MR. MAJID BAGHERI HOSSEIN ABADI (Orcid ID : 0000-0002-5477-199X)

DR. SEYED EHSAN SAMAEI (Orcid ID : 0000-0002-3152-7062)

Article type : Original Article

The associations of Workload, Individual and Organizational Factors on Nurses' Occupational Injuries

Running title: Nurses' Occupational Accidents and effective factors

Majid Bagheri Hosseinabadi[1], Narges Khanjani[2], Siavash Etemadinezhad[3], Seyed Ehsan Samaei[4*], Mehdi Raadabadi[5], Maryam Mostafaee[6]

1. School of Public Health, Shahroud University of Medical Sciences, Shahroud, Iran
2. Neurology Research Center, Kerman University of Medical Sciences, Kerman, Iran.
3. Department of Occupational Health Engineering, School of Public Health, Mazandaran University of Medical Sciences, Mazandaran, Iran.
4. Mobility Impairment Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.
5. Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran.
6. Institute for Environmental Research, Tehran University of Medical Sciences, Tehran, Iran.

* (Corresponding Author): Seyed Ehsan Samaei, Email: Samaeiehsan89@gmail.com,

Tel: +989127033994

Acknowledgement

The authors of this work would like to appreciate for sincerely cooperation of all the nurses participating in and authorities Kerman, Babol, Hamedan and Mashhad University of Medical Sciences Hospitals this research.

Conflicts of interest

The authors declare that they have no conflict of interests.

Abstract

Aims and objectives. The present study aimed to determine the prevalence and type of occupational injuries in nurses and their associations with workload, working shift, and nurses' individual and organizational factors.

Background. Nurses are vulnerable to occupational injuries due to the nature of their job.

Design. A cross-sectional correlational design (based on STROBE Statement) was conducted.

Methods. This study was conducted among 616 nurses of four public hospitals located in four different provinces in Iran. Data were collected using three questionnaires including an organizational and demographic questionnaire, an occupational injuries checklist and the NASA-TLX questionnaire (about mental workload). Chi square, one-way ANOVA and multivariate logistic regression was used in SPSS version 23.0 for statistical analysis.

Results. Blood and body fluid exposures had the highest prevalence (47.4%) among all injuries. Needle stick injuries showed a significant relation with gender, age, number of shifts in a month and work experience. With increase in mental workload, needle stick injuries increases by 35%. Also, injuries reported by nurses working in rotating shifts were 15-53% more than nurses working in fixed shifts.

Conclusion. Working in rotating shifts and work overload was significantly related to all injuries. Decreasing nurses' mental workload, introducing guidelines and efficient training in shift work schedules can help decrease occupational injuries among nurses.

Relevance to clinical practice. In order to reduce occupational injuries among nurses, in addition to incorporating advanced management and technology, it is necessary to pay attention to psychosocial, individual and organizational risk factors related to occupational injuries and their frequency in nurses. Also, reducing personnel's mental and occupational pressure should be considered.

Key words: Workload, injuries, Occupational, Nurses

Introduction

Occupational injuries can cause decreased occupational performance, increased medical costs, and loss of human resource and working hours (Bahcecik & Ozturk, 2009). The Bureau of Labor Statistics has reported that from three million injuries and nonfatal diseases recorded in 2014, 177000 cases happened in nursing and residential care facilities and its incidence was considerably higher than other industries. Moreover, 108000 of these accidents resulted in taking days away from work, job transfer or restrictions (Bureau of Labor Statistics, 2014).

In addition to the direct costs, occupational injuries may impose several indirect costs for patients, families and co-workers including mental, physical and psychological consequences (Gonçalves, da Silva, Lima, & al, 2008). Occupational injuries can also influence nurses' social life and can deteriorate their economic situation (García-Herrero, Mariscal, García-Rodríguez, & al, 2012).

The National Institute for Occupational Safety and Health (NIOSH) aims to decrease occupational injuries, diseases, and deaths through regular surveillance. Blood borne pathogens are one of the most important occupational safety and health hazards for healthcare providers' worldwide (Shiao, McLaws, Lin, & al, 2009).

Exposure to blood borne pathogens can happen by subcutaneous injuries, needle sticks, injuries caused by sharp objects or exposure of the mucous membranes to body fluids (Kasatpibal, Whitney, Katechanok, & al, 2016). People exposed to these injuries, are seriously vulnerable to diseases like hepatitis B, C and HIV which have serious life threatening complications(Priya, Krishnan, Jayalakshmi, & al, 2015).

A US study including 15 national monitoring systems for healthcare workers and 45 hospital exposure prevention programs, estimated that the number of percutaneous injuries in healthcare providers was annually 384,325 cases (Panlilio, Orelien, Srivastava, & al, 2004). In addition, trips, slips and falls cause a high rate of lost-workday injuries (Bell, Collins, Tiesman, & al, 2013) and patient handling plays a key role in back injuries among nurses(Akbari, Akbari, & Abadi, 2017). Working and organizational conditions are factors potentially involved in the occurrence of occupational injuries (García-Herrero et al., 2012).

Among working factors, it seems like workload can increase absence from work, occupational injuries, medical errors and burnout by affecting healthcare providers' physical and mental health (Robazzi, Mauro, Secco, & al, 2012). Nurses' heavy workload can cause adverse outcomes not only for nurses, but also for patients (Myny, Van Goubergen, Gobert, & al, 2011). These adverse outcomes can include stress, dissatisfaction, burnout (Leiter & Laschinger, 2006; Spooner-Lane & Patton, 2007) and patients' prolonged hospitalization and even death (Kane, Shamliyan, Mueller, & al, 2007).

Honda et al (2011) showed that the incidence of cuts by sharp instruments, as one of the most important occupational injuries among nurses can increase due to heavy workload (Honda, Chompikul, Rattanapan, & al, 2011). There has been worldwide effort to increase safety in the healthcare sector, improve healthcare quality and decrease patient injuries. Nowadays, most developed countries acknowledge the fact that advanced management and technology is not enough to promote safe behaviors in the workplace, and in order to achieve safety and prevent injuries, in addition to managerial systems and implementing safety principles; reducing health personnel's mental and occupational pressure should be considered (Rahimi, Ahmadi, & Akhond, 2004).

