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Situation and associated factors of needle stick and sharps injuries among health-care workers in a tertiary hospital: a cross-sectional survey

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Abstract

Purpose This study aimed to assess the prevalence of and factors associated with needle stick and sharps injuries (NSSIs) among health-care workers (HCWs) in a tertiary hospital in China.

Materials and methods This retrospective survey was conducted with 562 HCWs at a tertiary hospital in China in July 2023. Information was collected using a self-designed questionnaire, and all enrolled members were required to fill in the demographic characteristics, occurrence of NSSIs and other associated factors in the past year. Logistic analysis was used to identify variables associated with NSSIs.

Results The proportion of participants with at least one injury within the year preceding the investigation was 21.2%. Male (AOR = 2.116 [1.265, 3.538]), working hours per week > 40 (AOR = 1.718 [1.056,2.796]), rarely checking blood-borne infections before invasive operations (AOR = 2.219 [1.303,3.782]) were significantly associated with NSSIs.

Conclusion The prevalence of NSSIs was not low in the survey area, especially in male, individuals with longer working hours, and rarely checking blood-borne infections before invasive operations. Therefore, it is necessary to promote educational programs to enhance awareness of standard prevention measures, especially for key populations, and reduce heavy workloads to decrease the occurrence of such injuries.

Keywords Needle stick and sharps injuries, Health-care workers, Factors, Prevalence

Introduction

Needle stick and sharps injuries (NSSIs) among health-care workers (HCWs) are defined as accidental injuries caused by diverse sharp equipment, such as needles, scalpels, and glass slides, cutting through the skin during medical care work. NSSIs are universal occupational health problem among HCWs. About 3.35 million HCWs experience NSSIs every year globally [1]. According to a rough estimation, each HCW may undergo NSSIs four times annually [2]. An Egyptian study demonstrated that approximately two-thirds (66.2%) of the respondents reported sharps injuries at least once in their medical career [3]. In a hospital of Lao People's Democratic Republic, the occurrence of NSSIs among staff throughout the entire career was 42.1% [4]. Another cross-sectional survey showed 67.9% of workers had endured at least once such injury one year in University of Alexandria Hospitals [5]. Several studies on sharps injuries in

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China [6–8] and other countries [9–11] have been published, but the rate of NSSIs varies widely, ranging from 1.14 to 84.2%, which implies that there are still large gaps in the occurrence of needle stick and sharps injuries among different groups.

One study indicated that 65.9% of HCWs had been exposed to blood and body fluids within one year, of which 29.0% had NSSIs [12]. Over 20 species of blood-borne viruses have been shown to spread among HCWs through NSSIs, mostly hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) [13]. The probability of infection with HBV, HCV, or HIV through NSSIs is 1.9% to >40%, 2.7–10%, and 0.2–0.44%, respectively. Approximately 66,000 HBV infections, 16,000 HCV infections, and 1,000 HIV infections result from NSSIs among HCWs within one year globally [1]. In Japan, the total cost of NSSIs in medical institutions is estimated to be $302 million and cost per case was estimated as US $577 [14]. These values should not be ignored.

Health-care workers in developing countries tend to have an enhanced risk of infection of blood-borne diseases by means of occupational exposure, owing to the higher prevalence of those blood-borne pathogens in their countries, the shortage of engineering controls, such as needleless or protected needle devices, and lack of Hepatitis B vaccination [15, 16].

NSSIs are considered preventable as long as HCWs take a comprehensive approach to addressing the environmental, operational, and equipment issues that lead to the occurrence of sharp injuries. Although COVID-19 pandemic in 2020–2022 raised medical workers' awareness of occupational exposure, medical institutions also increased training related to occupational protection, and formulated corresponding institutional preventive measures, at present, HCWs in China still face higher occupational exposure risks. It is important to identify factors that reduce the occurrence of sharps injuries [17–19]. Therefore, this study aimed to assess the prevalence of and factors associated with NSSIs among HCWs in a tertiary hospital in China.

