

Work Related Stress and Needlestick Injuries (NIs): A Study among Iranian Nurses with/without NIs

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Abstract

Introduction: The aim of this study was to investigate the work related stress among Iranian nurses with/without needlestick injuries (NIs) as an exposure factor to blood-borne pathogens.

Materials and Method: This study was conducted on 1070 nurses in Iranian public hospitals. The data were collected using a NIs questionnaire and the HSE Management Standards Indicator Tool and then, analyzed through independent t-test and logistic regression.

Results: The mean work related stress scores among the groups of nurses with/without NIs were 114.49 and 110.37, respectively. Moreover, the mean for five out of the seven stress component including control, managerial support, peer support, role clarity, and change were lower in the group of nurses with NIs, as compared to the other group, resulting in a significant difference between the two groups regarding the five stress component and work related stress ($p < 0.05$). Further, the results showed that work related stress was significantly correlated with the variables of age, work experience, BMI, work shift the NIs last occurred, the way the NIs last occurred and received/unreceived Hepatitis B vaccine ($p < 0.05$).

Conclusion: The NIs incidence was observed to cause increased levels of work related stress and its associated stressors among nurses. Accordingly, the work related stress level increased after the NI incidence and over time, the work related stress severity declined among nurses. Post-NIs work related stress is considered as a mild PTSD with less severe effects. Therefore, it is essential to take control measures to reduce the work related stress and its negative effects.

Keywords: Work Related Stress, Needlestick Injuries (NIs); Sharp Injuries; Nurse

Introduction

In the hospital environment, nursing is one of the jobs with highest rates of occupational injuries. Among nurses, back injuries and needlestick incidents are most notable [1]. Needlestick injuries (NI) is the penetration of skin by a sharp (hollow needle, double-edged scalpel, scalpel, broken thermometer, etc.) while contacting blood or other body fluids which is a common problem among medical personnel [2]. Studies show that twenty blood-borne pathogens can be transmitted to health care workers following NIs, among which HBV-, HCV-, and HIV-caused diseases are more important [3]. In this regard, the incidence rate was between 30-60% for HBV infection, 3-4% for HCV infection and 0.3% for HIV infection [4]. In addition to such common and dangerous diseases, NIs may also result in transmission of diseases caused by viruses, bacteria, fungi and other microorganisms, including blastomycosis, brucellosis, cryptococcosis, diphtheria, gonorrhoea, etc. [5]. In addition to causing direct costs of treatment, NIs also lead to high costs related to long-term complications, lost-work hours due to care request and receive, fear, mental pressure, stress and anxiety-related job behavioral changes among the personnel [6].

Fear of needlestick incidence (pre-incidence, as a precaution) and also the NIs is regarded as a "stressor" among nurses and other health care workers, which can cause complications and symptoms associated with mental health including depression symptoms [7], post-traumatic stress disorder (PTSD) [8], adjustment disorder (AD) [9], etc., along with the possibility of creating potential health risks, including viral infections such as hepatitis and HIV. Sohn, et al. [10] in a study conducted on health care workers with NIs experience stated that these people had experienced high levels of stress, anxiety and depression after NIs, reducing which requires special attention. The researchers also found that NIs experience among nurses in the past year was a main hazard in the workplace that caused different levels of work related stress in this population [10]. Kim, et al. [11] examined the relationship between Work related stress and NIs. The result of this study showed that nurses with low job control or high job tension, i.e., high levels of Work related stress, suffered from higher rates of NIs [11]. In another study, Smith, et al. [12] reported that perceived high mental pressure among nurses was correlated with 1.75-

fold increased risk of NIs from an infected machine in them [12]. Lin, et al. [13] showed exposure to HIV caused exposed HCPs severe adverse psychological pressure, such as stress and anxiety. The reported exposure incidents in this study included needle sticks, sharps injuries, exposure to unprotected mucosa, and exposure to open wounds [13]. Also, Wicker, et al. [14] revealed that stress and tiredness were common factors contributing to the NSIs and that >80% of the respondents were concerned about the consequences of the NSI. Stressful working conditions was as one important factor contributing to NSIs [14]. Muralidhar, et al. [15] showed a large number of Healthcare workers suffered stress after NSIs (67%). They recommended that preventive strategies have to be devised and reporting of NSI need to be made mandatory [15].