This study was conducted to determine the prevalence and type of occupational injuries in nurses and the role of workload, and nurses' individual and organizational factors in these occupational injuries. Recognizing and evaluating factors associated with occupational injuries among nurses, can help managers find proper interventions to improve nurses' working condition, reduce adverse outcomes and promote safety.

The research questions in this study are: What are the most frequent occupational injuries? and What workload, individual and organizational factors are associated with nurses' occupational injuries?

Methods

Design

A cross-sectional observational design was conducted.

Population and sampling

This investigation was done in two parts. First, the prevalence and type of occupational injuries in nurses was determined from August 2015 to February 2016; and then the association between individual-organizational factors with occupational injuries was investigated. Participants included nurses working in four public hospitals in the cities of Babol, Kerman, Mashhad, and Hamedan. These cities were chosen respectively from the North, South, East and West of Iran. In each city, one public hospital was chosen randomly. The criteria for choosing the hospitals were having at least four main wards which were internal medicine, surgery, gynecology and obstetrics; and pediatrics.

The study population included all 1485 nurses working in the four selected hospitals. Then, 616 eligible nurses were selected by stratified random sampling from different hospital wards. However, five nurses did not thoroughly complete their questionnaires and the response rate was 92.2%.

The inclusion criteria were holding a bachelor degree in nursing (as a minimum degree), working as a full-time nurse, not working in a second job, not suffering from mental or physical problems, and working at least one year in the current medical ward. Nurses who were not interested to participate or had not thoroughly completed the questionnaires were excluded. This research was prepared based on the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist for cross-sectional study (See Supplementary File 1).

Measures

Data collection tools included the following questionnaires:

A demographic information questionnaire which was used to collect individual data including: gender, age, marital status, education and clinical experience; and organizational data including: employment status, shifts per month, job position, ward, attending occupational injury prevention training and shift work status. Shift work refers to a work schedule that includes regular and irregular working hours, which are not inside the range of the routine working hours which is 7 am - 6 pm (Khosro, Alireza, Omid, & al, 2011). Since the studied nurses worked in morning, afternoon and night shifts, they were classified into fixed and rotating shifts.

Nurses' occupational injuries were asked through a researcher-made questionnaire that was made for the purpose of this study. There were no reliable databases about nurses' occupational injuries in Iran's hospitals. Therefore, researchers used previous studies to list the common occupational injuries among nurses. In national and international studies, numerous different occupational injuries have been reported among nurses. In this study, only the most frequent occupational injuries found in the literature were selected. These injuries were: 1- Sharps Injuries (SIs), 2- Needle Stick Injuries (NSIs), 3- Blood and Body Fluid Exposures (BBFEs), 4- Drug and Chemical Splash in the Eyes (DCSEs), 5- Slip, Trip and Fall Injuries (STFIs), 6- Back Pain because of Patient Handling Tasks (BPPHTs). Needle stick injuries are wounds caused by needles that accidentally puncture the skin, whereas Sharps Injuries are skin-penetrating stab wounds caused by sharp instruments, such as a lancet, scalpel, trocar, scissors, drill bit, sawing blade, or broken glass. A self-evaluating occupational accident questionnaire was prepared which included the 6 injuries mentioned above, and asked about the occurrence (Yes\No) and the frequency (once, twice, and more than thrice) of these injuries during the last 6 months.

Perceived workload was one of the important explanatory variables in this study. There are different ways to estimate nurses' workload, including bed to nurse ratio which is an objective index and perceived workload which is a subjective index. The workload perceived by nurses is influenced by different items as well as personal difference in coping with workload and the bed to nurse ratio; although it may not be a flawless way for assessing workload. In addition, the bed to nurse ratio is also influenced by other factors such as "Inpatient bed occupancy ratio". In this study, mental

workload was assessed by the NASA-TLX (Task Load Index) questionnaire which evaluates different dimensions of perceived workload. The NASA-TLX was first used to assess workload in aviation, and is a valid tool to assess workload among healthcare providers as well (Young, Zavelina, & Hooper, 2008). The validity and reliability of this questionnaire has been approved in different languages including Persian (Malekpour, Mohammadian, Malekpour, & al, 2014; Mohammadi, Mazloumi, & al, 2013). This questionnaire is a multidimensional tool that allows task level workload's score to be estimated based on a weighted average of ranks in six subgroups. These six subgroups include mental demand, physical demand, temporal demand, performance, effort and frustration. Mental demand means the psychological and cognitive requirements for performing tasks. Physical demands include the ability to perform pushing, pulling, lifting and other activities related to the task. Immediate demand, evaluates constraints for completing a task. Effort assesses how much physical and mental work is required for a certain level of performance. Frustration assesses continuity, stress and satisfaction and it depends on completion of the task. The sixth subgroup, performance, has been developed to measure success or satisfaction against performance as well as completion of given tasks. Each subgroup, describes a special characteristic that is utilized for explaining the general aspects of workload. The three initial subgroups are in relation with workload demand that is imposed subjectively. And the remaining illustrates interactions with tasks. The twenty one-step bipolar scales are used to gain ratings on these dimensions, resulting in a score between 0 and 100, and a higher score indicates the higher experienced workload. This tool estimates the workload experienced by the employee through combining these six dimensions (Hart, 2006).

Ethical considerations

This study was approved by the Ethics Committee of Kerman University of Medical Sciences in September, 2016 (Ethics Code No. 930280). Researchers explained the aims of the study to the nurses in charge of each ward and the staff nurses. Written consent was inquired before completing the questionnaires. The participants were assured that they could leave the study whenever they wanted.

Data collection

After ethics approval, permission from the universities and hospitals under their supervision was sought, and required documents were given to the hospitals. Researchers visited the hospitals on all days of the week and in two working shifts (morning and afternoon) in order to be able to enroll all nurses; and asked them to complete the questionnaires. Completing each questionnaire took about one hour. The questionnaires were completed by the nurses themselves and were then collected by the researchers.

