

# Risk Assessment of Musculoskeletal Disorders Related to Patient Transfer Tasks Using the Direct Nurse Observation Instrument Method

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## Abstract

**Background:** Nurses represent an important job group commonly affected by musculoskeletal disorders (MSDs). One of the main reasons is patient transfer tasks. Handling patients using a safe work technique is considered as one prevention strategy when integrated in multidimensional interventions.

**Objectives:** The aim of this study was to assess the musculoskeletal disorders risks related to patient transfers in nursing personnel using the direct nurse observation instrument (DINO) method.

**Methods:** This cross-sectional study was conducted on 250 nurses working in affiliated hospitals of Isfahan University of Medical Sciences in 2015. Data were collected by Nordic questioners and the DINO index check list. The validity and reliability of the DINO checklist were reviewed and approved. To analyze the data, independent t- test, chi-square test and logistic regression were used.

**Results:** The prevalence of MSDs was 87.6% in a 12-month period. The average result of the DINO checklist was 9.73 points (SD = 1.8), which can suggest that the way in which the technical transfer was carried out might not have been the safest. The results from logistic regression showed that the occurrence of MSDs in nursing staff was significantly associated with final scoring of the DINO index ( $P < 0.001$  and  $B = -0.533$ ) (Odds ratio = 0.587).

**Conclusions:** According to the findings of the current study, DINO is an appropriate tool to assess MSDs risk due to patient handling in the nursing personnel. This method can be used in the evaluation of patient transfer educational programs and also to identify and assess an unsafe work technique used by the nurses.

**Keywords:** Musculoskeletal Disease, Patient Transfer, Nursing Staffs, DINO Methods

## 1. Background

Work-related musculoskeletal disorders (WMSDs) are known as important occupational problems with increasing health costs, work restriction, lost work time or absenteeism and lower quality of life (1-4).

Healthcare jobs are known to be at high risk for WMSDs (5-7). It is estimated that about 33% of all cases of sick leaves among healthcare providers are related to MSDs (8).

Although WMSD is a multi-factorial occurrence that may be produced by biomechanical, organizational, psychological and individual factors (9, 10), the etiology of MSDs among nurses shows that the major causes of these type of injuries are patient transfer, static postures, monotonous, and boring tasks and time pressure (9, 11). Inappropriate methods in patient handling activities as well as low awareness of the nursing staffs regarding the use of aid devices are known to be the main causes of occupational injuries in this job group (12).

In healthcare jobs, patient handling tasks are performed daily and repeatedly during a work shift and studies have shown a relation between patient handling and musculoskeletal problems among nurses and other workers caring for people with disabilities (13, 14).

Nursing is a stressful and physically demanding occupation with a high risk of WMSDs (15). Different studies reported MSDs as the most prevalent complaints among workers (16, 17). The cross-sectional study among nurses in Iran reported that the prevalence of low back pain in the past 12 months was about 73% (18). In the study among Indian nurses, respondents reported that a 12-month prevalence rate of WMSDs at any body region was 81% (19).

Using a safe work technique during patient handling is believed to be one prevention strategy when integrated in multidimensional interventions.

Studying nurses' work technique during patient transfers, Johnsson et al. (2004) developed an instrument called

DINO, which is assessed based on observation.

Nurses' work technique assessment during patient transfers with the DINO instrument is done without special equipment, and therefore this instrument can be used in both clinical and educational settings. This instrument has shown to have satisfactory content and criterion-related validity and also acceptable inter-observer reliability (20).

## 2. Objectives

The aim of this study was to evaluate the effectiveness of the DINO method for estimating the risk of MSDs caused by handling of the patients in the nursing staff of hospitals affiliated to Isfahan University of Medical Sciences.

## 3. Methods

This cross-sectional study was conducted in 5 hospitals affiliated to Isfahan University of Medical Sciences in Isfahan, Iran, in 2015. The study population consisted of 250 nurses responsible for patient handling and movement. The subjects were selected via the stratified random sampling method and each hospital was considered as a stratum (50 samples from each hospital). The criterion for inclusion was having more than a year of work experience and the criterion for exclusion was accidents and diseases affecting the musculoskeletal system. Furthermore, each subject completed a consent form to participate in the study in advance. In order to observe ethical principles, the members of the study group were assured that the information and questionnaires will be kept confidential and anonymous and results will be reported only as a whole.

