2015-5435/14/63-76-82
INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

IJOH 7: 76-82, 2015

ORIGINAL ARTICLE

Evaluation of Risk Factors Influencing Low Back Pain in Patient Transfer Tasks

SEYED EHSAN SAMAEI[1]; NASER HASHEMINEJAD[1*]; FARZANEH ZOLALA[2]

[1]Department of Occupational Health Engineering, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran; [2]Department of Epidemiology and Biostatistics, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran.

Received January 27, 2015; Revised April 16, 2015; Accepted June 22, 2015

This paper is available on-line at *http://ijoh.tums.ac.ir*

ABSTRACT

Low Back pain (LBP) is the most common type of musculoskeletal disorder (MSDs) in transfer tasks such as nursing personnel. Financial and economic costs expended for these disorders affect not only the individual, but the organization and society as well. The aim of this study was to evaluate associated factors in the incidence of LBP among nursing personnel according to risk assessment methods related to the patient's transfer. The present analytical study was conducted on 243 nurses in Kerman, Iran in 2014. The instruments for gathering data were Nordic Musculoskeletal Questionnaire (NMQ), MAPO and PTAI checklists. The data was analysed using SPSS.16 software. The prevalence of LBP among nursing personnel was 69.55%. Based on MAPO index, 48.2% of wards had moderate level of risk. In addition, the results of PTAI index also showed that 76.5% of the studied subjects were at the second risk level (moderate risk) of LBP. Work experience, work shifts and the final score of PTAI index were factors that affected prevalence of LBP the most. In this regard, we recommend the modification of factors such as guidance in work posture, use of patient transfer equipment and guidance in their use, work arrangement, mental strain of patient transfer, physical load of patient transfer and Frequency of manual patient transfer.

KEYWORDS: *Low Back Pain, Nordic Musculoskeletal Questionnaire, Patient Transfers, MAPO Index, PTAI Index*

INTRODUCTION

Nowadays, musculoskeletal disorders (MSDs) have become so popular and have progressively increased at work environments [1]. Recent statistics show a considerable and remarkable relationship between work and these disorders [2]. MSDs are common health problems and a significant cause of occupational injuries and disabilities in industrialized societies [3]. Risk factors at work such as excessive force, manual handling, repetitive tasks, work shift, job stress, and demographic characteristics such as age, weight, work experience, employment status, body mass index (BMI), smoking, and sex or gender are also important factors in the development of these disorders [4].

* ***Corresponding Author: Naser Hasheminejad***

Email: n_hasheminejad@kmu.ac.ir

Nurses working in hospitals are among groups that are susceptible to MSDs [5]. These disorders are considered serious problems in this occupational group [6].

Due to the nature of activities of nurses in different wards of a hospital, LBP is the most common musculoskeletal disorder [7]. Moreover, LBP is one of the major causes of discomfort, limitations in offering services, disability in daily activities, and absenteeism at work in this occupational group [8-9]. 16.2% of leave of absence or sick leave in nurses was due to LBP [10]. A substantial amount of costs is allocated directly or indirectly to treatment and health costs resulting from the prevalence of LBP in nursing personnel [11] because LBP is the cause of three-quarters of a million lost working days among nurses [12].

However, the main duty of patients' care during treatment is upon nurses' shoulders and they are responsible for that which includes works related to follow-up treatment and patient's routine work. The majority of hospitalized patients need movement or to be moved during treatment and this task is the responsibility of health care personnel. Moving patients in a way that has the minimum pain and discomfort for the patient and the minimum musculoskeletal injuries for nursing personnel is one of the important issues [13-14]. Results from investigations conducted by various organizations indicate a high prevalence of injuries associated with the patient transfer among nurses [15], so that about 22 million dollars was spent by Veterans' Health Administration (VHA) yearly on the expenses of injuries related to patients' transfer in 2002 [13]. Nurses have the biggest share of inpatients' care during hospitalization period; therefore, physical and mental health of health care personnel is of great importance in providing high-quality health care. Lack of attention to the physical health of nursing personnel results in the increase of lost workdays and reduction of job efficiency [16].