Data analysis

Descriptive statistics were reported for all variables. The Kolmogorov-Smirnov test was used to determine data normality and the Levene's test was used to show equality of variances. Logistic Regression analysis was used to identify risk factors for the dichotomous occupational injuries variable (Yes/No). All analysis was done by SPSS version 23.0.

Results

The total number of nurses that participated in this study was 616. Their mean age was 35.02 ±8.07. Participants were mostly female (68%), and 44.5% of them aged between 30 to 39 years, 75.6% of them were married and only 12% of them had work experience more than 21 years. Most of the participants (453 persons) were practicing nurses (73.5%) and 30.5% (188 persons) were working in Intensive Care Units (ICUs). In this study about 70% of nurses worked in rotating shifts, but had duties similar to fixed-shift nurses (Table 1).

Occupational injuries reported by nurses according to type are shown in Table 2. The highest rate was "BPPHTs" and "BBFEs" and more than one third of the nurses had reported at least one of these injuries in the last six months. Among the reported injuries, "DCSEs" had the lowest rate. There was a significant difference between "SIs", "NSIs", and "BBFEs" between the hospitals.

The different dimensions of workload in different hospitals have been shown in Table 3. From the different dimension of perceived workload in all hospitals, "MD" had the highest score. In all subscales, except "EF" and "FR", there was a significant difference between hospitals.

In order to determine the effect of individual and organizational factors as well as workload on nurses' occupational injuries, the incidence of adverse outcomes (a dichotomous variable) was entered into crude and multivariable logistic regression models. Shift work and Workload Index (NASA TLX) were independent variables in all events (Table 4).

Discussion

It is difficult to access detailed information about nurse's occupational injuries in Iran, as there is no database regarding nurses' occupational injuries in most hospitals. Based on this study, the rate of BBFEs, BPPHTs, SIs, and NSIs in the past 6 months reported by the nurses were respectively 47.4%, 36.2%, 25.3%, and 24.7%.

A study from Thailand showed that BBFEs had the highest and SIs had the lowest rate of occurrence. Furthermore, the occurrence rate of NSIs was 23.68% that was similar to the present study. The population surveyed in their study included 2031 surgical technologists of whom almost 70% had received no training about preventing occupational injuries (Kasatpibal et al., 2016).

Based on the report of the Exposure Prevention Information Network (EPINet) in 2012, in the US, the occurrence rate of BBFEs and NSIs were 47.7 and 36.2%, respectively (EPINet, 2012). This report shows that despite adopting control measures for decreasing occupational injuries, their occurrence rate has increased, even in developed countries.

The occurrence rate of BBFEs in Thai nurses, in a 5-year period was 4.2 per year (Chaiwarith, Ngamsrikam, Fupinwong, & al, 2013). The high occurrence rate of occupational injuries can be due to lack of continuous education and theoretical training programs. In the present study, more than one third of the nurses had not taken any occupational injury prevention training during the last year. In addition, there was no guideline about preventing BBFEs, BPPHTs, SIs, and NSIs in the hospitals under study. However, the prevalence of occupational injuries in this study was much less than the Raeissi et al (2015) study conducted in a women's teaching hospital in Iran (Raeissi, Omrani, Khosravizadeh, & al, 2015).

The highest rates of SIs and NSIs among hospitals were related to hospital B, which had the highest number of nurses working at the emergency ward (31.6%) in comparison to the other hospitals. As acute healthcare is necessary in emergency wards, nurses have to work faster and consequently this may increase errors and mistakes. The higher rate of injuries in hospital B, could be due to this difference. Also, Hospital B had more young nurses (age group 20 to 29 years old) than other hospitals. It can be argued that young nurses are more inclined and have a better culture to report incidents than older nurses.

Hospitals B and D had the highest rate of BBFEs among the other two hospitals. Initial surveys showed that the population under study in these two hospitals was more in the range of 20-29 years, also 79.1% and 85.0% of the participants from hospitals B and D were practicing nurses and due to the nature of their job were more in contact with blood and body fluids than their supervisors and head nurses.

Our results showed that with decrease in clinical experience, the number of shifts in a month increased, as well as mental workload and SIs occurrence. Also, the occurrence of SIs in nurses with rotating shift work was higher than nurses with fixed shifts. The number of shifts in a month can be considered as an index of the physical workload experienced by nurses. A study on healthcare staff in China has reported that among 98118 nurses, 7642 nurses had experienced SIs at least once in the last month. In addition, healthcare staff with less than 10-years work experience reported SIs more than those with more than 10-years work experience. They mentioned some possible factors like

high clinical workload, lack of safety culture and not using safety and protecting equipment such as Personal Protective Equipment, as contributing factors. They also mentioned that the nurse to bed ratio was 1:2.3; that shows a high physical workload, and this could be related to increased SIs (Gao, Hu, Suo, & al, 2017). In Egypt, 50% of the healthcare staff which include nurses, medical doctors and cleaners reported at least one case of SIs during the last year. Furthermore, there was a significant correlation between SIs, shift work and work experience. Unlike this study, there was not any significant relation between age group and SIs (Zawilla & Ahmed, 2013). Kasatpibal et al (2016) reported that the occurrence of SIs in morning and evening shift works was higher than night shift works, which they thought resulted from doing more surgery in these shifts (Kasatpibal et al., 2016).

