International Journal of General Practice Nursing, 2025, Volume 3, No Special
https://ojs.bbwpublisher.com/index.php/IJGPN
ISSN Online: 2981-9423
ISSN Print: 2981-9415

Analysis of the Current Awareness and Influencing Factors of Occupational Exposure to Sharp Instrument Injuries among Nursing Students During Hospital Internships

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Abstract: Through a cross-sectional survey, this study analyzes the current status of occupational exposure to sharp injuries among hospital nursing interns and further investigates its influencing factors. The findings aim to provide data and theoretical evidence for studying the situation and contributing factors of sharp injury exposure among nursing interns in clinical practice, and for reducing the incidence of such exposures. Nursing students from the 21st grade who are currently interning in Shanghai were selected as the survey participants. A comprehensive survey scale on sharp instrument injury experiences was used as the measurement tool for the cross-sectional survey. Quantitative data were described using mean ± standard deviation, while categorical data were described using frequency and percentage. With the total score of the sharp instrument injury experience survey as the dependent variable and general information as the independent variable, influence factor analysis was conducted. Analysis of variance (ANOVA) was used for univariate analysis, and linear regression analysis was used for multivariate analysis. The results of ANOVA showed significant differences ($P < 0.05$) among university academic performance, interning hospital, and the relationship with supervising teachers. Linear regression analysis revealed that university academic performance, interning hospital, and relationship with supervising teachers had significant influences ($P < 0.05$) on the awareness of occupational exposure to sharp instrument injuries. This study reveals that the incidence of occupational exposure to sharp injuries among 2021-grade nursing interns in Shanghai was lower than expected. The overall situation is not satisfactory. The three factors of university academic performance, interning hospital, and relationship with supervising teachers have significant impacts on the occurrence of sharp injury exposures.

Keywords: Nursing interns; Sharp instrument injuries; Occupational exposure

Online publication: December 31, 2025

1. Introduction

When the physical and mental health of individuals becomes a common pursuit in professional work, issues related to the physical and mental safety of nursing staff have also been continuously mentioned. Research on such topics has increased significantly since 2000 and has received widespread attention from the general public, especially after the outbreak of the COVID-19 pandemic in early 2019. On May 12, 2021, the National Health Commission jointly issued the *Guiding Opinions of the National Health Commission, Ministry of Human Resources and Social Security, and Ministry of Finance on Establishing a Long-term Mechanism for Protecting, Caring for, and Loving Medical Personnel*, which proposed "establishing a long-term mechanism for protecting, caring for, and loving medical personnel, effectively safeguarding their rights and interests, and promoting the formation of a good social atmosphere of respecting doctors and valuing health," describing specific provisions for maintaining the physical and mental health of medical personnel.

However, in recent years, new medical technologies and drugs have been continuously introduced into clinical practice, exposing medical personnel to higher risks of occupational exposure. Domestic research results indicate that nursing staff are a high-risk group for occupational exposure in medical institutions [1], and the safety of nursing staff is the cornerstone of patient safety guarantee. The National Health Commission proposed in the *National Nursing Development Plan (2021–2025)* to "effectively prevent and reduce potential hazards that nurses may encounter in the occupational environment, and effectively safeguard and protect their legitimate rights and interests" [2]. China has currently paid attention to and conducted many investigations and studies on occupational injuries of nurses, especially proposing relevant response and prevention measures for sharp instrument injury occupational exposure.

Nursing interns, as an important identity transition process from students to nurses, are also an unavoidable experience in the work history of every practicing nurse. During this stage, nursing interns lack practical operation experience, are not proficient in nursing operations, have insufficient professional knowledge of occupational protection, and experience psychological tension due to newly entering clinical practice, resulting in their lack of ability to cope with occupational exposure to sharp instrument injury and higher vulnerability to such dangerous situations. Educational practices on sharp instrument injury occupational exposure during the internship stage can have a positive impact on the future career of nursing interns. However, current research on sharp instrument injury occupational exposure mainly focuses on nurses, while there are relatively few studies on nursing interns.

