



ORIGINAL: Prevalence of Needle Stick and Sharp Injuries Among Surgical Specialist Hospital-Cardiac Center in Erbil City: A Cross-Sectional Study

Shalaw Faris Ahmed
Jamal Kareem Shakor

Titi Rahmawati Hamedon

Dlovan Mohammed Fatel Jalal
Dlzar Omer Qadir

Surgical Specialist, Hospital-Cardiac Center, Kurdistan Regional Government, Erbil, Iraq.
Nursing Department, Darbandikhan Technical Institute, Sulaimani Polytechnic University, Sulaymaniyah, Iraq.

Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor, Malaysia.

Surgical Specialist, Hospital-Cardiac Center, Kurdistan Regional Government, Erbil, Iraq.
Assistant Lecturer, College of Nursing, Hawler Medical University, Erbil, Iraq.

ARTICLE INFO

Submitted: 23 Dec 2019
Accepted: 31 Jan 2020
Published: 31 Jun 2020

Keywords:

Needle-stick and sharp injuries;
Surgical Specialist;
Erbil

Correspondence:

Shalaw Faris Ahmed, Surgical Specialist, Hospital-Cardiac Center, Kurdistan Regional Government, Erbil, Iraq.

Email: Shalawfaris@gmail.com

ORCID: 0000-0003-4111-8358

Citation:

Shalaw FA, Shakor JK, Hamedon TR, Jalal DMF, Qadir DO. Prevalence of Needle Stick and Sharp Injuries Among Surgical Specialist Hospital-Cardiac Center in Erbil City: A Cross-Sectional Study. Tabari Biomed Stu Res J. 2020;2(2):38-47.

10.18502/tbsrj.v2i2.3758

Introduction

Needle-stick and sharp injuries (NSSI) pose a serious problem and a major risk of work-related transmitted diseases among healthcare workers (HCW) in developing and developed countries (1). Each year,

about 3.5 million globally and around 600,000–1,000,000 workers in the United States suffered from NSSI (2,3). For healthcare worker, NSSIs is defined as any transcutaneous injury, a penetrating attempt

ABSTRACT

Introduction: Needle-stick and sharp injuries (NSSI) pose a serious problem and a major risk of work-related transmitted diseases among healthcare workers. The extent of NSI in the Kurdistan region / Iraq hospitals has been unknown. The factors related to NSIs among healthcare workers were evaluated in the present study. The main purpose of this study is to determine the prevalence of NSSI and its associated factors among the respondents.

Material and Methods: The cross-sectional study was conducted on 150 randomly selected healthcare staff with a working experience of at least 1 year in the hospital. The study location is a surgical specialist hospital-cardiac center, situated in Erbil/Iraq. The self-administered questionnaire was used to collect information on socio-demographic, employment and individual characteristics, as well as data on NSSI, suffered in the past 12 months.

Results: The majority of participants (34%) were in the 30 to 35 year age group. Most were male (60.7%), married (61.3%), have at least degree qualification (89%). The prevalence of NSSI was 67%. Needle stick was the main frequent of NSSRs (66%). Needle recap was all the time done among health workers 104 (69%), they almost use both hands for recap 136 (91%). Education, working environment satisfaction, sleeping quality of the health staff have been considered the main indicators of NSSI.

Conclusion: The rate of NSSI was considered high in this study compared to the rates in many developing countries. Arrangement schedules for work and sleeping of staff could decrease the NSSI rate.

wound from a sharp object or needle that possibly will consequence in contact to blood or else other body fluids. Intravenous cannulation, unsuitable needle disposal, needle recapping, and set of drips are the most common accomplishments causing NSSIs according to many studies (4,5). The magnitude of NSSI risks and associated practices among HCWs was not well understood, particularly in developing countries (6). Several studies have stated that although the prevalence of blood borne pathogens in many developing countries is unusual, many exposures to NSSI in these countries remain undocumented (6,7), for instance, only 4% of the global prevalence of work-related HIV infection is reported in sub Saharan Africa, where about 70% of the world's HIV-infected people lives (7). In different researches for NSSI occurrences, various risk factors have been proposed like inappropriate routine of using protective kit, working in intensive care or in surgical units, inadequate work experience, and low information level of blood-borne infections (1,8). Research studies have been conducted on work-related NSSI contacts, but it is not yet clear why HCWs do not report sharp injury incidents (9,10). It is commonly accepted that the socio-demographic, occupational and individual factors are contributory factors to get NSSIs. Accident at work affects the well-being of people in the workplace, and therefore need to be prevented from occurring (8). It seems that the most important points for no reporting are factors such as heavy work, fear of job loss, and lack of knowledge about the importance of NSIs. Further studies are needed to determine the cause of this behavior. NSSI prevention are an essential factor of workplace prevention programs, and HCW's instruction on safety procedures needs to be a continuing activity at a hospital. The factors related to NSSIs among HCW were evaluated in the present study.

