



## Association between Needlestick and Sharps Injury with Long Working Hours among Nurses in Thailand

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### Abstract

Needlestick and sharps injury (NSSI) is a significant public health problem. The objective of this study was to describe NSSI among Thai nurses from 2012–2021 and explore the association between long working hours and NSSI. We used data from the Health Data Center of the Ministry of Public Health and the 2012 Thai Nurse Cohort Study. Multiple logistic regression was used to assess the association between long working hours (more than 12 hours/day or more than 40 hours/week) and NSSI. The prevalence of NSSI among nurses increased between 2012 and 2021. Long working hours was significantly associated with NSSI (adjusted odds ratio 1.5, 95% confidence interval 1.3–1.8). Policies to regulate long working hours and excessive work shifts should be implemented.

**Keywords:** needlestick and sharps injury, registered nurses, long working hours, Thai nurses

### Introduction

Occupational hazard is a health condition that occurs from work activities.<sup>1</sup> It leads to health risks, and also causes losses in global gross domestic product of approximately 4–6% annually.<sup>2,3</sup> According to the World Health Organization, nursing and midwifery have the largest volume of health care workers (HCW) worldwide.<sup>4–8</sup> In the past decade, needlestick and sharps injury (NSSI) has been one of the major occupational hazards and the number of nurses affected by NSSI has been increasing.<sup>9–13</sup> Infections resulting from needlestick injuries include hepatitis B and C and HIV.<sup>14,15</sup>

According to previous studies, nurses are at greater risk of NSSI than other types of HCW.<sup>16,17</sup> The Institute of Occupational Safety and Health found that more than 12 hours on duty could affect a worker's performance and alertness and can also affect patient safety.<sup>18–22</sup> Evidence suggested that long working hours

(more than 12 hours/day or more than 40 hours/week) were an important risk factor for accidents.<sup>22</sup> NSSI among HCW in newly industrialized countries mostly occurred in hospital wards, especially medicine wards.<sup>23–25</sup>

In Thailand, there is limited evidence on the prevalence of NSSI and its risk factors. Therefore, the objective of this study was to describe NSSI among Thai nurses and to explore the association between NSSI and long working hours.

