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REVIEW

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, 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-to-patient 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).

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.

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 meta-analysis 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 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 random-effect 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. I^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.

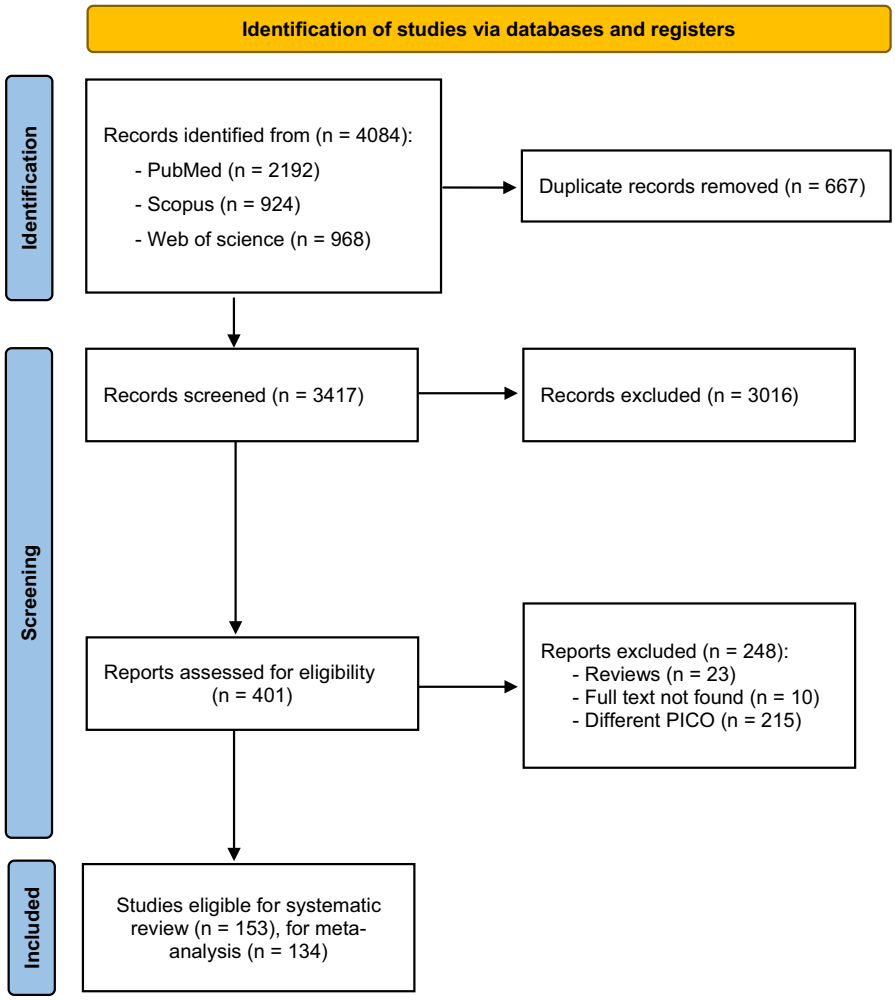

FIGURE 1 PRISMA flow diagram of study identification and selection process [Colour figure can be viewed at wileyonlinelibrary.com]

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 ($p < 0.00001$, $I^2 = 99.99\%$). 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 ($p < .00001$, $I^2 > 99\%$). 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,

