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### REVIEW

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## Global prevalence of needle stick injuries among nurses: A comprehensive systematic review and meta-analysis

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### Abstract

**Background:** Nurses usually provide direct patient care. However, they account for the majority of healthcare workers (HCWs) injured by needles or other sharp objects. **Objectives:** To assess the prevalence of needle stick injuries (NSI) among nurses worldwide; according to WHO regions, the socioeconomic development index (SDI) of countries, and the developmental status of individual countries, and in the Middle East.

Design: Systematic review and meta-analysis.

**Methods:** We searched PubMed, Scopus, and Web of Science databases. We calculated the pooled NSI prevalence estimates using a random-effect meta-analysis with the Comprehensive Meta-Analysis software. The report of the study was in accordance with the PRISMA 2020 statement.

**Results:** The overall worldwide NSI prevalence pooled from our analysis was 40.97% (95% confidence interval [CI]: 31.29–50.63%, p = .00001). A subgroup analysis of NSI prevalence according to WHO regions revealed the highest prevalence in Southeast Asia (49.9%, 95% CI: [23.4–76.3%]) and the lowest in the United States of America (25.1%, 95% CI: [18.1–32.1%]), respectively. The pooled prevalence in developed and developing countries was 30.5% (95% CI: 27.3–33.8%) and 46.6% (95% CI: 33.7–59.5%), respectively. According to the SDI, NSI prevalence was highest in low-middle SDI countries (48.9% [95% CI: 30.7–67.2%]).

**Conclusion:** Our results showed a high NSI prevalence among nurses worldwide. Developing countries had a significantly higher NSI prevalence than developed countries, especially low-middle SDI countries.

**Relevance to Clinical Practice:** This study highlighted the prevalence of NSI risk among nurses practising in clinical settings worldwide. The study findings suggest that continuous training programs should be implemented for nurses to enhance their knowledge, performance and attitude toward NSI prevention in clinical settings.

Protocol registration: This protocol is registered under the International Prospective Register of Systematic Review (PROSPERO) (york.ac.uk): (CRD42022299368).

**No Patient or Public Contribution:** Contributions from patients or the public are irrelevant because the purpose of this study was to examine the global prevalence of NSIs in nurses.

KEYWORDS different countries, needle stick injuries, nurses, prevalence, worldwide

### 1 | INTRODUCTION

Healthcare professionals are vulnerable to needle stick injuries (NSIs) because of the frequent use of sharp objects in the workplace (Deisenhammer et al., 2006). NSIs are defined as injuries caused by contact with any sharp item, including but not limited to subcutaneous needles, blood collection needles, cannulae, and needles used to connect components of intravenous administration systems (Norsayani & Hassim, 2003). Alternatively, it can be defined as penetrating trauma to the body caused by possibly infected sharp medical equipment (Zhang et al., 2009).

In most healthcare facilities, nurses provide more direct patient care than other medical professionals (Ramsay, 2005). Nurses account for the largest proportion of all healthcare workers (HCWs) injured by needles or other sharp objects (Senthil et al., 2015). NSIs most frequently occur during medicine delivery, surgical operations, blood sample collection, needle recapping, and improper needle removal. When dealing with potentially infectious materials, such as blood and bodily fluids, universal precautions must be taken to avoid exposure in the workplace (Foley & Leyden, 2012; Rodrigues, 2010). NSI prevalence can be reduced by implementing comprehensive programs that target institutional, behavioural, and device-related causes (Wang et al., 2003).

Annually, approximately 35 million HCWs are injured by needle sticks or other sharp objects, with 3 million being infected with the human immunodeficiency virus (HIV) or other bloodborne diseases (Shiao et al., 2002). According to a survey conducted by the Royal College of Nursing (Royal College of Nursing, 2009), nearly 50% of nurses have had NSI. Moreover, the NSI prevalence was 37.0% in the UK, a developed country, and 70.3% in Nepal, a developing country (Saia et al., 2010; Singh et al., 2015). According to the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2008), an estimated 385,000 HCWs in the United States have injuries due to sharp objects each year. NSI incidence is almost 90% higher in underdeveloped countries than in developed countries (Sagoe-Moses et al., 2001). According to a research by the World Health Organisation, the average annual number of NSIs per person among HCWs in Africa, Asia, and the Western Mediterranean is four per year (WHO, 2012). The NSI rate was 4.2 per person per year among HCWs in sub-Saharan Africa (Nsubuga & Jaakkola, 2005).

Needle stick injuries are a leading cause of infection, illness, disability, and mortality among HCWs, including nurses (Bekele & Kotisso, 2008). HIV and hepatitis B and C viruses (HBV and HCV,

## What does this paper contribute to the wider global clinical community?

- This systematic study revealed a high global prevalence (40.97% [95% confidence interval: 31.29-50.63%], p = .00001) of needle stick injuries (NSIs) among nurses in clinical settings.
- Developing countries had a significantly higher prevalence of NSIs than developed countries, especially countries with a low-middle socioeconomic development index.
- Continuous training programs should be implemented to enhance nurses' knowledge, performance, and attitude toward NSI prevention in clinical settings.

respectively) are bloodborne diseases that can be transmitted from one person to another (De Laune, 1990). NSIs account for 39% of HCV, 37% of HBV, and 4.5% of HIV infections among HCWs (Nagandla et al., 2015). Besides the risk of contracting severe infection, NSIs can bleed or scrape the skin, leaving obvious wounds (Kermode et al., 2005).

The high NSI prevalence has been attributed to protective suits, recapping needles, working for long hours or in an emergency room, and a lack of infection control training. NSIs have also been linked to hospital crowding (Abebe et al., 2018; Kebede & Gerensea, 2018; Weldesamuel et al., 2019), a decreased HCW-topatient ratio (Hanafi et al., 2011; Kakizaki et al., 2011), and a lack of suitable safety equipment (Jovic-Vranes et al., 2006). Despite the significant risk of infectious particle transmission (Sharma et al., 2009), NSI reporting is low. According to the CDC, half of the estimated 385,000 NSIs among HCWs go unreported each year (CDC, 2010).

### 2 | AIMS

This study aimed to assess NSI prevalence among nurses worldwide. We also aimed to analyse NSI prevalence by WHO region, socioeconomic development index (SDI), developmental status of individual countries, pooled studies from each region, and the Middle East alone.

### 3 | METHODS

### 3.1 | Study design

We performed this systematic review and prevalence metaanalysis according to the guidelines reported in the Cochrane Handbook and reported the study in strong accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Table S3; Page et al., 2021). The protocol was registered in PROSPERO, an international prospective register of systematic reviews (PROSPERO registration number: CRD42022299368).

### 3.2 | Literature search and eligibility criteria

We searched PubMed, Scopus, and the ISI Web of Science in June 2022 using the following terms: (Prevalence OR frequency OR magnitude OR occurrence OR incidence OR survey\* OR rates OR surveillance) AND (Needlestick OR 'Needlestick\*' OR 'Needle Stick\*' OR 'Sharps injur\*' OR Sharp\* OR needle injur\* OR 'percutaneous injur\*' OR NSI OR NSSI) AND (Nurse OR nurses OR nursing). Articles that met the following criteria were included in our study: (1) population: nurses, (2) exposure: NSI, (3) outcome: NSI prevalence, and (4) study design: all study designs. We did not include studies published before 2000 or in languages other than English. Additionally, we did not include reviews, letters to the editor, brief reports, and studies that lacked a full-text version.

### 3.3 | Study selection and data extraction

Two researchers worked independently on the search, selection, and extraction of study data. Any disagreement was resolved by a third author. After deleting duplicates, we reviewed the titles and abstracts of the remaining articles to ensure that they met our inclusion criteria. Papers that did not meet the criteria were excluded. We then reviewed the full text of the articles. Using the study's data extraction form, the necessary information was gathered from the included studies. The extracted data included the following: first author, WHO region, SDI status (high SDI, high-middle SDI, low-middle SDI, and low SDI), study period, sampling technique, study design, number of nurses, sex, NSI prevalence, and year of publication.

### 3.4 | Risk of bias assessment

Studies were assessed for their methodological quality using the National Institutes of Health (NIH) tool for assessing the quality of observational cohort and cross-sectional studies (NIH-National Health, Lung, and Blood Institute, 2021). This tool consists of several questions that assess the risk of different sources of bias and

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confounders. The reviewers' opinion is classified as 'good', 'fair' or 'poor' according to scores obtained during the assessment. In addition, Egger's test and funnel plot method were used to evaluate the risk of publication bias.

### 3.5 | Data synthesis

We revealed all the information we collected on NSI prevalence among nurses worldwide, as well as prevalence by WHO region, country, and SDI. To calculate pooled prevalence estimates with a 95% confidence interval (CI), NSIs were combined using a randomeffect meta-analysis. Furthermore, we analysed the prevalence of NSIs in nurses among all injured HCWs, as reported by a small number of the included studies. Subgroup analyses were performed to identify significant subgrouping variables.  $l^2$  tests were used to calculate the proportion of variation between trials attributable to heterogeneity. Meta-regression analysis was also performed to further characterise the linear relationship between the study variables and NSI prevalence. We conducted statistical analyses using the Comprehensive Meta-Analysis Software.

### 4 | RESULTS

### 4.1 | Study selection

We found 4084 studies after searching three databases. After removing duplicates, we screened the titles and abstracts of the remaining 3417 studies, and we found that 3016 had no relevance to our study. A total of 401 studies underwent full-text screening, and only 153 studies were included in our systematic review. The PRISMA flow diagram for study selection is shown in Figure 1.

### 4.2 | Study characteristics and quality

Our study included 153 studies involving 267,237 nurses from 35 countries. Most of these studies were conducted in the Eastern Mediterranean Region (EMR) (n = 37) and Western Pacific region (n = 30). Forty-two studies were conducted in the Middle East, 21 in Iran, 6 in Saudi Arabia, 5 in Turkey, 3 in Egypt and Jordan, and 1 in Israel, Jordan, Libya, Oman, and Qatar. Most studies were conducted in developing countries (n = 87) and countries with middle-to-high SDI (n = 97). The average NSI prevalence was 47.85% in Iran, 41.75% in Saudi Arabia, 51.73% in Egypt, 39.18% in China, and 26.3% in the United States. Figure 2 shows NSI prevalence among nurses from different countries. Sampling was mostly performed using the random sampling method (n = 80). According to the NIH tool, most of the included studies were cross-sectional (n = 138) and of fair quality (n = 118). Detailed study characteristics and risk of bias assessments are shown in Tables S1 and S2.