Therefore, this study aims to conduct a cross-sectional survey on the status of sharp instrument injury occupational exposure among nursing students of grade 2021 who are currently interning in Shanghai. Through the survey, we will gain an in-depth understanding of the current situation and related influencing factors of sharp instrument injury occupational exposure among nursing interns, provide data support for their clinical occupational protection, in order to better propose response measures, reduce the incidence of sharp instrument injury occupational exposure among nursing interns, and promote their physical and mental health during the internship period.

1.1. Research background

With the continuous advancement of medical technology and nursing skills, the personal physical and mental health issues of medical staff have received more attention after the pandemic. Studies have shown that medical personnel have more high-risk factors for occupational exposure and a higher probability of facing occupational exposure risks [3]. Occupational exposure of medical personnel refers to a type of occupational exposure in which

medical personnel come into contact with toxic or harmful reagents, instruments, or infectious pathogens during diagnosis, treatment, and nursing activities, thereby endangering health or life [4]. Data shows that the incidence of sharp instrument injuries remains high at home and abroad, excluding unreported cases [5]. Medical staff in China face a relatively high risk of occupational exposure [6], among whom nurses are the key group [7]. Sharp instrument injury refers to damage caused by objects with cutting edges or sharp tips. Studies have proven that occupational exposure caused by sharp instrument injuries can lead to the transmission and infection of more than 20 pathogens, such as hepatitis B, hepatitis C, and HIV. The psychological conflicts caused by sharp instrument injuries, such as anxiety, depression, fear, and irritability, will cause psychological pressure on nurses [8,9].

As nursing interns who are newly exposed to clinical work, they face a series of problems, such as a lack of practical experience, unfamiliarity with the hospital environment, unskilled techniques, and immature psychology, resulting in a higher probability of sharp instrument injuries compared to practicing nurses [10]. Therefore, focusing on the handling of sharp instrument injury occupational exposure among nursing interns who are more prone to such injuries can reduce the incidence from the source, promote sufficient awareness and standardized response measures during the internship, and cultivate positive coping styles for related issues. However, current research mainly focuses on sharp instrument injury occupational exposure among on-the-job nurses, while there is a lack of surveys on nursing interns.

Therefore, focusing on investigating and studying the current status and influencing factors of sharp instrument injury occupational exposure among nursing interns is of great significance for further understanding their relevant cognition and handling levels, helping improve the incidence rate, and enhancing their physical and mental status.

1.2. Research objectives

This study takes nursing interns of grade 2021 in Shanghai as the research subjects, and uses questionnaires to understand the current status and influencing factors of sharp instrument injury occupational exposure among them. It provides data support for comprehensively understanding and improving the situation of sharp instrument injury occupational exposure among nursing interns.

1.3. Research significance

This study aims to investigate the current status of sharp instrument injury occupational exposure among nursing interns and analyze its influencing factors through a cross-sectional survey, in order to provide a basis for improving such exposure.

1.4. Overseas and domestic research status

1.4.1. Domestic research status

Nursing interns already have a basic understanding of sharp instrument injuries and their occupational exposure before participating in clinical internships. However, as intern nurses who have just entered clinical practice, they are relatively unfamiliar with the work environment and lack sufficient attention to occupational exposure. For example, washing our hands before contacting patients or performing sterile procedures, wearing rubber gloves when contacting patient body fluids, disinfecting operating supplies with disinfectants, etc., or having a fluke mentality, leading to reduced self-protection awareness [11]. Studies by Huang and others found that nursing interns have a high incidence rate but low reporting rate of sharp instrument injuries [12], which may be related to their