Methods

Study Design and Study Population

The cross-sectional study design was used to determine the proportion of NSSI and its associated factors. This study was conducted on 150 randomly selected HCW, including nurses, doctors, laboratory staff and nursing assistants with a working experience of at least one year in the hospital. The study location is a surgical specialist hospital-cardiac center, situated Erbil / Iraq. Medical employees consist of doctors, nurses, laboratory staffs and nursing assistances are approved may work full time or part time and given rights to supply health care to patients in a special hospital or different health care facility.

Materials

The self-administered questionnaire, which was written in both English and Kurdish language was used to collect information. The questionnaire is divided into various sections. Section A collect information on socio-demographic background, such as gender, age, race, marital states and educational level. Section B is for the job position, length of employment, and working hours. Individual factors are collected in Section C, which collects information on the sleep pattern, overtime work and fatigue feeling. The last section, Section D, contained details of the occurrence of NSSIs suffered in the past 12 months, as well as the reasons for reporting or not reporting these injuries.

Data collection

The questionnaire was distributed directly to the respondents. They were informed about the purpose of the study and those participating in did so on a voluntary basis. Besides, the respondents were made sure that their answers will be kept confidential and will only be used for research purposes. After the respondents have finished answering the questions, the questionnaires were collected immediately.

Data Analysis

The data was analyzed using the IBM Statistical Package of Social Sciences

(SPSS) version 21. Initially, the data was analyzed descriptively using frequency, and percentage. Inferential analysis (Chi-square test) was used to determine the association between NSSIs and the independent variables (socio-demographic, occupational, and individual factors). Finally, a multivariate analysis using multiple logistic regressions was performed to determine the factors associated with the occurrence of NSSIs. The results were considered statistically significant if $P < 0.05$.

Ethical Consideration

This study had received ethical clearance from the Ethics Committee for Research Involving Human Subjects of surgical specialist hospital-cardiac center dated 22nd April 2017 and permission to do the study was given by the authority of the study location.

Results

Most of the health staff in the area were male 91 (61%), and age were between 30-35 years, 51(34%), and married 92 (61%). Most of the participant have a diploma degree 133 (88.6%) (*Table 1*). For the occupational characteristics, out of 150 respondents, 62% of them are permanent staff, work as nurses,

74% of them had been in service for less than 5 years (57%) and most of them work in shifts (74.7%). Majority of the respondents (83.3%) working 40 hours, did not do overtime work (68.7%) and did not have part-time work (58.3%) (*Table 2*).

Data on the individual characteristics shows that out of 150 respondents, majority (57%) of them sleep less than 6 hours a night, 52% did not feel sleepy during working time and 48% did not feel tired at work. Majority of the respondents (47.3%) have a normal BMI (*Table 3*). 67% (101) of the respondents reported having sustained from NSSIs (*Figure 1*).

The more frequent cause of injury among respondents is syringe needle 80 (53.3%), and nearly 31 (30%) of workers were injured more than three times in the last one year (*Table 4*).