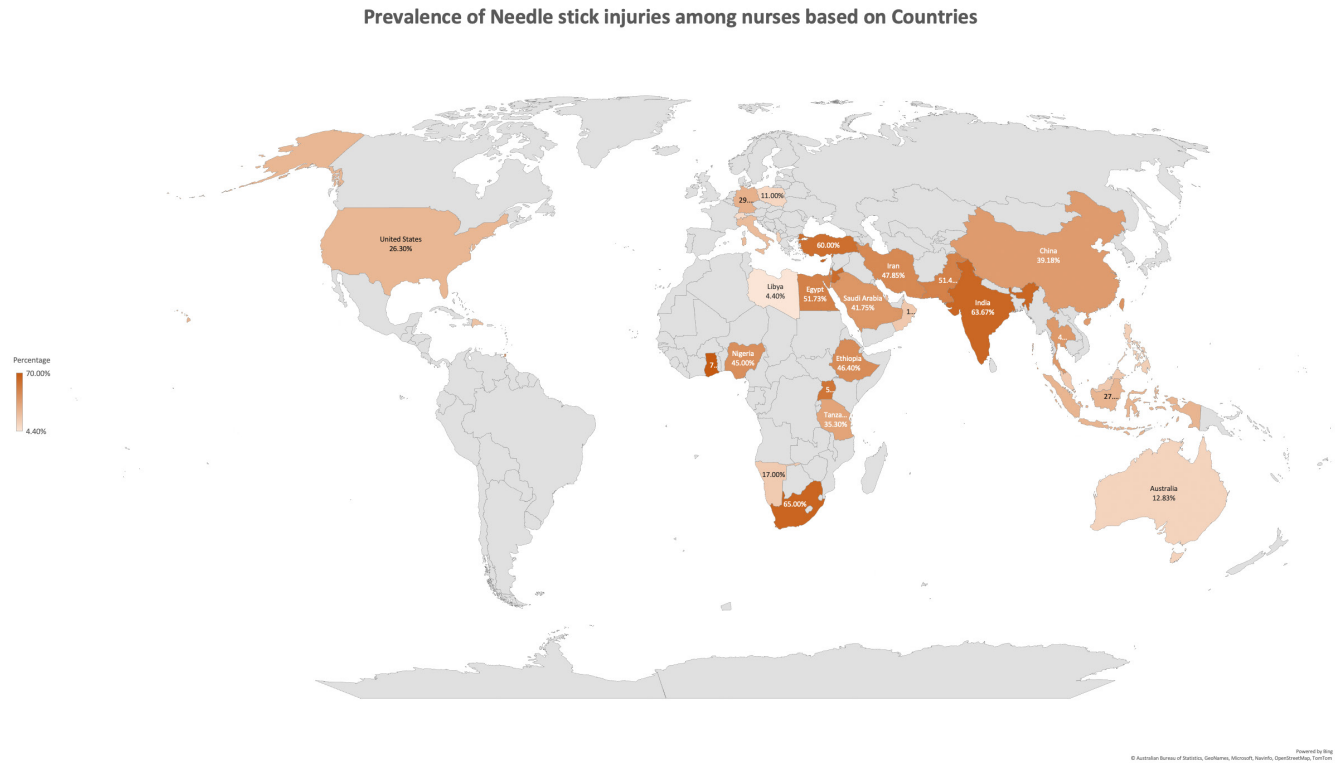

FIGURE 2 Prevalence of NSI among nurses based on countries [Colour figure can be viewed at wileyonlinelibrary.com]

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 ($p < .00001$, $I^2 = 96.2\%$). 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 male–female 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

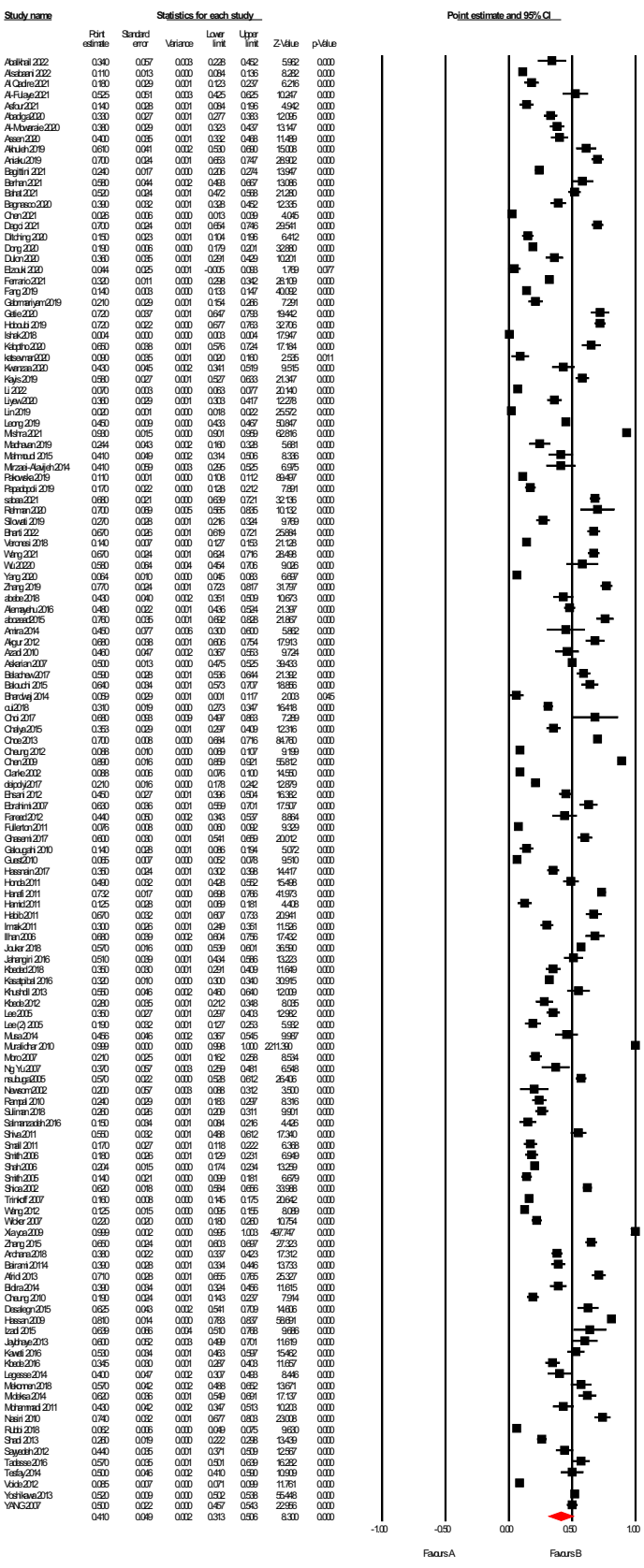

FIGURE 3 Overall prevalence of NSI among nurses [Colour figure can be viewed at wileyonlinelibrary.com]