lack of relevant knowledge and concerns about subsequent punishment [13]. Secondly, after entering the clinical setting, nursing interns inevitably experience anxiety and tension in front of patients and clinical instructors due to changes in environment and identity. In addition to learning clinical practical operations and basic knowledge, they also need to face various academic requirements assigned by the school. According to research by Zhang *et al.*, nursing interns have higher levels of stress than other health workers [14]. The role transition from "being served" to "serving others" and the complexity of clinical work pose significant challenges to nursing interns, leading to higher psychological stress [15]. This makes it difficult for them to fully adhere to careful and independent work at all times and perform the "three checks and eight verifications." Errors due to improper operations increase the probability of sharp instrument injuries, and criticism from clinical instructors, patients, or their families further increases their stress, creating a vicious cycle [16]. Studies by Luan, Zhang, etc., have all found that personal factors of nursing interns, such as personality traits and coping styles, have a certain impact on their methods of handling sharp instrument injury occupational exposure [17,18]. According to surveys, nursing interns' education on sharp instrument injury occupational exposure-related knowledge comes from clinical instructors' guidance and textbook content. In addition, communication among interns is also a major source. However, studies have found that hospitals and schools lack relevant education and training [19]. Even when education and training are conducted in hospitals and schools, there is a lack of assessment of interns' acceptance of knowledge content, thus limiting research on sharp instrument injuries among nursing interns.

1.4.2. Overseas research status

Currently, there are also relatively few overseas surveys on sharp instrument injuries among nursing interns, with more focus on occupational exposure among practicing nurses. Studies have shown that nursing interns have a significantly higher incidence of sharp instrument injuries than other medical professional groups, ranking second only to nurses among medical personnel, with a high incidence density [20]. For example, in a study at Jordan University Hospital, interns had the highest incidence density of sharp instrument injuries, followed by nurses and cleaning staff. Lian *et al.* found that the incidence of sharp instrument injuries decreased year by year with increasing age, professional title, and work experience [21]. Dong *et al.* found in their survey that nursing interns are more likely to experience sharp instrument injury occupational exposure when performing high-risk operations, including blood collection (22.6%), intravenous catheterization (11.3%), and needle recapping (11%). In addition, the use of insulin pens is also considered a common factor for sharp instrument injuries among nurses and nursing interns [22]. Data shows that only about 50% of nursing interns or nurses who experience occupational exposure report sharp instrument injury incidents to the hospital, mainly due to unfamiliarity with the reporting process, perception that the incident is not serious, or fear of professional consequences [20]. In a study by Abate *et al.*, different work environments also affect the probability of sharp instrument injury occupational exposure. For example, general surgery departments have high-frequency and high-risk exposure operations, where medical personnel may perform the same operations that could lead to sharp instrument injury exposure up to 3–4 times a week [23]. With the continuous progress of society, the work environment has undergone significant changes, leading to increasing pressure in various professions. According to surveys, medical personnel on the front lines of health maintenance are most vulnerable to the victims of such pressure changes, triggering physical and mental health disorders among nurses, such as emotional distress, decreased work efficiency, reduced quality of care, and even clinical medical accidents. Shah *et al.* believed this is due to high pressure and insufficient staffing in the current nursing work environment [24]. In one survey, researchers conducted an educational intervention on

nursing interns and provided personal immediate feedback. This intervention was widely accepted by students, who considered it more helpful than the initial training they received in nursing institutions and able to prepare them for nursing internship tasks [25]. A study conducted in a US hospital found that sharp instruments requiring manipulation or disassembly after use had a higher accident rate than syringes with disposable needles [26]. Passive safety products, where the protection mechanism is triggered through normal workflow without any action required by the user, activate an automatic protection mechanism at the end of application, such as covering the cannula or pulling it into a protective sheath, providing passive protection to medical personnel when using medical devices.

In summary, there are currently relatively few domestic and foreign surveys and studies on the occurrence of sharp instrument injury occupational exposure among nursing interns, with most research focusing on and analyzing occupational exposure among practicing nurses. However, there are many differences between nursing interns and nurses that cannot be equated. Nursing interns face higher challenges of sharp instrument injury occupational exposure. Therefore, hospitals and schools should attach great importance to the occurrence and causes of sharp instrument injury occupational exposure among nursing interns, maintain their physical and mental health, and provide them with basic awareness of occupational protection for their subsequent clinical internship work.