The Nordic questionnaire was used as the data collection tool to determine the prevalence of MSDs in the study (21). The Persian version of this questionnaire was validated in the study by Choobineh et al. and its validity and reliability were confirmed (22). This questionnaire examines demographic data and the prevalence of MSDs.

The DINO checklist, which was the observation criteria, was completed by expert observers. This instrument consists of 16 items divided into three phases of a transfer: the preparation, performance and result phases.

In the first and third phases, the answers are given by means of a dichotomous scale of Yes and No (yes rated 1 and no rated 0). However, items related to the second phase have a 5-point scale from 0 to 4 (Scale 0 rated zero, scale one rated 0.25, scale two rated 0.5, scale three rated 0.75 and scale four rated 1).

Final results of the DINO are the sum of points obtained in three phases. The final score is a score that can

vary between 0 and 16 points. The best score (16 points) means that the carrying technique is safe (20, 23).

To determine the validity of the DINO checklist, face validity and content-related validity were used. The questionnaire was first translated into Persian. Then it was given to an English language professor who was not aware of the original (English) version of the questionnaire to translate it into English using back translation. The English version of the Persian edition was compared with the original questionnaire and minor corrections were made and the final questionnaire was prepared. Face and content validity of the final questionnaire confirmed using the help of a panel of experts. For this purpose, the translated instrument was given to the 15 experts in the fields of occupational health, nursing and epidemiology. Then their recommendations and corrective comments were collected. After reform, the face and content validity of the DINO checklist were reviewed and confirmed (the content validity calculated by Lawash's method, CVR = 0.92).

To check the interobserver reliability, in 10% of the cases (25 persons), the DINO checklist was completed independently and simultaneously by two observers and the results were analyzed through the Kappa coefficient of agreement. According to the results, there was a great deal of agreement among observers in all checklist questions (more than 0.75).

Analyses were performed using the SPSS software version 19.0. P values less than 0.05 were regarded as statistically significant. Descriptive statistics were used to describe the variables. To analyze the data, t-test and chi-square test were used. Finally, logistic regression was used to determine the relation between the DINO final score and the prevalence of MSDs in the nursing staff.

## 4. Results

The mean age of the participants was 34.56 years (SD = 6.36). From a total of 250 nurses, 80.8% were females and 19.2% were males. Seventy percent of the participants were married and 29.6% were single. The mean of work experience was 10.3 years (SD = 6.17). Moreover, 84.8% of the respondents were nurses and 15.2% were nurse aides and 84% of them were shift workers. Table 1 shows the comparison between the average of demographic characteristics of nurses with and without symptoms and signs of MSDs. The results showed a statistically significant difference between the mean age and experience in both groups ( $P < 0.001$ ). However, the relationship between these disorders and other demographic variables was not statistically significant ( $P > 0.05$ ).

The results obtained from the Nordic questionnaire showed that 87.6% of the subjects suffered from WMSDs

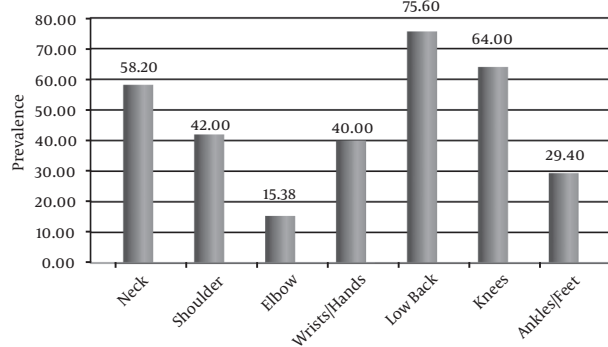
**Table 1.** General Characteristics of Subjects According to Musculoskeletal Symptoms (n = 250)<sup>a</sup>