Pearson's chi-square test was used to determine the association among socio-demographic characteristics, employment characteristics, and individual factors with NSSI. *Table 5* below illustrates the result of the analysis. Overall, 101 (67%) of workers suffered from NSSI during the last years of during their experience working in hospital. There is statistically significant association among educational level, sleeping hours per night, getting enough sleep at night, quality

Table 1. Socio-demographic characteristics of the respondents (n=150)

| Variables | Frequency | Percentage |
|----------------------------------|-----------|------------|
| Gender | | |
| Male | 91 | 60.7 |
| Female | 59 | 39.3 |
| Age (Year) | | |
| < 25 | 24 | 16.0 |
| 25-29 | 39 | 26.0 |
| 30- 35 | 51 | 34.0 |
| > 35 | 36 | 24.0 |
| Marital status | | |
| Single | 58 | 38.7 |
| Married | 92 | 61.3 |
| Highest Educational level | | |
| Primary school | 4 | 2.7 |
| Secondary school | 13 | 8.7 |
| Diploma degree and above | 133 | 88.6 |

Table 2. Distribution of the respondent by occupational characteristics (n=150)

| Variables | Frequency | Percentage |
|--|-----------|------------|
| Type of employment | | |
| Permanent | 93 | 62.0 |
| Contract | 57 | 38.0 |
| Job Title | | |
| Nurse | 111 | 74.0 |
| Physician | 14 | 9.3 |
| Others | 25 | 16.7 |
| Experience working in Hospital (year) | | |
| < 5 | 65 | 43 |
| > 5 | 85 | 57 |
| Work in shifts | | |
| Yes | 112 | 74.7 |
| No | 38 | 25.3 |
| Working hours per week (Hours) | | |
| 40 | 125 | 83.3 |
| > 40 | 25 | 16.7 |
| Working overtime | | |
| Yes | 47 | 31.3 |
| No | 103 | 68.7 |
| Part-time work | | |
| Yes | 61 | 40.7 |
| No | 89 | 58.3 |

Table 3. Distribution of the respondent according to individual characteristics (n=150)

| Variables | Frequency | Percentage |
|---------------------------------|-----------|------------|
| Sleeping hours per night | | |
| < 6 | 85 | 57 |
| > 6 | 65 | 43 |
| Feeling sleepy at work | | |
| Yes | 36 | 24 |
| No | 78 | 52 |
| Sometimes | 36 | 24 |
| Feeling fatigue at work | | |
| Yes | 42 | 28.0 |
| No | 72 | 48.0 |
| Sometimes | 36 | 24.0 |
| Body Mass Index | | |
| Under weight | 3 | 2.0 |
| Normal | 71 | 47.3 |
| Overweight | 57 | 38.0 |
| Obese | 19 | 12.7 |

of sleeping at night, body mass index, and satisfied with the working environment with NSSI, ($X^2=10.88, P=0.004$), ($X^2=4.004, P=0.045$), ($X^2=13.263, P=0.010$), ($X^2=11.359, P=0.003$), ($X^2=8.275, P=0.041$), and ($X^2=6.831, P=0.033$), respectively.

Logistic regression analysis was used to predict the factors related to not NSSI. The model accounted for 79.9 % of the variance in not NSSI. The result of this analysis showed that eight variables, with a significant odds ratio (*Table 6*). In this

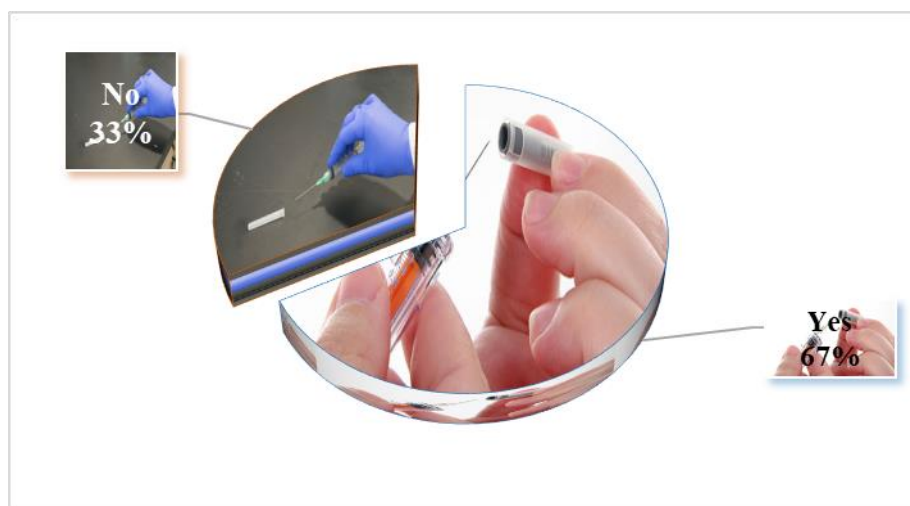


Figure 1. Proportion of NSSIs (n=150)