### Methods

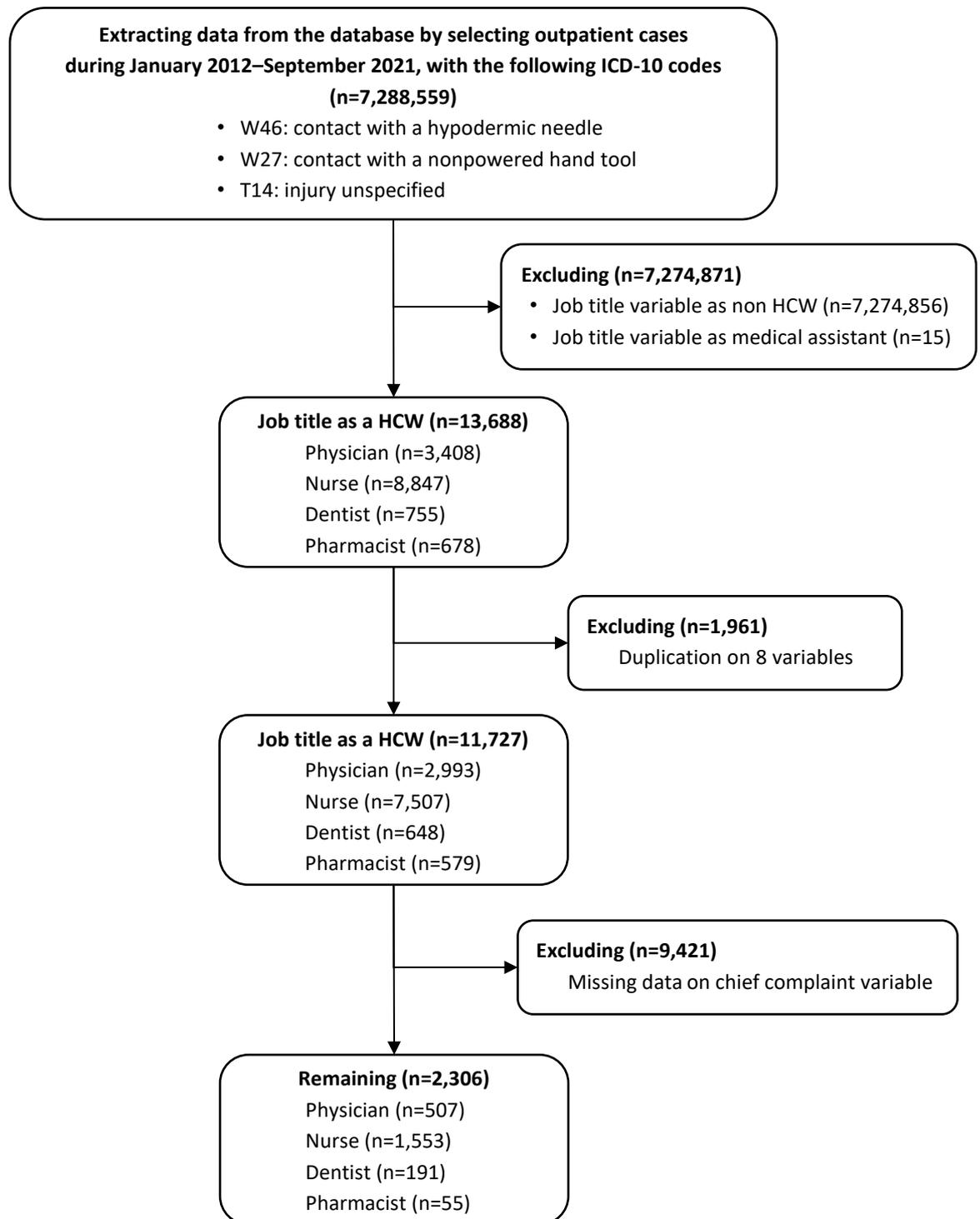
#### Study Design

Data from two data sources were used in this study, namely, the Health Data Center (HDC) database and the 2012 Thai Nurse Cohort Study (TNCS).

The HDC of the Ministry of Public Health contains a large amount of health service data of the Thai population, mostly from public health facilities, with a

small portion of data from private health facilities. We extracted the data from the HDC on 30 Dec 2021, to describe the current situation and trend of NSSI during 2012–2021. A cross-sectional study design was used to describe the types of injuries that occurred. We focused on the following ICD-10 codes: W46 (contact

with a hypodermic needle), W27 (contact with a nonpowered hand tool) and T14 (injury unspecified). Other variables included age, gender, marital status, job title (physician, nurse, dentist, pharmacist), and workplace. Figure 1 shows the data extraction flow and data management process.



**Figure 1. Flow diagram of data extraction from Thailand's Health Data Center database**

The Thai Nurse Cohort Study (TNCS) was initiated by the Thailand Nursing and Midwifery Council in 2012. All health care facilities through government sectors,

private sectors, and administrative sectors were included. Mailed questionnaires were used to collect the data. We extracted the data on 3 Feb 2020.

To assess the strength of association between NSSI and potential risks, we performed an analytic cross-sectional study among nurses participating in the TNCS. We included only Thai registered nurses who responded to the TNCS questionnaire on NSSI as

shown in Figure 2. We focused on the following exposure variables: gender, age, education level, marital status, body mass index (BMI), job position, workplace, department, and work pattern (shift-hours). The outcome variable was the occurrence of NSSI.