2. Research design and methods

2.1. Research design

This study took nursing interns of grade 2021 in Shanghai as the survey subjects. General information of the respondents was collected through a general information questionnaire; the status of sharp instrument injury occupational exposure among nursing interns of grade 2021 in Shanghai was collected through a comprehensive questionnaire on sharp instrument injury occupational exposure. SPSS 27.0 was used for data analysis, and statistical methods included descriptive analysis, analysis of variance, and multiple linear regression analysis.

2.1.1. Inclusion and exclusion criteria

Inclusion criteria: (1) Full-time nursing major students; (2) In the pre-graduation internship stage.

Exclusion criteria: (1) Nursing interns unwilling to cooperate in this survey; (2) Postgraduate students in the clinical internship stage.

2.1.2. Calculation of sample size

According to Kendall's sample size estimation method [27], sample size = number of variables × 5–10 times. Considering the inefficiency of the sample, the sample size was increased by 10–20%. This study used 10 independent variables. Substituting into the formula: n = 10×(5-10)×(1.1-1.2)=55-120. A total of 120 questionnaires were expected to be distributed in this study.

2.2. Research tools

2.2.1. General information survey form

The general information questionnaire was self-designed based on the research purpose and literature review, covering 10 items: gender, academic performance at university, internship hospital, busyness level of the current department, frequency of night shifts, degree of liking for the nursing major, current perceived stress level, relationship with clinical instructors, current commute time, and daily sleep duration.

2.2.2. Comprehensive survey scale for sharps injury experience

The main contents include: frequency of sharp instrument injuries, contamination status, wound treatment after sharp instrument injuries, reporting status, understanding of bloodborne pathogen exposure sources, vaccination and preventive treatment, whether the respondent has participated in sharp instrument injury protection training, whether they frequently come into contact with sharp instruments during internship, whether they need to speed up work completion, whether they remind themselves to avoid sharp instrument injuries, relationship with clinical instructors, whether they have learned relevant knowledge on preventing sharp instrument injuries, and understanding of the hazards of sharp instrument injuries, etc.

This questionnaire is a structured questionnaire [28], consisting of four dimensions: causes of sharp instrument injuries, post-injury treatment, work environment, and personal cognition of nursing interns. The split-half reliability coefficient of the questionnaire is 0.786, and the α coefficients of the four dimensions are 0.823, 0.807, 0.651, and 0.735, respectively. The correlation coefficients between the scores of each item and the total score of its corresponding dimension range from 0.501 to 0.816, and the correlation coefficients with the total score range from 0.306 to 0.683. The cumulative variance contribution of the four common factors is 60.18%, and the communality of 61.33% of the items after extracting common factors exceeds 0.50, indicating good reliability and validity of the questionnaire.

2.3. Data collection

This study mainly used convenience sampling to select undergraduate nursing interns who are currently interning and meet the inclusion and exclusion criteria for investigation. Based on the principles of ethics and confidentiality, data were collected in the form of questionnaires, and invalid questionnaires were deleted after screening. A total of 121 valid questionnaires were finally collected in this study.

2.4. Statistic

After verification, the collected valid questionnaires were statistically analyzed using SPSS 27.0. Measurement data were described as percentages and mean ± standard deviation (SD), and analyzed using descriptive analysis, analysis of variance, and multiple linear regression.

2.5. Quality control

All respondents were undergraduate and junior college nursing interns; efforts were made to maximize their participation; no interference was made in the process of filling out the questionnaires; after the survey, the questionnaires were re-verified, and invalid ones were eliminated.

2.6. Ethic principles

All respondents were undergraduate and junior college nursing interns; efforts were made to maximize their participation; no interference was made in the process of filling out the questionnaires; after the survey, the questionnaires were re-verified, and invalid ones were eliminated.

3. Results

3.1. Basic information of 2021-grade nursing interns in Shanghai

The questionnaire analyzed the general situation of nursing interns of grade 2021 in Shanghai, covering 10 main

items: gender, academic performance at university, internship hospital, busyness level of the current department, frequency of night shifts, degree of liking for the nursing major, current perceived stress level, relationship with clinical instructors, current commute time, and daily sleep duration. The total sample size was 121, and the specific results are shown in Table 1 below.