Subgroup analysis based on regions (WHO)

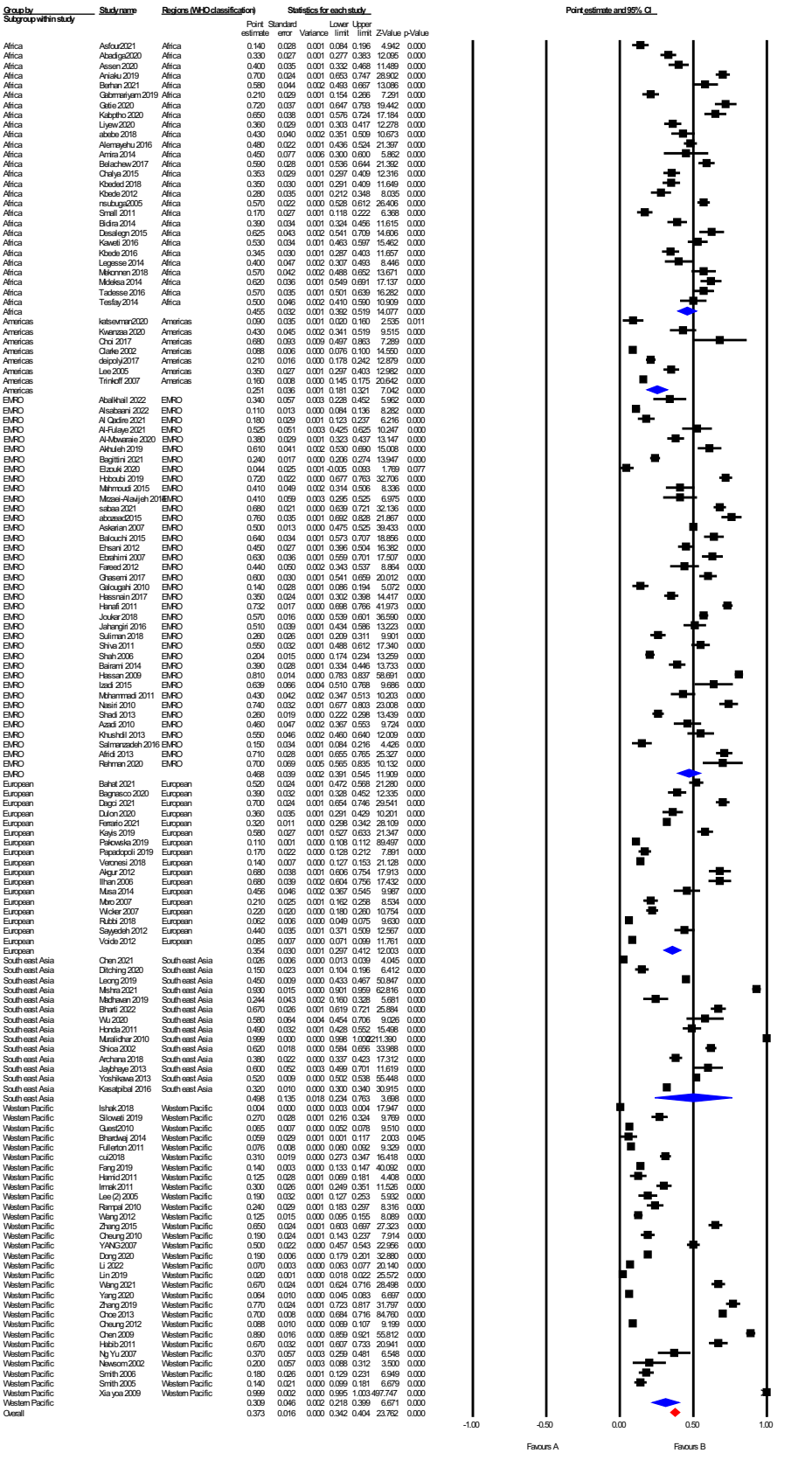

FIGURE 4 Subgroup analysis based on regions (WHO) [Colour figure can be viewed at wileyonlinelibrary.com]