FIGURE 1 PRISMA flow diagram of study identification and selection process [Colour figure can be viewed at wileyonlinelibrary.com]

### 4.3 | Worldwide NSI prevalence among nurses

We assessed NSI prevalence among nurses by pooling 133 studies from 35 countries. The reported prevalence ranged from 2% in Lin et al.'s study to 99.9% in Muralidhar et al.'s study. The overall worldwide NSI prevalence pooled from our analysis was 40.97% (95% CI: 31.29–50.63%, p < 0.00001). The pooled studies were heterogeneous (p < 0.00001,  $l^2 = 99.99$ %). The worldwide NSI prevalence is shown in Figure 3. According to Egger's test with a visual inspection of the funnel plot, we found no risk of publication bias (p = .2581; Figure S1).

### 4.4 | NSI prevalence in different regions

Our subgroup analysis of NSI prevalence according to WHO region revealed that Southeast Asia and Africa had the highest NSI prevalence, while the Western Pacific region had the lowest. The pooled prevalence was 49.9% (95% CI: 23.4–76.3%, p < .00001) in Southeast Asia, 45.5% (95% CI: 39.2–51.9%, p < .00001) in Africa, 25.1% (95% CI: 18.1–32.1%, p < .00001) in the United States of America, 46.8% (95% CI: 39.1–54.5%, p < .00001) in the EMR, 35.4% (95% CI: 29.7–41.2%, p < .00001) in the European region, and 30.9% (95% CI: 21.8–39.9%, p < .00001) in the Western Pacific region. The pooled studies from the

subgroup analysis of NSI prevalence according to WHO region were heterogeneous, with *p*-values >.00001. The NSI prevalence in different regions is shown in Figure 4. The prevalence in the Middle East countries alone was 26.5% (95% CI: 24.5–28.5%, p >.00001; Figure 5).

# 4.5 | NSI prevalence in developed and developing countries

Our analysis included 47 and 88 studies conducted in developed and developing countries, respectively. The pooled NSI prevalence in developed and developing countries was 30.5% (95% CI: 27.3–33.8%, *p* < .00001) and 46.6% (95% CI: 33.7–59.5%, *p* < .00001), respectively. The pooled studies from the two groups were heterogeneous (*p* < .00001,  $l^2$  > 99%). Our analysis revealed a significant difference between the two groups, with a *p*-value of 0.018. A subgroup analysis of NSI prevalence in developed and developing countries is shown in Figure 6.

### 4.6 | NSI prevalence according to SDI

Among the included studies, 59 were in the high-middle SDI category, 37 in the high SDI category, 12 in the low-middle SDI category,



FIGURE 2 Prevalence of NSI among nurses based on countries [Colour figure can be viewed at wileyonlinelibrary.com]

and 25 in the low SDI category. The pooled prevalence was 39.4% (95% CI: 33.5–45.4%) in high-middle SDI countries, 37.4% (95% CI: 18.1–56.6%) in high SDI countries, 48.9% (95% CI: 30.7–67.2%) in low-middle SDI countries, and 45.9% (95% CI: 39.9–52%) in low SDI countries. All pooled studies in the SDI country groups were heterogeneous, with p <.00001. A subgroup analysis of NSI prevalence based on SDI is presented in Figure 7.

# 4.7 | NSI prevalence in nurses among injured HCWs

The overall NSI prevalence in nurses among all injured HCWs pooled from 19 studies was 53.38% (95% CI: 44.76-62.01%, p < .00001). The pooled studies were heterogeneous (p < .00001,  $l^2 = 96.2$ %). The worldwide NSI prevalence in nurses among injured HCWs is shown in Figure S2. According to Egger's test with a visual inspection of the funnel plot, we found no risk of publication bias (p = .14; Figure S3).

### 4.8 | Meta-regression findings

Based on meta-regression analyses, we can deduce that the malefemale ratio, sampling technique, number of participants in each study, and WHO region did not significantly contribute to the heterogeneity of NSI prevalence among nurses worldwide (p > .05). However, the year of publication significantly contributed to the heterogeneity of NSI prevalence (p = .0001). Figures S4–S7 show the regression analysis of point estimates for the year of publication, sample size, sampling method and male–female ratio, respectively.

### 5 | DISCUSSION

Needle stick injuries (NSI) is one of the most significant threats to safety in modern healthcare systems. We included 153 studies involving 267,237 nurses from 35 countries. We found that 41% of nurses experienced NSIs worldwide. Additionally, a study on percutaneous injuries identified NSIs as the leading cause of contact injuries, with a prevalence of 35.3% (Auta et al., 2017). However, a study by Bouya et al. reported a higher NSI rate of 44.5%. The following factors can be attributed to high NSI prevalence: age, education, number of shifts and needle stick management training (Motaarefi, 2016). NSI is distressing, especially with high-risk patients, such as those with HCV and HIV, which can negatively impact mental health. Between 42% and 60% of nurses and other HCWs experience stress and depression due to NSIs (Lee, Botteman, et al., 2005; Lee, Nicklasson, et al., 2005). Furthermore, we found that NSI prevalence was higher in Southeast Asia than in other WHO regions. However, Bouya et al. reported a higher prevalence in the EMR than in other regions. Furthermore, in contrast to other studies (Auta et al., 2017, 2018; Prüss-Üstün et al., 2003), our study found that the United States of America had the lowest NSI prevalence.

We also found a higher NSI prevalence in developing countries than in developed countries. This may be due to variations in the

Overa	ll	pr	ev	el	ar	ICE	) (	<b>of</b>
Study name		:	Sta <u>tistics f</u>		study			
	Rint estimate	Standard error	\fariance	Lover limit	Upper limit	Z-Válue	p\alue	
Abalikhail 2022 Alsabaani 2022	0.340 0.110	0.057	0.003	0.228	0.452 0.136	5962 8282	0000	
A Qadre2021 A-Fulaye2021 Astor2021	0.180 0.525 0.140	0029 0051 0028	0.001 0.003 0.001	0.123 0.425 0.084	0.237 0.625 0.196	6216 10247 4942	0.000 0.000	
Abadga2020 Al-Movaraie2020	0330	0.027	0.001	0.277	0.383	12095 13.147	0000	
Assen 2020 Akhuleh 2019	0.400 0.610	0.035 0.041	0.001 0.002	0.332 0.530	0.468 0.690	11.489 15008	0000	
Aniaku2019 Bagittini 2021	0700	0024	0.001	0663	0.747	28902 13947	0000	
Barhan 2021 Bahat 2021 Bagnasco 2020	0.580 0.520 0.390	0044 0024 0032	0.002 0.001 0.001	0.498 0.472 0.328	0.667 0.568 0.452	13086 21,280 12,335	0000 0000 0000	
Chen 2021 Dagoi 2021	0.026	0.006	0.000	0.013	0.039	4045 29541	0000	
Ditching 2020 Dong 2020	0.150 0.190	0.023 0.006	0.001 0.000	0.104 0.179	0.196 0.201	6412 32880	0000	
Dukm 2020 Elizauki 2020 Ferrario 2021	0.360 0.044 0.320	0035 0025 0011	0.001 0.001 0.000	0291 -0005 0298	0.429 0.098 0.342	10201 1.769 28.109	0000 0077 0000	
Fang 2019 Galomaniyam 2019	0.140	0.003	0.000	0.133	0.147	40.092	0000	
Gatie 2020 Habouti 2019	0.720 0.720	0.087	0.001	0.647 0.677	0.798 0.763	19442 32706	0.000	
Ishak2018 Kabpho2020 Ishaa ama0000	0.004 0.650 0.090	0000 0036 0035	0.000	0.003 0.576 0.020	0.004 0.724 0.190	17.947 17.184	0.000 0.000 0.011	
katsemari2020 Kwanzae.2020 Kawis.2019	0430	0.045	0.001 0.002 0.001	0.341	0.160 0.519 0.633	2535 9515 21347	0000	
Li 2022 Liyew2020	0070	0003	0000	0.063	0077 0417	20.140 12.278	0.000	
Lin2019 Leong 2019	0020	0.001	0000	0.018	0.022	25572 50847	0000	
Mistra 2021 Madhavan 2019 Matmoud 2015	0.980 0.244 0.410	0.015 0.043 0.049	0000 0002 0002	0.901 0.160 0.314	0.959 0.328 0.506	62816 5681 8336	0000 0000 0000	
Mirzaei-Alavijeh 2014 Pakovska 2019	0410 0.110	0.059	0.003	0295	0.525 0.112	6975 89497	0000	
Papadipoli 2019 sabaa 2021	0.170 0.680	0.022 0.021	0000 0000	0.128 0.639	0212 0721	7.891 32:136	0000	
Reiman 2020 Silovati 2019	0700 0270 0670	0.069	0.005	0.565	0835 0324	10.132 9.769	0000	
Bharti 2022 Veronesi 2018 Weng 2021	0.140	0.026 0.007 0.024	0.001 0.000 0.001	0.619 0.127 0.624	0.721 0.153 0.716	25884 21.128 28.498	0.000 0.000 0.000	
Wu20220 Yang 2020	0.580	0.064	0.004	0.454	0706	9026 6697	0000	
Zhang 2019 ababe 2018	0.770 0.430	0.024 0.040	0.001	0.723 0.361	0.817 0.509	31.797 10.673	0.000	
Alemayehu 2016 abozeed 2015	0.480 0.760 0.460	0022 0035 0077	0.001 0.001 0.006	0.436 0.692 0.300	0.524 0.828 0.600	21.397 21.867 5862	0000 0000 0000	
Amira2014 Algur 2012 Azadi 2010	0.680	008	0.001	0606	0.000	5862 17.913 9724	0000	
Askarian 2007 Belachew 2017	0500	0.013 0.028	0.000	0.475	0.525	39433 21392	0000	
Balouchi 2015 Bhardwaj 2014	0.640 0.059	0.034 0.029	0.001 0.001	0.573 0.001	0.707 0.117	18856 2003	0.000 0.045	
0.12018 Ond 2017 Onalya.2015	0.310 0.680 0.353	0.019 0.028 0.029	0000 0009 0001	0.273 0.497 0.297	0.347 0.863 0.409	16418 7.289 12.316	0000 0000 0000	
Chee2013 Cheerg 2012	0.700	0.008	0000	0.684	0.716	84760 9199	0000	
Chen 2009 Clarke 2002	0.890 0.086	0.016 0.006	0.000 0.000	0.859	0.921 0.100	55812 14550	0000 0000	
daipdiyi2017 Ehsani 2012	0210 0450	0.016	0.000	0.178 0.396 0.559	0242	12879 16382 17577	0.000	
Ebrahimi 2007 Fareed 2012 Fullerton 2011	0.630 0.440 0.076	0.036 0.050 0.006	0.001 0.002 0.000	0.343	0.701 0.537 0.092	17.507 8864 9329	0000 0000 0000	
Graseni 2017 Galougari 2010 Guest 2010	0.600	0.030	0.001 0.001	0.541 0.086	0.659 0.194	20012 5072	0000	
Hassnain 2017	0.065	0.007	0.000 0.001	0.062	0.078	9510 14417	0000	
Honda2011 Hanali 2011 Hamid2011	0.490 0.732 0.125	0.032 0.017 0.028	0.001 0.000 0.001	0.428 0.698 0.069	0.552 0.766 0.181	15498 41.973 4408	0000 0000 0000	
Habib2011 Imak2011	0.670	0022	0.001	0.607	0.733	20941 11.526	0000	
llhan 2006 Jouler 2018	0.680 0.570	0.039 0.016	0.002	0.604 0.539	0.756 0.601	17.432 36.590	0.000	
Jahangiri 2016 Koedad 2018 Kasatoibal 2016	0.510 0.350 0.320	0.039 0.030 0.010	0.001 0.001 0.000	0.434 0.291 0.300	0.586 0.409 0.340	13.223 11.649 30.915	0.000 0.000 0.000	
Khushdil 2013 Khushdil 2013	0.550	0046	0.002	0.460 0.212	0.348	12009 8035	0000	
Lee 2005 Lee (2) 2005	0350	0027	0.001	0297	0.403 0.253	12982 5982	0000	
Musa2014 Muralichar 2010	0.456	0.046 0.000	0.002	0.367	0.545 1.000 0.258	9987 2211.390	0000	
Maro2007 Ng Yu2007 nsubuga2005	0210 0370 0570	0.025 0.057 0.022	0001 0003 0000	0.162 0.259 0.528	0.258 0.461 0.612	8534 6548 26406	0000	
Navisom/2002 Rampai 2010	0200	0.057	0.003	0.088	0.312 0.297	3500 8316	0000	
Suliman 2018 Salmanzadah 2016	0.280	0.026 0.084	0.001 0.001	0.209 0.084	0.311 0.216	9901 4426	0000	
Shive2011 Shall 2011 Shill 2016	0.550 0.170 0.180	0.032 0.027 0.026	0.001 0.001 0.001	0.488 0.118 0.129	0.612 0.222 0.231	17.340 6.368 6.949	0000 0000 0000	
Shah2006 Shah2005	0204	0015	0000	0.174	0234	13259 6679	0000	
Shica2002 Trinkoff 2007	0.620	0.018	0000	0.584	0.666 0.175	33988 20642	0000	
Wang 2012 Wilder 2007	0.125	0.015	0.000	0.095	0.155 0.260	8089 10754	0.000	
Xayoa2009 Zhang 2015 Archana2018	0999 0660 0380	0.002 0.024 0.022	0.000 0.001 0.000	0995 0603 0337	1.003 0.697 0.423	497.747 27.323 17.312	0.000 0.000 0.000	
Bairani 20114 Afrid 2013	0.390	0028	0.001	0.334	0.446	13733 25327	0000	
Bdira2014 Chaung 2010	0.390 0.190	0.034 0.024	0.001 0.001	0.324 0.143	0.466 0.237	11.615 7.914	0.000	
Desalegn 2015 Hassan 2009 Izadi 2015	0.625 0.810 0.639	0.043 0.014 0.066	0002 0000 0004	0.541 0.783 0.510	0.709 0.837 0.768	14606 58691 9686	0000 0000 0000	
12201 2015 Jaykhaye 2013 Kaweli 2016	0600 0.530	0.052 0.034	0004 0003 0001	0.499 0.463	0.701 0.597	9686 11.619 15462	0000	
Kbade 2016 Lagasse 2014	0.345 0.400	0.030 0.047	0.001	0.287	0.403 0.493	11.657 8446	0000 0000	
Mekomen 2018 Mobiksa 2014	0.570	0042	0.002	0.488 0.549	0.652	13671 17.137	0000	
Mohammadi 2011 Nasiri 2010 Rubbi 2018	0.430 0.740 0.062	0042 0032 0006	002 001 000	0.347 0.677 0.049	0.513 0.803 0.075	10208 23008 9630	0000 0000 0000	
Shadi 2013 Sayedah 2012	0.280 0.440	0.019	0.000 0.001	0.222 0.371	0.298 0.509	13439 12567	0000 0000	
Tadasse 2016 Testay 2014	0.570	0.025	0.001	0.501	0.639	16282 10909	0000	
Voide:2012 Yoshikava:2013 YANG:2007	0.085 0.520 0.500	0.007 0.009 0.022	0.000 0.000 0.000	0.071 0.502 0.457	0.099 0.538 0.543	11.761 55.448 22.956	0.000 0.000 0.000	
	0410	0.049	0.002	0.313	0.506	8300	0.000	-



