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## ORIGINAL RESEARCH

# RISK FACTORS OF NEEDLESTICK AND SHARP INJURIES AMONG HEALTH CARE WORKERS AT SANGLAH TERTIARY HOSPITAL

*Faktor Risiko Cedera Tertusuk Jarum pada Tenaga Kesehatan di Rumah Sakit Rujukan Tersier Sanglah*

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### ABSTRACT

**Background:** Needlestick and sharp injuries (NSIs) remain one of the main occupational hazards among health care workers (HCWs) that lead to blood-borne pathogen exposure. **Purpose:** This study examined the risk factors for NSIs among HCWs at a tertiary referral hospital in Bali. **Methods:** A case-control study was conducted at Sanglah General Hospital, Bali, involving 171 HCWs, divided into 81 cases and 90 control subjects. The sample was selected using a simple random sampling technique. Data were collected using questionnaires and analyzed using multiple logistic regression. **Results:** The majority of respondents had experienced NSIs once, in the morning shift, and had affected an individual's hands. The most frequent activity leading to NSIs was giving an injection and most of the situations causing NSIs involved accidental self-action, and recapping needles. Factors associated with the incidence of NSIs were work career or experience of <5 years ( $p < 0.01$ ; adjusted odds ratio [AOR]=5.04; 95% confidence interval [CI] = 2.04–12.42), non-compliance with working procedures ( $p = 0.01$ ; AOR = 2.47; 95%CI= 1.26–4.82), female HCWs ( $p = 0.03$ ; AOR = 2.21; 95% CI = 1.01–4.55), and unsafe workplace conditions ( $p = 0.04$ ; AOR = 2.23; 95% CI = 1.01–4.92). **Conclusion:** Personal and environmental factors such as gender, work experience, compliance with working procedures, and workplace conditions are among the risk factors for NSIs. Occupational health and safety policies and programs focusing on the relevant factors, accompanied by adequate supervision, are necessary to reduce the risk of NSIs occurring.

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## ABSTRAK

**Latar Belakang:** Cedera akibat tertusuk jarum dan benda tajam (CTJ/NSIs) merupakan salah satu bahaya potensial utama pada tenaga kesehatan yang mengakibatkan pajanan terhadap patogen yang ditularkan melalui darah. **Tujuan:** Penelitian ini bertujuan untuk mencari dan membuktikan faktor-faktor risiko CTJ pada tenaga kesehatan di sebuah rumah sakit rujukan tersier di Bali. **Metode:** Penelitian dengan rancangan kasus-kontrol dilakukan di RSUP Sanglah Denpasar, melibatkan 171 tenaga kesehatan, yang terdiri dari 81 kasus dan 90 kontrol. Sampel dipilih menggunakan teknik acak sederhana. Pengumpulan data dilakukan dengan kuesioner, dan data dianalisis dengan regresi logistik berganda. **Hasil:** Mayoritas responden pernah mengalami CTJ dengan frekuensi sekali, terjadi selama shift pagi, dan mengenai tangan. Kegiatan yang mengarah ke CTJ dalam sebagian besar kasus adalah memberikan suntikan, dan situasi yang menyebabkan CTJ adalah kecelakaan sendiri dan saat menutup jarum. Faktor yang berhubungan secara bermakna dengan kejadian CTJ adalah masa kerja <5 tahun ( $p < 0,01$ ; AOR=5,04; 95% CI=2,04-12,42), ketidakpatuhan terhadap prosedur ( $p = 0,01$ ; AOR=2,47; 95% CI=1,26-4,82), jenis kelamin perempuan ( $p = 0,03$ ; AOR=2,21; 95% CI=1,01-4,55), dan kondisi tempat kerja yang kurang aman ( $p = 0,04$ ; AOR=2,23; 95% CI=1,01-4,92). **Kesimpulan:** Faktor individu dan lingkungan seperti jenis kelamin, pengalaman kerja, kepatuhan terhadap prosedur kerja, dan kondisi tempat kerja adalah faktor-faktor risiko untuk terjadinya CTJ. Kebijakan dan program keselamatan dan kesehatan kerja yang berfokus pada faktor-faktor tersebut, disertai dengan pengawasan yang memadai, diperlukan untuk mengurangi tingkat risiko mengalami CTJ.