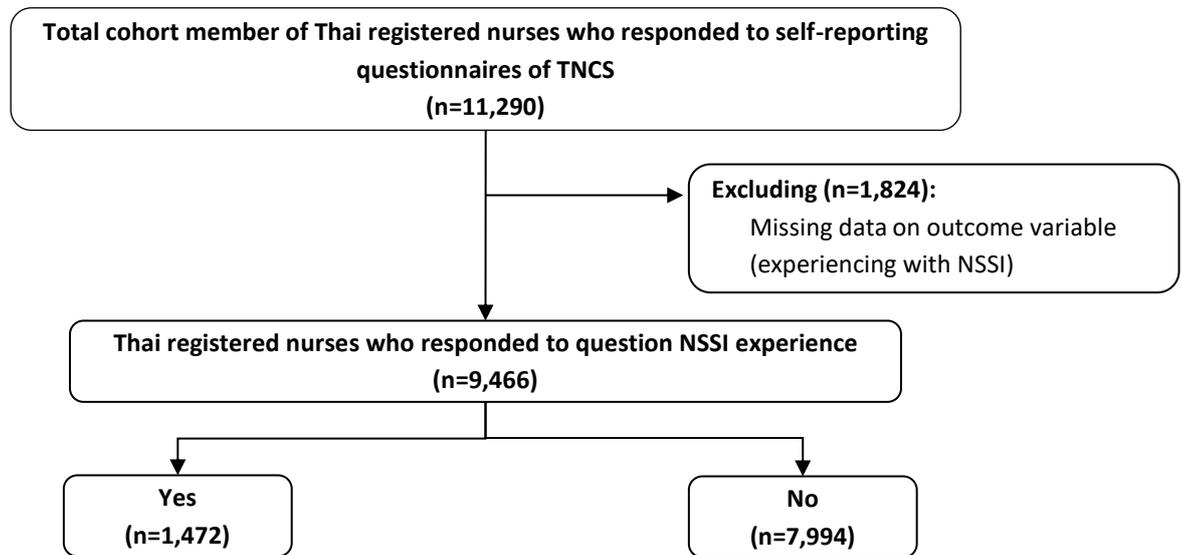


Figure 2. Flow diagram of data extraction from the Thai Nurse Cohort Study database

### Operational Definitions

A health care worker (HCW) is a health professional working in well-founded health facilities. NSSI in this case included both a needlestick injury (medical instrument accidentally puncturing the skin) and a sharps injury (medical instrument accidentally cutting the skin). Thai registered nurses were nurses who received a nursing license from the Thailand Nursing and Midwifery Council. Long working hours was defined as a history of working for more than 12 hours/day or more than 40 hours/week. We classified a workplace department within a health facility as emergency or non-emergency. An emergency department included any sub-units in a hospital that are involved with medical procedures done under emergency conditions, such as operating room, labour room, and intensive care unit. General outpatient and inpatient wards were categorized as non-emergency departments. Shift-work was categorized as either fixed or rotating (on duty for two continuous shifts).

### Sample Size and Sampling Method

The sample size was calculated using the proportion for infinite population formula.<sup>26</sup> For the HDC database, we used the incidence of NSSI among professional Korean nurses, which was reported as 80% in a study by Smith, et al.<sup>27</sup> Thereupon, at least 246 medical records were needed to estimate the incidence of NSSI. For associated factors of NSSI, we used an odds ratio (OR) of long working hours as 1.90 in the

calculation according to a previous study by Nsubuga FM, et al.<sup>28</sup> Based on this, at least 496 medical records (248 medical records for each case and control) were needed. However, in both databases, we included all records in the analysis.

### Data Analysis and Outcome Identification

Descriptive statistics were used to depict all variables that we selected to be studied. We used the TNCS to identify an association between NSSI and potential risks using a univariable logistic regression model. Variables with a *p*-value less than 0.1 were included in the multiple logistic regression modelling process. Crude and adjusted odds ratios and 95% confidence intervals (CI) were presented. Both data sources were encrypted, therefore anonymity of all cases was guaranteed. Data management was done using Microsoft Excel<sup>®</sup> and data analysis using Stata<sup>®</sup> v14.

### Results

As shown in Table 1, among all HCW with NSSI, the majority (83.7%) were female, most (63.8%) were aged below 30 years with a median (interquartile range) age of 27 (24–33) years. Most were single (overall 72.9%, physicians 84.6%, nurses 67.6%, dentists 85.9%, and pharmacists 72.7%). Unspecified injuries (ICD-10: W46) were the most common NSSI. More than half of all HCW experiencing NSSI worked in a community hospital. Approximately 86% of all NSSI were needle stick injuries, and this proportion was consistent across all job titles.