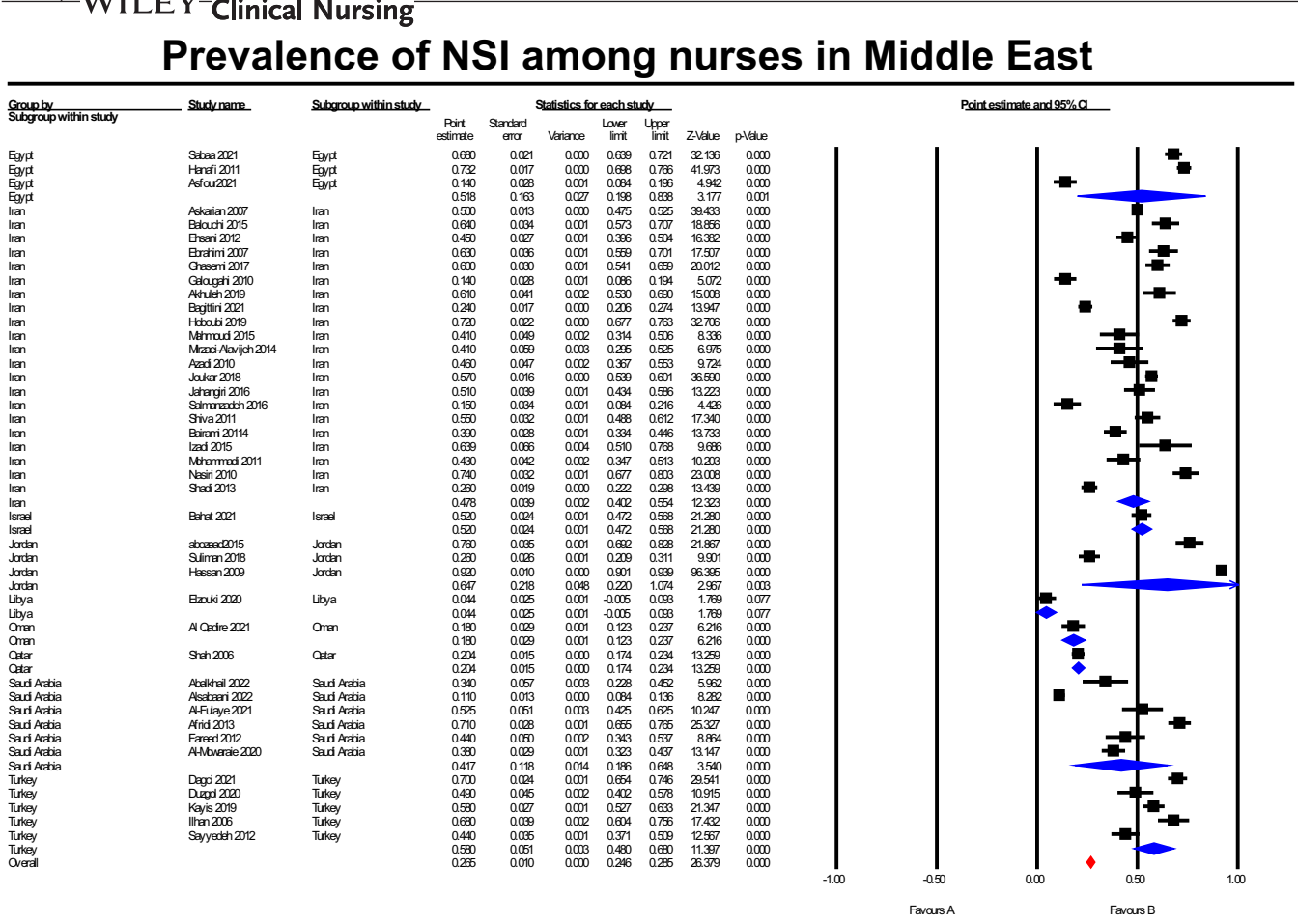

FIGURE 5 Prevalence of NSI among nurses in Middle East [Colour figure can be viewed at wileyonlinelibrary.com]