-1.00

FIGURE 3 Overall prevalence of NSI among nurses [Colour figure can be viewed at wileyonlinelibrary.com]

Subgroup analysis based on regions (WHO)

	9.0			.,	0.0		4000			<u></u>	(
Group by Subgroup within study	Studyname	Regions (WHO c	<u>lassifica</u> tion) Point S		tis <u>tics for eachs</u>					Point <u>estimate and 95% C</u>	L
Africa	Asfour2021	Africa	estimate 0.140	error 0.028	Variance limit 0.001 0.084		Z-Value p-Value 4.942 0.000				
Africa Africa	Abadiga2020 Assen 2020	Africa Africa	0.330	0.027	0.001 0.277 0.001 0.332	0.383	12.095 0.000				
Africa Africa	Aniaku 2019 Berhan 2021	Africa Africa	0.700 0.580	0.024	0.001 0.653 0.002 0.493	0.747 0.667	28.902 0.000 13.086 0.000				*
Africa Africa	Gabrmariyam 2019 Gatie 2020	9 Africa Africa	0.210 0.720	0.029	0.001 0.154 0.001 0.647	0.266 0.793	7.291 0.000 19.442 0.000			-	╸╵╼╴╵
Africa Africa	Kabptho 2020 Liyew 2020	Africa Africa	0.650 0.360	0.038 0.029	0.001 0.576 0.001 0.303	0.724	17.184 0.000 12.278 0.000				+ +
Africa Africa	abebe 2018 Alemavehu 2016	Africa Africa	0.430	0.040	0.002 0.351 0.001 0.436	0.509					
Africa Africa	Amira 2014 Belachew 2017	Africa Africa	0.450 0.590	0.077	0.006 0.300 0.001 0.536	0.600	5.862 0.000 21.392 0.000				
Africa Africa	Chalya 2015 Kbeded 2018	Africa Africa	0.353	0.029	0.001 0.297	0.409	12.316 0.000 11.649 0.000				<b>\$</b>
Africa Africa	Kbede 2012 nsubuga2005	Africa Africa	0.280 0.570	0.035 0.022	0.001 0.212 0.000 0.528	0.612	8.035 0.000 26.406 0.000				≠  +
Africa Africa	Small 2011 Bidira 2014	Africa Africa	0.170 0.390	0.027 0.034	0.001 0.118 0.001 0.324	0.456	6.368 0.000 11.615 0.000			<b>−</b>	· •   _
Africa Africa	Desalegn 2015 Kaweti 2016	Africa Africa	0.625 0.530	0.043 0.034	0.002 0.541 0.001 0.463	0.597	14.606 0.000 15.462 0.000				_ <del>   </del>
Africa Africa	Kbede 2016 Legesse 2014	Africa Africa	0.345	0.030 0.047	0.001 0.287 0.002 0.307	0.493	11.657 0.000 8.446 0.000				
Africa Africa Africa	Mekonnen 2018 Mideksa 2014 Tadesse 2016	Africa Africa Africa	0.570 0.620 0.570	0.042 0.036 0.035	0.002 0.488 0.001 0.549 0.001 0.501	0.691	13.671 0.000 17.137 0.000 16.282 0.000				
Africa Africa	Tesfay 2014	Africa	0.500	0.046	0.001 0.301 0.001 0.001 0.001 0.001 0.001	0.590	10.909 0.000 14.077 0.000				Ŧ
Americas Americas	katsevman2020 Kwanzaa 2020	Americas Americas	0.090	0.035	0.001 0.020 0.002 0.341	0.160	2.535 0.011 9.515 0.000				
Americas Americas	Choi 2017 Clarke 2002	Americas Americas	0.680	0.093	0.009 0.497	0.863	7.289 0.000				⁻┝╼╾ │
Americas Americas	deipolyi2017 Lee 2005	Americas Americas	0.210	0.016	0.000 0.178 0.001 0.297	0.242	12.879 0.000			-•	• _
Americas Americas	Trinkoff 2007	Americas	0.160	0.008	0.000 0.145 0.001 0.181	0.175	20.642 0.000 7.042 0.000				•
EMRO EMRO	Abalkhail 2022 Alsabaani 2022	EMRO EMRO	0.340	0.057 0.013	0.003 0.228	0.452 0.136	5.962 0.000 8.282 0.000				
EMRO EMRO	Al Qadire 2021 Al-Fulaye 2021	EMRO EMRO	0.180 0.525	0.029 0.051	0.001 0.123 0.003 0.425	0.625	6.216 0.000 10.247 0.000				
EMRO EMRO	Al-Mowaraie 2020 Akhuleh 2019	EMRO	0.380 0.610	0.029 0.041	0.001 0.323 0.002 0.530	0.690	13.147 0.000 15.008 0.000				_ <sup>●</sup>  →
EMRO EMRO	Bagittini 2021 Elzouki 2020	EMRO EMRO	0.240 0.044	0.017 0.025	0.000 0.206 0.001 -0.005	0.093	13.947 0.000 1.769 0.077				•   _
EMRO EMRO	Hoboubi 2019 Mahmoudi 2015	EMRO EMRO	0.720 0.410	0.022 0.049	0.000 0.677 0.002 0.314	0.506	32.706 0.000 8.336 0.000				- <u>+</u>   *
EMRO EMRO	Mizaei-Alavijeh 2 sabaa 2021 abozead2015	EMRO EMRO EMRO	0.410	0.059 0.021	0.003 0.295 0.000 0.639	0.721	6.975 0.000 32.136 0.000				
EMRO EMRO	Askarian 2007	EMRO	0.760	0.035	0.001 0.692 0.000 0.475	0.525	21.867 0.000 39.433 0.000				
EMRO EMRO EMRO	Balouchi 2015 Ehsani 2012 Ebrahimi 2007	EMRO EMRO EMRO	0.640 0.450 0.630	0.034 0.027 0.036	0.001 0.573 0.001 0.396 0.001 0.559	0.504	18.856 0.000 16.382 0.000 17.507 0.000				-
EMRO EMRO	Fareed 2012 Ghasemi 2017	EMRO	0.440	0.050	0.002 0.343 0.001 0.541	0.537	8.864 0.000				
EMRO EMRO	Galougahi 2010 Hassnain 2017	EMRO EMRO	0.140	0.028	0.001 0.086	0.194	5.072 0.000				• [
EMRO EMRO	Hanafi 2011 Joukar 2018	EMRO EMRO	0.732 0.570	0.017 0.016	0.000 0.698	0.601	41.973 0.000 36.590 0.000				
EMRO EMRO	Jahangiri 2016 Suliman 2018	EMRO EMRO	0.510 0.260	0.039 0.026	0.001 0.434 0.001 0.209	0.311	13.223 0.000 9.901 0.000				+†
EMRO EMRO	Shiva 2011 Shah 2006	emro Emro	0.550 0.204	0.032 0.015	0.001 0.488 0.000 0.174	0.234	17.340 0.000 13.259 0.000				∙_ <sup>†</sup>
EMRO EMRO	Bairami 2014 Hassan 2009	EMRO EMRO	0.390 0.810	0.028 0.014	0.001 0.334 0.000 0.783	0.837	13.733 0.000 58.691 0.000				*   _ •
EMRO EMRO EMRO	Izadi 2015 Mohammadi 2011 Nasiri 2010	EMRO EMRO EMRO	0.639 0.430 0.740	0.066 0.042 0.032	0.004 0.510 0.002 0.347 0.001 0.677	0.513	9.686 0.000 10.203 0.000 23.008 0.000				
EMRO EMRO	Shadi 2013 Azadi 2010	EMRO EMRO	0.260	0.032	0.001 0.077 0.000 0.222 0.002 0.367	0.298	13.439 0.000 9.724 0.000				•
EMRO EMRO	Khushdil 2013 Salmanzadeh 201	EMRO	0.550	0.046	0.002 0.460 0.001 0.084	0.640	12.009 0.000 4.426 0.000				. 7 – 1
EMRO EMRO	Afridi 2013 Rehman 2020	EMRO EMRO	0.710 0.700	0.028 0.069	0.001 0.655 0.005 0.565	0.765	25.327 0.000 10.132 0.000				_‡_
EMRO European	Bahat 2021	European	0.468 0.520	0.039 0.024	0.002 0.391 0.001 0.472	0.568	11.909 0.000 21.280 0.000				<b>_</b>
European European	Bagnasco 2020 Dagci 2021	European European	0.390 0.700	0.032 0.024	0.001 0.328 0.001 0.654	0.746	12.335 0.000 29.541 0.000				<b>→</b>
European European	Dulon 2020 Ferrario 2021 Kayis 2019	European European European	0.360 0.320 0.580	0.035 0.011 0.027	0.001 0.291 0.000 0.298 0.001 0.527	0.342	10.201 0.000 28.109 0.000 21.347 0.000				
European European European	Pakowska 2019 Papadopoli 2019	European European	0.110	0.001	0.000 0.108	0.112	21.347 0.000 89.497 0.000 7.891 0.000				. 1 – 1
European European	Veronesi 2018 Akrur 2012	European	0.140	0.007	0.000 0.127	0.153				- I -	
European European	llhan 2006 Musa 2014	European European	0.680 0.456	0.039 0.046	0.002 0.604 0.002 0.367	0.756 0.545	17.432 0.000 9.987 0.000				
European European	Mbro 2007 Wicker 2007	European European	0.210 0.220	0.025 0.020	0.001 0.162 0.000 0.180	0.260	8.534 0.000 10.754 0.000				
European European	Rubbi 2018 Sayyedeh 2012	European European	0.062	0.006 0.035	0.000 0.049 0.001 0.371	0.509	9.630 0.000 12.567 0.000				-
European European South east Asia	Voide 2012 Chen 2021	European South east Asia	0.085 0.354 0.026	0.007 0.030 0.006	0.000 0.071 0.001 0.297 0.000 0.013	0.412	11.761 0.000 12.003 0.000 4.045 0.000			L-	•
South east Asia South east Asia	Ditching 2020 Leona 2019	South east Asia South east Asia	0.150	0.008	0.000 0.013	0.196	6.412 0.000 50.847 0.000			Г <del>т</del>	
South east Asia South east Asia	Mishra 2021 Madhavan 2019	South east Asia South east Asia	0.930	0.015	0.000 0.901 0.002 0.160	0.959	62.816 0.000 5.681 0.000			<u> </u>	
South east Asia South east Asia	Bharti 2022 Wu 2020	South east Asia South east Asia	0.670	0.026	0.001 0.619						⁻ ∔₌≞ ∣
South east Asia South east Asia	Honda 2011 Muralidhar 2010	South east Asia South east Asia	0.490	0.032	0.001 0.428 0.000 0.998	1.00022	11.390 0.000				+ +
South east Asia South east Asia	Shioa 2002 Archana 2018	South east Asia South east Asia	0.620 0.380	0.018 0.022	0.000 0.584 0.000 0.337	0.423	17.312 0.000				•   •
South east Asia South east Asia	Jaybhaye 2013 Yoshikawa 2013	South east Asia South east Asia	0.600 0.520	0.052 0.009	0.003 0.499 0.000 0.502	0.538	11.619 0.000 55.448 0.000				
South east Asia South east Asia Western Pacific	Kasatpibal 2016 Ishak 2018	South east Asia Western Pacific	0.320 0.498 0.004	0.010 0.135 0.000	0.000 0.300 0.018 0.234 0.000 0.003	0.763	30.915 0.000 3.698 0.000 17.947 0.000			1	
Western Pacific Western Pacific	Silowati 2019 Guest2010	Western Pacific Western Pacific	0.270	0.028	0.001 0.216	0.324	9.769 0.000			T.	+
Western Pacific Western Pacific	Bhardwaj 2014 Fullerton 2011	Western Pacific Western Pacific	0.059	0.029	0.001 0.001 0.001 0.000 0.060	0.117	2.003 0.045 9.329 0.000				
Western Pacific Western Pacific	cui2018 Fang 2019	Western Pacific Western Pacific	0.310 0.140	0.019	0.000 0.273 0.000 0.133	0.347	16.418 0.000 40.092 0.000			<b>-</b>	•
Western Pacific Western Pacific	Hamid 2011 Irmak 2011	Western Pacific Western Pacific	0.125	0.028	0.001 0.069 0.001 0.249	0.181 0.351	4.408 0.000 11.526 0.000				.+
Western Pacific Western Pacific	Lee (2) 2005 Rampal 2010	Western Pacific Western Pacific	0.190 0.240	0.032 0.029	0.001 0.127 0.001 0.183	0.297	5.932 0.000 8.316 0.000				
Western Pacific Western Pacific	Wang 2012 Zhang 2015	Western Pacific Western Pacific	0.125 0.650	0.015	0.000 0.095 0.001 0.603	0.697	8.089 0.000 27.323 0.000			<b>-</b>	.   +
Western Pacific Western Pacific	Cheung 2010 YANG 2007	Western Pacific Western Pacific	0.190	0.024 0.022 0.006	0.001 0.143 0.000 0.457	0.543	7.914 0.000 22.956 0.000				[ <b>+</b>
Western Pacific Western Pacific Western Pacific	Dang 2020 Li 2022 Lin 2019	Western Pacific Western Pacific Western Pacific	0.190 0.070 0.020	0.006 0.003 0.001	0.000 0.179 0.000 0.063 0.000 0.018	0.077	32.880 0.000 20.140 0.000 25.572 0.000				'
Western Pacific Western Pacific	Wang 2021 Yang 2020	Western Pacific Western Pacific Western Pacific	0.020 0.670 0.064	0.001	0.001 0.624	0.716				Γ	=
Western Pacific Western Pacific Western Pacific	Zhang 2019 Choe 2013	Western Pacific Western Pacific Western Pacific	0.064 0.770 0.700	0.010	0.001 0.723	0.817	8.897 0.000 31.797 0.000 84.760 0.000			I_	*
Western Pacific Western Pacific	Cheung 2012 Cheung 2009	Western Pacific Western Pacific	0.088	0.010	0.000 0.069	0.107	9.199 0.000				
Western Pacific Western Pacific	Habib 2011 Ng Yu 2007	Western Pacific Western Pacific	0.670 0.370	0.032 0.057	0.001 0.607	0.733 0.481	20.941 0.000 6.548 0.000				₽-  ┺ ¯
Western Pacific Western Pacific	Newsom 2002 Smith 2006	Western Pacific Western Pacific	0.200 0.180	0.057 0.026	0.003 0.088 0.001 0.129	0.312 0.231	3.500 0.000 6.949 0.000				
Western Pacific Western Pacific	Smith 2005 Xia yoa 2009	Western Pacific Western Pacific	0.140	0.021 0.002 0.046	0.000 0.099	1.0034	6.679 0.000 97.747 0.000 6.671 0.000			●	<u> </u>
Western Pacific Overall			0.309 0.373	0.046	0.002 0.218 0.000 0.342	0.404		-1.00	-0.50	0.00	
								-1.00	-0.50 Favours A	uuu	0.50 1.00 Favours B
									rav0urs A		ravuus o

FIGURE 4 Subgroup analysis based on regions (WHO) [Colour figure can be viewed at wileyonlinelibrary.com]