Table 1. Basic information table of 2021-grade nursing interns in Shanghai

	Category	Frequency (n = 121)	Frequency ratio (%)
Gender	Male	20	16.5
	Female	101	83.5
Academic performance at university	Poor	3	2.5
	General	61	50.4
	Better	45	37.2
	Good	12	9.9
Internship hospital	Second-level Grade A hospital	10	8.3
	Third-level Grade B hospital	46	38.0
	Third-level Grade A hospital	65	53.7
Frequency of night shifts	> 5 times per month	1	0.8
	3 to 5 times per month	53	43.8
	< 1 times per month	67	55.4
Degree of liking for the nursing major	Dislike	33	27.3
	General	48	39.7
	Love	40	33.0
	Like very much	0	0
Current perceived stress level	Higher	20	16.5
	Normal	86	71.1
	Lower	15	12.4
	Very high	0	0
Busyness level of the current department	Very busy	3	2.5
	Busier	44	36.4
	General	53	43.8
	Not busy	21	17.3
Relationship with clinical instructors	Not great	0	0
	General	0	0
	Very good	43	39.1
	Good	78	61.9
Current commute time	>90 minutes	0	0
	60–90 minutes	9	7.4
	30–60 minutes	78	64.5
Daily sleep duration	<30 minutes	34	28.1
	<5 hours	0	0
	5–6 hours	25	20.7
	6–7 hours	71	58.6
	7–8 hours	25	20.7

3.2. The total score of the Comprehensive Questionnaire on Sharp Instrument Injury Occupational Exposure among nursing interns of grade 2021 in Shanghai

The total score of the Comprehensive Questionnaire on Sharp Instrument Injury Occupational Exposure was 126.00 ± 25.88. The average item scores of the four dimensions were as follows: Causes of Sharp Instrument Injury Dimension (20.23 ± 0.57), Post-Injury Treatment Dimension (64.92 ± 5.76), Work Environment Dimension (18.90 ± 0.43), and Personal Situation of Nursing Interns Dimension (19.52 ± 4.62).

3.3. Comparison of sharp instrument injury occupational exposure among nursing interns of grade 2021 in Shanghai with different characteristics

The questionnaire analyzed the sharp instrument injury occupational exposure of nursing interns. As shown in Table 2 below, one-way analysis of variance (ANOVA) revealed significant differences in the total score of the Comprehensive Questionnaire on Sharp Instrument Injury Occupational Exposure among nursing interns with different academic performance at university, internship hospitals, and relationships with clinical instructors ($P \leq 0.05$). No significant differences were found in the total score based on gender, frequency of night shifts, degree of liking for the nursing major, busyness level of the current department, current perceived stress level, current commute time, or daily sleep duration ($P > 0.05$).

Table 2. Comparison of occupational exposure to sharp instrument injuries among grade 2021 student nurses in Shanghai by different characteristics

Variable	Grouping	*n*	Acute Instrumentation Occupational Exposure Scale score	*t/F*	*P*
Gender	Male	20	126.85 ± 25.88	0.760	0.827
	Female	101	125.83 ± 26.01		
Academic performance at university	Poor	3	150.33 ± 3.79	4.213	0.001*
	General	61	131.26 ± 26.4		
	Better	45	121.47 ± 25.42		
	Good	12	110.17 ± 15.71		
Internship hospital	Second-level Grade A hospital	10	112.23 ± 24.33	2.094	0.014*
	Third-level Grade B hospital	46	135.63 ± 24.72		
	Third-level Grade A hospital	65	143.7 ± 21.41		
Frequency of night shifts	> 5 times per month	1	113 ± 0	1.594	0.439
	3 to 5 times per month	53	116.85 ± 23.3		
Degree of liking for the nursing major	< 1 times per month	67	133.43 ± 25.78	1.783	0.510
	Dislike	33	135.82 ± 24.3		
	General	48	127.69 ± 26.45		
	Love	40	115.88 ± 23.31		
	Like very much	0	0		
Current perceived stress level	Higher	35	114.95 ± 25.99	1.223	0.063
	Normal	86	124.3 ± 25.21		
	Very high	0	0		
	Lower	0	0		