Materials and methods

This cross-sectional study among healthcare workers was carried out at The First Affiliated Hospital of Anhui University of Chinese Medicine, the largest integrated hospital of 3 A Traditional Chinese Medicine Hospital in Anhui Province, in July 2023. The healthcare workers who had worked for at least one year in this medical institution were selected for this study, but not including those rarely exposed to sharps injuries in daily work (administrative staff, drug dispensers, and radiographers). These workers include doctors, nurses, technicians (laboratory staff and pathology technicians) and trainees.

A self-administered questionnaire based on previous literature [6, 19] on sharps injuries in China and other regions was used to collect information about the participants. A pre-survey was conducted in the obstetrics and gynecology departments of 50 workers (data were excluded from further analysis). Confusing questions were modified by a group of experts who were members of the infection control committee of the hospital after the pre-survey. The questionnaire has four parts, namely demographic characteristics (age, sex, educational level, occupation category, professional title level, working years, department, working hours per week), occurrence of sharp injuries (history and number of NSSIs during the past year, instruments causing sharps injuries, operations when injuries occur, injured parts, sources of exposure), behavioral factors (whether to follow the standard prevention, whether to check blood-borne infections, training times) and consequences (emergency treatment, reporting, and reexamination of hematogenous disease). The questionnaires were distributed directly to the respondents, and then collected by infection control professionals, while checking the completeness and consistency of the questionnaires.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) 20.0 software. Associations between dependent and independent variables were evaluated using bivariable and multivariate logistic regression analyses sequentially and presented as crude odds ratios (CORs) and adjusted odds ratios (AORs) with 95% confidence intervals (CI). A p-value of <0.05 was considered statistically significant.

Results

Characteristics of the included HCWs

A total of 562 health-care workers responded voluntarily and completely to the questionnaire resulting in a response rate of 99.5%, and three workers either rejected or submitted questionnaires with missing items. Of the participants, 93 (16.5%) were male, 186 (33.1%) had a primary title with a professional qualification, and 375 (66.7%) had a bachelor's degree. The age range of the selected participants was between 19 and 60 years with mean of 32.69 (SD=±8.816) years. Nearly one-fifth of the study participants (19.0%) were doctors and more than half of the participants (60.3%) were nurses. (Table 1).

Needle stick and sharps injuries (NSSIs)

There were 119 (21.2%) participants who had experienced at least one injury, among them, 21 (17.6%) suffered more than three injuries in the past year. Of the sharps instruments that caused NSSIs, 58.1% were needles, 28.8% were glasses, and the remainder were scalpels. In the