Effort to improve safety in patient transfer and to reduce prevalence of LBP among nurses is of particular importance. In one hand, it brings about protection of this occupational group from existing risks at work places. On the other hand, it increases satisfaction level and subsequently organizational efficiency and efficacy [3]. Therefore, special attention should be paid to such disorders and factors influencing their development. They should be identified and reduced. Recently, new methods such as MAPO and PTAI indexes have been developed to assess the risk of musculoskeletal disorders in personal patient transferring.

Totally, few studies have been done in this field in Iran. This study with the aim of evaluation of risk factors on Low Back Pain (LBP) in patient transfer tasks was done. In this study, in addition to assess demographic and organizational factors, ergonomic factors affecting on musculoskeletal disorders (such as MAPO and PTAI risk assessment methods) were also assessed and the effect of the final score of two methods (MAPO and PTAI) in incidence of LBP were considered. Only the lower back region examined to assess musculoskeletal disorders in patient transfer tasks. It is hoped that this study is a step toward improving conditions at hospitals and enhancing the quality of occupational health care and productivity at hospitals.

MATERIALS AND METHODS

The present analytical study was conducted in three catchment hospitals of Kerman University of Medical Sciences in 2014, Kerman, Iran. The population of the study for investigating LBP involved all nursing personnel involved in or had a role in handling, transferring, and moving patients in the hospitals (nurse, nurse assistant, nurse co-assistant). Furthermore, all clinical departments involved in patient handling, movement, and transfer in each of the studied hospitals were selected for evaluation of wards by MAPO and PTAI assessment methods and wards with no patient movement, or transfer were omitted from the study and were not included. Based on the prevalence of LBP among nurses (in this study, prevalence of LBP was assumed 75%) [17-21], the population in this cross-sectional study (N=1001) and according to acceptable error of 5% and α=0.05 the number of samples was obtained to 243.

Criterion for the inclusion of nursing personnel in the study was work experience for more than a year and activity in work shifts. Employees who had congenital musculoskeletal diseases or ever had musculoskeletal injuries in accidents were excluded from the study.

The instruments for gathering data included:

A) Nordic Musculoskeletal Questionnaire (NMQ) related to lower back region, consisted 12 questions related to the prevalence of LBP. The validity and reliability of NMQ were investigated and confirmed in different studies and languages, including the Persian language [22-23]. Additionally, in this questionnaire, demographic and organizational information consisting age, weight, height, work experience, gender, marital status, employment status, work shift, and BMI were included.

B) Movement and Assistance of Hospital Patients (MAPO): MAPO method is one of the methods of assessing the risk of musculoskeletal injuries caused by patient handling, movement, and transfer in the hospital. Influencing factors in MAPO method included Lifting equipment Factor (LF), the Assistant equipment Factor (AF), Wheelchair Factor (WF), Environmental Factor (EF), and Training Factor (TF).In this quantitative procedure, there are three levels: negligible, moderate, and severe risk levels. The resulting number was placed in one of the three levels:

1) Level 1 (MAPO score 0 to 1.5): Risk is negligible; here the prevalence of LBP appears to be identical to those of the general population.

2) Level 2 (MAPO score 1.51 to 5): Shows that LBP may have an incidence 2.4 times higher than the level one. At this level, it is necessary to make a medium- and long-term intervention plan for health surveillance, aid equipment and training.

3) Level 3 (MAPO score >5): Corresponds to a higher risk, where LBP may have an incidence up to 5.6 times higher the expected incidence. In this case, an immediate intervention plan must be

Published online: June 20, 2015

made for health surveillance, aid equipment, training and environmental improvement [24].

The reliability and validity of MAPO index in external and internal studies has been reviewed and approved [6, 25].

C) Patient Transfer Assessment Instrument (PTAI): PTAI method is one of the ways of assessing the risk of musculoskeletal injury caused by the patient transfer and displacement by nursing personnel. PTAI checklist included items in which factors such as environmental conditions, Guidance in work posture, use of patient transfer equipment and guidance in their use, work arrangement, mental strain of patient transfer, physical load of patient transfer and frequency of manual patient transfer were evaluated. In this index, the risk of musculoskeletal injuries in employees who were dealing with patient movement was assessed in three negligible, moderate and severe risk levels. This level is:

1) Level 1 (PTAI score > 80%): The ergonomic status of patient transfer was good.