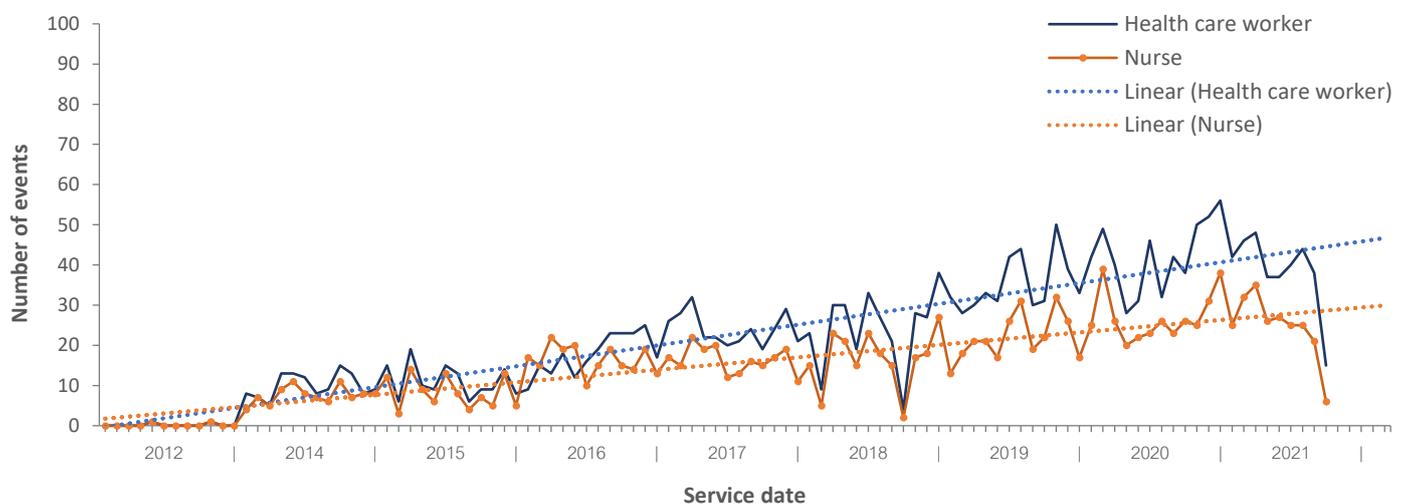
**Table 1. Demographic characteristics of health care workers with needlestick and sharps injuries, Thailand, January 2012 to September 2021**

Characteristics	Type of health care worker				
	Total n (%) (N=2,306)	Physician n (%) (n=507)	Nurse n (%) (n=1,553)	Dentist n (%) (n=191)	Pharmacist n (%) (n=55)
<b>Gender</b>					
Male	376 (16.31)	225 (44.38)	84 (5.41)	57 (29.84)	10 (18.18)
Female	1,930 (83.69)	282 (55.62)	1,469 (94.59)	134 (70.16)	45 (81.82)
<b>Age group (years)</b>					
<30	1,472 (63.83)	355 (70.02)	969 (62.40)	116 (60.73)	32 (58.18)
≥30	834 (36.17)	152 (29.98)	584 (37.60)	75 (39.27)	23 (41.82)
Range	20–75	21–75	20–70	22–53	23–47
Mean ± SD	29.95 ± 8.19	29.06 ± 7.22	30.26 ± 8.77	29.62 ± 5.89	30.49 ± 5.72
Median (IQR)	27 (24–33)	26 (25–31)	27 (24–34)	28 (25–33)	29 (26–33)
<b>Marital status</b>					
Single	1,682 (72.94)	429 (84.62)	1,049 (67.55)	164 (85.86)	40 (72.73)
Married/divorce/separated	624 (27.06)	78 (15.38)	504 (32.45)	27 (14.14)	15 (27.27)
<b>ICD-10 code</b>					
W46: contact with a hypodermic needle	1,083 (46.96)	276 (54.44)	701 (45.14)	89 (46.60)	17 (30.91)
W27: contact with a nonpowered hand tool	516 (22.38)	93 (18.34)	365 (23.50)	42 (21.99)	16 (29.09)
T14: injury unspecified	707 (30.66)	138 (27.22)	487 (31.36)	60 (31.41)	22 (40.00)
<b>Workplace</b>					
Community hospital	1,306 (56.63)	182 (35.90)	955 (61.49)	131 (68.59)	38 (69.09)
General hospital	518 (22.46)	138 (27.22)	329 (21.19)	38 (19.90)	13 (23.64)
Regional hospital	382 (16.57)	148 (29.19)	214 (13.78)	17 (8.90)	3 (5.45)
University hospital	62 (2.69)	24 (4.73)	33 (2.12)	5 (2.61)	0 (0.00)
Health promoting hospital	38 (1.65)	15 (2.96)	22 (1.42)	0 (0.00)	1 (1.82)
<b>Type of NSSI</b>					
Needle stick injury	1979 (85.82)	440 (86.79)	1,346 (86.67)	156 (81.68)	37 (67.27)
Sharps injury	327 (14.18)	67 (13.21)	207 (13.33)	35 (18.32)	18 (32.73)