Table 4. Materials that cause NSSIs and frequency of injures

| What material was cause the injury? | Frequency | Percentage |
|---|------------|--------------|
| Lancet/Scalpel/blade | 21 | 14.0 |
| Syringe needle | 80 | 53.3 |
| Glass/other sharp objects | 17 | 12.0 |
| Suture needle | 18 | 12.0 |
| Seldinger needle | 6 | 4.0 |
| Others | 7 | 4.7 |
| How many times have you had needle & sharp injuries in Cardiac center the last 12 months | | |
| Once | 29 | 29.4 |
| Twice | 26 | 25.5 |
| Three | 15 | 14.7 |
| More than three times | 31 | 30.4 |
| Total | 101 | 100.0 |

model, those who feel that they have good night sleep (OR=20.53, P=0.003), and good quality sleep were more likely to not suffer from NSSI (OR=7.26, P=0.023). And those who are more satisfied with working environment were more likely to not suffer from NSSI (OR=5.381, P= 0.010). Having other job and overtime work have come out with negative outcome.

Discussion

The aim of this study was to find out the NSSI proposition among health worker. Most of health worker in this study were male (60.7%), married (61%) and have a diploma degree (89%). This study found that the prevalence of NSSI among respondents

are (67%) and nearly 30% of them had NSSI three times in last years. Needle stick were the main causes of the NSSI (66%). This is mainly due to most of the staff have overtime work (71%), and nearly half of the health worker unsatisfied with the work environment, certain independent variables are significantly associated with NSSI. Another reason may relate to needle recap which is done by (67%), and most of them use both hand for recap (91%). Some other studies also revealed that recapping needles as the main cause of NSSI (11,12). Stressful work environment and needle recapping have been identified as the reasons for NSSI (13,14). Similarly regarding to working environment this study found that NSSI was significantly associated unsatisfied with job

Table 5. Association between sociodemographic characteristics with NSSI

| Independent Variables | NSSIs | | X ² | P-value |
|--|--------------|-------------|----------------|---------|
| | Yes N (%) | No N (%) | | |
| Gender | | | | |
| Male | 58(63.7) | 33(36.3) | 2.614 | 0.106 |
| Female | 45(76.3) | 14(23.7) | | |
| Age (year) | | | | |
| < 25 | 14(58.3) | 10(41.7) | 2.560 | 0.465 |
| 25-29 | 28(71.8) | 11(28.2) | | |
| 30- 35 | 38(74.5) | 13(25.5) | | |
| > 35 | 23(63.9) | 13(36.1) | | |
| | | | | |
| Marital status | | | | |
| Single | 40(69.0) | 18(31.0) | 0.004 | 0.950 |
| Married | 63(68.5) | 29(31.5) | | |
| Educational level | | | | |
| Primary school | 3(100) | 0(0.0) | 10.883 | 0.004 |
| Secondary school | 4(30.8) | 9(69.2) | | |
| Diploma degree and above | 96(72.2) | 37(27.8) | | |
| Employment status | | | | |
| Permanent | 66(71.0) | 27(29.0) | 0.602 | 0.438 |
| Contract | 37(64.9) | 20(35.1) | | |
| Working overtime | | | | |
| Yes | 35(74.5) | 12(25.5) | 1.071 | 0.301 |
| No | 68(66.0) | 35(34.0) | | |
| Part-time work | | | | |
| Yes | 37(60.7) | 24(39.3) | 3.067 | 0.080 |
| No | 66 (74.2) | 23(25.8) | | |
| Working in shift | | | | |
| Yes | 69(65.1) | 37(34.9) | 2.143 | 0.143 |
| No | 34(77.3) | 10(22.7) | | |
| Working Experience in Hospital (year) | | | | |
| < 5 | 43(66.2) | 22(33.8) | 0.337 | 0.562 |
| > 5 | 60(70.6) | 25(29.4) | | |
| Working hours per week (Hours) | | | | |
| 40 | 88(70.4) | 37(29.6) | 3.207 | 0.073 |
| > 40 | 13(52.0) | 12(48.0) | | |
| Job Title | | | | |
| Nurse | 80(72.1) | 31(27.9) | 5.441 | 0.066 |
| Physician | 9(73.3) | 5(35.7) | | |
| Other | 12(48.0) | 13(52.0) | | |
| Do you usually feel sleepy during working time? | | | | |
| Yes | 24(66.7) | 12(33.3) | 0.804 | 0.669 |
| No | 56(71.8) | 22(28.2) | | |
| Sometimes | 23(63.9) | 13 (36.1) | | |
| Sleeping hours per night | | | | |
| < 6 | 64(75.3) | 21(24.7) | 4.004 | 0.045 |
| > 6 | 39(60.0) | 26(40.0) | | |
| Feeling fatigue at work | | | | |
| Yes | 29(69.0) | 13(31.0) | 0.267 | 0.875 |
| No | 47(65.3) | 25(34.7) | | |
| Sometimes | 25(69.4) | 11(30.6) | | |