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## INTRODUCTION

Needlestick and sharp injuries (NSIs) are common occupational health problems among health personnel, and their potential impacts include increased risks of contracting blood-borne infections such as hepatitis B, hepatitis C, and HIV/AIDS (Qazi et al., 2016). The prevalence or incidence of NSIs among health care workers (HCWs) has been reported to vary widely across different countries. A study conducted in Malaysia reported a total of 1,234 NSI cases in 2016, representing an overall incidence rate of 6 cases per 1,000 HCWs (Ishak, Haque, & Sadhra, 2018), while a meta-analysis assessing the prevalence of NSIs among HCWs in Iranian hospitals indicated a prevalence of 42.58% (95% CI = 36.91–48.26) (Gheshlagh, Aslani, Shabani, Dalvand, & Parizad, 2018). In 2017, Soleman & Nugroho (2017) reported that, among 133 health care workers in

the Sleman, Yogyakarta, the prevalence of NSIs was 70.67%.

The results from published research have indicated various risk factors of NSIs, including the availability of personal protective equipment, inadequate supplies of needle equipment, inadequate information on the risk of NSIs, non-compliance with standard procedures, and inappropriate disposal of sharp objects (Gabr, El-Badry, & Younis, 2018; Matsubara, Sakisaka, Sychareun, Phensavanh, & Ali, 2017). Using unsafe containers for medical waste, inadequate work experience, poor working environments, insufficient health workforce numbers, and unsafe behaviors by workers have also been identified as risk factors for NSIs (Reddy, Lavoie, Verbeek, & Pahwa, 2017; Zhang et al., 2018). Additionally, safety motivation, fatigue, sleep disturbances, job satisfaction, and job stresses have been reported to be predictors of the occurrence of NSIs (Akbari,

Ghasemi, Akbari, & Adibzadeh, 2018; Fathi, Barati, Zandiyeh, & Bashirian, 2017).

Tertiary referral hospitals in developing countries are generally busy teaching hospitals combining crowded medical services and education programs for junior doctors and nurses. This current study aims to determine the risk factors of NSIs among HCWs at Sanglah General Hospital, which is the only tertiary referral hospital in Bali, Indonesia. The findings will fill a research gap regarding the determinants of NSIs in tertiary and teaching hospitals, especially in Indonesian settings.

## METHODS

This study was conducted in August to September 2017 and employed a case-control design. The reference population consisted of HCWs who worked in the service units at Sanglah General Hospital, comprising a total population of 2,781 people. The sample size required per group at the two-sided 5% significance level for an odds ratio (OR) of 2.5 and 80% power was 80 samples. This study involved 171 HCWs, consisting of 81 cases and 90 controls, who were selected using a simple random sampling technique, with the list of NSI cases and the list of current employees as the sampling frame. The inclusion criterion for the cases was HCWs who were reported as receiving NSIs between 2015 and 2016, which amounted to 148 people. The inclusion criteria for the control group were HCWs who had never been reported as having NSIs and who were actively working during the study period. Frequency matching was performed to match cases with controls by age and type of occupation. The types of occupation were as follows: doctor, junior doctor, nurse or midwife, radiology staff, laboratory staff, cleaning staff, and nursing student.

The variables of interest were classified as personal factors, environmental factors, and management factors. Personal factors included gender, employment status (permanent or non-permanent staff), education level, work history (more or less than 5 years, level of knowledge on occupational health and safety [OHS] [ $\geq 80\%$  correct answers defined as good]), compliance with procedures (scores of  $\geq 80\%$  defined as compliance), and workload (scores equal to or above the median value defined as heavy workload). The environmental factors were concerned with workplace conditions (scores equal to or above the median value defined as safe). Management factors included OHS policy and

OHS training (scores equal to or above the median value defined as adequate). Data collection was carried out through individual direct interviews using questionnaires.

A multivariate analysis was performed using multiple logistic regression to determine the adjusted odds ratio (AOR) with 95% confidence interval (CI). Prior to data collection, informed consent was obtained from each study participant. This study has been approved by the Ethics Committee of Faculty of Medicine, Udayana University, and Sanglah General Hospital, Bali (No. 1858/UN.14.2/KEP/2017).

## RESULTS

Table 1 shows the comparability of cases and controls based on matching variables, including age and type of occupation as well as other characteristics such as residence, marital status, and work unit. The median (interquartile range [IQR]) age for the case group was 24 (8) years, and that for the control group was 30 (12) years. The median age of the controls was slightly higher than that of the cases, but this difference was not statistically significant ( $p = 0.16$ ). In addition, there was no significant difference in the distribution of occupation types between cases and controls ( $p = 0.64$ ), indicating that the matching variables (age and type of occupation) were comparable between the two groups.