In the present study, there was a significant relation between NSIs and gender, age, number of shifts in a month, clinical work experience, shift work, and workload. The odd ratio for NSIs in female nurses was 32% more than male nurses. A significant correlation between NSIs with aging and number of shift works per month among nurses has been found by Gholami et al(Gholami, Borji, Lotfabadi, & al, 2013). Smith et al (2006) found that NSIs in nurses aged less than 27 years was 4.5 folds more than other nurses, in South Korea (Smith, Choe, Jeong, & al, 2006). Our study showed that the odd ratio for NSIs in nurses with less clinical experience was more than nurses with more work experiences, which was in line with the results of Honda et al's study in 2011 in Thailand (Honda et al., 2011). Increase in the number of shift works per month is an important factor in the occurrence of NSIs mentioned in other investigations (Honda et al., 2011; Kakizaki, Ikeda, Ali, & al, 2011). Zhang et al (2015) found a significant relationship between NSIs, age and ward among nurses working in a teaching hospital in China. In their study, 80% of NSIs had happened among nurses aged 25 or younger. In their study the surgical department had the highest rate of NSIs which was in contrast with this study. Almost 50% of participants in their study had work experience less than 5 years, and this probably explains the difference in NSIs between different wards and the high occurrence rates (Zhang, Gu, Cui, & al, 2015). In a study conducted by Lo et al (2016), working hours in a week, age and ward were reported as factors affecting such injuries. They also showed that shortage in the number of nurses resulted in increased workload, that consequently increased occupational injuries and illness among Thai nurses (Lo, Chiou, Huang, & al, 2016). Furthermore, a study in Iran found that high workload is the main reason for 33% of needle injuries (Nejadghaderi, Safizadeh, & Khanjani, 2012).

According to our findings, the odds of BBFEs in female nurses was less than male nurses which is in line with Shaghaghian et al's study in Iran (Askarian, Shaghaghian, Gillen, & Assadian, 2008). This finding was also similar to surveys conducted in France (Denis, Ecochard, Bernadet, & al, 2003), Australia (Dement, Epling, Østbye, & al, 2004), and the US (Clarke, 2007). In addition, in this present study, the odds of BBFEs in nurses having less than 10 years' work experience was more than experienced nurses, which was similar with Kasatpibal et al's findings in Thailand (Kasatpibal et al., 2016). Experienced nurses can probably protect themselves better from blood and body fluids. On the other hand, experienced nurses due to their higher knowledge and more professional skills are able to prevent injuries better than new personnel (Clarke, 2007). Increased working years has been introduced as an effective factor on the increased rate of BBFEs among nurses in Ethiopia (Yenesew

& Fekadu, 2014). The healthcare staff in Yugoslavia who worked in rotating shifts had more injuries in comparison with nurses working in fixed day shifts; although, the relation was not significant (Marković-Denić, Branković, Maksimović, & al, 2013). Other investigations showed significant correlations between prolonged shift work (more than 8 hours), rotating shift work and night work with BBFEs (Zhao, Bogossian, & Turner, 2010). Quan et al (2015) reported that workload had a negative correlation (r= -0.12) with standard precautions for occupational injuries. They showed that increase in Chinese nursing staff's workload worsened the use of standard precautions methods. Previous studies show that shortage in nurses increases workload and work pressure; and therefore, nurses lose their concentration on the given tasks and this consequently increases the rate of BBFEs (Quan, Wang, Wu, & al, 2015).

In this study, the rate of STFIs was 45% more in women than men. This trend is similar to the findings of Mogale et al's study (2015) which reported that 73% of the healthcare providers in South Africa, in which STFIs had happened were women (Mogale, Malangu, & Huma, 2015). In other studies, this proportion reached 80% (Miller, 2013; Yeoh, Lockhart, & Wu, 2013). However, most healthcare providers in different countries are women and this can explain the high proportion of women involved. Our findings also showed that the rate of STFIs was significantly less in young rather than old nurses. Other investigations have also shown the relation between STFIs and aging (Mogale et al., 2015; Troy, Donovan, & Grabiner, 2009). Falls are in relation with aging and results from decreased neuromuscular function. This explains the reason why older employees face STFIs more than young ones (Yeoh et al., 2013). Among occupational groups, nurses are more vulnerable to STFIs. These findings are similar to Bell et al (2013) and Yeoh et al (2013) in the US that reported high rates of STFIs in nurses (Bell et al., 2013; Yeoh et al., 2013). Shift work and workload were two other factors affecting the occurrence of STFIs in our study. Yeoh et al (2013) concluded that shortage in the number of nurses, puts excess pressure on nurses and consequently increases their workload and occupational injuries (Yeoh et al., 2013). American nurses have faced harmful work situation such as long working hours, shift work, high physical and mental demand tasks, time constraints and heavy workload, and this can result in serious occupational burnout (Han, Trinkoff, & Geiger-Brown, 2014). This increases the possibility of occupational injuries as well as related injuries like STFIs.

Results show that aging as well as increase in number of shifts per month, work experience and workload results in increase in BPPHTs and these injuries happen more in men than women, in emergency wards than other wards, and in nurses than other occupations. Shieh et al (2016) reported aging and working years as two risk factors that increase the prevalence of low back pain. In their study, Thai nurses who worked averagely more than nine hours a day were more prone to low back pain. Furthermore, they found that decrease in nurse to bed ratio increases physical workload and consequently increases the prevalence of low back pain among nurses. In their study, there was not a significant relation between low back pain, job position, education and marital status (Shieh, Sung, Su, & al, 2016). Akbari et al in Iran, found that increase in body mass index (BMI) and nurse to bed ratio could be a risk factor for BPPHTs. Nurse to bed ratio, as an index for physical workload, can increase the prevalence of back pain. In addition, women experienced low back pain three folds more than men (Akbari et al., 2017) which is in line with our study. In Arsalani et al's

study in Iran (2014) gender, wards and shift work were related to low back pain among nurses. Also, carrying patients, prolonged standing, high work demand, low job satisfaction and awkward postures were related to low back pain (Arsalani, Fallahi-Khoshknab, Josephson, & al, 2014).

In the present study, occupational injury prevention training showed no significant relation with injuries. This fact, probably shows the ineffectiveness of our trainings in preventing occupational injuries that might be because of unsuitable training, or theoretical and non-practical education. However, research done in Iran and other countries has shown that occupational injuries can be prevented by training (Cheetham, Thompson, Liira, Afilaka, & Liira, 2016; Samaei, Raadabadi, Khanjani, & al, 2015).

Research strengths, limitations and suggestions

The present study was one of the first studies about the rate of occupational injuries among nurses and its related factors in Iran. One of the strengths was that this study was conducted in four different provinces of Iran which makes the results more generalizable than other studies. Additionally, this study tried to consider a set of occupational injuries that were not all reported in previous studies.