Table 1 Logistic regression analysis of factors associated with NSSIs

Variable		Number (%)	NSSIs		COR (95% CI)	*P* Value	AOR (95% CI)	$P_{adj.}$ Value
			Yes(%)	No(%)				
Gender	Male	93(16.5)	29(31.2)	64(68.8)	1.908 (1.163,3.131)	0.011*	2.116 (1.265,3.538)	0.004*
	Female	469(83.5)	90(19.2)	379(80.8)	1		1	
Age	≤ 25 years	120(21.4)	26(21.7)	94(78.3)	0.774 (0.372,1.611)	0.494		
	26–45 years	385(68.5)	78(20.3)	307(79.7)	0.711 (0.375,1.349)	0.297		
	>45 years	57(10.1)	15(26.3)	42(73.7)	1			
Educational level	Junior college and below	82(14.6)	9(11.0)	73(89.0)	0.375 (0.165,0.852)	0.019*		
	Bachelor	375(66.7)	84(22.4)	291(77.6)	0.877 (0.529,1.454)	0.611		
	Master and above	105(18.7)	26(24.8)	79(75.2)	1			
Professional title level	No	113(20.1)	24(21.2)	89(78.8)	0.674 (0.323,1.405)	0.293		
	Primary	186(33.1)	45(24.2)	141(75.8)	0.798 (0.408,1.559)	0.509		
	Medium	207(36.8)	34(16.4)	1z73(83.6)	0.491 (0.247,0.976)	0.042*		
	Senior	56(10.0)	16(28.6)	40(71.4)	1			
Occupation category	Doctor	107(19.0)	28(26.2)	79(73.8)	1.122 (0.598,2.107)	0.719		
	Nurse	339(60.3)	64(18.9)	275(81.1)	0.737 (0.432,1.256)	0.262		
	Technician	16(2.8)	3(18.8)	13(81.2)	0.731 (0.192,2.781)	0.646		
	Trainee student	100(17.8)	24(24)	76(76)	1			
Department	Internal medicine department	220(39.1)	42(19.1)	178(80.9)	0.734 (0.322,1.671)	0.462		
	Surgery department	213(37.9)	53(24.9)	160(75.1)	1.031 (0.457,2.323)	0.942		
	Obstetrics and gynecology	31(5.5)	6(19.4)	25(80.6)	0.747 (0.233,2.394)	0.623		
	Outpatient department	61(10.9)	9(14.8)	52(85.2)	0.538 (0.192,1.511)	0.240		
	Operation room	37(6.6)	9(24.3)	28(75.7)	1			
Working years	≤ 5 years	206(36.7)	50(24.3)	156(75.7)	1.961 (1.072,3.586)	0.029*		
	6–10 years	136(24.2)	29(21.3)	107(78.7)	1.658 (0.860,3.197)	0.131		
	11–15 years	99(17.6)	23(23.2)	76(76.8)	1.851 (0.926,3.703)	0.082		
	>15 years	121(21.5)	17(14.0)	104(86.0)	1			
Working hours per week	>40 h	393(69.9)	93(23.7)	300(76.3)	1.705 (1.057,2.751)	0.029*	1.718 (1.056,2.796)	0.029*
	≤ 40 h	169(30.1)	26(15.4)	143(84.6)	1		1	
Whether to follow the standard prevention	Rarely	27(4.8)	10(37.0)	17(63.0)	2.799 (1.220,6.425)	0.015*		
	Occasionally	201(35.8)	51(25.4)	150(74.6)	1.618 (1.057,2.476)	0.027*		
	Always	334(59.4)	58(17.4)	276(82.6)	1			
Whether to check blood-borne infections	Rarely	227(40.4)	62(27.3)	165(72.7)	1.939 (1.155,3.256)	0.012*	2.219 (1.303,3.782)	0.003*
	Occasionally	181(32.2)	32(17.7)	149(82.3)	1.108 (0.624,1.967)	0.726	1.116 (0.624,1.996)	0.710
	Always	154(27.4)	25(16.2)	129(83.8)	1		1	

Table 1 (continued)

Variable		Number (%)	NSSIs		COR (95% CI)	*P* Value	AOR (95% CI)	$P_{adj.}$ Value
			Yes(%)	No(%)				
Training times	Once and below	179(31.9)	36(20.1)	143(79.9)	1.188 (0.718,1.964)	0.503		
	Twice	160(28.5)	44(27.5)	116(72.5)	1.790 (1.097,2.920)	0.020*		
	Three times and above	223(39.7)	39(17.5)	184(82.5)	1			

NSSIs: needle stick and sharp injuries; COR: crude odds ratio; AOR: adjusted odds ratio; CI: confidence interval; P_{adj}:adjusted *P*-value;*$P<0.05$