(Continue to the next page)

($X^2=6.8$, $P=0.033$). Among the socio-demographic characteristics, education level was significantly associated with NSSI ($X^2=10.88$, $P=0.004$). Some other study indicates being female and have Nursing Bachelor's Degree significantly associated with (15).

The prevalence of NSSI (69%) in this study was higher compared to findings in many Ethiopian studies 43%, 26%, 19.1%, 37.1%,

58.8%, 18.7%, (5,11,14,16,17) respectively, study in China 27.5% (18), and study among dentist student in Brazil 43.1%, (19). In some Iranian studies the prevalence of NSI were 42.5%, 41.2% respectively and sharp injury was 19.2% (20, 21). The prevalence of NSSI in Serbian student was 29% (22).

Sleep quality is identified as important factor for NSSI. More than half of the respondents in this study (57%) have night sleep of more

(Continue of the previous page)

Table 5. Association between sociodemographic characteristics with NSSI

| Independent Variables | NSSIs | | X ² | P-value |
|--|--------------|-------------|----------------|---------|
| | Yes N (%) | No N (%) | | |
| Getting enough sleep at night | | | | |
| Always | 10(40.0) | 15(60.0) | | |
| Usually | 27(67.5) | 13(32.5) | | |
| Sometimes | 46(75.4) | 15(24.6) | 13.263 | 0.010 |
| Rarely | 15(83.3) | 3(16.7) | | |
| Not at all | 5(83.3) | 1(16.7) | | |
| Quality of sleeping at night | | | | |
| Well | 17(50.0) | 17(50.0) | | |
| Normal | 53(67.9) | 25(32.1) | 11.359 | 0.003 |
| Bad | 33(86.8) | 5(13.2) | | |
| Body Mass Index | | | | |
| Under Weight | 1(33.3) | 2(66.7) | | |
| Normal | 51(71.8) | 20(28.2) | | |
| Overweight | 41(71.9) | 16(28.1) | 8.275 | 0.041 |
| Obese | 8(42.1) | 11(57.9) | | |
| Did you recap needles after use? | | | | |
| Never | 2(66.7) | 1(33.3) | | |
| Sometimes | 10(47.6) | 11(52.4) | | |
| Mostly | 16(72.7) | 6(27.3) | 5.073 | 0.167 |
| All the time | 75(72.1) | 29(27.9) | | |
| Are you satisfied with the working environment? | | | | |
| Yes | 52(61.2) | 33(38.8) | | |
| No | 18(69.2) | 8(30.8) | 6.831 | 0.033 |
| Not totally | 33(84.6) | 6(15.4) | | |
| How do you recap the needles after use? | | | | |
| With one hand | 9(64.3) | 5 (35.7) | | |
| Using both hand | 94(69.1) | 42(30.9) | 0.138 | 0.711 |
| Do you think disease is transmitted by needle & sharp injuries? | | | | |
| Yes | 100(70.4) | 42(29.6) | | |
| No | 3(37.5) | 5(62.5) | 3.815 | 0.051 |
| Do you use personal protective equipment? | | | | |
| Yes | 77(65.8) | 40(34.2) | | |
| No | 26(78.8) | 7(21.2) | 2.014 | 0.156 |