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

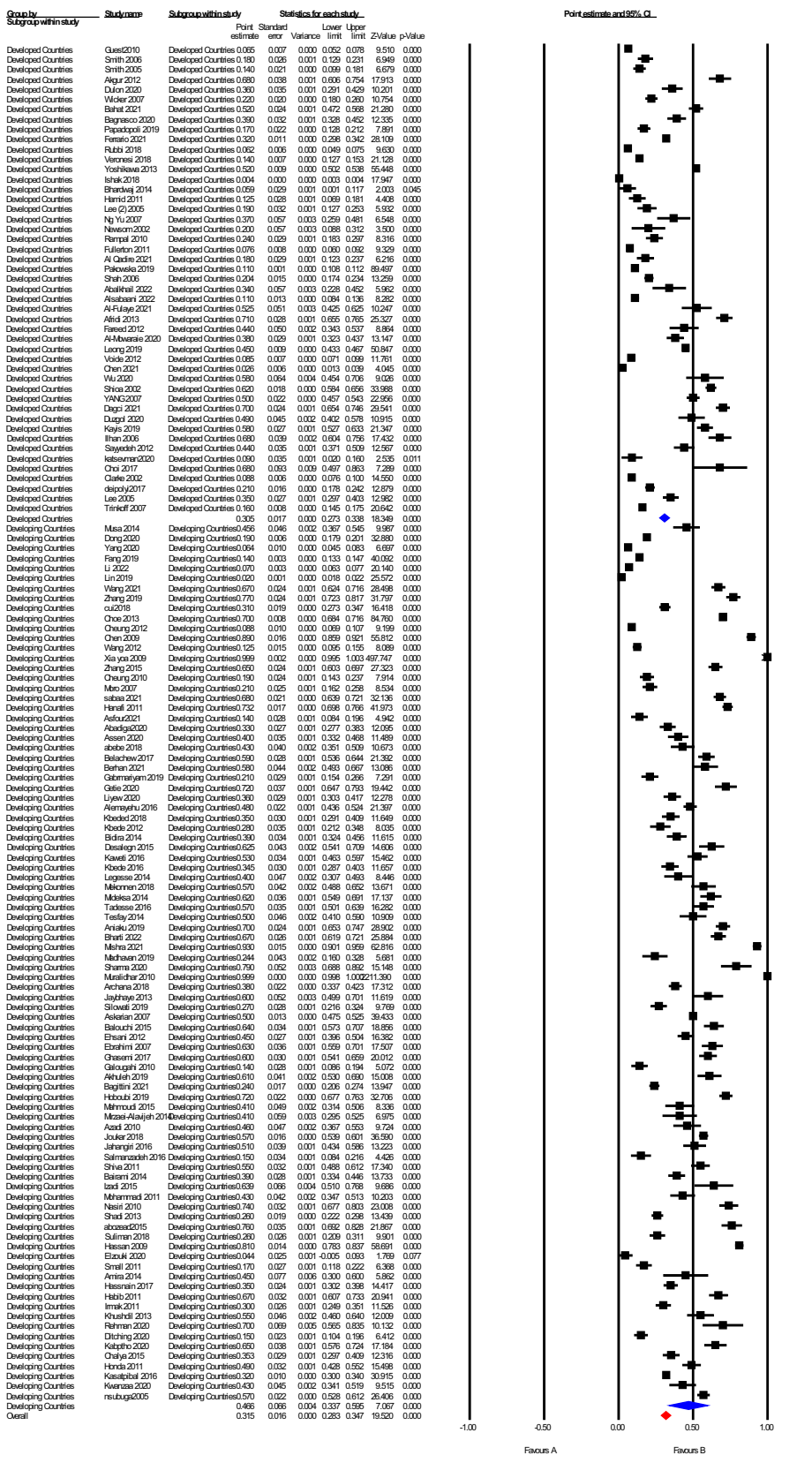

FIGURE 6 Prevalence of NSI in developed and developing countries [Colour figure can be viewed at wileyonlinelibrary.com]