In addition to various physical, chemical, biological and psychosocial variables which are regarded as enduring stressors of hospital related jobs, the NIs incidence as a warning and preventable risk factor (pre-incidence; negative effects on mental health that caused as a result of fear of the occurrence of an undesirable event, such as NSIs), and also as a potential risk of physical health impairment (post-incidence; negative effects, physical or mental, after the occurrence of an undesirable event, such as NSIs) can cause varying degrees of job tension and stress among health care workers, especially nurses. The same factor could cause negative effects on health care workers' mental health, and also lead to increased fear and loss of skills and productivity among them and negatively impact their occupational and social life. In this study, the prevalence rate of NIs and Work related stress level have been investigated among Iranian nurses, aiming to initiate a monitoring measure to prevent such adverse effects on physical and mental health.

Materials and Methods

This study was conducted on 1070 shift-work nursing personnel (237 males and 833 females) in Iranian public hospitals who were selected with random cluster sampling method during 2014 to 2016. Every member of the nurses has a statistically equal chance of being included in each section of hospitals. A demographic/NIs history questionnaire as well as the HSE Management Standards Indicator Tool was distributed among the

participants. The questionnaires were completed and collected under the supervision of the researchers. The demographic information collected in the questionnaire included age, gender, weight, height, marital status, occupation, workplace division, academic major, education level and work experience. To determine the incidence rate of NIs among those surveyed, several studies on NIs and related areas were examined. Accordingly, the NI incidence rate, conditions and associated factors were extracted and utilized to develop a questionnaire to determine the status of NIs (Table 1). Since needlestick incidents may not be reported in some cases due to various reasons, in addition to examining the records in the needlestick incidents reporting system, the participants were also investigated through self-report and filling out the questionnaires.

In the late 1990s, the Department of Health and Safety Executive in England (HSE) designed the HSE management standards indicator tool which is a 35-item questionnaire to determine seven primary stressors identified in the management standards for work related stress [16]. The questions are classified into seven stress component domains including; *Demand* (maximum score: 35): the types of demands made on workers in areas such as workload, working patterns and working environment; *Control over work* (maximum score: 30): determines the extent to which individual performs his/her own duties properly; *managerial support* (maximum score: 25): shows support received by individual including that from managers and the organization in general; *peer support* (maximum score: 20); *Relationship at work* (maximum score: 20): presents collective connections and prevents dispute and struggle at workplace; *Role or responsibility* (maximum score: 25): presents understanding an individual role within the organization; and *Changes*, organizing method and human resources of an

organization (maximum score: 15). However, the two domains of managerial support and peer support have been integrated in some studies, and also in the documents issued by the HSE and the questions have been divided into 6 stress component domains. So, this indicator tool comprehensively include critical concepts related to job, correct doing of duties, social relations and supports at job, and individual effectiveness in organization.

The absence/ decrease one or more than one of this concepts could be threaten safety performance in work and causing some incidents such as NSIs. The questions are scored on a five-point Likert scale including never, rarely, sometimes, regularly, and always. Higher scores on this scale indicate greater health and safety in terms of stress and lower scores indicate greater stress among individuals. As a rule of thumb, to assess the situation, a response rate of over 50% can be considered sufficient, over 60% favorable, over 70% good and over 80% excellent [17]. Validity and reliability of the HSE Management Standards Indicator Tool have been evaluated and measured in Iran by Azad [18]. The results in their study were obtained regarding the seven stress component domains of the questionnaire, indicating a strong correlation between the factors extracted from the factor analysis and its domains. Moreover, the validity of the questionnaire was obtained as 0.78 and 0.65 using Cronbach's alpha and split-half method, respectively [18,19].

To analyze the data, the mean and standard deviation values were first calculated using descriptive statistics. Then, multivariate-adjusted linear regression and independent t-test were used to analyze the obtained results.

Question Subjects	Response Options	Resources Used
Incidence of needlestick and sharp injuries		-
The time the needlestick incident last occurred	Previous day	(Norsayani and Noor Hassim, Schmid, et al., Nsubuga and Jaakkola) [20-22]
		Previous week
		Previous month
		Last six months
	Last year	
The number of needlestick injuries in the last 12 months		(Trinkoff, et al., Jayanth, et al., Schmid, et al., Kazemi Galougahi, Ayranci and Kosgeroglu) [21,23-26]
The work shift the NI last occurred	Morning/Early afternoon (7-14)	(Ilhan, et al., Smith, et al., Lockley, et al., Smith, et al., Jayanth, et al.) [6,12,24,27,28]
		Early afternoon/Evening (14-20)
		Evening/Early morning (20-7)