One of the limitations was that nurses participating in this study either had rotating shifts or worked only during the day. This situation did not allow us to determine the shift with the highest rate of occupational injuries. Another limitation was the lack of an integrated database about occupational injuries in the hospitals under study. Thus, we had to collect occupational injuries information based on a self-evaluated questionnaire. The last limitation was not including factors such as burnout, violence, infections and workplace understaffing that can affect the rate of occupational injuries. It is suggested that future researchers consider other factors such as time of shift work and number of occupational injuries and conduct stronger longitudinal studies about this topic.

Conclusion

The highest rate of occupational injuries was related to BPPHTs and BBFEs. Working in rotating-shifts and work overload is an important issue among healthcare providers especially nurses. These risk factors were associated with all injuries investigated in this study. Reducing mental workload along with other routine safety precautions, can not only decrease the rate of occupational injuries, but also decrease socio-mental stress at work, and increase occupational safety and satisfaction.

We highly recommend that a nation-wide database be established to collect occupational injury information from nurses. This system can be equipped with a computerized anonymous form that nurses can directly report occupational injuries without any fear of getting blamed. Therefore, the health care managers can become aware about the rate of different occupational injuries and their related factors, and can effectively work to reduce these injuries.

References:

Akbari, H., Akbari, H., & Abadi, M. B. H. (2017). 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. *Iran Red Crescent Med J, 19*(2), 1-8. doi:10.5812/ircmj.39860

Arsalani, N., Fallahi-Khoshknab, M., Josephson, M., & al, e. (2014). Musculoskeletal disorders and working conditions among Iranian nursing personnel. *Int J Occup Saf Ergon, 20*(4), 671-680. doi:10.1080/10803548.2014.11077073

Askarian, M., Shaghaghian, S., Gillen, M., & Assadian, O. (2008). Body fluid exposure in nurses of Fars province, Southern Iran. *Arch Iran Med, 11*(5), 515-521.

Bahcecik, N., & Ozturk, H. (2009). The occupational safety and health in hospitals from the point of nurses. *Coll Antropol, 33*(4), 1205-1214.

Bell, J. L., Collins, J. W., Tiesman, H. M., & al, e. (2013). Slip, trip, and fall injuries among nursing care facility workers. *Workplace Health Saf, 61*(4), 147-152. doi:10.3928/21650799-20130318-28

Bureau of Labor Statistics. (2014). *Employer-Reported Workplace Injuries and Illnesses*. Retrieved from USA: http://www.bls.gov/news.release/osh.nr0.htm

Chaiwarith, R., Ngamsrikam, T., Fupinwong, S., & al, e. (2013). Occupational exposure to blood and body fluids among healthcare workers in a teaching hospital: an experience from northern Thailand. *Jpn J Infect Dis, 66*(2), 121-125. doi:10.7883/yoken.66.121

Cheetham, S., Thompson, S. C., Liira, J., Afilaka, O. A., & Liira, H. (2016). Education and training for preventing sharps injuries and splash exposures in healthcare workers. *Cochrane Database of Systematic Reviews*. doi:10.1002/14651858.CD012060

Clarke, S. P. (2007). Hospital work environments, nurse characteristics, and sharps injuries. *Am J Infect Control, 35*(5), 302-309. doi:10.1016/j.ajic.2006.07.014

Dement, J. M., Epling, C., Østbye, T., & al, e. (2004). Blood and body fluid exposure risks among health care workers: results from the Duke Health and Safety Surveillance System. *Am J Ind Med, 46*(6), 637-648. doi:10.1002/ajim.20106

Denis, M.-A., Ecochard, R., Bernadet, A., & al, e. (2003). Risk of occupational blood exposure in a cohort of 24,000 hospital healthcare workers: position and environment analysis over three years. *J Occup Environ Med, 45*(3), 283-288. doi:10.1097/01.jom.0000052961.59271.9d

EPINet. (2012). *Report For Needlestick And Sharp Object Injuries,* . Retrieved from USA: https://internationalsafetycenter.org/wp-content/uploads/2014/12/2012-NeedleSummaryReport2.pdf

Gao, X., Hu, B., Suo, Y., & al, e. (2017). A large-scale survey on sharp injuries among hospital-based healthcare workers in China. *Sci Rep, 7*(16), 1-7. doi:10.1038/srep42620

García-Herrero, S., Mariscal, M., García-Rodríguez, J., & al, e. (2012). Working conditions, psychological/physical symptoms and occupational accidents. Bayesian network models. *Saf Sci, 50*(9), 1760-1774. doi:10.1016/j.ssci.2012.04.005

Gholami, A., Borji, A., Lotfabadi, P., & al, e. (2013). Risk factors of needlestick and sharps injuries among healthcare workers. *Int j hosp res, 2*(1), 31-38.

Gonçalves, S. M. P., da Silva, S. A., Lima, M. L., & al, e. (2008). The impact of work accidents experience on causal attributions and worker behaviour. *Saf Sci, 46*(6), 992-1001. doi:10.1016/j.ssci.2007.11.002

Han, K., Trinkoff, A. M., & Geiger-Brown, J. (2014). Factors associated with work-related fatigue and recovery in hospital nurses working 12-hour shifts. *Workplace Health Saf, 62*(10), 409-414. doi:10.3928/21650799-20140826-01

Hart, S. G. (2006). NASA-task load index (NASA-TLX); 20 years later. *Proc Hum Factors Ergon Soc Annu Meet, 50*(9), 904-908. doi:10.1177/154193120605000909

Honda, M., Chompikul, J., Rattanapan, C., & al, e. (2011). Sharps injuries among nurses in a Thai regional hospital: prevalence and risk factors. *Int J Occup Environ Med, 2*(4), 215-223.