General Characteristics	Musculoskeletal Symptom (+) (n = 219)	Musculoskeletal Symptom (-) (n = 31)	P Value
Age, y	35.3 ± 6.14	29.7 ± 5.82	< 0.01 <sup>b</sup>
Tenure, y	10.88 ± 6.08	6.16 ± 5.12	< 0.01 <sup>b</sup>
Height, cm	164.65 ± 7.1	164.87 ± 7.2	0.875 <sup>b</sup>
Weight, kg	65.56 ± 10.84	65.77 ± 10.29	0.920 <sup>b</sup>
BMI	19.88 ± 2.46	19.86 ± 2.85	0.973 <sup>b</sup>
Sex			0.318 <sup>c</sup>
Man	40 (83.3)	8 (16.7)	
Woman	179 (88.6)	23 (11.4)	
Job class			0.704 <sup>c</sup>
Nurse	185 (87.3)	27 (12.7)	
Nurse Aid	34 (89.5)	4 (10.5)	
Shift work			0.651 <sup>c</sup>
No	59 (90.8)	6 (9.2)	
Yes	149 (86.6)	23 (13.4)	

Abbreviation: BMI, body mass index.

<sup>a</sup>Values are expressed as No. (%) or mean ± SD.<sup>b</sup>T-test.<sup>c</sup>Chi-square test.

in one or more than one part of their body in the last 12 months. Figure 1 shows the prevalence of WMSDs in different body regions.

**Figure 1.** Prevalence of Work-Related Musculoskeletal Disorders in Different Body Regions

The results of the DINO checklist showed that the final average score was 9.73 (SD = 1.8). The lowest score was 7 and the highest score was 14.5. Given that the ratings of the DINO index are between the number zero to 16, in evaluating patient handling cases, points lower than 7 and more

than 14.5 were not found. In Tables 2 to 4, the results of the patient transfer techniques with the DINO checklist in its three phases are shown.

**Table 2.** Distribution of the Preparation Phase Results<sup>a</sup>

Preparation Phase Items	Yes	No
Is the patient encouraged to cooperate?	232 (92.8)	18 (7.2)
Is enough space prepared for the transfer?	149 (59.6)	101 (40.4)
Are wheelchairs, and other objects that the patient is transferred between, positioned and locked in a correct way?	219 (87.6)	31 (12.4)
Is the height of the bed correct?	28 (11.2)	222 (88.8)
Are transferring aids used?	36 (14.4)	214 (85.6)
Are transferring aids used correctly?	25 (10)	225 (90)
Are there enough staff?	210 (84)	40 (16)

<sup>a</sup>Values are expressed as No. (%).

In the first phase of the DINO checklist (the preparation phase), which includes 43.8% of the final score of the DINO index, 7 items are available. In this phase, results showed that only in 7.2% of the cases, the patient was not encouraged to cooperate. In 101 observations there was not enough space to perform the transfer (40.4%). In 12.4% of the transfers, we noticed that the equipment with which the patients were transferred were not properly positioned and used. The height of the beds in 88.8% of the observations was not appropriate for patient transfers. In 85.6% of the cases, there were no transferring aids or equipment for patient transfers and in 90% of the cases this equipment was not used correctly. Finally, in 16% of the observations the number of the nurses was not sufficient.

In the second phase (the performance phase) we examined the items related to team work, communication and interaction with the patient, back and shoulder load and the nurse's balance. These items make up 37.5% of the final DINO score.

The third phase of the checklist (the results phase) comprises 19.7% of the final score of the DINO index. The results showed that in 7.6% of the observations, the chosen technique for carrying out this task caused pain to the patient. Moreover, in 3.6% of the cases, patient transfer techniques caused feelings of fear or distrust in the patient. Finally, in 59.6% of the transfers, the patient was not in a proper position at the end of the transfer.

Examining the relationship between DINO final scores and the prevalence of MSDs, results from the processing of logistic regression showed that with adjusting the effect of confounding variables (age and work experience, based on the output of Table 1), the final score of the DINO checklist was significantly associated with the prevalence of this

disorder ( $P < 0.001$  and  $B = -0.533$ ). Therefore, as the DINO score increased, the risk of MSDs decreased (Odds ratio = 0.587) (Tables 3 and 4).

## 5. Discussion

Age and job tenure means of the participants were  $34.56 \pm 6.36$  and  $10.3 \pm 6.17$  years, respectively. The frequency of MSDs in this study was 87.6%, which was in agreement with the results of other studies conducted on nursing staff (24, 25).

The frequency of MSDs in various body regions showed that lower back (75.6%) was the most commonly affected region among our study population. This is consistent with the result of other studies (26, 27).