Table 2 presents descriptions of the NSIs occurring among the cases. Of the 81 cases, 44 individuals (54.32%) had suffered NSIs in the past two years, 41 (50.62%) had suffered NSIs in the past year, and none of them had suffered NSIs in the past six months. Most of the cases (88.89%) had experienced NSIs once, most of the NSIs (64.20%) occurred during the morning shift, and most of the NSIs (97.52%) affected hands. The activity leading to NSIs in the highest number of cases (34.57%) was giving an injection, and most of the situations or conditions causing NSIs involved accidental self-action (55.55%) and recapping needles (29.62%).

Table 3 shows the results of the bivariate analysis to determine the relationship between the independent and dependent variables. The factors shown to have a significant relationship with the incidence of NSIs were working experience of under five years ( $p < 0.01$ ), non-compliance with standard procedures ( $p = 0.01$ ), and unsafe working conditions ( $p = 0.01$ ). Management factors (OHS policies and OHS training) did not

show a statistically significant relationship with NSIs.

**Table 1**  
Comparability of Cases and Controls

Characteristics	Case		Control		<i>p</i> value
	n	%	n	%	
<b>Age (years)</b>					
Median [IQR]	24	[8]	30	[12]	
≥ 25 years	35	43.21	60	66.67	0.16
< 25 years	46	56.79	30	33.33	
<b>Residence</b>					
Denpasar	51	62.96	51	56.67	0.40
Non-Denpasar	30	37.04	39	43.33	
<b>Marital status</b>					
Married	38	46.91	38	42.22	0.54
Single	43	53.09	52	57.78	
<b>Occupation</b>					
Doctor	15	18.52	17	18.90	0.64
Junior doctor	13	16.05	14	15.56	
Nurse/Midwife	19	23.46	21	23.33	
Radiology staff	1	1.24	2	2.22	
Laboratory staff	4	4.93	4	4.44	
Cleaning staff	3	3.71	3	3.33	
Nursing student	26	32.09	29	32.22	
<b>Work unit</b>					
Emergency unit	25	30.86	27	30.00	0.99
Outpatient unit	7	8.64	3	3.33	
Ward	36	44.44	40	44.44	
Operating room	10	12.35	0	0.00	
Hemodialysis	2	2.47	8	8.90	
Laboratory	1	1.24	4	4.44	
Radiology	0	0.00	2	2.22	
Forensic	0	0.00	6	6.67	
<b>Total</b>	<b>81</b>	<b>100.00</b>	<b>90</b>	<b>100.00</b>	

IQR: inter-quartile range

In the next step, all variables with a *p*-value of <0.25—gender, work history, compliance with procedures, workplace conditions, and OHS policy—were incorporated into a multivariate analysis using the Enter method. The results obtained are shown in Table 4. Variables that independently significantly increased the risk of NSIs were working history of <5 years (AOR = 5.04; 95% CI = 2.04–12.42; *p* = <0.01), non-compliance with procedures (AOR = 2.47; 95% CI = 1.26–4.82; *p* = 0.01), female HCWs (AOR = 2.21; 95% CI = 1.07–4.55; *p* = 0.03), and unsafe workplace conditions (AOR = 2.23; 95% CI = 1.01–4.92; *p* = 0.04).

**Table 2**  
Frequency Distribution of NSIs among the Cases

Variable	n	%
<b>NSIs in the past 2 years</b>		
Yes	44	54.32
No	37	45.68
<b>NSIs in the past 1 year</b>		
Yes	41	50.62
No	40	49.38
<b>NSIs in the past 6 months</b>		
Yes	0	0.00
No	81	100.00
<b>Frequency of NSIs</b>		
Once	72	88.89
Twice	8	9.87
Thrice	1	1.24
<b>Time of occurrence</b>		
Morning shift	52	64.20
Afternoon shift	13	16.05
Night shift	16	19.75
<b>Affected body parts</b>		
Face	1	1.24
Hand	79	97.52
Foot	1	1.24
<b>Device type</b>		
Syringe needle	30	37.04
Insulin needle	18	22.22
Blood sugar stick	9	11.11
Surgical needle	11	13.58
Intravenous catheter	1	1.24
Wing needle	5	6.17
Scalpel	1	1.24
Others	6	7.40
<b>Activity leading to NSIs</b>		
Injection	28	34.57
Taking laboratory specimen	11	13.58
Intravenous catheter insertion	1	1.24
Suturing wound	8	9.87
Treating injury	3	3.71
Tiding up tools	18	22.22
Waste handling	7	8.64
Others	5	6.17
<b>Situation causing NSIs</b>		
Recapping needles	24	29.62
Restless patients	6	7.40
Accidentally pierced him/herself	45	55.55
Accidentally punctured by others	3	3.71
Crushed needles or sharp objects	1	1.24
Crowded situation/ many patients	1	1.24
Others	1	1.24
<b>Total</b>	<b>80</b>	<b>100.00</b>