Table 2 NSSIs among healthcare workers

NSSIs		Number	Percent (%)
Experience NSSIs	Yes	119	21.2
	No	443	78.8
The number of NSSIs	≤ 3	98	82.4
	>3	21	17.6
Sharp instruments	Needles	93	58.1
	Glasses	46	28.8
	Scalpels	21	13.1
Operations when injuries occur	Withdrawing the needle	52	35.9
	Injection or drawing blood	41	28.2
	Disposing medical waste	31	21.4
	Operation	21	14.5
Injured part	Hand	119	96.8
	Face	1	0.8
	Other	3	2.4
The source of exposure	HBV	16	13
	HCV	1	0.8
	Syphilis	2	1.6
	None or unknown	104	84.6
Carry out correct emergency treatment	Yes	111	93.3
	No or don't know how	8	6.7
Report	Yes	42	35.3
	No or don't know how	77	64.7
Reexamination of hematogenous disease	Yes	27	22.7
	No	92	77.3

NSSIs: needle stick and sharp injuries; HBV: hepatitis B virus; HCV: hepatitis C virus

process of causing sharp injuries, 35.9% were withdrawing the needle, 28.2% were injection or drawing blood. The main (96.8%) area injured was the hands. There were 19 (15.4%) cases with clear exposure sources of blood-borne infectious diseases. One hundred and eleven (93.3%) participants underwent correct emergency treatment. Only 42 (35.3%) reported to the infection control department, and 27 (22.7%) re-examined hematogenous disease (Table 2).

Factors associated with the occurrence of NSSIs

In bivariable logistic regression analysis, gender, educational level, professional title level, working years, working hours per week, whether to follow the standard prevention, whether to check blood-borne infections and training times were statistically associated with needle stick and sharps injuries with p-value<0.05. The prevalence of sharp injuries among male (31.2%) was higher than the female (19.2%). HCWs with master's degree or higher (24.8%) were often more prone to sharp injuries than those with junior college or below (11.0%). HCWs with senior professional titles (28.6%) had higher proportion of sharp injuries than those with medium titles (16.4%). Compared to those who had worked for >15 years (14.0%), those<5 years (24.3%) were more likely to experience injuries. Compared with those working≤40 h per week (15.4%), those working >40 h (23.7%) were more likely to face NSSIs. HCWs who rarely (37.0%) or occasionally (25.4%) followed the standard prevention often had a higher prevalence of NSSIs than those who always followed (17.4%). Similarly, those who rarely (27.3%) checking blood-borne infections often had higher

prevalence of NSSIs than those always checking(16.2%). HCWs who have received two training (27.5%) often had higher rate of sharp injuries than those received three or more (17.5%).(Table 1).

After bivariable analysis, only those variables with p-value < 0.05, were selected for further multivariate analysis. In the multivariate logistic regression analysis, only sex, working hours per week, and whether to check for blood-borne infections before invasive operations were significantly associated with NSSIs. Male health-care workers were 2.116 times (AOR = 2.116 [1.265, 3.538]) more likely to experience needle stick and sharps injuries than female HCWs. Compared with those working ≤ 40 h per week, those working > 40 h were 1.718 times (AOR = 1.718 [1.056, 2.796]) more likely to face NSSIs. Compared with those always checking blood-borne infections before invasive operations, those rarely checking were 2.219 times (AOR = 2.219 [1.303,3.782]) more likely to face NSSIs. (Table 1).

Discussion

This study aimed to investigate the predictive factors for NSSIs among HCWs in a public hospital in China. Sex, working hours, and rarely checking blood-borne infections were significantly associated with NSSIs. The results indicated that the prevalence of NSSIs was 21.2%, which was almost consistent with the result of a prior study in China (27.5%) [6] but significantly lower than the another in China (60.3%) [20], which included only nursing students with poor protective awareness and skills. This variation was mainly due to the differences between the research groups. The prevalence in this study was also lower than those reported in studies conducted in Yemen (60%) [21], Iran (42.5%) [22] and Ethiopia (40.1%) [19]. Its prevalence in developing countries is higher than that in developed countries such as Switzerland (9.7%) [23] and the United States (9.4%) [24]. Numerous studies have reported a strong correlation between NSSI prevalence and socioeconomic development [25, 26]. The main reasons for this phenomenon may be the less access to safety engineering controls and education, and so on.