2) Level 2 (PTAI score between 60 to 80%): Strain of patient transfer was high, so solving the identified problems in workplaces is recommended.

3) Level 3 (PTAI score < 60%): Immediate ergonomic measures was necessary to improve work methods.

Assessing the reliability or intra-observer correlation coefficient of this index was determined and the intra-observer correlation coefficient was obtained to be 0.80 or 80% using the test, which is perfectly acceptable [26].

Data analysis was done using of SPSS.16 software (Chicago, IL, USA) and descriptive statistics to describe subjects' demographic and organizational data. To assess the relationship between incidence of LBP and independent variables (demographic, organizational and work ergonomic factors), binary logistic regression (Univariate and multivariate analyses) was used for analyses. All variables related to incidence of LBP in univariate analyses were entered into the multivariate analyses. Only the remaining significant variables were included in the multivariate analyses (A backward likelihood ratio stepwise method was used). The odds ratio (OR) was calculated, and a 95% confidence interval (95% CI) was estimated. The significance level for all tests was considered less than 0.05.

To respect the rights, principles, and ethical considerations, all the subjects were aware of the purpose and importance of the study. Throughout the study, they were also assured that the data was only used for research purposes, and their information was confidentially reserved. Nursing personnel were also stressed to the extent that at any stage of research they could withdraw from participating in the survey.

RESULTS

Out of 243 studied nurses, 87.7% were women and 80.7% were married. Furthermore, according to the classification of BMI, 1.6% of individuals were underweight, 52.3% had normal weight, and 40.7% of them were overweight and 5.3% suffered from obesity. The prevalence of LBP in the studied subjects was 69.55% (Table 1).

Table 1. Demographic and organizational characteristics among nursing personnel, 2014

Variable	Mean	Standard deviation
Age (yr)	33.6	3.18
Weight (kg)	65.79	9.15
Stature (cm)	163.73	6.32
Work experience (yr)	10.69	6.37
BMI (kg/m^2)	24.53	3.13
	Classification	**Frequency (percentage)**
Shift work	Rotational shift	205 (84.4)
	Fixed shift	38 (15.6)
Education Level	Pre-Bachelor's degree	57 (23.4)
	Bachelor's degree	158 (65.1)
	Master's degree	28 (11.5)
Sex	Female	213 (87.7)
	Male	30 (12.3)
Marital status	Married	196 (80.7)
	Single	47 (19.3)

The results of NMQ showed that the prevalence of LBP among nursing personnel in the period of 12 months was 69.55%. According to the assessments conducted in 58 hospital wards by MAPO method, 48.2% of the studied sections were at average risk level of LBP. The results of PTAI method also showed that 76.5% of the studied subjects were at the second risk level (moderate risk) of LBP (Tables 2 and 3).

Table 2. The results of LBP risk Assessment by MAPO method among nursing personnel studied, 2014

Score	The risk level of MAPO index	Frequency	Percent
0 - 1.5	Level 1: Negligible	7	12.1
1.51 - 5	Level 2: Medium risk	25	48.2
>5	Level 3: Sever risk	33	39.7
	Total (Wards)	58	100

Table 3. The results of LBP risk Assessment by PTAI method among nursing personnel studied, 2014

Score	The risk level of PTAI index	Frequency	Percent
>80	Level 1: Negligible	22	9.1
60-80	Level 2: Medium risk	186	76.5
<60	Level 3: Sever risk	35	14.4
Total (Nursing personnel)		243	100

Based on the results of multivariate logistic regression analysis, there was a significant relationship between the prevalence of LBP and variable work experience, shift work and the final score of PTAI so much so that, with an increase in one unit of work experience (years), the chances of LBP had increased by about 9% (Table 4).

Table 4. The factors affecting the incidence of LBP based on univariate logistic regression among nursing personnel studied, 2014

Variable	Univariate		
	OR	CI (OR)	*P*-value
Age	1.12	1.01 to 2.21	*0.037
Work Experience	1.15	1.04 to 1.61	*<0.001
BMI	1.14	1.09 to 3.30	*0.039
Work Shift	1.83	1.05 to 4.24	*0.013
Final score PTAI	1.14	1.06 to 2.98	*0.013
Final score MAPO	1.06	1.03 to 1.53	*0.048

Table 5. The factors affecting the incidence of LBP based on multivariate logistic regression among nursing personnel studied, 2014

Variable	Multivariate		
	OR	CI (OR)	*P*-value
Work Experience	1.14	1.03 to 1.57	*0.006
Work Shift	1.74	1.04 to 4.13	*0.031
Final score PTAI	1.12	1.05 to 2.67	*0.023

DISCUSSION

The results of the study revealed prevalence of LBP was 69.55 percent in a period of 12 months.