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Group by Subgroup within study	Study name	Subgroup within study							Point estimate and 95% Cl						
Subgroup within study			Point estimate	Standard error	Variance	Lover limit	Upper limit	Z-Value	p-Value						
Egypt	Sabaa 2021	Egypt	0.680	0.021	0.000	0.639	0.721	32,136	0.000						
Egypt	Hanafi 2011	Egypt	0.732	0.017	0.000	0.698	0.766	41.973	0.000						
Egypt	Asfour2021	Egypt	0.140	0.028	0.001	0.084	0.196	4,942	0.000						
Egypt		3.1	0.518	0.163	0.027	0.198	0.838	3.177	0.001						
Iran	Askarian 2007	Iran	0.500	0.013	0.000	0.475	0.525	39.433	0.000						
Iran	Balouchi 2015	Iran	0.640	0.034	0.001	0.573	0.707	18.856	0.000						
Iran	Ehsani 2012	Iran	0.450	0.027	0.001	0.396	0.504	16.382	0.000						
Iran	Ebrahimi 2007	Iran	0.630	0.036	0.001	0.559	0.701	17.507	0.000						
Iran	Ghasemi 2017	Iran	0.600	0.030	0.001	0.541	0.659	20.012	0.000						
Iran	Galougahi 2010	Iran	0.140	0.028	0.001	0.086	0.194	5.072	0.000						
Iran	Akhuleh 2019	Iran	0.610	0.041 0.017	0.002	0.530	0.690	15.008	0.000						
Iran	Bagittini 2021	Iran	0.240	0.072	0.000	0.206	0.274	13.947	0.000						
lran Iran	Habaubi 2019 Mahmaudi 2015	lran Iran	0.720 0.410	0.049	0.000	0.677 0.314	0.763 0.506	32,706 8,336	0.000						
Iran	Mirzaei-Alavijeh 2014	Iran	0.410	0.049	0.002	0.295	0.525	6.975	0.000						
Iran	Azadi 2010	Iran	0.460	0.047	0.002	0.367	0.553	9.724	0.000						
Iran	Joukar 2018	Iran	0.400	0.047	0.002	0.539	0.601	36,590	0.000						
Iran	Jahangiri 2016	Iran	0.510	0.039	0.000	0.434	0.586	13,223	0.000						
Iran	Salmanzadeh 2016	Iran	0.150	0.034	0.001	0.084	0.216	4,426	0.000						
Iran	Shiva 2011	Iran	0.550	0.032	0.001	0.488	0.612	17.340	0.000						
Iran	Bairami 20114	Iran	0.390	0.028	0.001	0.334	0.446	13.733	0.000						
Iran	Izadi 2015	Iran	0.639	0.066	0.004	0.510	0.768	9.686	0.000						
Iran	Mohammadi 2011	Iran	0.430	0.042	0.002	0.347	0.513	10.203	0.000						
Iran	Nasiri 2010	Iran	0.740	0.032	0.001	0.677	0.803	23.008	0.000						
Iran	Shadi 2013	Iran	0.260	0.019	0.000	0.222	0.298	13.439	0.000						
Iran			0.478	0.039	0.002	0.402	0.554	12.323	0.000						
Israel	Bahat 2021	Israel	0.520	0.024	0.001	0.472	0.568	21.280	0.000						
Israel			0.520	0.024	0.001	0.472	0.568	21.280	0.000						
Jordan	abozead2015	Jordan	0.760	0.035	0.001	0.692	0.828	21.867	0.000						
Jordan	Suliman 2018	Jordan	0.260	0.026	0.001	0.209 0.901	0.311	9.901	0.000						
Jordan Jordan	Hassan 2009	Jordan	0.920 0.647	0.010 0.218	0.000	0.901	0.939 1.074	96.395 2.967	0.000						
Libya	Elzouki 2020	Libya	0.044	0.218	0.048	-0.005	0.093	1.769	0.077						
Libya		шоуа	0.044	0.025	0.001	-0.005	0.093	1.769	0.077						
Oman	Al Qadire 2021	Oman	0.180	0.029	0.001	0.123	0.030	6.216	0.000						
Oman		Giui	0.180	0.029	0.001	0.123	0.237	6.216	0.000						
Qatar	Shah 2006	Qatar	0.204	0.015	0.000	0.174	0.234	13.259	0.000						
Qatar			0.204	0.015	0.000	0.174	0.234	13,259	0.000						
Saudi Arabia	Abalkhail 2022	Saudi Arabia	0.340	0.057	0.003	0.228	0.452	5.962	0.000						
Saudi Arabia	Alsabaani 2022	Saudi Arabia	0.110	0.013	0.000	0.084	0.136	8.282	0.000						
Saudi Arabia	Al-Fulaye 2021	Saudi Arabia	0.525	0.051	0.003	0.425	0.625	10.247	0.000						
Saudi Arabia	Afridi 2013	Saudi Arabia	0.710	0.028	0.001	0.655	0.765	25.327	0.000						
Saudi Arabia	Fareed 2012	Saudi Arabia	0.440	0.050	0.002	0.343	0.537	8.864	0.000						
Saudi Arabia	Al-Moveraie 2020	Saudi Arabia	0.380	0.029	0.001	0.323	0.437	13.147	0.000						
Saudi Arabia	D : 0004	<b>T</b> .	0.417	0.118	0.014	0.186	0.648	3.540	0.000						
Turkey	Dagci 2021	Turkey	0.700	0.024	0.001	0.654	0.746	29.541	0.000						
Turkey	Duzgol 2020 Kautia 2020	Turkey	0.490 0.580	0.045 0.027	0.002 0.001	0.402	0.578 0.633	10.915 21.347	0.000						
Turkey Turkev	Kayis 2019 Ilhan 2006	Turkey Turkev	0.680	0.039	0.002	0.527 0.604	0.756	21.347	0.000						
Turkey	Sayyedeh 2012	Turkey	0.440	0.035	0.001	0.371	0.509	12.567	0.000						
Turkey	Cay your 12012	uncy	0.580	0.051	0.003	0.371	0.680	12.307	0.000						
Overall			0.265	0.010	0.000	0.400	0.285	26.379	0.000						
				0.010		0.2.0		20.010		-1.00 -0.50 0.00 0.50 1.00					
										Favours A Favours B					
										Tavous A Tavous D					

### Meta Analysis

FIGURE 5 Prevalence of NSI among nurses in Middle East [Colour figure can be viewed at wileyonlinelibrary.com]

procedure, number of included studies from each county, and the level of supervision in measuring NSI prevalence in different WHO regions. In addition, the low NSI prevalence in developed countries may be attributed to the implementation of comprehensive hospital-level NSI prevention programs, the establishment of training courses, and the availability of accurate information related to NSI management, categorization of NSIs as a priority and the establishment of a preventive perspective on NSIs among nurses. In contrast, the high NSI prevalence in developing countries in our study can be attributed to the relationship between staff shortages and NSI (Clarke et al., 2002). Nurses reported NSIs twice as often as highly staffed units, suggesting that proper staffing is safe for both patients and nurses. The reasons for underreporting of accidents by nurses include forgetting about them, underestimating the danger involved, being reluctant to disclose their ignorance about the proper use of tools, worrying about a positive serological test result, and being too busy or pressed for time (Doebbeling et al., 2003; Elmiyeh et al., 2004; Wicker et al., 2008).

We investigated the pooled prevalence in each of the 35 countries included in our meta-analysis. We found that NSI frequency varies greatly from country to country. In our meta-analysis, the highest

NSI rate was found in Ghana (70%). The NSI prevalence was 26.3% in the United States, 39.18% in China, 47.85% in Iran and 51.73% in Egypt. Another comprehensive analysis in Iran found an NSI prevalence estimate between 10% and 84.3% (Fereidouni et al., 2018). A study by Yazie et al. in Ethiopia reported a pooled NSI prevalence of 43.6% over a person's lifetime, which was similar to those in studies from India (40% and 45.0%) (Farrukh Nagi et al., 2017; Makade et al., 2017; Yazie et al., 2019), Iran (42.5%), Nigeria (46.0%), Saudi Arabia (46%) (Jahan, 2005) and Pakistan (45%) (Afridi et al., 2013). However, extremely high prevalence estimates were observed in Pakistan (77%), Iran (76%) and India (68%) (Archana Lakshmi et al., 2018; Jahangiri et al., 2016; Rais & Jamil, 2013), possibly due to a lack of occupational health and infection prevention training or a lack of suitable or proper personal protective equipment. The possible causes for this discrepancy include recall bias, modest methodological discrepancies between studies, and variations in study participants' knowledge levels, training access, and frequency of needle exposure. The prevalence varies by institution and may be affected by factors such as quality control, staffing levels, patient/ visitor ratios, the nature of the job being performed, availability of resources and expertise of the staff (Yazie et al., 2019).