Male HCWs were more likely to experience sharps injuries than female HCWs. Similar research findings in Ethiopia implied a significant association between sex and the occurrence of NSSIs among HCWs [27]. A possible explanation might be that males are less likely to use universal precautions and females are better at safety precautions.

Working long hours was also linked to the risk of NSSIs, this finding is consistent with those of earlier studies in sub-Saharan Africa [28]. Excessive working hours can increase fatigue and stress [29], which are likely to affect memory and attention at work, leading to poor compliance with standard prevention measures. Long working hours are also a sign of insufficient manpower, which is a common problem in health-care systems in developing countries.

We also investigated the association between whether to check for blood-borne infections before invasive procedures and the risk of needle stick and sharps injuries, the results showed that health-care workers who rarely checked had a higher risk of developing NSSIs. We speculate that this may be due to individuals who often check for blood-borne infections have a stronger protective awareness and are better able to follow standard preventive measures in their work. Therefore, it is important to raise awareness about protection, which can be achieved through strengthened training and promotion [30, 31].

The sharp instruments that caused sharps injuries were mainly needles, and the operations when injuries occur were mainly in withdrawing the needle, which is similar to another study [32]. The vast majority of injuries, 119 (96.8%), occurred in the hand, undoubtedly because invasive operations are almost always performed manually.

The underreporting rate of sharps injuries was generally high (64.7%). Similar results have been reported in other studies, with rates of 69.7% and 67%, respectively [33, 34]. However, the rate was higher than the 55.5% reported in Italy [35], and the 52.2% reported in Turkey [36]. The reasons for not reporting NSSIs to the infection control department included poor risk assessment ability, lack of knowledge of the reporting process, forgetting to report due to busy work, the blameworthy culture, and worry about abnormal serological test results [37–40]. In addition, the vast majority (77.3%) of HCWs with NSSIs did not undergo follow-up examinations for blood-borne disease. After a sharps injury occurs, the exposed individual should immediately undergo emergency treatment and report it. The relevant departments of the hospital should evaluate and recommend further blocking measures to establish a follow-up mechanism [41, 42]. Research has shown that underreporting of NSSIs must be improved, and it is recommended to increase training in reporting procedures and improve reporting systems [43].

Based on the results of this study, a series of preventive measures should be formulated, such as increasing manpower, using correct engineering controls, avoiding unnecessary injections or wearing latex gloves when injecting, and intensive and repeated training in standard preventive operations.

Some limitations of this study should be considered when interpreting the results. First, recall bias may be a major limitation, especially when recalling the number of injuries and risk factors in the past year. Second, the study sample came from only one hospital, often indicating weak representativeness. In the future, we plan to conduct a multicenter study to validate our results. Third,

because of the cross-sectional design of the study, it was difficult to define a causal relationship between risk factors and NSSIs.

Conclusion

This study revealed that nearly one-fifth (21.2%) of the study participants had encountered NSSIs at least once within 12 months, which shows that this kind of injury should not be ignored. In addition, NSSIs were the most important factor in the infection of blood-borne diseases in the workplace for HCWs, especially in males, with longer work times and weak protective awareness. Therefore, efforts must be made to reduce the prevalence of sharps injuries, by promoting education and training programs to enhance awareness of standard prevention and reduce heavy workloads.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-024-11439-5.

Supplementary Material 1

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Author contributions
XN Li and H Zhao conceived and designed the research. Q He was responsible for data collection and management. XN Li performed the statistical analysis and wrote the paper. All authors read and approved the final manuscript.

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Data availability
The data supporting the conclusion of this study are available from the corresponding author upon request.

Declarations

Ethics approval and consent to participate
All enrolled participants were fully aware of the aim of the study, and informed consent was acquired from each one. This research was approved by the clinical medical research ethics committee of The First Affiliated Hospital of Anhui University of Chinese Medicine (2022AH-19) and conducted in accordance with the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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