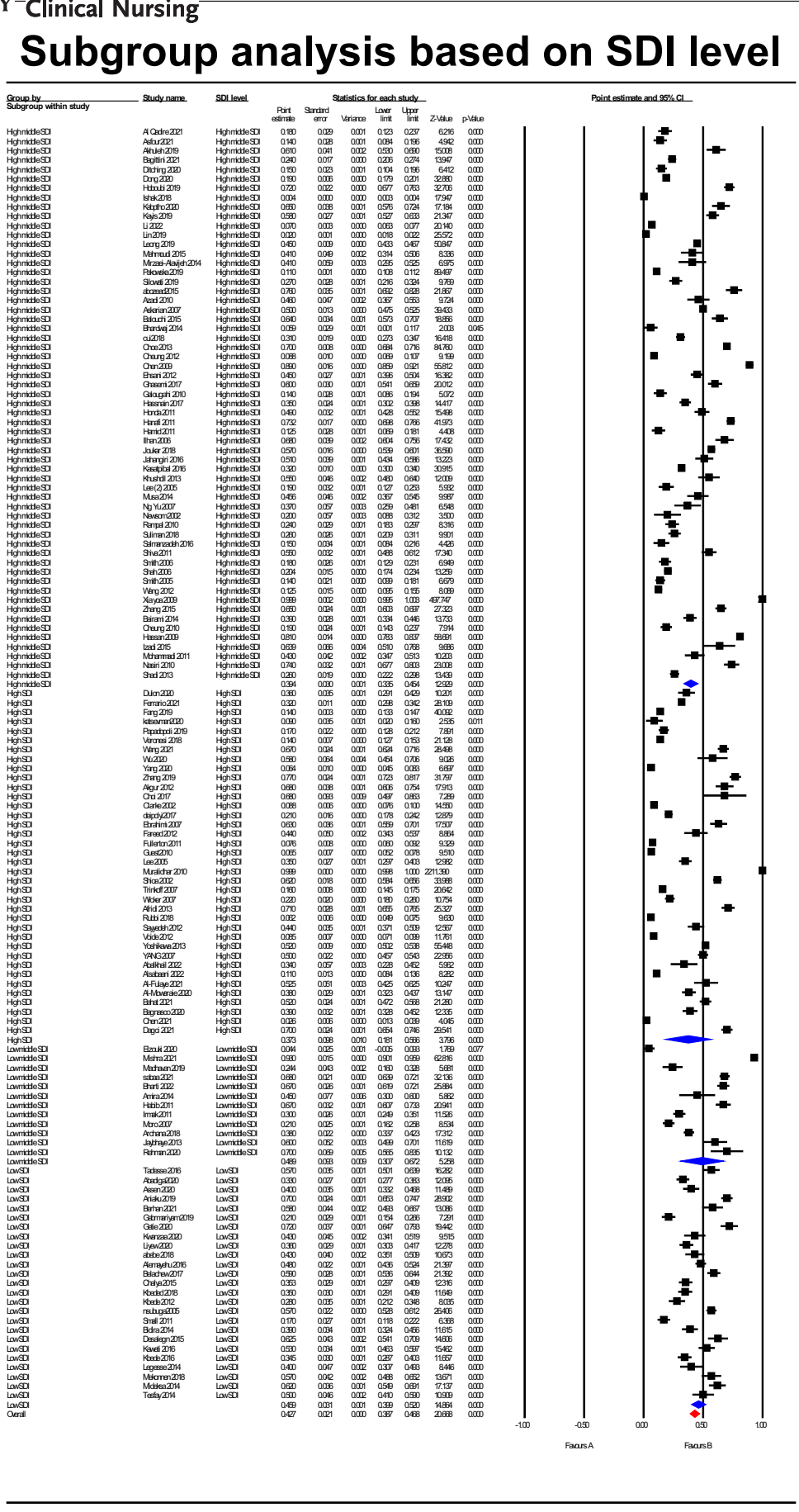

FIGURE 7 Subgroup analysis based on SDI level [Colour figure can be viewed at wileyonlinelibrary.com]

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.

6 | CONCLUSION

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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REFERENCES

Abebe, A. M., Kassaw, M. W., & Shewangashaw, N. E. (2018). Prevalence of needle-stick and sharp object injuries and its associated factors among staff nurses in Dessie referral hospital Amhara region, Ethiopia, 2018. *BMC Research Notes*, *11*(1), 840. https://doi.org/10.1186/s13104-018-3930-4

Afridi, A. A. K., Kumar, A., & Sayani, R. (2013). Needle stick injuries–risk and preventive factors: A study among health care workers in tertiary care hospitals in Pakistan. *Global Journal of Health Science*, *5*(4), 85–92. https://doi.org/10.5539/gjhs.v5n4p85

Archana Lakshmi, P. A., Raja, A., Meriton Stanly, A., Paul, C. M., & Gladius Jennifer, H. (2018). A cross sectional study on needle stick and sharp injuries among health care providers in tertiary centers, Tamil Nadu. *International Journal of Community Medicine and Public Health*, *5*(3), 982. https://doi.org/10.18203/2394-6040.ijcmph20180524

Auta, A., Adewuyi, E. O., Tor-Anyiin, A., Aziz, D., Ogbole, E., Ogbonna, B. O., & Adeloye, D. (2017). Health-care workers' occupational exposures to body fluids in 21 countries in Africa: Systematic review and meta-analysis. *Bulletin of the World Health Organization*, *95*(12), 831F–841F. https://doi.org/10.2471/BLT.17.195735

Auta, A., Adewuyi, E. O., Tor-Anyiin, A., Edor, J. P., Kureh, G. T., Khanal, V., Oga, E., & Adeloye, D. (2018). Global prevalence of percutaneous injuries among healthcare workers: A systematic review and meta-analysis. *International Journal of Epidemiology*, *47*(6), 1972–1980. https://doi.org/10.1093/ije/dyy208

Bekele, A., Kotisso, B., & Shiferaw, S. (2008). Work-related operating theatre accidents among surgical residents in Addis Ababa, Ethiopia. *East and Central African Journal of Surgery*, *13*(1), 27–33.

CDC. (2010). *Sharps injuries stop sticks campaign*. Centers for Disease Control and Prevention; National Institute for Occupational Safety and Health.

Centers for Disease Control and Prevention. (2008). *Workbook for designing, implementing and evaluating a sharp injury prevention program*. The Centers. www.cdc.gov/sharpssafety/pdf/sharpsworkbook_2008.pdf.