The way the NI last occurred	Needle recapping	(Singru and Banerjee, Hanafi, et al.) [29,30]
		During blood specimen collection
		Transfusion
	Injections	
		During waste discharge
		Moving contaminated clothing
		During suturing
	Others	
NIs causing instruments	Needle	(Jagger, et al., Wilburn) [31,32]
		Suture needle
	Scalpel	
		I.V Cannula/Branula
	Knife	
	Others	
Reported/unreported NIs		(Vaz, et al., Elmiyeh, et al., Norsayani and Noor Hassim, Thomas and Murray) [20,33-35]
Received/un-received Hepatitis B vaccine		(Talaat, et al., Mast, et al., Okeke, et al., Poland and Jacobson, Rajesh, et al.) [36-40]
Incidence/non-occurrence of NIs in the past year	Blood or fluids splash into the mouth or eyes	(Alamgir, et al., Organization, Ashford, et al., Prüss-Üstün, et al., Azap, et al.) [41-45]
		Open wound contact
		Incised wounds

Table 1: Domains to determine the prevalence of needlestick and sharp injuries among the subjects.

Results

Because completing of questionnaires in absentia (email, phone, mail, etc.) would not be possible, and researchers in person on completing the questionnaires had direct control, all the 1070 subjects under the study completed the study questionnaires. Since the focus in this study was on nurses, the midwives ($n = 10$), medical records employee ($n = 1$), auxiliary nurses ($n = 14$), operating room specialists ($n = 12$), anesthesia specialists ($n = 4$), and laboratory sciences specialist ($n = 1$) were excluded from the samples and the remaining 1028 nurses in different hospital wards comprising of 240 males (21.3%) and 788 females (78.7%) were analyzed.

The demographic information of the subjects is summarized in Table 2. The mean (SD) age of the subjects was 33.12 (6.3) years. In addition, of the total population participating in the study, 308 individuals (29%) were singles and 720 individuals (71%) were married. The mean (SD) weight, height, and BMI were respectively obtained as 66.59 (11.04) kg, 166.06 (8.57) cm, and 24.15 (3.65) kg/m², indicating that a large percentage (61.2%) of the study participants had normal weight. Table 2 also presents the body weight classification in terms of BMI. Moreover, the frequency and percentage frequency of the education level and mean work experience of the participants have been shown in this table.

Variable		Frequency	(%)	Mean (SD)	Min	Max
Age (year)	Up to 30 years	329	31.9	33.12 (6.3)	19	52
	30-35 years	518	50.7			
	40 years and above	181	17.4			
Gender	Male	240	21.3			
	Female	788	78.7			
Weight (kg)		1028		66.59 (11.04)	37	105
Height (cm)		1028		166.06 (8.57)	98	190
BMI(kg.m ⁻²)	Normal weight*	631	61.2	24.15 (3.65)	13.06	38.30
	Weight Loss	29	2.7			
	Weight Gain	325	31.8			
	Obesity I	40	3.9			

	Obesity II, III	3	0.3		
Marital status	Single	308	29		
	Married	720	71		
Education	Diploma	0	0		
	Associate Degree	22	2.1		
	Bachelor's degree	369	37.5		
	Master's degree	615	57.5		
	PhD	22	2.1		
Work experience (year)		1028		8.86 (1.9)	1 28

Table 2: Demographic information and employment conditions of the subjects.

*Normal weight (BMI 18.5-24.9 kg m⁻²), weight loss (BMI <18.5 kg m⁻²), weight gain (BMI 25.0-29.9 kg m⁻²), Obesity I (BMI 30-34.9 kg m⁻²), Obesity III/II (BMI ≥ 35 kg m⁻²) [46].