**Table 3**  
The Relationships of Personal, Environmental, and Management Factors with NSIs

Variable	Case		Control		OR	95% CI	P value
	n	%	n	(%)			
<b>Gender</b>							
Male	21	25.93	35	38.89	Reff		
Female	60	74.07	55	61.11	1.82	0.95-3.49	0.07
<b>Employment status</b>							
Permanent staff	26	32.09	33	36.67	Reff		
Non-permanent staff	55	67.91	57	63.33	1.23	0.65-2.31	0.53
<b>Education level</b>							
College	78	96.30	85	94.44	Reff		
High school	3	3.70	5	5.56	0.65	0.15-2.83	0.57
<b>Working history (years)</b>							
≥5	8	9.88	29	32.22	Reff		
<5	73	90.12	61	67.78	4.34	1.85-10.18	<0.01
<b>Level of OHS knowledge</b>							
Good	21	25.93	29	32.22	Reff		
Poor	60	74.07	61	67.78	1.36	0.69-2.64	0.37
<b>Compliance with procedures</b>							
Yes	35	43.21	56	62.22	Reff		
No	46	56.79	34	37.78	2.17	1.17-3.99	0.01
<b>Workload</b>							
Light	49	60.49	46	51.11	Reff		
Heavy	32	39.51	44	48.89	0.70	0.37-1.32	0.27
<b>Workplace conditions</b>							
Safe	17	20.99	32	35.56	Reff		
Unsafe	64	79.01	58	64.44	2.08	1.05-4.13	0.04
<b>OHS policy</b>							
Adequate	33	40.74	42	46.67	Reff		
Poor	48	59.26	48	53.33	1.53	0.76-3.09	0.24
<b>OHS training</b>							
Adequate	20	24.69	33	36.67	Reff		
Poor	61	75.31	57	63.33	1.31	0.64-2.72	0.46
Total	81	100.00	90	100.00			

CI: confidence interval, OHS: occupational health and safety, OR: odds ratio, Reff: reference category

## DISCUSSION

The results indicate that four significant factors associated with the incidence of NSIs are the personal factors of working history, compliance with procedures, and female workers, and the environmental factor of workplace conditions. The length of an individual's working history has a significant relationship with the incidence of NSIs as short working experience influences knowledge and awareness of work hazards as well as working skills (Asilian-Mahabadi, Khosravi, Hassanzadeh-Rangi, Hajizadeh, & Behzadan, 2018). A previous study in Semarang, Indonesia, found that nurses with working experience of five years or more showed a lower prevalence of NSIs compared with those

with work histories shorter than five years (Putranto, Setyaningsih, & Kurniawan, 2019).

The incidence of NSIs has a significant relationship with compliance with standard procedures. In the current study sample, HCWs with NSIs were 2.47 times more likely to be non-compliant than those who had never been reported to get NSIs. The occurrence of NSIs was mainly due to accidental self-actions and recapping needles. This is similar to several previous studies that have also reported that non-compliance with standard procedures is associated with an increased risk of NSIs (Anupriya & Manivelan, 2015). Factors that contribute to low compliance are related to barriers to the use of standard precautions (Powers, Armellino, Dolansky, & Fitzpatrick, 2016).