This prevalence indicates that many nursing personnel suffer from LBP due to the nature of their work at hospital sections and wards.

MSDs are considered as consequences related to inappropriate ergonomic conditions in the workplace. Nurses are exposed to MSDs due to the nature of their heavy tasks [27] . This result is consistent with the findings of others researchers [8, 25, 28, 29], but in contrast with Smith et al. study, where the most prevalence was in the shoulder and leg regions respectively [30]. This difference can be attributed to differences in samples and their work environments.

In the present study, the results of logistic regression analysis showed that one of the associated factors in the incidence of LBP was aging. Accordingly, the increase of a single unit of age (a year), the chance of the prevalence of getting LBP increases to 12%. In the study by Sikiru et al. among nurses in a typical Nigerian hospital, a significant relationship between aging and the increase of MSDs was reported in various parts of the body, which supports the findings of the present study [31]. Natural process of aging is associated with deterioration of motor function and physical capacity, which can cause the prevalence of pain in musculoskeletal disorders [32].

Based on Logistic regression results, another important factor in the incidence of LBP is work experience. Accordingly, with increased work experience, the chances of getting LBP increased and these results are consistent with the study by Reisee et al. [33].

The BMI-based result is an important factor that can be considered as a contributing factor to the incidence LBP among patient transfer tasks (nursing personnel). In other words, with the increase in every unit of BMI (kg/m^2) chances, the chance of getting LBP increases to 14%. Karahan et al. confirm this significance as well [34]. However, the study by Atrchi et al. (on 454 nurses of public hospitals in Iran), reported no significant

relationship between the prevalence of LBP and BMI which is in contradiction with the results of the present study [35]. Maintaining the normal body weight reduces the pressure on the spine and abdomen, while excess weight can cause chronic spasms in the lower back region.

Furthermore, the results of this study indicate that the prevalence of LBP in nursing personnel who had rotating shifts was more than those with constant shifts were. In addition, this relationship was statistically significant. By changing constant or fixed shifts to rotating shifts, the risk of getting LBP increases 1.83 times. Moreover, some other studies confirmed the relationship between work shift and the prevalence of LBP [36-37]. Meanwhile, rotational shift was recorded as one of the most important factors in the incidence of LBP in nursing personnel [38]. The relationship between work shift and incidence of LBP can be due to work pressure during unconventional times of the day and night [38]. The work done and its pressure in unconventional shifts at night due to the lack of nursing personnel can be more in comparison to day shifts. The body also needs rest and recuperation during this period is an important factor in the incidence of LBP.

The results of the evaluation of the 58 wards of the hospitals in this study by MAPO method showed that about half of these wards (48.2%) were at intermediate risk level, which is in line with the study by Abedini et al. [25] and in contrast with the study by Saremi and Khayati [39]. Based on the results of multivariable logistic regression analysis, a significant relationship could not be established between the prevalence of LBP in nurses and the final score in MAPO method. Perhaps, this lack of relationship was attributed to the fact that in calculating the final MAPO score, WF, EF and TF had more influence than other factors and these factors had a relatively good condition at the studied hospitals.

However, in multivariable logistic regression analysis, there was a significant relationship between LBP and PTAI final scores. Perhaps, the cause of this relationship can partly be attributed to the criterion affecting PTAI index such as work arrangement, mental stress of patient transfer and physical load of patient transfer. It should be noted that the results of this study are in line with the results obtained by Abedini et al. [26].

According to this cross-sectional study, casual relationships between risk factors and LBP cannot be determined. On the other hand, this study can provide the basis for decisions about risk factors of LBP among nurses in follow-up studies. In addition, the incidence of LBP among nursing personnel was influenced by many organizational factors, which had impact on the results of studies such as Nurse-to- bed ratio. In addition, a psychological factor in workplaces, which may affect the prevalence of LBP, was not included in the study. Therefore, each of these factors can be a cause of inconsistent results compared with other studies.