SD: standard deviation, IQR: interquartile range, ICD-10: International classification of diseases, 10<sup>th</sup> edition, NSSI: needlestick and sharps injury

Figure 3 shows the trend of NSSI events among all health care workers and specifically for Thai nurses from January 2012 to September 2021. There was an

increasing trend in NSSI events among Thai nurses with the number of cases increasing from two in 2012 to 347 in nine months of 2021.



**Figure 3. Trend of monthly events of needlestick and sharps injury among all health care workers and Thai nurses, January 2012 to September 2021**

Table 2 shows results of the univariable and multivariable analyses based on the TNCS database. Being aged below 30 years, holding a degree not higher than bachelor's degree, being single, obese, being a staff nurse, working in an emergency department, having a fixed work pattern, and working long hours were significantly associated with NSSI on the univariable analysis. After controlling for age, education level,

marital status, BMI, job position, work department, and work pattern, long working hours were significantly associated with NSSI with an adjusted OR of 1.5 (95% CI 1.3–1.8). Being single (OR 1.2, 95% CI 1.1–1.4), a staff nurse (OR 2.0, 95% CI 1.6–2.4), working in an emergency department (OR 1.3, 95% CI 1.1–1.5), and having a rotating shift (OR: 1.7, 95% CI 1.4–2.0) were also significant risk factors.

**Table 2. Univariable and multivariable analyses on needlestick and sharps injury**

Variables	n	Ever experienced NSSI		Crude OR (95% CI)	Adjusted OR (95% CI)
		Yes (%)	No (%)		
<b>Gender</b>					
Male	269	47 (3.23)	222 (2.81)	Reference	–
Female	9,082	1,406 (96.77)	7,676 (97.19)	0.87 (0.63–1.22)	
<b>Age group (years)</b>					
≥30	7,981	1,118 (76.94)	6,863 (86.80)	Reference	
<30	1,379	335 (23.06)	1,044 (13.20)	1.97 (1.71–2.27)*	1.12 (0.94–1.33)
<b>Education level</b>					
>Bachelor's degree	1,867	215 (14.68)	1,652 (20.72)	Reference	
≤Bachelor's degree	7,572	1,250 (85.32)	6,322 (79.28)	1.52 (1.30–1.78)*	0.99 (0.82–1.20)
<b>Marital status</b>					
Married/divorced/separated	6,867	974 (66.53)	5,893 (73.91)	Reference	
Single	2,570	490 (33.47)	2,080 (26.09)	1.43 (1.26–1.61)*	1.22 (1.06–1.40)
<b>Body mass index</b>					
Not exceeding normal range	5,206	865 (59.61)	4,341 (55.18)	Reference	
Exceeding normal range	4,112	586 (40.39)	3,526 (44.82)	0.83 (0.74–0.94)*	0.91 (0.80–1.04)
<b>Job position</b>					
Other <sup>†</sup>	3,024	234 (16.34)	2,790 (35.61)	Reference	
Staff nurse	6,243	1,198 (83.66)	5,045 (64.39)	2.83 (2.44–3.29)*	1.97 (1.63–2.39)
<b>Workplace</b>					
Private hospital	673	98 (7.83)	575 (8.38)	Reference	
University hospital	979	138 (11.02)	841 (12.26)	0.96 (0.73–1.27)	–
Government hospital	6,460	1,016 (81.15)	5,444 (79.36)	1.10 (0.87–1.37)	
<b>Department</b>					
Non-emergency	5,509	742 (61.99)	4,767 (72.98)	Reference	
Emergency	2,220	455 (38.01)	1,765 (27.02)	1.66 (1.45–1.89)*	1.31 (1.14–1.50)
<b>Work shift</b>					
Fixed	6,538	736 (51.11)	5,802 (73.97)	Reference	
Rotating	2,746	704 (48.89)	2,042 (26.03)	2.72 (2.42–3.05)*	1.69 (1.43–2.00)
<b>Work duration (hours/day)</b>					
≤12	7,709	1,013 (70.20)	6,696 (85.56)	Reference	
>12	1,560	430 (29.80)	1,130 (14.44)	2.52 (2.21–2.87)*	1.51 (1.28–1.78)