Kakizaki, M., Ikeda, N., Ali, M., & al, e. (2011). Needlestick and sharps injuries among health care workers at public tertiary hospitals in an urban community in Mongolia. *BMC research notes, 4*(1), 1. doi:10.1186/1756-0500-4-184

Kane, R. L., Shamliyan, T. A., Mueller, C., & al, e. (2007). The association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. *Med Care, 45*(12), 1195-1204. doi:10.1097/MLR.0b013e3181468ca3

Kasatpibal, N., Whitney, J. D., Katechanok, S., & al, e. (2016). Prevalence and risk factors of needlestick injuries, sharps injuries, and blood and body fluid exposures among operating room nurses in Thailand. *Am J Infect Control, 44*(1), 85-90. doi:10.1016/j.ajic.2015.07.028

Khosro, S., Alireza, S., Omid, A., & al, e. (2011). Night work and inflammatory markers. *Indian J Occup Environ Med, 15*(1), 38-41. doi:10.4103/0019-5278.82996

Leiter, M. P., & Laschinger, H. K. S. (2006). Relationships of work and practice environment to professional burnout: testing a causal model. *Nurs Res, 55*(2), 137-146.

Lo, W.-Y., Chiou, S.-T., Huang, N., & al, e. (2016). Long work hours and chronic insomnia are associated with needlestick and sharps injuries among hospital nurses in Taiwan: A national survey. *Int J Nurs Stud, 64*(1), 130-136. doi:10.1016/j.ijnurstu.2016.10.007

Malekpour, F., Mohammadian, Y., Malekpour, A., & al, e. (2014). Assessment Of Mental Workload In Nursing By Using Nasa- Tlx. *Journal of Nursing and Midwifery Urmia University of Medical Sciences, 11*(11), 0-0.

Marković-Denić, L., Branković, M., Maksimović, N., & al, e. (2013). Occupational exposures to blood and body fluids among health care workers at university hospitals. *Srp Arh Celok Lek, 141*(11-12), 789-793. doi:10.2298/SARH1312789M

Miller, K. (2013). Risk factors and impacts of occupational injury in healthcare workers: A critical review. *OA Musculoskeletal Medicine, 1*(1), 4-10.

Mogale, N. M., Malangu, N., & Huma, M. (2015). Occurrence of occupational slips, trips and falls amongst health workers in Limpopo Province of South Africa. *Pula, 28*(1), 72-80.

Mohammadi, M., Mazloumi, A., & al, e. (2013). Designing questionnaire of assessing mental workload and determine its validity and reliability among ICUs nurses in one of the TUMS's hospitals. *J Sch Public Health Inst Public Health Res, 11*(2), 87-96.

Myny, D., Van Goubergen, D., Gobert, M., & al, e. (2011). Non-direct patient care factors influencing nursing workload: a review of the literature. *J Adv Nurs, 67*(10), 2109-2129. doi:10.1111/j.1365-2648.2011.05689.x

Nejadghaderi, M., Safizadeh, H., & Khanjani, N. (2012). The Knowledge and Practice of Medical Staff about Needle Injuries In Rafsanjan's Ali-ebne-Abitaleb Hospital, Iran. *Journal of health and development, 1*(1), 1-10.

Panlilio, A. L., Orelien, J. G., Srivastava, P. U., & al, e. (2004). Estimate of the annual number of percutaneous injuries among hospital-based healthcare workers in the United States, 1997–1998. *Infect Control Hosp Epidemiol, 25*(7), 556-562. doi:10.1086/502439

Priya, N., Krishnan, K., Jayalakshmi, G., & al, e. (2015). An analysis of multimodal occupational exposure leading to blood borne infections among health care workers. *Indian J Pathol Microbiol., 58*(1), 66-68. doi: 10.4103/0377-4929.151191

Quan, M., Wang, X., Wu, H., & al, e. (2015). Influencing factors on use of standard precautions against occupational exposures to blood and body fluids among nurses in China. *Int J Clin Exp Med, 8*(12), 22450.

Raeissi, P., Omrani, A., Khosravizadeh, O., & al, e. (2015). Occupational Accidents among Hospital Staff. *Journal of Client-Centered Nursing Care, 1*(2), 97-102.

Rahimi, A., Ahmadi, F., & Akhond, M. (2004). An investigation of amount and factors affecting nurses' job stress in some hospitals in Tehran. *Hayat, 10*(3), 13-22.

Robazzi, M. L. d. C., Mauro, M. Y. C., Secco, I. A. d. O., & al, e. (2012). Health Changes From Overwork Among Health Sector Workers. *Rev Enferm 20*(4), 526-532.

Samaei, S. E., Raadabadi, M., Khanjani, N., & al, e. (2015). Safety Attitudes among Nurses and Its Relation with Occupational Accidents: A Questionnaire Based Survey. *Int J Occup Hyg, 7*(4), 177-186.

Shiao, J. S.-C., McLaws, M.-L., Lin, M.-H., & al, e. (2009). Chinese EPINet and recall rates for percutaneous injuries: an epidemic proportion of underreporting in the Taiwan healthcare system. *J Occup Health, 51*(2), 132-136. doi:10.1539/joh.L8111

Shieh, S.-H., Sung, F.-C., Su, C.-H., & al, e. (2016). Increased low back pain risk in nurses with high workload for patient care: A questionnaire survey. *Taiwan J Obstet Gynecol, 55*(4), 525-529. doi:10.1016/j.tjog.2016.06.013

Smith, D. R., Choe, M.-A., Jeong, J. S., & al, e. (2006). Epidemiology of needlestick and sharps injuries among professional Korean nurses. *J Prof Nurs, 22*(6), 359-366. doi: 10.1016/j.profnurs.2006.10.003

Spooner-Lane, R., & Patton, W. (2007). Determinants of burnout among public hospital nurses. *Aust J Adv Nurs, 25*(1), 8-16.