Variable		Frequency	%Frequency
The time the needlestick incident last occurred	Previous day	6	1.2
	Previous week	21	4.1
	Previous month	56	10.4
	Last 6 months	127	23.5
	Last year	345	60.8
The work shift the NI last occurred	Morning/Early afternoon (7-14)	170	30.9
	Early afternoon/Evening (14-20)	150	27.2
	Evening/Early morning (20-7)	235	41.9
The way the NI last occurred	Needle recapping	156	28.2
	During blood specimen collection	170	30.7
	Transfusion	9	1.6
	Injections	82	14.7
	During waste discharge	8	1.4
	Moving contaminated clothing	4	0.7
	During suturing	29	5.2
Others*	97	17.4	
NIs causing instruments	Needle	413	74.1
	Suture needle	24	4.3
	Scalpel	24	4.3
	I.V Cannula/Branula	45	8.2
	Knife	0	0
	Others*	50	9.1
Incidence/non-incident of NIs in the past year	Blood or fluids splash into the mouth or eyes	191	17.8
	Open wound contact	90	8.4
	Incised wounds	159	14.9
	No	588	58.9

Table 3: Frequency and percentage frequency of the needlestick and sharpinjuries in the subjects.

* means stating conditions or cases other than the options mentioned in the questionnaire. The purpose was to enlist conditions or cases which were not normally occurring or existing during the workflow or task and were unconventional practices or instruments. In this study, the responses recorded by the subjects showed that the performance of a duty or use of an instrument leading to NIs incidence was outside their domain of expertise under normal operating conditions and thus, was entitled as "others" in the table considering the number of such cases.

Study of the prevalence rate of needlestick and sharp injuries among the participants revealed that the injuries had occurred to 555 individuals (53.9%) at least once during the past year; accordingly, 6 individuals (1.2%) had experienced the injuries the day before the study, 21 individuals (4.1%) had experienced the injuries within the week before the study, 56 individuals (10.4%) within the month before the study, 127 individuals (23.5%) within the last 6 months before the study, and 345 individuals (60.7%) within the last 12 months before the study. However, the rest of the subjects (n=473, 46.1%) had not experienced the needlestick and sharp injuries during this period. Table 3 shows the needlestick and sharp injuries status as frequency and percentage frequency values for the study participants. As shown in the table, the highest rate of the needlestick and sharp injuries occurred during the night shift (41.9%), whereas the lowest rate occurred during the afternoon shift (27.2%). Moreover, the results in Table 3 indicate that the needle cap piercing was the most prevalent among the needlestick and sharp injuries. Accordingly, the highest rate of the needlestick and sharp injuries occurred during blood specimen collecting (30.7%) and needle recapping (28.2%), both resulting in needle cap piercing (74.1%). Examining the other study variables showed that 386 of the subjects (69.6%) reported the needlestick and sharp injuries, whereas 169 of the subjects (30.4%) had not reported or recorded the incidence. Also, among all the

participants in the study (n=1028), the number of 23 individuals (2.3%) had not received hepatitis B vaccine. Another item in the questionnaire had focused on potential risk factors for blood-borne viral infections. In this regard, the results showed that 588 of the subjects (58.9%) had not experienced any related risk factors during the past year. This is while 191 of the subjects (17.9%) had experienced blood or fluids splash into the mouth or eyes, 159 (9/14%) had experienced incised wounds (except for the needle stick), and 90 (8.4%) had experienced open wound contact.

The results obtained through investigating and comparing Work related stress status in the NIs reporting group of nurses and the non-reporting group revealed a significantly higher level of Work related stress among the former group ($p = 0.016$). Table 4 presents the standard deviation and t-test significance level for the subjects. Based on the results presented in Table 4, the mean values for the domains of control, managerial support, peer support, role and change were respectively $p = 0.002$, $p = 0.035$, $p = 0.001$, $p = 0.025$, and $p = 0.008$, which were significantly different between the groups with/without NIs history. However, no significant differences were observed between the two groups regarding the mean values for the two domains of demands and relationships which were obtained as $p = 0.076$ and $p = 0.210$, respectively.

Domain	With NIs history		Without NIs history		Total		Significance level
	Mean	SD	Mean	SD	Mean	SD	
Demands	20.45	6.09	19.53	6.09	20.03	6.10	0.076
Control	17.96	5.00	19.26	4.92	18.55	5.00	0.002
Managerial support	17.61	4.38	18.39	4.92	17.96	4.51	0.035
Peer support	14.27	3.55	15.20	3.43	14.68	3.52	0.001
Relationships	10.62	3.24	10.28	3.35	10.47	3.29	0.210
Role	19.67	4.74	20.53	4.60	20.06	4.69	0.025
Change	9.94	2.79	10.42	2.83	10.16	2.82	0.008
Work related stress	110.37	17.24	114.49	17.00	112.27	17.24	0.016

Table 4: The mean (SD) scores for Work related stress and its associated areas among the subjects.