# **Developed Vs. developing countries**

					_		J	
Group by Subgroup within study	Studyname	Subgroup within study Point estimate		tis <u>tics for each study</u> Lower Uppe Variance limit limi	r t Z-Value	a n-Value	Point <u>estimate</u>	and 95% CL
Developed Countries	Guest2010 Smith 2006	Developed Countries 0.065	0.007	0.000 0.052 0.078 0.001 0.129 0.231		0.000	I	
Developed Countries Developed Countries	Smith 2005	Developed Countries 0.180 Developed Countries 0.140	0.021	0.000 0.099 0.181	6.679	0.000		
Developed Countries Developed Countries	Akgur 2012 Dulon 2020	Developed Countries 0.680 Developed Countries 0.360	0.035	0.001 0.606 0.754	10.201	0.000		
Developed Countries Developed Countries	Wicker 2007 Bahat 2021	Developed Countries 0.220 Developed Countries 0.520	0.020	0.000 0.180 0.260 0.001 0.472 0.568	21.280	0.000		∎_∔
Developed Countries Developed Countries	Bagnasco 2020 Papadopoli 2019	Developed Countries 0.390 Developed Countries 0.170	0.032	0.001 0.328 0.452 0.000 0.128 0.212	7.891	0.000		
Developed Countries Developed Countries	Ferrario 2021 Rubbi 2018	Developed Countries 0.320 Developed Countries 0.062	0.011 0.006	0.000 0.298 0.342 0.000 0.049 0.075	9.630			
Developed Countries Developed Countries	Veronesi 2018 Yoshikawa 2013	Developed Countries 0.140 Developed Countries 0.520	0.007 0.009	0.000 0.127 0.153 0.000 0.502 0.538	55.448	0.000		
Developed Countries Developed Countries	Ishak 2018 Bhardwaj 2014	Developed Countries 0.004 Developed Countries 0.059	0.000 0.029	0.000 0.003 0.004 0.001 0.001 0.001 0.001	2.003			
Developed Countries Developed Countries	Hamid 2011 Lee (2) 2005	Developed Countries 0.125 Developed Countries 0.190	0.028	0.001 0.069 0.181 0.001 0.127 0.253	4.408 5.932	0.000		
Developed Countries Developed Countries	Ng Yu 2007 Newsom 2002	Developed Countries 0.370 Developed Countries 0.200	0.057 0.057	0.003 0.259 0.481 0.003 0.088 0.312	3.500	0.000		
Developed Countries Developed Countries	Rampal 2010 Fullerton 2011	Developed Countries 0.240 Developed Countries 0.076	0.029 0.008	0.001 0.183 0.297 0.000 0.060 0.092	8.316 9.329			
Developed Countries Developed Countries	Al Qadire 2021 Pakowska 2019	Developed Countries 0.180 Developed Countries 0.110	0.029 0.001	0.001 0.123 0.237 0.000 0.108 0.112	6.216 89.497	0.000		
Developed Countries Developed Countries	Shah 2006 Abalkhail 2022	Developed Countries 0.204 Developed Countries 0.340	0.015	0.000 0.174 0.234 0.003 0.228 0.452		0.000		•
Developed Countries Developed Countries	Alsabaani 2022 Al-Fulaye 2021	Developed Countries 0.110 Developed Countries 0.525	0.013 0.051	0.000 0.084 0.136 0.003 0.425 0.625	10.247	0.000		│╹ ╆╴ │
Developed Countries Developed Countries	Afridi 2013 Fareed 2012	Developed Countries 0.710 Developed Countries 0.440	0.028 0.050	0.001 0.655 0.765 0.002 0.343 0.537	8.864	0.000		│ <u> </u>
Developed Countries Developed Countries	Al-Mowaraie 2020 Leong 2019	Developed Countries 0.380 Developed Countries 0.450	0.029 0.009	0.001 0.323 0.437 0.000 0.433 0.467	50.847	0.000		
Developed Countries Developed Countries	Voide 2012 Chen 2021	Developed Countries 0.085 Developed Countries 0.026	0.007 0.006	0.000 0.071 0.099 0.000 0.013 0.039	4.045			
Developed Countries Developed Countries	Wu 2020 Shica 2002	Developed Countries 0.580 Developed Countries 0.620	0.064 0.018	0.004 0.454 0.706 0.000 0.584 0.656	33.968	0.000		
Developed Countries Developed Countries	YANG2007 Dagci 2021	Developed Countries 0.500 Developed Countries 0.700	0.022 0.024	0.000 0.457 0.543 0.001 0.654 0.746	22.956 29.541	0.000		† +
Developed Countries Developed Countries	Duzgol 2020 Kayis 2019	Developed Countries 0.490 Developed Countries 0.580	0.045	0.002 0.402 0.578 0.001 0.527 0.633	21.347	0.000 0.000		
Developed Countries Developed Countries	Ilhan 2006 Sayyedeh 2012	Developed Countries 0.680 Developed Countries 0.440	0.039	0.002 0.604 0.756 0.001 0.371 0.509	12.567	0.000 0.000		│
Developed Countries Developed Countries	katsevman2020 Choi 2017	Developed Countries 0.090 Developed Countries 0.680	0.035	0.001 0.020 0.160 0.009 0.497 0.863	2.535	0.011 0.000		
Developed Countries Developed Countries	Clarke 2002 deipolvi2017	Developed Countries 0.088 Developed Countries 0.210	0.006	0.000 0.076 0.100		0.000		■
Developed Countries Developed Countries	Lee 2005 Trinkoff 2007	Developed Countries 0.350 Developed Countries 0.160	0.027	0.001 0.297 0.403 0.000 0.145 0.175	12.982 20.642	0.000 0.000		*
Developed Countries Developing Countries	Musa 2014	0.305 Developing Countries0.456	0.017	0.000 0.273 0.338 0.002 0.367 0.545	18.349	0.000		
Developing Countries Developing Countries	Dong 2020 Yang 2020	Developing Countries0.190 Developing Countries0.064	0.006	0.000 0.179 0.201 0.000 0.045 0.083	32.880	0.000		
Developing Countries Developing Countries	Fang 2019 Li 2022	Developing Countries0.140 Developing Countries0.070	0.003	0.000 0.133 0.147 0.000 0.063 0.077	40.092	0.000 0.000		
Developing Countries Developing Countries	Lin 2019 Wang 2021	Developing Countries0.020 Developing Countries0.670	0.001	0.000 0.018 0.022	25.572	0.000		P   -
Developing Countries	Zhang 2019 cui2018	Developing Countries0.770 Developing Countries0.310	0.024	0.001 0.723 0.817 0.000 0.273 0.347	31.797 16.418	0.000 0.000		.   *
Developing Countries Developing Countries	Choe 2013 Cheung 2012	Developing Countries0.700 Developing Countries0.088	0.008	0.000 0.684 0.716 0.000 0.069 0.107	84.760 9.199	0.000		
Developing Countries Developing Countries	Chen 2009 Wang 2012	Developing Countries0.890 Developing Countries0.125	0.016 0.015	0.000 0.859 0.921 0.000 0.095 0.155	55.812	0.000 0.000		
Developing Countries Developing Countries	Xia yoa 2009 Zhang 2015	Developing Countries0.999 Developing Countries0.650	0.002	0.000 0.995 1.003 0.001 0.603 0.697	497.747 27.323	0.000		+ +
Developing Countries Developing Countries	Cheung 2010 Mbro 2007	Developing Countries0.190 Developing Countries0.210	0.024	0.001 0.143 0.237 0.001 0.162 0.258	7.914	0.000		
Developing Countries Developing Countries	sabaa 2021 Hanafi 2011	Developing Countries0.680 Developing Countries0.732	0.021	0.000 0.639 0.721 0.000 0.698 0.766	32.136	0.000		
Developing Countries Developing Countries	Asfour2021 Abadiga2020	Developing Countries0.140 Developing Countries0.330	0.028	0.001 0.084 0.196 0.001 0.277 0.383	4.942	0.000 0.000		* .   _
Developing Countries Developing Countries	Assen 2020 abebe 2018	Developing Countries0.400 Developing Countries0.430	0.035	0.001 0.332 0.468 0.002 0.351 0.509	11.489	0.000 0.000		1