Choi, L. Y., Torres, R., Syed, S., Boyle, S., Ata, A., Beyer, T. D., & Rosati, C. (2017). Sharps and Needlestick injuries among medical students, surgical residents, faculty, and operating room staff at a single academic institution. *Journal of Surgical Education*, *74*(1), 131–136. https://doi.org/10.1016/j.jsurg.2016.06.003

Clarke, S. P., Rockett, J. L., Sloane, D. M., & Aiken, L. H. (2002). Organizational climate, staffing, and safety equipment as predictors of needlestick injuries and near-misses in hospital nurses. *American Journal of Infection Control*, *30*(4), 207–216. https://doi.org/10.1067/mic.2002.123392

De Laune, S. (1990). Risk reduction through testing, screening and infection control precautions: With special emphasis on Needlestick injuries. *Infection Control and Hospital Epidemiology*, *11*(10), 563–565. https://doi.org/10.2307/30145186

Deisenhammer, S., Radon, K., Nowak, D., & Reichert, J. (2006). Needlestick injuries during medical training. *Journal of Hospital Infection*, *63*(3), 263–267. https://doi.org/10.1016/j.jhin.2006.01.019

Doebbeling, B. N., Vaughn, T. E., McCoy, K. D., Beekmann, S. E., Woolson, R. F., Ferguson, K. J., & Torner, J. C. (2003). Percutaneous injury, blood exposure, and adherence to standard precautions: Are hospital-based health care providers still at risk? *Clinical Infectious Diseases*, *37*(8), 1006–1013. https://doi.org/10.1086/377535

Elmiyeh, B., Whitaker, I. S., James, M. J., Chahal, C. A. A., Galea, A., & Alshafi, K. (2004). Needle-stick injuries in the National Health Service: A culture of silence. *JRSM*, *97*(7), 326–327. https://doi.org/10.1258/jrsm.97.7.326

Farrukh Nagi, M. L., Haider Kazmi, S. T., Saleem, A. A., Khan, D., Afsar, H. H., & Akhtar, H. S. (2017). Needle stick and sharps injuries. *The Professional Medical Journal*, *24*(11), 1685–1690. https://doi.org/10.29309/tpmj/2017.24.11.665

Fereidouni, Z., Kameli Morandini, M., Dehghan, A., Jamshidi, N., & Najafi Kalyani, M. (2018). The prevalence of Needlestick injuries and exposure to blood and body fluids among Iranian healthcare workers: A systematic review. *International Journal of Medical Reviews*, *5*(1), 35–40. https://doi.org/10.29252/ijmr-050106

Foley, M., & Leyden, A. (2012). American nurses association independent study module, needlestick safety and prevention, 2003. *Sóttþann*, *2*, 3–6.

Garcia, V. H. (2017). Preventive training among medical interns in Mexico City and its association with Needlestick and sharp injuries – A cross sectional study. *Journal of Clinical and Diagnostic Research*, *11*, IC05–IC07. https://doi.org/10.7860/JCDR/2017/24606.9594

Hanafi, M. I., Mohamed, A. M., Kassem, M. S., & Shawki, M. (2011). Needlestick injuries among health care workers of University of Alexandria hospitals. *Eastern Mediterranean Health Journal*, *17*(1), 26–35. https://doi.org/10.26719/2011.17.1.26

Jahan, S. (2005). Epidemiology of needlestick injuries among the health care workers in a secondary care hospital in Saudi Arabia. *Annals of Saudi Medicine*, *25*(3), 233–238. https://doi.org/10.5144/0256-4947.2005.233

Jahangiri, M., Rostamabadi, A., Hoboubi, N., Tadayon, N., & Soleimani, A. (2016). Needle stick injuries and their related safety measures among nurses in a university hospital, shiraz, Iran. *Safety and Health at Work*, *7*(1), 72–77. https://doi.org/10.1016/j.shaw.2015.07.006

Jovic-Vranes, A., Jankovic, S., & Vranes, B. (2006). Safety practice and professional exposure to blood and blood-containing materials in Serbian health care workers. *Journal of Occupational Health*, *48*(5), 377–382. https://doi.org/10.1539/joh.48.377

Kakizaki, M., Ikeda, N., Ali, M., Enkhtuya, B., Tsolmon, M., Shibuya, K., & Kuroiwa, C. (2011). Needlestick and sharps injuries among health care workers at public tertiary hospitals in an urban community in Mongolia. *BMC Research Notes*, *4*, 184. https://doi.org/10.1186/1756-0500-4-184

Kebede, A., & Gerensea, H. (2018). Prevalence of needle stick injury and its associated factors among nurses working in public hospitals of Dessie town, Northeast Ethiopia, 2016. *BMC Research Notes*, *11*(1), 413. https://doi.org/10.1186/s13104-018-3529-9

Kermode, M., Jolley, D., Langkham, B., Thomas, M. S., & Crofts, N. (2005). Occupational exposure to blood and risk of bloodborne virus infection among health care workers in rural north Indian health care settings. *American Journal of Infection Control*, *33*(1), 34–41. https://doi.org/10.1016/j.ajic.2004.07.015

Lee, J. M., Botteman, M. F., Nicklasson, L., Cobden, D., & Pashos, C. L. (2005). Needlestick injury in acute care nurses caring for patients with diabetes mellitus: A retrospective study. *Current Medical Research and Opinion*, *21*(5), 741–747. https://doi.org/10.1185/030079905X46205