Considering assumptions such as independence of observations, general covariance structure between observations, homoscedasticity on the predictor variables and multivariate normal distribution of residuals which are taken into account to obtain the best results, the variables in Tables 2 and 3 were investigated as likely impacting variables and their relationship with Work related stress was modeled using logistic regression. The results of multivariate, adjusted linear regression

analyses showed that Work related stress was significantly correlated with the variables of age ($\beta=0.11$; 95% CI = 0.03-0.18; p -value= 0.004), work experience ($\beta=0.16$; 95% CI =0.08-0.26; p -value<0.001), BMI ($\beta=0.10$; 95% CI =0.09-0.24 , p -value= 0.005), work shift the needlestick incident last occurred ($\beta=0.12$; 95% CI =0.05-0.18; p -value= 0.005), the way the needlestick incident last occurred ($\beta=0.13$; 95% CI =0.06-0.17; p -value= 0.004), and received/unreceived Hepatitis B vaccine ($\beta=0.61$; 95%

CI =0.23-1.04 , p-value= 0.001). However, the other variables in Tables 2 and 3 were not significantly correlated with Work related stress (p-value>0.05).

Discussion

In this study, Work related stress and workplace stressors were studied among the groups of nurses with/without NIs history. Although NIs are not regarded as medical errors in terms of the concept and severity of effects as well as individual undergoing such influences, they cause complications and also occur by medical staff [47]. The results of examining the documents and records in the target hospitals showed that NIs occur only due to errors committed by nursing staff or workplace problems. Although coherent documentation and reporting systems are used in Iranian hospitals for such incidents, medical errors are not recorded by such systems. The results of investigating the NI prevalence rate among the 1070 Iranian nurses under the study focus showed a rate of 53.9%, mostly occurred due to the needle cap (involved in 74.1% of the cases) used in various tasks and practices(30.7% by blood specimen collecting and 28.2% by needle recapping). Similar studies conducted in England have reported the NI prevalence rate to be 37% [48] and hepatitis C and HIV transmission rate to be 1.43 cases per year among nurses [49]. Moreover, the NI prevalence rate in Australia has also been annually reported as one in five people equal to 47000 NIs per year [50]. Similarly, the NI prevalence rate has also been reported in Turkey in the study by Talas, et al. [51] who reported a rate of 49% [51]. Yet in South Korea, the NI prevalence rate was reported in a study to be 79.7% in which the needle cap with the rate of 52%, similar to the results obtained in our study, was reported as the most frequent instrument leading to NIs [6]. By comparing the results obtained in this study with those of other studies, high NIs prevalence rate can be concluded among Iranian nurses.

The current study also showed that among the subjects with NIs history, the highest percentage was related to young nurses (up to 30 years); however, by increasing age and work experience, the NI prevalence rate was reduced among the nursing population which could be attributed to greater work experience and expertise as well as numerous training programs to carry out working practices, and also more familiarity with the workplace and equipment. In a similar vein, Ilhan, et al. [27] reported a greater NIs prevalence rate among people aged 24 years or less or with work experience of less than 4 years [27]. The results in our study indicated that the highest NIs frequency occurred during the night shift

(41.9%), morning shift (9/30%), and afternoon shift (28.2%), respectively. Furthermore, the mean Work related stress scores obtained in the study revealed that the highest measured value (similar to the order of the highest NIs frequency) was obtained during the night shift (42.3%), morning shift (30.2%), and afternoon shift (27.5%), respectively. Also, the analysis of the work stress-NIs link by the type of shift work, as an effect-modifier, showed working during the night and then morning shifts increases the likelihood of NIs among nurses, as compared to the afternoon shift, and also increases their Work related stress. Consistent with our study, Ayas, et al. [52] in a study on interns reported that injuries more frequently occur during the night than in the day [52]. Studies show that the body's level of cortisol secretion during the night is reduced to its half during the day which decreases consciousness level and thus, may result in a higher incidence of errors [53]. Accordingly, the same factor can be said to decrease level of work safety and thus, cause NIs incidents and increased Work related stress.