Table 2 (Continued)

Variable	Grouping	n	Acute Instrumentation Occupational Exposure Scale score	*t/F*	*P*
Busyness level of the current department	very busy	3	100.67 ± 12.58	2.727	0.053
	busier	44	113.09 ± 21.05	3.415	0.002*
Relationship with clinical instructors	General	53	145.14 ± 18.79		
	Not busy	21	107.12 ± 14.85		
	Very good	43	117.32 ± 24.04		
	Good	78	133.73 ± 25.16		
	General	0	0		
	Not great	0	0		
Current commute time	60–90 minutes	34	120.01 ± 24.4	2.766	0.097
	30–60 minutes	78	123.37 ± 21.9		
	<30 minutes	9	104.44 ± 20.47		
	>90 minutes	0	0		
Daily sleep duration	6–7 hours	71	109.48 ± 21.49	2.803	0.584
	7–8 hours	25	124.76 ± 25.39		
	5–6 hours	25	146.04 ± 17.32		
	<5 hours	0	0		

*$P < 0.05$

3.4. Multiple regression analysis of influencing factors on sharp instrument injury occupational exposure among nursing interns of grade 2021 in Shanghai

The total score of the Comprehensive Scale for Sharp Instrument Injury Occupational Exposure was taken as the dependent variable, and general information was included as an independent variable in the regression analysis. The partial assignment of each variable is shown in Tables 3 and 4 below.

Table 3 below presents the multiple linear regression analysis with the total score of the Comprehensive Scale for Sharp Instrument Injury Occupational Exposure as the dependent variable and general information as independent variables. The results show that academic performance at university significantly positively predicted the total score of the Comprehensive Questionnaire on Sharp Instrument Injury Occupational Exposure among nursing interns ($\beta = 9.828$, $P = 0.002$), meaning that better academic performance at university was associated with better protection against sharp instrument injury occupational exposure; internship hospital significantly positively predicted the total score ($\beta = 5.006$, $P = 0.009$), indicating that higher-level internship hospitals were associated with better protection; and relationship with clinical instructors significantly positively predicted the total score ($\beta = 6.778$, $P = 0.005$), suggesting that better relationships with clinical instructors were associated with better protection against sharp instrument injury occupational exposure.

Table 3. Independent variable assignment

Variable properties	Variable name	Symbol	Variable assignment description
Independent variable	Gender	X1	1=male, 2=female
	Academic performance at university	X2	1=Poor, 2=General, 3=Better, 4=good
	Internship hospital	X3	1=Second-level Grade A hospital, 2=Third-level Grade B hospital, 3=Third-level Grade A hospital
	Frequency of night shifts	X4	1=very busy, 2=busier, 3=General, 4=Not busy
	Degree of liking for the nursing major	X5	1=> 5 times per month, 2=3 to 5 times per month, 3=< 1 times per month
	Current perceived stress level	X6	1=Dislike, 2=General, 3=Love, 4=Like very much
	Busyness level of the current department	X7	1=Very high, 2=Higher, 3=Normal, 4=Lower
	Relationship with clinical instructors	X8	1=Not great, 2=Average, 3=Good, 4=Very good
	Current commute time	X9	1=>90 minute, 2=60–90 minutes, 3=30–60 minutes, 4=<30 minute
	Daily sleep duration	X10	1=<5 hours, 2=5–6 hours, 3=6–7 hours, 4=7–8 hours
Dependent variable	Total score of the Sharp Instrument Occupational Exposure Comprehensive Survey Form	Y	Actual score