**Table 4**  
Multivariate Analysis of Factors Associated with NSIs

Variable	Case		Control		AOR	95% CI	P value
	n	%	n	%			
<b>Working history (years)</b>							
≥5	8	9.88	29	32.22	Reff		
<5	73	90.12	61	67.78	5.04	2.04-12.42	<0.01
<b>Compliance with procedures</b>							
Yes	35	43.21	56	62.22	Reff		
No	46	56.79	34	37.78	2.47	1.26-4.82	0.01
<b>Gender</b>							
Male	21	25.93	35	38.89	Reff		
Female	60	74.07	55	61.11	2.21	1.07-4.55	0.03
<b>Workplace conditions</b>							
Safe	17	20.99	32	35.56	Reff		
Unsafe	64	79.01	58	64.44	2.23	1.01-4.92	0.04
<b>OHS policy</b>							
Adequate	33	40.74	42	46.67	Reff		
Poor	48	59.26	48	53.33	1.11	0.49-2.49	0.81
Total	81	100.00	90	100.00			

CI: confidence interval, OHS: occupational health and safety, AOR: adjusted odds ratio, Reff: reference category

Gender also has a significant relationship with the incidence of NSIs, with female HCWs at higher risk of experiencing NSIs than male HCWs. This result is in line with research conducted by Mohohammadnejad & Dopolani (2015), which shows a 3.50 times higher probability of NSIs in women than men. However, Garus-Pakowska & Górajski (2019) findings suggest that there is no association between an HCW's gender and their risk of getting NSIs. The difference between the results of these studies are due to the composition of the research respondents between men and women being different. The imbalance composition also occurred in our study. More research is needed to determine the role of gender in the incidence of NSIs.

Other personal factors that do not show a significant relationship with NSIs are age, education level, type of work, employment status, knowledge level, and workload. In most existing articles, knowledge level has been shown to be a factor associated with the incidence of NSIs (Ibrahim, Mardiah, & Priambodo, 2014; Makayaino, Wahyudiono, & Qomaruddin, 2016). The findings in the current study may be due to the deficient number of HCWs with lower education levels in both groups, which could have influenced the statistical analysis.

Workplace conditions have a significant relationship with the incidence of NSIs. Respondents who had experienced NSIs were 2.23 times more likely to work in an unsafe environment than respondents who had never

reported NSIs. This is similar to Lo, Chiou, Huang, & Chien (2016) findings that a poor work environment increases the risk of NSIs.

Workplace management factors in current study do not have a significant relationship with the incidence of NSIs. A previous study Bekele, Gebremariam, Kaso, & Ahmed (2015) found that the unavailability of guidelines in the workplace was responsible for 46.15% of sample NSI cases; however, the difference was not statistically significant.

Another finding of the current study is that, although there is no statistically significant relationship indicated between OHS training and the incidence of NSIs, 75.31% of the 81 NSI cases had poor OHS training history. Bekele, Gebremariam, Kaso, & Ahmed (2015) also found that trainees who had not received training accounted for 81.54% of their sample NSI cases.

Collaboration is needed between educational institutions and hospitals regarding the implementation of safe clinical practices for medical and nursing students and trainees (Bekele, Gebremariam, Kaso, & Ahmed, 2015). More systematic supervision, monitoring, and evaluation to improve trainees' knowledge, as well as regular dissemination of policies, programs, and standards related to OHS, need to be established.

The findings of this research highlight the importance of focusing on individual factors such as gender, work history/number of years' experience, and compliance with standard procedures in developing OHS policies and

programs at a tertiary referral hospital. This is due to the fact that HCW teams consist of health personnel from different backgrounds (medicine, nursing, and supporting staff) and with varied employment status (permanent and non-permanent staff), which influences HCW turnover in hospitals. In particular, this includes medical and nursing students who need specialized knowledge and skills around NSI prevention and management (Reddy, Lavoie, Verbeek, & Pahwa, 2017; Zhang et al., 2018).

### Research Limitations

This study was conducted only in Sanglah General Hospital, which is the main tertiary referral hospital in the region and has high numbers of medical and nursing trainees. Therefore, any generalization of the results would need to be applied carefully. In addition, recall biases may have occurred as the study data were collected retrospectively.

### CONCLUSION

Personal risk factors that have been found to be associated with the incidence of NSIs are gender, working history/number of years' experience, and compliance with standard procedures. In addition, the environmental factor of workplace condition has been shown to be associated with the occurrence of NSIs. Occupational safety and health policies and programs focusing on those factors, accompanied by adequate supervision of their implementation, are needed to reduce the risk level of NSIs occurring. Regular training sessions on prevention and management of NSIs should be performed, focusing on the implementation of the available standard procedures and targeting those with short work histories, including medical and nursing students.

### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

### AUTHOR CONTRIBUTION

Conceptualization: IKWA, IMAW, and IKS. Data curation: IKWA and IMAW. Formal analysis: IKWA and IKS. Methodology: IKWA and IMAW. Writing – original draft: IKWA and IMAW. Writing – review and editing: IKWA, IMAW, and IKS.

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