Checking the validity and reliability of the DINO checklist in this study showed that the questionnaire had high reliability and validity in Iran. The reliability and validity of the DINO method were reviewed and approved in a study by Johnson et al. in 2004, during transporting patients in a hospital in Sweden (20).

The result of the DINO scores in this study was 9.73 ( $SD = 1.8$ ), which suggests that the way patient transfer was carried out might not have been the safest. In Cotrim et al. study (23), the average result was 11.28 ( $SD = 4.99$ ). The mean difference in the results of the two studies may be due to the lack or absence of transferring aids in the hospitals in our study.

Lifting patients in bed and transferring patients out of bed were the job activities most commonly reported as sources of back pain among nurses (28). Lifting or transferring dependent patients and treating an excessive number of patients in one work shift were the most perceived job risk factors precipitating WMSDs among the nurses in this study.

These findings are consistent with previous studies indicating manual patient handling, transferring or moving as important predictors of musculoskeletal diseases and low back pain among nurses (19, 29). Patient handling is a particularly important issue in nursing, because nurses must meet the demands of patients at any time (30). Moreover, many patient handling activities need to be undertaken in less than ideal spaces and in suboptimal time frames (31). Such situations may eventually lead to the development of WMSDs.

In this study, there was a high correlation between the prevalence of MSDs and the DINO index, which indicates the suitability of this index to assess the risk of these disorders.

The DINO method is designed to assess nurses work technique in patient transfer tasks. Daynard was shown that nurses who were not compliant had higher peak

spinal loading than those who were compliant (32). Therefore, using a safe work technique by nurses might lead to a reduced load to their musculoskeletal system.

It is necessary to assess that nurses comply with safe working techniques. The direct nurse observation instrument can be used to identify and assess an unsafe work technique and to register what items in the questionnaire are not performed in a safe way by nurses (16, 19). Furthermore, results from other studies indicate that by following the recommended technique one may expect a reduced risk of low-back disorders through patient transfer tasks (33).

The DINO method can be used by anyone with knowledge in transfer methods and ergonomics. This method can be used in many situations, at a ward, in patients' homes, in a classroom setting or in other places where handling occur, as no special equipment is needed (20).

Finally, the results indicate that noncompliance criteria such as sufficient space and configurability of devices such as patients' beds and chairs, using lifting equipment and other aids, patient handling skills, correct posture, etc., are among the influential factors in the prevalence of MSDs and should be considered in the programs for reducing the risk of these disorders.

Due to lack of access of researchers to the similar studies in this field, perhaps this is the first study to evaluate the risk of patient handling based on the DINO index and its association with the prevalence of MSDs. Since this index is based on a checklist completed by the observer, the observer error is likely to occur. Therefore, it seems with further and more comprehensive studies by experts in the field of the DINO index, stronger results can be achieved.

### 5.1. Conclusions

The results of this study show that DINO is a suitable and useful way to identify and assess the risks of MSDs caused by patient movement tasks among nursing staff. This technique can be used to assess the risk of MSDs in the manual transferring of patients. In addition, the results of this study showed that DINO is an efficient tool to identify unsafe methods of carrying a patient, and is useful for planning precautionary measures to reduce the risk of WMSDs in the health system.

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**Table 3.** Distribution of the Performance Phase Results

Performance Phase Items	Results			
	Median	Mean ± SD	Min	Max
Good balance	0.509	0.50 ± 0.241	0	1
Good coordination	0.760	0.75 ± 0.236	0	1
Good movement economy	0.475	0.50 ± 0.240	0	1
Load on the back and shoulders	0.478	0.50 ± 0.237	0	1
Are communication and interaction with patients criteria fulfilled?	0.811	0.75 ± 0.189	0	1
Is the patient allowed to participate according to his ability to perform voluntary movements?	0.823	0.75 ± 0.200	0	1

**Table 4.** Distribution of the Result Phase Results<sup>a</sup>

Result Phase	No		Yes	
	No	Yes	No	Yes
Did the transfer technique cause any pain to the patient?	231 (92.4)	19 (7.6)		
Did the patient transfer technique cause any feelings of fear or uncertainty to the patient?	241 (96.4)	9 (3.6)		
Is the patient in a functional position at the end of the transfer?	101 (40.4)	149 (59.6)		

<sup>a</sup>Values are expressed as No. (%).

## Footnote

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