Troy, K. L., Donovan, S. J., & Grabiner, M. D. (2009). Theoretical contribution of the upper extremities to reducing trunk extension following a laboratory-induced slip. *J Biomech, 42*(9), 1339-1344. doi:10.1016/j.jbiomech.2009.03.004

Yenesew, M. A., & Fekadu, G. A. (2014). Occupational exposure to blood and body fluids among health care professionals in Bahir Dar town, Northwest Ethiopia. *Saf Health Work, 5*(1), 17-22. doi:10.1016/j.shaw.2013.11.003

Yeoh, H. T., Lockhart, T. E., & Wu, X. (2013). Nonfatal Occupational Falls Among US Health Care Workers, 2008–2010. *Workplace Health Saf, 61*(1), 3-8. doi:10.3928/21650799-20121221-52

Young, G., Zavelina, L., & Hooper, V. (2008). Assessment of workload using NASA Task Load Index in perianesthesia nursing. *J Perianesth Nurs, 23*(2), 102-110. doi:10.1016/j.jopan.2008.01.008

Zawilla, N., & Ahmed, D. (2013). Sharps injuries among health care workers in Cairo University Hospitals. *Int J Risk Saf Med, 25*(2), 79-92. doi:10.3233/JRS-130587

Zhang, X., Gu, Y., Cui, M., & al, e. (2015). Needlestick and sharps injuries among nurses at a teaching hospital in China. *Workplace Health Saf, 63*(5), 219-225. doi:10.1177/2165079915580035

Zhao, I., Bogossian, F., & Turner, C. (2010). Shift work and work related injuries among health care workers: A systematic review. *Aust J Adv Nurs, 27*(3), 62.

What does this paper contribute to the wider global clinical community?

- This paper contributes to the growing research and helps recognize the common types of occupational injuries among Iranian nurses.
- This study provides information about workload, individual and organizational factors which affect occupational injuries among nurses.
- These, can help managers improve nurses' working conditions, reduce adverse outcomes and promote their safety.

Tables

Table1. The demographics of the participating nurses

Variables	Hospital A *n* =177 (%)	Hospital B *n* =158 (%)	Hospital C *n* =134 (%)	Hospital D *n* =147 (%)	Total *n* =616 (%)
Individual Characteristics					
Gender					
Female	116 (65.5)	120 (75.9)	96 (71.6)	87 (59.2)	419 (68.0)
Male	61 (34.5)	38 (24.1)	38 (28.4)	60 (40.8)	197 (32.0)
Age(years)					
20-29	44 (24.9)	53 (33.5)	26 (19.4)	47 (31.9)	170 (27.6)
30-39	76 (42.9)	57 (36.1)	54 (40.3)	87 (59.3)	274 (44.5)
≥40	57 (32.2)	48 (30.4)	54 (40.3)	13 (8.8)	172 (27.9)
Marital status					
Married	138 (78.0)	105 (66.4)	106 (79.1)	117 (79.6)	466 (75.6)
Unmarried	39 (22.0)	53 (33.6)	28 (20.1)	30 (20.4)	150 (24.4)
Employment Status					
Permanent	48 (27.1)	45 (28.5)	56 (41.8)	47 (32.0)	196 (31.8)
Contract	129 (72.9)	113 (71.5)	78 (58.2)	100 (68.0)	420 (68.2)
Shifts per month					
≤ 30	57 (32.2)	37(23.4)	38(28.3)	55(37.4)	187(30.3)
> 30	120(67.8)	121(76.6)	96(71.6)	92(62.6)	429(69.7)
Education Level					
Bachelor of Science	122 (68.9)	120 (75.9)	101 (75.4)	96 (65.3)	439 (71.3)
Master of Science/Doctor of Philosophy	55 (31.1)	38 (24.1)	33 (24.6)	51 (34.7)	177 (28.7)
Clinical Experience (years)					
10 ≥	92 (52.0)	75 (47.5)	56 (42.8)	72 (49.0)	295 (47.9)
11-20	68 (38.4)	53 (33.5)	59 (44.0)	67 (45.6)	247 (40.1)
≥ 21	17 (9.6)	30 (19.0)	19 (14.2)	8 (5.4)	74 (12.0)
Organization Characteristics					
Job position					
Nurse	116 (65.5)	125 (79.1)	87 (64.9)	125 (85.0)	453 (73.5)
Supervisor	48 (27.2)	20 (12.7)	31 (23.2)	12 (8.2)	111 (18.1)
Head nurse	13 (7.3)	13 (8.2)	16 (11.9)	10 (6.8)	52 (8.4)
Ward					
Internal wards	52 (29.4)	50 (31.6)	19 (14.2)	27 (18.4)	148 (24.0)
Surgical wards	71 (40.1)	38 (24.1)	12 (8.9)	27 (18.4)	148 (24.0)
Intensive Care Units (ICUs)	26 (14.7)	20 (12.7)	70 (52.3)	72 (49.0)	188 (30.5)
Emergency ward	28 (15.8)	50 (31.6)	33 (24.6)	21 (14.2)	132 (21.5)
Occupational injury prevention training					
Yes	105 (59.3)	85 (53.8)	93 (69.4)	112 (76.2)	395 (64.1)
No	72 (40.7)	73 (46.2)	41 (30.6)	35 (23.8)	221 (35.9)
Shift Work					
Rotating	135 (76.3)	120 (76.0)	94 (70.1)	90 (61.2)	439 (71.3)
Fixed	42 (23.7)	38 (24.0)	40 (29.9)	57 (38.8)	177 (28.7)