CONCLUSION

The prevalence of LBP among nursing personnel was high. According to results from MAPO and PTAI risk assessment methods, most of the nursing personnel were in the moderate risk level (the second level). Based on the results, work experience, work shifts and the final score of PTAI index were the most important factors affecting the prevalence of LBP. A significant relationship was observed between the incidence of LBP and PTAI risk assessment method, which confirmed the effectiveness of this method (PTAI) in predicting the incidence of LBP in patient transfer tasks.

In addition, regarding the importance of the final score of PTAI index in the incidence of LBP in patient transfer tasks (nursing personnel), the modification of factors in this method mentioned already are recommended.

ACKNOWLEDGEMENTS

This paper has been extracted from Mr. Seyed Ehsan Samaei's Master's Degree thesis in Occupational Health Engineering. This thesis has been supported by Kerman University of Medical Sciences with Registration number 93/395, Kerman, Iran. The authors would like to express their appreciation and thanks to all the nurses of the hospitals of Kerman University of Medical Sciences who cooperated with the research team for conducting this study. The authors declare that there is no conflict of interest.

REFERENCES

1. Skotte JH, Essendrop M, Hansen AF, Schibye B. A dynamic 3D biomechanical evaluation of the load on the low back during different patient-handling tasks. J Biomechan 2002;35:1357-66.
2. Punnett L, Wegman DH. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. J Electromyogr Kinesiol 2004;14:13-23.
3. Smith DR, Leggat PA. Musculoskeletal disorders in nursing. ANJ 2003;11:19-21.
4. Cagnie B, Danneels L, Van Tiggelen D, De Loose V, Cambier D. Individual and work related risk factors for neck pain among office workers: a cross sectional study. Europ Espine J 2007;16:679-86.
5. Mitchell T, O'Sullivan PB, Burnett AF, Straker L, Rudd C. Low back pain

characteristics from undergraduate student to working nurse in Australia: a cross-sectional survey. IJNS 2008;45:1636-44.
6. Battevi N, Menoni O, Ricci MG, Cairol S. MAPO index for risk assessment of patient manual handling in hospital wards: a validation study. Ergonomics 2006;49:671-87.
7. Warming S, Precht D, Suadicani P, Ebbehøj N. Musculoskeletal complaints among nurses related to patient handling tasks and psychosocial factors–based on logbook registrations. Appl Ergon 2009;40:569-76.
8. Choobineh A, Rajaeefard AR, Neghab M. Perceived demands and musculoskeletal disorders among hospital nurses. Hakim Res J 2007;10:70-6.
9. French P, Flora LF, Ping LS, Bo LK, Rita WHY. The prevalence and cause of occupational back pain in Hong Kong registered nurses. JAN 1997;26:380-8.
10. Bing Yip Y. A study of work stress, patient handling activities and the risk of low back pain among nurses in Hong Kong. JAN 2001;36:794-804.
11. Videman T, Ojajärvi A, Riihimäki H, Troup JDG. Low back pain among nurses: a follow-up beginning at entry to the nursing school. Spine 2005;30:2334-41.
12. Moffett JA, Hughes GI, Griffiths P. A longitudinal study of low back pain in student nurses. IJNS 1993;30:197-212.
13. Nelson A, Mat M, Chen F, Siddharthan K, Lloyd J, Fragala G. Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. IJNS 2006;43:717-33.
14. Trinkoff AM, Brady B, Nielsen K. Workplace prevention and musculoskeletal injuries in nurses. JONA 2003;33:153-8.
15. Pompeii LA, Lipscomb HJ, Schoenfisch AL, Dement JM. Musculoskeletal injuries resulting from patient handling tasks among hospital workers. AJIM 2009;52:571-8.
16. Santaguida PL, Pierrynowski M, Goldsmith C, Fernie G. Comparison of cumulative low back loads of caregivers when transferring patients using overhead and floor mechanical lifting devices. Clin Biomech 2005;20:906-16.
17. Choobineh AR, Rajaeefard A, Neghab M. Association between perceived demands and musculoskeletal disorders among hospital nurses of Shiraz University of Medical Sciences: a questionnaire survey. JOSE 2006;12:409-16.
18. Abedini R, Choobineh AR, Hasanzadeh J. Musculoskeletal disorders related to patient transfer in hospital nursing personnel. Health Sys Res 2012;8:385-96.
19. Rashidi M. Study of prevalence and causes of low back pain in the islamic azad university of semnan. Koomesh 2007;8:233-7.
20. Eftekhar Sadat B, Babaei A, Amidfar N, Jedari Eslami MR. Prevalence and risk factors for low back pain in nursing staffs of tabriz hospitals in 2008. J Nurs Midwif Urmia University Med Sci 2013;11:659-66.
21. Ramazani Badr F, Nikbakht AR, Mohammadpour A. Low-back pain prevalence and its risk factors in nurses. IJNR 2006;1:37-42.
22. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 1987;18:233-7.
23. Choobineh AR, Lahmi M, Shahnavaz H, Khani Jazani R, Hosseini M. Musculoskeletal symptoms as related to ergonomic factors in iranian hand-woven carpet industry and general guidelines for workstation design. JOSE 2004;10:157-68.
24. Battevi N, Menoni O, Ricci MG, Cairoli S. MAPO index for risk assessment of patient manual handling in hospital wards: a validation study. Ergonomics 2006;49:671-87.
25. Abedini R, Choobineh A, Hasanzadeh J. Ergonomics risk assessment of musculoskeletal disorders related to patient transfer operation among hospital nurses using PTAI technique. Iran J Nurs 2013;25:75-84.
26. Abedini R, Choobineh AR, Hasanzadeh J. Musculoskeletal disorders related to patient transfer in hospital nursing personnel. Health Sys Res 2013;8:385-96.
27. Lela M, Frantz JM. Physical activity among nurses in kanombe military hospital. Afr J Physio Rehab Sci 2012;4:63-6.
28. Tinubu BMS, Mbada CE, Oyeyemi AL, Fabunmi AA. Work-related musculoskeletal disorders among nurses in ibadan, south-west nigeria: a cross-sectional survey. BMC Musculoskeletal Disord 2010;11:12-20.

