physical risk factors for MSDs in patient transfer. A further contribution is that it considered individual and organizational risk factors in the prevalence of such disorders.

The results of the present study can be used to develop an ergonomic intervention program according to the results of the patient transfer risk assessment. This can serve to eliminate or minimize MSDs among healthcare workers other than nurses, such as nurses' aides and paramedics, who are often neglected in the research on this topic.

This study had some limitations that should be mentioned. On the one hand, in relation to the methodology used, only individual, organizational, and physical demands were considered; however, other risk factors, such as environmental, temporal, and management factors were not considered, and this may have may affect the results. The inclusion or exclusion of each of these factors may have been responsible for results that were inconsistent with those of previous studies. On the other hand, the questionnaire that was used was an unscaled questionnaire aiming to determine the intensity of the reported pain and relied on the statements of the nursing personnel; reliable diagnostic tests, such as electrodiagnosis, were not used for the exact assessment of MSDs. A final limitation of this study was that personality tests were not used to precisely determine the MSDs reported from the participants.

The high incidence of MSDs among the participants indicated a high level of exposure to the risk factors related

to such disorders. One of the predominant risk factors for the occurrence of the MSDs among nurses is patient handling. Due to the strain it puts on the body, this factor has an important role in the development of MSDs. The methods applied to determine the risk of patient handling are appropriate tools for assessing the development and occurrence of such disorders. In this study, the MAPO and PTAI were two methods applied to assess the risk of developing MSDs; the results showed that more than 90% of the nurses had such a risk. It can be inferred from the results that programs aiming to improve and reduce the risk of developing such disorders among nursing staff are needed. In this regard, ergonomic interventional plans should include providing and equipping the hospitals with the tools required for patient handling and educating staff about how to properly use such devices. In addition, increasing the nurse-to-bed ratio will lower the load placed on nursing staff in the area of patient handling, which will contribute to a decrease in the occurrence of MSDs in this population.

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### Footnotes

**Authors' Contribution:** Majid Bagheri Hossein Abadi and Hamed Akbari were responsible for the study conception and design, acquisition of data, preparing the draft of manuscript, and making critical revisions to the paper for important intellectual content and English editing. Mohammad Gholami Fesharaki contributed to analysis and interpretation of data and statistical analysis. Hesam Akbari and Mohammad Ghasemi contributed administrative, technical, and material support.

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