Table2. Occupational injuries reported by nurses on duty in the last 6 months

Occupational injuries	Frequency	Hospital A N. (%)	Hospital B N. (%)	Hospital C N. (%)	Hospital D N. (%)	Total N. (%)	*p-Value**
Sharps Injuries	Occurrence	35(19.7)	68(42.9)	28(21.1)	25(17)	156(25.3)	0.002
	Once	18 (9.9)	25 (15.9)	5 (3.5)	10 (6.8)	58 (9.4)	
	Twice	2 (1.2)	5 (3.2)	7 (5.3)	10 (6.8)	24 (3.9)	
	Three times and more	15 (8.6)	38 (23.8)	16 (12.3)	5 (3.4)	74 (12.0)	
Needle Stick Injuries	Occurrence	48(27.2)	68(42.9)	19(14.1)	17(11.9)	152(24.7)	<0.001
	Once	35 (19.8)	33 (20.6)	7 (5.3)	10 (6.8)	85 (13.8)	
	Twice	4 (2.5)	4 (2.4)	5 (3.5)	5 (3.4)	16 (2.9)	
	Three times and more	9 (4.9)	31 (19.8)	7 (5.3)	2 (1.7)	49 (8.0)	
Blood and Body Fluid Exposures	Occurrence	61(34.6)	83(52.3)	63(47.4)	85(57.6)	292(47.4)	0.038
	Once	18 (9.9)	18 (11.1)	14 (10.5)	27 (18.6)	77 (12.5)	
	Twice	4 (2.5)	12 (7.9)	12 (8.8)	20 (13.6)	48 (7.8)	
	Three times and more	39 (22.2)	53 (33.3)	38 (28.1)	37 (25.4)	167(27.1)	
Drug and Chemical Splash in the Eyes	Occurrence	15(8.6)	23(14.3)	7(5.3)	7(5.1)	52(8.5)	0.223
	Once	9 (4.9)	8 (4.8)	2 (1.8)	5 (3.4)	24 (3.9)	
	Twice	4 (2.5)	5 (3.2)	5 (3.5)	0 (0.0)	14 (2.3)	
	Three times and more	2 (1.2)	10 (6.3)	0 (0.0)	2 (1.7)	14 (2.3)	
Slip and Trip and Fall Injuries	Occurrence	22(12.4)	20(12.7)	19(14.1)	2(1.7)	63(10.2)	0.098
	Once	7 (3.7)	10 (6.3)	8 (6.3)	2 (1.7)	27 (4.4)	
	Twice	11 (6.2)	8 (4.8)	5 (3.5)	0 (0.0)	24 (3.9)	
	Three times and more	4 (2.5)	2 (1.3)	6 (4.3)	0 (0.0)	13 (1.9)	
Back Pain in Patient Handling Tasks	Occurrence	61(34.5)	60(38.0)	48(35.8)	52(35.6)	221(35.9)	0.976
	Once	37 (21)	18 (11.1)	16 (12.3)	25 (16.9)	96 (15.6)	
	Twice	9 (4.9)	20 (12.7)	9 (7.0)	10 (6.8)	48 (7.8)	
	Three times and more	15 (8.6)	22 (13.9)	23 (17.5)	17 (11.9)	77 (12.5)	

** Chi-square test.*

Table 3. NASA-TLX subscales reported by nurses in different hospitals

Workload Subscale	**Hospital A** Mean (SD)	**Hospital B** Mean (SD)	**Hospital C** Mean (SD)	**Hospital D** Mean (SD)	**Total** Mean (SD)	*p-Value**
Mental Demand	74.7 (21.5)	68.3 (20.1)	60.4 (24.4)	62.5 (24.2)	67.3 (23.1)	0.001
Physical Demand	40.0 (18.0)	43.1 (19.1)	55.2 (20.6)	58.7 (25.6)	48.3 (22.1)	<0.001
Temporal Demand	55.8 (25.7)	64.3 (20.6)	53.5 (21.0)	50.1 (22.1)	56.3 (23.1)	0.008
Performance	46.9 (32.6)	56.1 (27.2)	51.1 (27.4)	64.8 (19.6)	54.1 (28.3)	0.002
Effort	50.3 (24.7)	58.2 (23.5)	47.6 (27.5)	56.2 (25.6)	52.1 (25.5)	0.07
Frustration	44.6 (25.5)	54.1 (31.5)	45.1 (26.2)	52.7 (27.4)	49.2 (27.8)	0.085
NASA TLX	65.3 (13.8)	61.5 (16.7)	63.2 (14.2)	68.9 (11.4)	64.7 (14.4)	0.029

**One-way ANOVA*

Table4. Factors related to occupational injuries: Odds Ratios from multivariate logistic regression

Predictors	Occupational injuries				
	SIs	**NSIs**	**BBFEs**	**STFIs**	**BPPHTs**
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Individual Characteristics					
Gender					
Male vs Female	-	0.68 (0.49-0.92)**	2.02 (1.06-4.54)*	0.65 (0.44-0.96)*	1.67 (1.28-2.44)*
Age (year)					
30-39 vs 20-29	-	0.71 (0.65-0.77)*	-	1.57 (1.09-2.23)*	2.08 (0.79-5.50)
≥40 vs 20-29	-	0.63 (0.52-0.85)*	-	2.51 (1.02-3.89)*	2.27 (1.01-5.19)*
Years					
11-20 vs 10 ≥	0.49 (0.41-0.83)*	0.66 (0.45-0.97)*	0.87 (0.78 - 0.97)*	-	1.27 (1.41-3.93)*
≥21 vs 10 ≥	0.38 (0.25-0.81)*	0.51 (0.32-0.75)*	0.71 (0.62 - 0.81)**	-	2.61 (1.04-7.43)*
Shifts per month	1.62 (1.27-1.97)*	1.59 (1.09-2.64)**	-	-	2.89 (1.38-6.03)*
Organizational Characteristics					
Job position					
Supervisor vs Nurse	-	-	-	0.47 (0.19-0.99)*	0.82 (0.74-0.91)*
Head Nurse vs Nurse	-	-	-	0.66 (0.35-1.25)	0.63 (0.46-0.93)*
Ward					
Surgical wards vs Internal wards	-	-	-	-	1.49 (0.61-3.69)
Intensive Care Units vs Internal wards	-	-	-	-	1.78 (0.73-4.33)

Emergency ward vs Internal wards	-	-	-	-	2.33 (1.02-5.31)*
Shift Work	0.64 (0.45-0.92)*	0.47 (0.51-0.88)**	0.79 (0.63-0.98)*	0.85 (0.46-0.94)*	0.69 (0.49-0.97)*
Workload Index (NASA TLX)	1.04 (1.01-1.06)*	1.35 (1.12-1.67)*	1.04 (1.02-1.07)*	1.03 (1.01-1.08)*	1.04 (1.01-1.06)*

** P<0.05, ** P<0.01*