Published online: June 20, 2015

29. Magnago TSBS, Lisboa MTL, Griep RH, Kirchhof AL, Guido LA. Psychosocial aspects of work and musculoskeletal disorders in nursing workers. RLAE 2010;18:429-35.
30. Smith DR, Mihashi M, Adachi Y, Koga H, Ishitake T. A detailed analysis of musculoskeletal disorder risk factors among Japanese nurses. J Saf Res 2006;37:195-200.
31. Sikiru L, Hanifa S. Prevalence and risk factors of low back pain among nurses in a typical Nigerian hospital. Afr Health Sci 2010;10:26-30.
32. Kjellberg K, Lagerström M, Hagberg M. Work technique of nurses in patient transfer tasks and associations with personal factors. SJWEH 2003:468-77.
33. Raeisi S, Hosseini M, Attarchi MS, Golabadi M, Rezaei MS, Namvar M. The association between job type and ward of service of nursing personnel and prevalence of musculoskeletal disorders. RJMS 2013;20:1-10.
34. Karahan A, Bayraktar N. Determination of the usage of body mechanics in clinical settings and the occurrence of low back pain in nurses. IJNS 2004;41:67-75.
35. Attarchi MS, Raeisi S, Namvar M, Golabadi M. Association between shift working and musculoskeletal symptoms among nursing personnel. IJNMR 2014;19:309.
36. Demerouti E, Bakker AB, Bulters AJ. The loss spiral of work pressure, work–home interference and exhaustion: Reciprocal relations in a three-wave study. J Vocational Behav 2004;64:131-49.
37. Janssen D, Nachreiner F. Health and psychosocial effects of flexible working hours. RSP 2004;38:11-8.
38. Eriksen W, Bruusgaard D, Knardahl S. Work factors as predictors of intense or disabling low back pain; a prospective study of nurses' aides. OEM 2004;61:398-404.
39. Saremi M, Khayati F. Evaluation of ergonomic risk of manual handling of patients with MAPO index and its relationship with incidence of low back pain among nurses. Advanced Engineering Forum; December 2013; Switzerland. Switzerland: Trans Tech Publ; 2013.

Published online: June 20, 2015