than 6 hours, and 52% of them do not feel sleepy during working time. While, nearly one quarter (24%) feel that they had poor night sleep qualities, and this is considerably better than sleep qualities in nursing staff in Turkey (79.1%) (23,24). Nurses with poor night sleep qualities were more prone to NSSI (24). Similar finding was observed in this study where high NSSI was found among respondents who did not have enough night sleep ($X^2=13.263$, $P=0.010$), or those who did not have good sleep at night ($X^2=11.35$, $P=0.003$), as well as those who sleep less than 6 hours at night ($X^2=4.004$, $P=0.045$).

The results of logistic regression analysis showed that sleep quality is predictor for NSSI. These findings are more parallel with other study (25,26). Those who feel that they have adequate night sleep ($OR=20.53$,

$P=0.003$), and good quality sleep are more likely to not suffer from NSSI ($OR=7.26$, $P=0.023$). And those who are more satisfied with working environment were more likely to not suffer from NSSI ($OR=5.381$, $P=0.010$). The extend work to night shift and satisfaction have always determined as predictors of NSSI (27).

Conclusion

The NSSI prevalence in this study (67%) is higher compared to the figures found in other developing countries. Level of education, working environment satisfaction, sleep quality of the health staff have been found to be main factors associated with NSSI. Improvement of work schedule and sleep quality could decrease the NSSI rate.

Table 6. Logistic Regression predicting likelihood of having NSSI

| Variables | Categories | B | Wald | Sig. | Exp(B) | 95% CI for EXP(B) | |
|--|--------------------------|--------|------|------|--------|-------------------|--------|
| | | | | | | Lower | Upper |
| Gender | Female | | | | | | |
| | Male | .29 | .22 | .635 | 1.348 | .39 | 4.63 |
| Age | Years | .03 | .69 | .406 | 1.036 | .95 | 1.12 |
| | Married | | | | | | |
| Marital Status | Single | .46 | .53 | .466 | 1.595 | .45 | 5.60 |
| | Diploma degree and above | | | | | | |
| Educational Level | Primary school | -22.07 | .00 | .999 | .000 | .00 | . |
| | Secondary school | .58 | .14 | .700 | 1.800 | .09 | 35.62 |
| Are you currently | Current | | | | | | |
| | Permanent | -.04 | .00 | .944 | .955 | .26 | 3.47 |
| Do you usually work overtime at this hospital? | No | | | | | | |
| | Yes | .66 | .40 | .526 | 1.934 | .25 | 14.88 |
| Do you have a second job or private clinic? Overtime | No | | | | | | |
| | Yes | 1.89 | 8.28 | .004 | 6.659 | 1.82 | 24.26 |
| Experiences | No | | | | | | |
| | Yes | 2.85 | 5.77 | .016 | 17.443 | 1.69 | 179.47 |
| Did you recap needles after use? | Less than 5 years | | | | | | |
| | Less than 5 years | .23 | .12 | .722 | 1.266 | .34 | 4.63 |
| How do you recap the needles after use? | All the time | | | | | | |
| | Never | 1.02 | .42 | .517 | 2.790 | .12 | 62.00 |
| Do you think disease is transmitted by needle & sharp injuries? | Sometimes | -.08 | .00 | .944 | .921 | .09 | 9.25 |
| | Mostly | -.55 | .63 | .426 | .576 | .14 | 2.24 |
| Do you use personal protective equipment | Both hand | | | | | | |
| | With one hand | .04 | .00 | .960 | 1.045 | .18 | 5.87 |
| Are you satisfied with the working environment? | No | | | | | | |
| | Yes | -2.40 | 3.80 | .051 | .090 | .00 | 1.01 |
| How often do you think that you get enough sleep night? | No | | | | | | |
| | Yes | .27 | .15 | .696 | 1.319 | .32 | 5.28 |
| How would you rate your night sleep | Not totally | | | | | | |
| | Yes | 1.68 | 6.71 | .010 | 5.381 | 1.50 | 19.21 |
| Do you usually feel sleepy during working time? | No | | | | | | |
| | Yes | 1.81 | 4.44 | .035 | 6.124 | 1.13 | 33.04 |
| sleep duration | Not at all | | | | | | |
| | Always | 1.97 | 1.14 | .285 | 7.192 | .19 | 267.32 |
| Constant | Usually | .56 | .11 | .738 | 1.767 | .06 | 49.89 |
| | Sometimes | -.09 | .00 | .957 | .913 | .03 | 24.33 |
| Do you usually feel sleepy during working time? | Rarely | .79 | .19 | .659 | 2.208 | .06 | 74.44 |
| | Bad | | | | | | |
| Do you usually feel sleepy during working time? | Well | 3.02 | 8.82 | .003 | 20.53 | 2.79 | 150.87 |
| | Normal | 1.98 | 5.14 | .023 | 7.26 | 1.31 | 40.28 |
| Do you usually feel sleepy during working time? | Sometimes | | | | | | |
| | Yes | .54 | .476 | .490 | 1.730 | .36 | 8.21 |
| Do you usually feel sleepy during working time? | No | -.90 | 2.07 | .150 | .404 | .11 | 1.38 |
| | More than 6 hours | | | | | | |
| Do you usually feel sleepy during working time? | Less than 6 hours) | -1.37 | 5.41 | .020 | .253 | .08 | .80 |
| | Constant | -6.31 | 5.02 | .025 | .002 | | |