Developing Countries Developing Countries	Belachew 2017 Berhan 2021	Developing Countries0.590 Developing Countries0.590	0.028	0.001 0.536 0.644 0.002 0.493 0.667	21.392 13.086	0.000		
Developing Countries Developing Countries	Gabrmariyam 2019 Getie 2020	Developing Countries0.210 Developing Countries0.720	0.029	0.001 0.154 0.266 0.001 0.647 0.793	7.291 19.442	0.000		
Developing Countries Developing Countries	Liyew 2020	Developing Countries 0.360 Developing Countries 0.480	0.029	0.001 0.303 0.417 0.001 0.436 0.524	12.278	0.000		│ ╇₄ │
Developing Countries Developing Countries	Kbeded 2018 Kbede 2012	Developing Countries0.350 Developing Countries0.280	0.030	0.001 0.291 0.409 0.001 0.212 0.348	11.649 8.035	0.000		
Developing Countries Developing Countries	Bidira 2014 Desalegn 2015	Developing Countries0.390 Developing Countries0.625	0.034 0.043	0.001 0.324 0.456 0.002 0.541 0.709	11.615 14.606	0.000 0.000		│ <sup>╼</sup> ╎ <sub>╼</sub> │
Developing Countries Developing Countries	Kaweti 2016 Kbede 2016	Developing Countries0.530 Developing Countries0.345	0.034 0.030	0.001 0.463 0.597 0.001 0.287 0.403	11.657	0.000 0.000		_ ₹ _
Developing Countries Developing Countries	Legesse 2014 Mekonnen 2018	Developing Countries0.400 Developing Countries0.570	0.047	0.002 0.307 0.493 0.002 0.488 0.652	13.671	0.000		│ <sup>╼</sup> ᠯ <sub>┹</sub> │
Developing Countries Developing Countries	Mideksa 2014 Tadesse 2016	Developing Countries0.620 Developing Countries0.570	0.036 0.035	0.001 0.549 0.691 0.001 0.501 0.639	16.282	0.000		
Developing Countries Developing Countries	Tesfay 2014 Aniaku 2019	Developing Countries0.500 Developing Countries0.700	0.046 0.024	0.002 0.410 0.590 0.001 0.653 0.747	28.902	0.000		+ + +
Developing Countries Developing Countries	Bharti 2022 Mishra 2021	Developing Countries0.670 Developing Countries0.930	0.026 0.015	0.001 0.619 0.721 0.000 0.901 0.959	62.816	0.000		
Developing Countries Developing Countries	Madhavan 2019 Sharma 2020	Developing Countries0.244 Developing Countries0.790	0.043 0.052	0.002 0.160 0.328 0.003 0.688 0.892	15.148	0.000		
Developing Countries Developing Countries	Muralidhar 2010 Archana 2018	Developing Countries0.999 Developing Countries0.380	0.000 0.022	0.000 0.998 1.000 0.000 0.337 0.423	17.312	0.000		● _ ▼
Developing Countries Developing Countries	Jaybhaye 2013 Silowati 2019	Developing Countries0.600 Developing Countries0.270	0.052 0.028	0.003 0.499 0.701 0.001 0.216 0.324	9.769	0.000		
Developing Countries Developing Countries	Askarian 2007 Balouchi 2015	Developing Countries0.500 Developing Countries0.640	0.013 0.034	0.000 0.475 0.525 0.001 0.573 0.707	18.856	0.000		│ _ Т ╼ │ │
Developing Countries Developing Countries	Ehsani 2012 Ebrahimi 2007	Developing Countries0.450 Developing Countries0.630	0.027 0.036	0.001 0.396 0.504 0.001 0.559 0.701	17.507	0.000		¶+
Developing Countries Developing Countries	Ghasemi 2017 Galougahi 2010	Developing Countries0.600 Developing Countries0.140	0.030 0.028	0.001 0.541 0.659 0.001 0.086 0.194	5.072	0.000		
Developing Countries Developing Countries	Akhuleh 2019 Bagittini 2021	Developing Countries0.610 Developing Countries0.240	0.041 0.017	0.002 0.530 0.690 0.000 0.206 0.274	13.947	0.000 0.000		.   .
Developing Countries Developing Countries	Hoboubi 2019 Mahmoudi 2015	Developing Countries0.720 Developing Countries0.410	0.049	0.000 0.677 0.763 0.002 0.314 0.506	8.336			<u>-</u> , <b>-</b>
Developing Countries Developing Countries	Azadi 2010	Meveloping Countries0.410 Developing Countries0.460	0.059 0.047	0.003 0.295 0.525 0.002 0.367 0.553	9.724	0.000		
Developing Countries Developing Countries	Joukar 2018 Jahangiri 2016	Developing Countries 0.570 Developing Countries 0.510		0.000 0.539 0.601 0.001 0.434 0.586	13.223	0.000 0.000		_ ∔
Developing Countries Developing Countries	Shiva 2011	Developing Countries0.150 Developing Countries0.550 Developing Countries0.390	0.034	0.001 0.084 0.216 0.001 0.488 0.612	17.340	0.000		│ <sup>╼╾</sup> _┢╾ │
Developing Countries Developing Countries	Bairami 2014 Izadi 2015	Developing Countries 0.639	0.028 0.066	0.001 0.334 0.446 0.004 0.510 0.768	9.686	0.000		
Developing Countries Developing Countries	Mbhammadi 2011 Nasiri 2010	Developing Countries0.430 Developing Countries0.740	0.042	0.002 0.347 0.513 0.001 0.677 0.803	23.008	0.000		_ =   +
Developing Countries Developing Countries	Shadi 2013 abozead2015	Developing Countries0.260 Developing Countries0.760	0.019 0.035	0.000 0.222 0.298 0.001 0.692 0.828	21.867	0.000		=
Developing Countries Developing Countries	Suliman 2018 Hassan 2009	Developing Countries0.260 Developing Countries0.810	0.014	0.001 0.209 0.311 0.000 0.783 0.837	58.691	0.000		
Developing Countries Developing Countries	Elzouki 2020 Small 2011	Developing Countries0.044 Developing Countries0.170		0.001 -0.005 0.093 0.001 0.118 0.222	6.368	0.000		
Developing Countries Developing Countries	Amira 2014 Hassnain 2017	Developing Countries0.450 Developing Countries0.350	0.077	0.006 0.300 0.600 0.001 0.302 0.398	14.417	0.000		
Developing Countries Developing Countries	Habib 2011 Imak 2011	Developing Countries0.670 Developing Countries0.300 Developing Countries0.300	0.026	0.001 0.607 0.733 0.001 0.249 0.351	11.526	0.000 0.000		+ <u> </u> -
Developing Countries Developing Countries	Khushdil 2013 Rehman 2020	Developing Countries0.550 Developing Countries0.700	0.069	0.002 0.460 0.640 0.005 0.565 0.835	10.132	0.000		_ 1=−−
Developing Countries Developing Countries	Ditching 2020 Kabptho 2020	Developing Countries0.150 Developing Countries0.650 Developing Countries0.252	0.023	0.001 0.104 0.196 0.001 0.576 0.724	17.184	0.000		* _   +
Developing Countries Developing Countries	Chalya 2015 Honda 2011 Kanataibal 2016	Developing Countries0.353 Developing Countries0.490 Developing Countries0.200	0.029	0.001 0.297 0.409 0.001 0.428 0.552	15.498	0.000		_ +
Developing Countries Developing Countries	Kasatpibal 2016 Kwanzaa 2020	Developing Countries0.320 Developing Countries0.430	0.010	0.000 0.300 0.340 0.002 0.341 0.519	9.515			∣ •+, ∣
Developing Countries Developing Countries	nsubuga2005	Developing Countries0.570 0.466 0.315	0.022 0.066 0.016	0.000 0.528 0.612 0.004 0.337 0.595 0.000 0.383 0.347	7.067	0.000		🔫
Overall		0.315	0.016	0.000 0.283 0.347	19.520	0.000 I -1.00 -0.	50	0.00 0.50 1.00
						Favo	ns A	Favours B