Table 4. Multivariate linear regression analysis

	Unstandardized coefficient		Standardization coefficient	*t*	*P*
	B	Standard error	Beta		
(Constant)	13.229	30.470		0.434	0.665
Gender	-0.287	5.496	-0.004	-0.052	0.958
Academic performance at university	9.828	3.404	-0.034	-0.360	0.002*
Internship hospital	5.006	4.403	0.095	1.869	0.009*
Frequency of night shifts	3.592	4.790	0.072	0.750	0.455
Degree of liking for the nursing major	-4.338	3.335	-0.130	-1.301	0.196
Current perceived stress level	5.610	4.532	0.117	1.238	0.218
Busyness level of the current department	6.052	4.001	0.179	1.513	0.167
Relationship with clinical instructors	6.778	4.261	0.228	0.764	0.005*
Current commute time	7.513	5.434	0.163	1.383	0.170

*$P < 0.05$

4. Discussion

4.1. Analysis of general information of nursing interns

The results showed that among the surveyed nursing interns of grade 2021 in Shanghai, female interns accounted for 83.5% and male interns accounted for 16.5%, showing a significant gender ratio difference. Most nursing

interns had good or average academic performance at university, accounting for 87.6% of the total. Notably, over 50% of nursing interns interned in Grade A tertiary hospitals, and most of the remaining chose Grade B tertiary hospitals. In addition, all nursing interns worked night shifts less than five times a month, but most expressed dislike or an average attitude towards the nursing major, with only 40% clearly stating they liked it. The survey found that most nursing interns reported adapting to the current perceived stress. Although 44% of the total reported that their current departments were busy, 53% stated that their departments were moderately busy. Fortunately, all nursing interns had good relationships with their clinical instructors. Furthermore, the survey found that most nursing interns had a commute time of 30 minutes to one hour, with a corresponding daily sleep duration of six to seven hours. The internship stage is a necessary path for nursing interns to integrate theory with practice in clinical settings, apply and familiarize themselves with learned knowledge through operations, and is also an important stage for learning basic nursing operations and education. Sharp instrument injury occupational exposure, as a long-discussed topic, continues to affect nurses' physical and mental health. Moreover, with the current improvement in medical standards and technical operations, nursing work has become increasingly complex, undoubtedly placing higher requirements on future practicing nurses. Developing a good knowledge reserve on sharp instrument injury occupational exposure during internship can better lay a solid foundation for clinical work.

4.2. Analysis of the current situation of occupational exposure to sharp instrument injuries among nursing interns

In this study, the total score of the Comprehensive Questionnaire on Sharp Instrument Injury Occupational Exposure was 126.00 ± 25.88, and the scores of the four dimensions were as follows: Causes of Sharp Instrument Injury Dimension (20.23 ± 0.57), Post-Injury Treatment Dimension (64.92 ± 5.76), Work Environment Dimension (18.90 ± 0.43), and Personal Situation of Nursing Interns Dimension (19.52 ± 4.62). Analysis of the overall scores showed that 56 interns had a low level of sharp instrument injury occupational exposure, accounting for 47% of the total. Among the remaining interns, many had no sharp instrument injury occupational exposure. The score of the fourth dimension, Personal Cognition of Nursing Interns, was relatively low (19.52 ± 4.62), indicating that the current cognition of nursing interns regarding sharp instrument injury occupational exposure is lower than expected. Analysis of each dimension revealed that the Post-Injury Treatment Dimension had the highest score difference, followed by the Personal Cognition Dimension, and finally the Causes of Injury and Work Environment Dimensions. This suggests that post-injury treatment-related operations most significantly affect the sharp instrument injury occupational exposure of nursing interns, which is consistent with the view of Chinese scholars such as Xu *et al.* that clinical professional training on standard precautions and nursing operation norms is important [29].