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Authors' contributions

Study design: F.A.S., J.S., T.R.H.
Writing: D.M.F.J., D.O.Q.
Final revision: All authors

References

1. Wicker S, Ludwig AM, Gottschalk R, Rabenau HF. Needlestick injuries among health care workers: Occupational hazard or avoidable hazard?. *Wiener Klinische Wochenschrift*. 2008;120(15-16):486-92.
2. Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. *Medical Devices (Auckland, NZ)*. 2017;10:225.
3. Leigh JP, Markis CA, Iosif AM, Romano PS. California's nurse-to-patient ratio law and occupational injury. *International archives of occupational and environmental health*. 2015;88(4):477-84.
4. Foley M, Leyden AT. American Nurses Association: Independent Study Module Needlestick Safety and Prevention. WHO, Geneva. 2002.
5. Alemayehu TA, Worku A, Assefa N. Sharp injury and exposure to blood and body fluids among health care workers in health care centers of eastern Ethiopia. *The international journal of occupational and environmental medicine*. 2016;7(3):172.
6. Mannocci A, De Carli G, Di Bari V, Saulle R, Unim B, Nicolotti N, Carbonari L, Puro V, La Torre G. How much do needlestick injuries cost? A systematic review of the economic evaluations of needlestick and sharps injuries among healthcare personnel. *infection control & hospital epidemiology*. 2016;37(6):635-46.
7. Spiegel PB, Bennedsen AR, Claass J, Bruns L, Patterson N, Yiweza D, Schilperoord M. Prevalence of HIV infection in conflict-affected and displaced people in seven sub-Saharan African countries: a systematic review. *The Lancet*. 2007;369(9580):2187-95.
8. Cho E, Lee H, Choi M, Park SH, Yoo IY, Aiken LH. Factors associated with needlestick and sharp injuries among hospital nurses: a cross-sectional questionnaire survey. *International journal of nursing studies*. 2013;50(8):1025-32.
9. GGoel V, Kumar D, Lingaiah R, Singh S. Occurrence of needlestick and injuries among health-care workers of a tertiary care teaching hospital in North India. *Journal of laboratory physicians*. 2017;9(1):20.
10. Morinaga K, Hagita K, Yakushiji T, Ohata H, Sueishi K, Inoue T. Analysis of needlestick and similar injuries over 10 years from april 2004 at Tokyo Dental College Chiba Hospital. *The Bulletin of Tokyo Dental College*. 2016;57(4):299-305.
11. Bekele T, Gebremariam A, Kaso M, Ahmed K. Factors associated with occupational needle stick and sharps injuries among hospital healthcare workers in Bale Zone, Southeast Ethiopia. *PloS one*. 2015 ;10(10):e0140382.
12. Garus-Pakowska A, Górajski M, Szatko F. Did legal regulations change the reporting frequency of sharp injuries of medical personnel? Study from 36 hospitals in Łódź Province, Poland. *Int J Occup Med Environ Health*. 2018;31(1):37-46.
13. Ding E, Li WH, Wang P, Jian XD. Somewhere in tertiary hospital clinical laboratory in pursuance of personnel sharp injury incidence status investigation and relative factor analysis. *Zhonghua lao dong wei sheng zhi ye bing za zhi= Zhonghua laodong weisheng zhiyebing zazhi= Chinese journal of industrial hygiene and occupational diseases*. 2016;34(7):502-5.
14. Dilie A, Amare D, Gualu T. Occupational Exposure to Needle Stick and Sharp Injuries and Associated Factors among Health Care Workers in Awi Zone, Amhara Regional State, Northwest Ethiopia, 2016. *Journal of environmental and public health*. 2017;2438713.
15. Veronesi L, Giudice L, Agodi A, Arrigoni C, Baldovin T, Barchitta M, Benedetti T, Caggiano G, Cannizzaro SG, De OG, D'Errico M. A multicentre study on epidemiology and prevention of needle stick injuries among students of nursing schools. *Annali di igiene: medicina preventiva e di comunita*. 2018;30(5 Supple 2):99-110.
16. Abebe AM, Kassaw MW, Shewangashaw NE. Prevalence of needlestick and sharp object injuries and its associated factors among staff nurses in Dessie referral hospital Amhara region,