\*P-value <0.1, <sup>†</sup>Administrative/nurse educator/academic/researcher

OR: odds ratio, CI: confidence interval, NSSI: needlestick and sharps injury

## Discussion

Our study revealed that the majority of health care workers experiencing NSSI were middle-aged, and the proportion of nurses experiencing NSSI were mostly aged below 30 years. A previous study by Lo et al. in Taiwan in 2014 found that the mean age of HCW experiencing NSSI was 31.4 years.<sup>20</sup> Previous studies have shown that factors associated with an increase in NSSI events include a lack of work experience, rotating shift, and long working hours.<sup>29–31</sup> A likely explanation

is that as age and working years increase, nurses become more experienced in preventing NSSI.

NSSI among HCW has been continually increasing during 2012–2021 and several associated factors were identified. The growing number of NSSI might be due to either an increase in the coverage of health facilities under the reporting system or an increase in the true NSSI incidence. However, this needs to be verified by other approaches, such as surveillance evaluation using health facilities' data.

We found that being single, a staff nurse, working in an emergency department, having a rotating shift and long working hours were significantly associated with NSSI. In terms of workplace risk, nurses working in an emergency department faced a greater risk of NSSI than their colleagues in non-emergency departments. Previous studies by Kasatpibal et al. and Wicker et al. also found a high prevalence of NSSI in the operating room, a place where emergency conditions frequently occurred.<sup>32,33</sup>

Our study found that working continuously for more than 12 hours a day increased the risk of NSSI. Long working hours caused a negative effect on the performance of HCW and patient safety as supported by numerous previous studies.<sup>34-41</sup> Fatigue was the most common symptom after long working hours and this may lead to inattention, lack of energy, resulting in workplace accidents, including NSSI.<sup>39,41</sup>

In a review by McDonald, the author emphasized that legislation sets clear expectations about working hours and enables accountability for both the regulated individuals' performance and the regulators' monitoring and enforcement. Therefore, by implementing working hour regulations among HCW, we can enhance patient safety and improve the quality of treatment in health care services.<sup>42</sup>

### Limitations

This study contained both strengths and limitations. For strengths, we used two large databases to investigate NSSI among Thai nurses. Thus, power of the analysis was not the main concern. However, some limitations and challenges exist. First, although the TNCS occurred 10 years ago (2012), it was the latest cohort data of Thai nurses that was available. Second, participants who responded to the TNCS questionnaire were those with a valid address to receive the mailed questionnaire. Third, as the questionnaires asked about their experience in the past, recall bias was inevitable. Additionally, participants experiencing NSSI might be more likely to report the event and recall their experience of long working hours than others. Also, most of the reported cases in the HDC were found in community hospitals and higher levels hospitals. This might be because the reporting system at the hospital level might be more systematic compared with health facilities at lower level of care, such as health promoting hospitals. Thus, the NSSI events in lower level of care might be subject to missing. Finally, private health facilities are not obliged to submit service data to the HDC.

### Conclusion and Policy Recommendations

In summary, we demonstrated that needlestick and sharps injury among HCW, especially nurses, showed a growing trend over the past decade. Long working hours increased the risk of NSSI. Long working hours should be restricted by implementing the white coat labour law. Adequate supervision on occupational safety for nurses, especially those working in an emergency department and those of young age, should be implemented. Regular monitoring of work-related health status and occupational safety should be introduced in order to help generate evidence to support policy decisions for better working conditions.

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### Conflicts of Interest

The authors declare no conflict of interest.

### Suggested Citation

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