4.3. Influencing factors of occupational exposure to sharp instrument injuries among 21-grade nursing interns in Shanghai

4.3.1. The impact of university academic performance on the current status of occupational exposure to sharp instrument injuries

The survey results showed that the better the academic performance of nursing interns at the university, the better their protection against sharp instrument injury occupational exposure. Academic performance at university reflects, to a certain extent, the degree to which nursing interns understand and absorb basic knowledge, including educational courses on sharp instrument injury occupational exposure, which in turn affects their clinical response

to sharp instrument injuries or occupational exposure incidents, i.e., the impact of theoretical foundations on clinical practice. According to the survey, 73.91% of nursing interns had systematically learned knowledge related to sharp instrument injuries at school [30]. Given that the university platform has provided sufficient learning opportunities, it is necessary for students to exert their subjective initiative, actively record what they have learned, and lay a foundation for clinical work. Secondly, universities should consider increasing the frequency of relevant courses and improving teaching methods. Multiple studies have shown that educational programs can reduce the number of sharp instrument injuries [31]. At the same time, more diverse educational methods can be used, such as video course learning and case practice. By inviting nurses with rich clinical experience to share knowledge about occupational protection in daily work and answer relevant questions from nursing interns, communication between both parties can help nursing interns gain a deeper understanding of occupational protection [32].

4.3.2. The impact of internship hospitals on the current status of occupational exposure to sharp instrument injuries

Survey and analysis showed that the higher the level of the internship hospital, the better the protection against sharp instrument injury occupational exposure, which is consistent with the research conclusion of Li *et al.* [33]. Hospitals' education and training on sharp instrument injury occupational exposure are the second place where nursing interns can obtain comprehensive learning opportunities outside the university. In many literatures, we can find that the incidence of sharp instrument injuries in tertiary hospitals is lower than that in primary hospitals [34]. This may be related to tertiary hospitals having more improved handling systems, higher requirements for standardized operations, and sufficient training on sharp instrument injury protection. In a clinical study of a needlestick injury protection program, after video learning of standardized operations and head nurses' verification and rectification of improper operations, the incidence of sharp instrument injuries decreased by 38.5% [35]. Therefore, standardized operation of various sharp instruments can largely avoid the occurrence of sharp instrument injuries. Thus, we can conclude that hospitals not only need to strengthen education and training on sharp instrument injury occupational exposure for nursing interns, focus on practicing and exercising vulnerable links and post-injury treatment measures, but also conduct periodic assessments to emphasize the importance of consolidating these skills during the nursing internship stage. In addition, another study reached the opposite conclusion [36]. This may be because some tertiary hospitals have heavier workloads and more complex medical work than primary hospitals, leading to a higher incidence of sharp instrument injuries. It may also be because primary hospitals have incomplete functions and fewer medical resources than tertiary hospitals, resulting in more underreporting events and lower statistical incidence. Therefore, hospitals should reasonably arrange the workload and scope of work for nursing interns, avoiding assigning workloads and pressures beyond their capabilities. Foreign studies have also shown that high workload is associated with an increase in the frequency of nurses' occupational injuries [37]. At the same time, hospitals should attach importance to the improvement of medical instruments and create a good working environment. In China, many medical staff have stated that the use of safety indwelling needles has a lower probability of causing sharp instrument injuries compared with traditional indwelling needles [38].

4.3.3. The impact of the relationship with clinical mentors on the current status of occupational exposure to sharp instrument injuries

Studies have shown that better relationships with clinical instructors are associated with better protection against sharp instrument injury occupational exposure, which is similar to the views of Yang *et al.* [39]. As one of the most frequently contacted groups by nursing interns during this stage, clinical instructors also have the responsibility

to teach them. Education on sharp instrument injury occupational exposure by clinical instructors is based on clinical practice, which is naturally suitable for guiding nursing interns to practically apply the learned knowledge on prevention and post-injury treatment, and summarize experiences and lessons into their own knowledge in practice. Therefore, clinical instructors should pay attention to occupational protection education for nursing interns in daily work, and use the method of combining theory with practice to improve their understanding and application of sharp instrument injury occupational exposure. Secondly, after entering clinical practice, nursing interns will face a new environment and inevitably experience anxiety and tension in front of patients and clinical instructors. In addition to learning clinical practical operations and basic knowledge, nursing interns also have to face various academic requirements assigned by the university, leading to academic burnout and high psychological pressure. Therefore, clinical instructors need to pay timely attention to the psychological state of nursing interns and implement personalized education to enhance their confidence and subjective initiative in tasks such as operations.

Disclosure statement

The authors declare no conflict of interest.

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