FIGURE 6 Prevalence of NSI in developed and developing countries [Colour figure can be viewed at wileyonlinelibrary.com]

# Subgroup analysis based on SDI level

<u> </u>				- J											
Group by Subgroup within study	Study name	SDI level	Rint	Standard	Statistics for	Lover	study Upper limit	714-	- 144			Point estimate	and 95% Cl		
HghniddeSDI HohniddeSDI	Al Qadire 2021 Asfour 2021	HighmiddleSDI HighmiddleSDI	estimate 0.180 0.140	error 0.029 0.028	Variance 0.001 0.001	limit 0.123 0.084	limit 0.237 0.196	Z-Value 6.216 4.942	p-Válue 0.000 0.000	I.	1		12	I	L
HghmiddeSDI HghmiddeSDI	Aktuleh 2019 Bagittini 2021	HighmiddleSDI HighmiddleSDI	0.610	0.041	0002	0.530	0.690 0.274	15008 13947	0.000				-		
HighmiddleSDI HighmiddleSDI	Ditching 2020 Dong 2020	HighmiddleSDI HighmiddleSDI	0.150 0.190	0.023	0.001	0.104 0.179	0.196 0.201	6412 32,880	0.000				*		
HighmiddeSDI HighmiddeSDI HighmiddeSDI	Httoubi 2019 Ishak 2018 Kabptho 2020	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.720 0.004 0.650	0.022 0.000 0.038	0.000 0.000 0.001	0.677 0.003 0.576	0.763 0.004 0.724	32,706 17.947 17.184	0.000 0.000 0.000				<b>•</b>		
HighmiddleSDI HighmiddleSDI	Kayis 2019 Li 2022	HighmiddleSDI HighmiddleSDI	0.580	0.027	0.001	0.527	0.633	21.347 20.140	0.000					-	
HighmiddleSDI HighmiddleSDI	Lin 2019 Leang 2019	HighmiddleSDI HighmiddleSDI	0.020 0.450	0.001	0.000	0.018 0.433	0.022 0.467	25.572 50.847	0000				F _		
HghmiddleSDI HghmiddleSDI	Mahmoudi 2015 Mirzaei-Alaviieh 2014	HighmiddleSDI HighmiddleSDI	0.410 0.410	0.049	0.002	0.314 0.295	0.506 0.525	8336 6975	0.000				_ 🗰	1	
HighmiddeSDI HighmiddeSDI HighmiddeSDI	Pakowska 2019 Slovati 2019 abozead 2015	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.110 0.270 0.760	0.001 0.028 0.035	0.000 0.001 0.001	0.108 0.216 0.692	0.112 0.324 0.828	89,497 9,769 21,867	0.000					-	
HighmiddleSDI HighmiddleSDI	Azadi 2010 Askarian 2007	HighmiddleSDI HighmiddleSDI	0.460 0.500	0.047	0.002	0.367	0.553	9724 39,433	0.000				-		
Highmiddle SDI Highmiddle SDI	Balouchi 2015 Bhardwaj 2014	HighmiddleSDI HighmiddleSDI	0.640	0034	0.001	0.573	0.707	18.856 2003	0.000				+ _	-	
HighmiddeSDI HighmiddeSDI HighmiddeSDI	cui2018 Choe2013 Cheung 2012	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.310 0.700 0.088	0.019 0.008 0.010	0.000 0.000 0.000	0.273 0.684 0.069	0.347 0.716 0.107	16418 84,760 9,199	0.000 0.000 0.000				_ <b>-</b>	•	
HighmiddeSDI HighmiddeSDI	Chen 2009 Ehsari 2012	HighmiddleSDI HighmiddleSDI	0.890	0.016	0.000	0.859	0.921	55.812 16.382	0000					-	
HighmiddleSDI HighmiddleSDI	Graseni 2017 Galougahi 2010	HighmiddleSDI HighmiddleSDI	0.600	0.030 0.028	0.001	0.541 0.086	0.659 0.194	20.012 5.072	0000				÷ _	-	
HghmiddeSDI HghmiddeSDI HahmiddeSDI	Hassnain 2017 Honda 2011 Hanafi 2011	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.360 0.490 0.732	0.024 0.032 0.017	0.001 0.001 0.000	0.302 0.428 0.696	0.398 0.552 0.766	14.417 15.498 41.973	0.000 0.000 0.000				-	ŧ _	
HighmiddleSDI HighmiddleSDI	Hamid 2011 Ihan 2006	HighmiddleSDI HighmiddleSDI	0.125	0.028	0.001 0.002	0.069	0.181	4408	0.000				+		
HighmiddleSDI HighmiddleSDI	Jouker 2018 Jahangiri 2016	HighmiddleSDI HighmiddleSDI	0.570 0.510	0.016	0.000 0.001	0.539 0.434	0.601	36.590 13.223	0.000					-	
HighmiddleSDI HighmiddleSDI	Kasalpibal 2016 Khushdil 2013	HighmiddleSDI HighmiddleSDI	0.320	0.010	0.000	0.300	0.340	30.915 12.009	0.000				· · ·	╆╾	
HighmiddeSDI HighmiddeSDI HighmiddeSDI	Lee (2) 2005 Musa 2014 Ng Yu 2007	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.190 0.466 0.370	0.032 0.046 0.057	0.001 0.002 0.003	0.127 0.367 0.259	0.253 0.545 0.481	5.982 9.987 6.548	0.000 0.000 0.000					+	
HghmiddleSDI HghmiddleSDI	Navisom2002 Rampal 2010	HighmiddleSDI	0200	0.057	0.003	0.088	0.312 0.297	3.500 8.316	0.000						
HighmiddleSDI HighmiddleSDI	Suliman 2018 Salmanzadah 2016	HighmiddleSDI HighmiddleSDI	0.260	0.026	0.001 0.001	0.209 0.084	0.311 0.216	9901 4.426	0.000				-**	L	
HghmiddeSDI HghmiddeSDI HghmiddeSDI	Shiva.2011 Smith.2006 Shah.2006	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.550 0.180 0.204	0.032 0.026 0.015	0.001 0.001 0.000	0.488 0.129 0.174	0.612 0.231 0.234	17.340 6949 13.259	0.000 0.000 0.000				1 <b>t</b>		
HighmiddleSDI HighmiddleSDI	Smith 2005 Wang 2012	HghmiddleSDI	0.140	0.015	0000	0.099	0.181	6679	0.000						
HighmiddleSDI HighmiddleSDI	Xiayoa2009 Zhang 2015	HighmiddleSDI HighmiddleSDI	0.999 0.660	0.002	0.000	0.995 0.603	1.003	497.747 27.323	0.000					-	1
HghmiddleSDI HghmiddleSDI	Bairami 2014 Cheung 2010	HighmiddleSDI HighmiddleSDI	0.390	0.028	0.001	0.334	0.446 0.237 0.837	13,733 7,914 58,691	0000				- *	I _	
HghmiddeSDI HghmiddeSDI HghmiddeSDI	Hassan 2009 Izadi 2015 Mohammadi 2011	HighmiddleSDI HighmiddleSDI HighmiddleSDI	0.810 0.639 0.430	0.014 0.066 0.042	0.000 0.004 0.002	0.783 0.510 0.347	0.768	9686 10.203	0.000 0.000 0.000					╞╼╌╹	
HighmiddleSDI HighmiddleSDI	Nasiri 2010 Shadi 2013	HighmiddleSDI HighmiddleSDI	0.740 0.260	0.032	0.001 0.000	0.677 0.222	0.803	23008 13,439	0.000					-	
HighmiddleSDI HighSDI	Dulon 2020	HighSDI	0.394	0.030	0.001	0.335	0.454 0.429	12929 10201	0.000				-		
HghSDI HghSDI HghSDI	Ferrario 2021 Fang 2019 katsevnan 2020	HighSDI HighSDI HighSDI	0.320 0.140 0.090	0.011 0.003 0.035	0.000 0.000 0.001	0.298 0.133 0.020	0.342 0.147 0.160	28.109 40.092 2535	0.000 0.000 0.011				<b>.</b>		
HghSDI HghSDI	Papadopoli 2019 Veronesi 2018	High SDI High SDI	0.170	0.022	0000	0.128	0.212	7.891 21.128	0.000						
HighSDI HighSDI	Wang 2021 Wu 2020	High SDI High SDI	0.670 0.580	0.024	0.001	0.624 0.454	0.716 0.706	28.498 9.026	0.000				L -	<b>⊨</b> ≞	
HighSDI HighSDI HighSDI	Yang 2020 Zhang 2019 Algur 2012	HighSDI HighSDI HighSDI	0.064 0.770 0.680	0.010 0.024 0.038	0.000 0.001 0.001	0.045 0.723 0.606	0.083 0.817 0.754	6697 31.797 17.913	0.000 0.000 0.000					_*	
HghSDI HghSDI	Chri 2017 Clarke 2002	HghSDI HghSDI	0.680	0.093	0009	0.497	0.863	7.289 14.550	0.000					┝╼╴	
HghSDI HghSDI	deipolyi2017 Ebrahimi 2007	HighSDI HighSDI	0.210 0.630	0.016	0.000 0.001	0.178 0.559	0.242	12879 17.507	0000				•		
HghSDI HghSDI HghSDI	Fareed 2012 Fullerton 2011 Guest 2010	HighSDI HighSDI HighSDI	0.440 0.076 0.065	0.050	0.002 0.000 0.000	0.343 0.060 0.052	0.537 0.092 0.078	8.864 9.329 9.510	0.000 0.000 0.000					T	
HghSDI HghSDI	Lee 2005 Muralicher 2010	HghSDI HghSDI	0.360	0.027	0.001	0.297	0.403	12982 2211.390	0.000						1
High SDI High SDI	Shica2002 Trinkoff 2007	High SDI High SDI	0.620 0.160	0.018	0000 0000	0.584 0.145	0.656 0.175	33.988 20.642	0.000					-	
HghSDI HghSDI	Wicker 2007 Afridi 2013 Rubbi 2018	High SDI High SDI High SDI	0.220 0.710 0.062	0.020 0.028 0.006	0.000 0.001 0.000	0.180 0.665 0.049	0.280 0.765 0.075	10.754 25.327 9.630	0.000 0.000 0.000					-	
HghSDI HghSDI HghSDI	Sayedeh 2012 Voide 2012	HghSDI HghSDI	0.440	0005	0.001	0.371	0.509	12567 11.761	0000				<b>-</b> −	1	
HghSDI HghSDI	Yoshikawa.2013 YANG.2007	HighSDI HighSDI	0.520 0.500	0.009	0.000	0.502 0.457	0.538 0.543	55,448 22,956	0000				_ +		