The results of assessing the NI prevalence and Work related stress level during work shifts (morning, afternoon, and night) in this study showed that the individual aspects and human errors-by considering the use of similar equipment and instruments-are risk factors for NIs and Work related stress among nurses. Moreover, the results also showed that the mean Work related stress and five out of the seven stress component domains were higher among the subjects with NIs history, as compared with those without NIs history. The subjects with NIs history also had lower job control, meaning that they would less manage to properly carry out their tasks. This group of nurses also self-reported that they had less received managerial as well as peer support. Further, in comparison with the nurses without NIs history, the nurses with NIs history indicated lower perception towards their role and assigned tasks performance in the hospital, and also self-reported that they less perceived changes in the organization and staffing in the hospital. As a result of such factors, this group of nurses revealed greater Work related stress level than those without NIs history. Study of the mean Work related stress scores in this population (patients with NIs history) showed that the nurses who had experienced NIs during the previous day had much higher Work related stress than those who had experienced NIs during the previous week, month or year. Similar to the results obtained in our study, Sohn, et al. [10] reported that health care workers who had experienced NIs, had higher levels of anxiety, depression and stress compared to those who had never experienced NIs, and also revealed significantly higher levels of

depression and stress after the injuries [10]. Based on the results obtained in our study and the study by Sohn, et al. [10], it can be concluded that the less time passed since the last NI incident results in greater level of Work related stress among nurses.

In other words, after the NI incident, nurses experience higher levels of Work related stress and its contributing factors (including anxiety and depression) which decrease over time. In addition, the results in our study showed that receiving prophylactic vaccines including hepatitis B vaccine did not result in lower levels of stress; accordingly, among the nurses with NIs history, those who had received hepatitis B vaccine showed higher levels of Work related stress than those who had not received the vaccine, which was in contrast with the research hypothesis that regarded Hepatitis B vaccine to cause the stress level to decrease and confidence level to increase among nurses. Further research is required to find out the reasons behind such controversy. In a similar vein, d'Ettorre [54] reported high levels of Work related stress among people with NIs history and thus, considered preventive measures as costly but effective [54]. Yet in another study by Wicker, et al. [14], Work related stress was regarded as one consequence of NIs and stressful working conditions were reported as a major contributing factor to NIs [14]. Post-traumatic stress disorder (PTSD) is a mental disorder that potentially occurs following an incident one has experienced or witnessed, or due to exposure to threats or a serious injury as a result of fear, despair and so on [55]. According to the definition of PTSD as well as its up-to-date conditions, post-NIs Work related stress can be considered a form of PTSD expression that causes negative effects on the mental health of nurses. However, the severity of this type of PTSD is assumed to be much lower than the stress caused by other acute traumas and therefore, it is more sensible to take into account determination of PTSD symptoms in individuals with less severe NIs history. In this regard, Naghavi, et al. [8] in their study reported evidence of the occurrence of PTSD symptoms among nurses with NIs history [8]. Moreover, Makay, et al. [56] reported in their study a significant prevalence rate of PTSD symptoms among intern surgeons with NIs history [56].

This was the first study conducted in Iran that examined Work related stress and NIs among nurses and is regarded as a credible research in this aspect and also in terms of its results. In order to reduce NIs, future studies are recommended to attempt to identify individuals susceptible to NIs in health care divisions. Also, by carrying out further studies on ways to prevent and determine critical and influential factors, the

incidence of such minor trauma can be prevented. Ultimately, since no coherent system exists in Iran to document, examine and report medical errors, it is recommended to develop such system and link it to the NI reporting system.

One limitation of this study was the recall bias whereby the nurses might not remember exactly the number of NSIs they had in the past one year. This bias solved by checking the needlestick incidents reporting system. Because of all nurses had any email or other similar access ways, other limitations of this study were study design, selection, how to collect information, and integration of information, and more cost and time.

Conclusion

The prevalence rate of needlestick and sharp injuries was observed to be high among the Iranian nurses, mostly due to the use of needle cap while carrying out related tasks, including blood specimen collecting and needle recapping. Further, the NI incidence among the nurses caused an increased level of Work related stress and its contributing stressors; accordingly, the level of Work related stress increased among the nurses after NIs, but declined over time. During the 24-hour nursing shift, NIs were more frequently observed in the night shift which can be mainly due to the decreased cortisol level and awareness decline and thus, increased errors. Post-NIs Work related stressis regarded as a mild PTSD with less severe effects. Therefore, it is essential to take control, comforting and soothing measures to reduce the level of work related stress and its negative effects on the mental health of nurses with NIs history.

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Conflict of Interest

Authors of the manuscript did not have a conflict of interest.

Authors' Contribution

Authors contribute to this study as following items: Jafar Akbari: Study design and management, writing and

reviewing the final version of the manuscript, statistical analysis;

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