- Ethiopia, 2018. BMC research notes. 2018;11(1):1-6
17. Bekele T, Gebremariam A, Kaso M, Ahmed K. Attitude, reporting behaviour and management practice of occupational needle stick and sharps injuries among hospital healthcare workers in Bale zone, Southeast Ethiopia: a cross-sectional study. *Journal of Occupational Medicine and Toxicology*. 2015;10(1):42.
18. Cui Z, Zhu J, Zhang X, Wang B, Li X. Sharp injuries: a cross-sectional study among health care workers in a provincial teaching hospital in China. *Environmental health and preventive medicine*. 2018;23(1):1-7
19. Fernandes LHF, Nunes WB, Silva LC, Wanderley RL, Barros CMB, Cavalcanti AL. Needlestick and Sharp Instruments Injuries among Brazilian Dentistry Students. *Contemporary clinical dentistry*. 2017;8(1):112-5.
20. Ghanei Gheshlagh R, Aslani M, Shabani F, Dalvand S, Parizad N. Prevalence of needlestick and sharps injuries in the healthcare workers of Iranian hospitals: an updated meta-analysis. *Environmental health and preventive medicine*. 2018;23(1):44.
21. Ghasemi M, Khabazkhoob M, Hashemi H, Yekta A, Nabovati P. The incidence of needle stick and sharp injuries and their associations with visual function among hospital nurses. *Journal of current ophthalmology*. 2017;29(3):214-20.
22. Marusic V, Markovic-Denic L, Djuric O, Protic D, Dubljanin-Raspopovic E. Knowledge about Blood-borne Pathogens and the Prevalence of Needle Stick Injuries among Medical Students in Serbia. *Zdravstveno varstvo*. 2017;56(3):179-84.
23. Fisman DN, Harris AD, Rubin M, Sorock GS, Mittleman MA. Fatigue increases the risk of injury from sharp devices in medical trainees: results from a case-crossover study. *Infection control and hospital epidemiology*. 2007;28(1):10-7.
24. Zencirci AD, Arslan S. Morning-evening type and burnout level as factors influencing sleep quality of shift nurses: a questionnaire study. *Croatian medical journal*. 2011;52(4):527-37.
25. Lo WY, Chiou ST, Huang N, Chien LY. Long work hours and chronic insomnia are associated with needlestick and sharps injuries among hospital nurses in Taiwan: A national survey. *International journal of nursing studies*. 2016;64:130-6.
26. Suzuki K, Ohida T, Kaneita Y, Yokoyama E, Uchiyama M. Daytime sleepiness, sleep habits and occupational accidents among hospital nurses. *Journal of advanced nursing*. 2005;52(4):445-53.
27. Ayas NT, Barger LK, Cade BE, Hashimoto DM, Rosner B, Cronin JW, et al. Extended work duration and the risk of self-reported percutaneous injuries in interns. *JAMA*. 2006;296(9):1055-62.