HghSD HghSD HghSD	Abelikheil 2022 Alsebeeni 2022 Al-Fulave 2021	HighSDI HighSDI HighSDI	0.340 0.110 0.525	0.057 0.013 0.051	0.003 0.000 0.003	0.228 0.084 0.425	0.452 0.136 0.625	5962 8282 10247	0.000 0.000 0.000						
HghSDI HghSDI	A-Moveraie 2020 Bahat 2021	HighSDI HighSDI	0.380	0.029	0003	0.323 0.472	0.437 0.568	13.147 21.280	0.000				-	Ē.	
HghSDI HghSDI	Bagnasco 2020 Chen 2021	High SDI High SDI	0.390 0.026	0.032	0.001 0.000	0.328 0.013	0.452 0.039	12.335 4.045	0.000						
HghSDI HghSDI LowniddeSDI	Dagci 2021 Elzouki 2020	HighSDI LowmiddleSDI	0.700 0.373 0.044	0.024 0.098 0.025	0.001 0.010 0.001	0.654 0.181 -0.005	0.746 0.566 0.093	29.541 3.796 1.769	0.000 0.000 0.077					-	
Lownidde SDI Lownidde SDI	Mishra 2021 Madhavan 2019	Lownidde SDI	0980	0.015	0000	0.901	0.959	62.816 5.681	0.000				<b>□</b>		•
Lowmiddle SDI Lowmiddle SDI	sabaa 2021 Bharti 2022	LowmiddleSDI LowmiddleSDI	0.680 0.670	0.021	0.000	0.639 0.619	0.721 0.721	32.136 25.884	0.000				_	1	
LowniddeSDI LowniddeSDI LowniddeSDI	Amira2014 Habib2011 Imak2011	LowniddleSDI LowniddleSDI LowniddleSDI	0.460 0.670 0.300	0.077 0.032 0.026	0.006 0.001 0.001	0.300 0.607 0.249	0.600 0.733 0.351	5.862 20.941 11.526	0.000 0.000 0.000					<b>⊢</b> ⊷	
Lownidde SDI Lownidde SDI	Maro 2007 Archana 2018	LowniddeSDI	0210	0025	0.001	0.162	0.258 0.423	8534 17312	0000				-		
Lowmiddle SDI Lowmiddle SDI	Jajohaye 2013 Rehman 2020	LowmiddleSDI	0.600	0.052	0.003	0.499 0.565	0.701	11.619 10.132	0.000				_		
LowniddeSDI LowSDI	Tadasse 2016	LowSDI	0.489	0.093	0.009	0.307	0.672	5258 16282	0.000					<b>I</b>	
ICE/VICI ICE/VICI ICE/VICI ICE/VICI	Abadiga2020 Assen 2020 Ariaku 2019	LawSDI LawSDI LawSDI	0.330 0.400 0.700	0.027 0.035 0.024	0.001 0.001 0.001	0.277 0.332 0.663	0.383 0.468 0.747	12095 11.489 28.902	0.000 0.000 0.000				-		
ICE/ALL	Berhan 2021 Gabrmaniyam 2019	LowSDI LowSDI	0.580	0.044	0.002	0.493	0.667	13.086 7.291	0.000				-	╞═╌╴	
ICEvical ICEvical	Getie 2020 Kwanzae 2020	LowSDI LowSDI	0.720	0.037	0.001	0.647 0.341	0.793	19.442 9.515	0.000				<del>•</del>	╡╺┻╴	
DavaD LavSD LavSD	Liyew2020 ababe2018 Alemawehu2016	ICEWAL ICEWAL ICEWAL	0.360 0.430 0.480	0.029 0.040 0.022	0.001 0.002 0.001	0.303 0.351 0.436	0.417 0.509 0.524	12.278 10.673 21.397	0.000 0.000 0.000				•		
(CE)vol	Belachew/2017 Chalya/2015	LowSDI LowSDI	0.590 0.363	0.028	0.001	0.536 0.297	0.644	21.392 12.316	0.000				<b>-</b>	]=	
LowSDI LowSDI	Kbeded2018 Kbede2012	LowSDI LowSDI	0.350 0.280	0.030	0.001	0.291 0.212	0.409 0.348	11.649 8.035	0.000				-	<b> _</b>	
D2vaJ D2vaJ D2vaJ	nsubuga2005 Small 2011 Bidira 2014	ICEWAL ICEWAL ICEWAL	0.570 0.170 0.390	0.022 0.027 0.034	0.000 0.001 0.001	0.528 0.118 0.324	0.612 0.222 0.456	26406 6.368 11.615	0.000 0.000 0.000				• -	1	
LoveDi LoveDi LoveDi	Bidira 2014 Desalegn 2015 Kaweti 2016	LowSDI LowSDI	0.625 0.530	0.043	0.002 0.001	0.324 0.541 0.463	0.466 0.709 0.597	11.615 14.606 15.462	0000				.		
LOWSDI LOWSDI	Kbede 2016 Legesse 2014	LowSDI LowSDI	0.345 0.400	0.030	0.001	0.287 0.307	0.403 0.493	11.657 8.446	0.000				🔹	ł_	
الكامط الكامط الكامط	Makamen 2018 Mataksa 2014 Testav 2014	ICE/VICI ICE/VICI ICE/VICI	0.570 0.620 0.500	0.042 0.036 0.046	0.002 0.001 0.002	0.488 0.549 0.410	0.652 0.691 0.590	13.671 17.137 10.909	0.000 0.000 0.000					[	
LovSDI Overall	∙coloy∠J™	Linut	0.459 0.427	0.031	0.002 0.001 0.000	0.399	0.520 0.468	10909 14,864 20,668	0.000				🟅	F	
										-1.00	-0.5	10 0		50	1.00
											Facus	sA	Facu	rsB	

To decrease NSI prevalence worldwide, we should establish and improve the registration and reporting system for nurses and HCWs after injuries, arrange reasonable working hours, add occupational protection courses, provide adequate occupational protection equipment, and commit to safety in the workplace (Choi et al., 2017; Garcia, 2017). We must also abide by the following rules: do not recap needles after use and dispose of them in a secure container, and always use gloves when handling needles that have come into contact with bodily fluids.

#### 5.1 **Strengths and limitations**

The strengths of our study include the following: we conducted the most comprehensive study with a large number of nurses (267,237) from 35 different countries, ensuring a high level of evidence and certainty. In addition, we performed different subgroup analyses according to WHO region, SDI, and developing or developed countries, as well as meta-regression model analysis based on different variables. The limitations we faced included a high level of heterogeneity in the pooled studies, self-reporting outcomes vulnerable to recall bias, which may affect the prevalence rate, and most of the studies being in high-middle SDI countries, which limited the clarification of results and generalised them, especially in low SDI countries.

#### CONCLUSION 6

Our results showed a high worldwide NSI prevalence of 41% among nurses. The pooled prevalence in developing countries was significantly higher than in developed countries, especially in countries with a low-middle SDI. The persistently high NSI prevalence despite the use of preventative measures points to either the inadequacy of present management practices or a failure to strictly follow established protocols. Standardised training programs to improve nurses' knowledge, performance and attitude are essential, as is revising existing programs to integrate diverse programs in developed countries and applying the basic principles of NSI prevention in less developed countries that lack a systematic NSI management program.

#### 6.1 **Relevance to clinical practice**

Nurses provide more direct patient care than other medical professionals. They account for the largest proportion of needle stick injuries (NSI) among healthcare workers. The most frequent NSIs occur during medicine delivery, surgical operations, blood sample collection, needle recapping and improper disposal. This study highlighted the prevalence of NSI risk among nurses practising in clinical settings worldwide. This study suggests that continuous training programs should be implemented for nurses to enhance their knowledge, performance, and attitude toward NSI prevention in clinical settings.

### AUTHOR CONTRIBUTIONS

The authors in this study contributed to the drafting of the paper. Study design, data analysis, data interpretation, revisions, and manuscript preparation: MA, FA and HF; data acquisition and analysis and manuscript revision: MM, IB, AAL, AM and AAB. All authors of this work approved the manuscript version before submission.

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### CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

### DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

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### SUPPORTING INFORMATION

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