Lee, W. C., Nicklasson, L., Cobden, D., Chen, E., Conway, D., & Pashos, C. L. (2005). Short-term economic impact associated with occupational needlestick injuries among acute care nurses. *Current Medical Research and Opinion*, *21*(12), 1915–1922. https://doi.org/10.1185/030079905X65286

Makade, K. G., Bhawnani, D., Verma, N., & Dengani, M. (2017). Knowledge and response of health care workers after needle - stick injury in a tertiary care hospital setting in tribal Rajnandgaon, Chhattisgarh, India. *International Journal of Research in Medical Sciences*, *5*(3), 816. https://doi.org/10.18203/2320-6012.ijrms20170534

Motaarefi, H. (2016). Factors associated with needlestick injuries in health care occupations: A systematic review. *Journal of Clinical and Diagnostic Research*, *10*, IE01–IE04. https://doi.org/10.7860/JCDR/2016/17973.8221

Nagandla, K., Kumar, K., Bhardwaj, A., Yhmin, C., Lun, L. W., Shi, W. W., & Abd Razak, N. I. B. (2015). Prevelence of needlestick Injuries and their under-reporting among health care workers in the departments of obstetrics and gynaecology. *International Archives of Medicine*, *18*, 8.

NIH-National Health, Lung, and Blood Institute. (2021). Available from: https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools.

Norsayani, M. Y., & Hassim, I. N. (2003). Study on incidence of needle stick injury and factors associated with this problem among medical students. *Journal of Occupational Health*, *45*(3), 172–178. https://doi.org/10.1539/joh.45.172

Nsubuga, F. M., & Jaakkola, M. S. (2005). Needle stick injuries among nurses in sub-Saharan Africa. *Tropical Medicine and International Health*, *10*(8), 773–781. https://doi.org/10.1111/j.1365-3156.2005.01453.x

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/BMJ.N71

Prüss-Üstün, A., Rapiti, E., & Hutin, Y. (2003). *Global burden of disease from sharps injuries to health-care workers*. *Environmental Burden of Disease Series*, *No. 3*. World Health Organization Protection of the Human Environment.

Rais, N., & Jamil, H. M. (2013). Prevalence of needle stick injuries among health care providers. *International Journal of Endorsing Health Science Research*, *1*(2), 73–79.

Ramsay, J. A. (2005). The development and use of JHAs in the emergency department. *Journal of Safety, Health and Environmental Research*, *2*(2), 2–18.

Rodrigues, G. (2010). Needlestick injuries and the health care worker. *Indian Journal of Medical Research*, *131*, 384–386.

Royal College of Nursing. (2009). *Needlestick injuries: the point of prevention*. Author. Available from: https://www.rcn.org.uk/__data/assets/pdf_file/0007/230884/003313.pdf

Sagoe-Moses, C., Pearson, R. D., Perry, J., & Jagger, J. (2001). Risks to health Care Workers in Developing Countries. *New England Journal of Medicine*, *345*(7), 538–541. https://doi.org/10.1056/nejm200108163450711

Saia, M., Hofmann, F., Sharman, J., Abiteboul, D., Campins, M., Burkowitz, J., Choe, Y., & Kavanagh, S. (2010). Needlestick injuries: incidence and cost in the United States, United Kingdom, Germany, France, Italy, and Spain. *Biomedicine International*, *1*, 41–49.

Senthil, A., Anandh, B., Jayachandran, P., Thangavel, G., Josephin, D., Yamini, R., & Kalpana, B. (2015). Perception and prevalence of work-related health hazards among health care workers in public health facilities in southern India. *International Journal of Occupational and Environmental Health*, *21*(1), 74–81. https://doi.org/10.1179/2049396714Y.0000000096

Sharma, G. K., Gilson, M. M., Nathan, H., & Makary, M. A. (2009). Needlestick injuries among medical students: Incidence and implications. *Academic Medicine*, *84*(12), 1815–1821. https://doi.org/10.1097/ACM.0b013e3181bf9e5f

Shiao, J., Guo, L., & McLaws, M. L. (2002). Estimation of the risk of bloodborne pathogens to health care workers after a needlestick injury in Taiwan. *American Journal of Infection Control*, *30*(1), 15–20. https://doi.org/10.1067/mic.2002.119928

Singh, B., Paudel, B., & Kc, S. (2015). Knowledge and practice of health care workers regarding needlestick injuries in a tertiary care center of Nepal. *Kathmandu University Medical Journal*, *51*(3), 230–233.

Wang, H., Fennie, K., He, G., Burgess, J., & Williams, A. B. (2003). A training programme for prevention of occupational exposure to bloodborne pathogens: Impact on knowledge, behaviour and incidence of needle stick injuries among student nurses in Changsha, People's Republic of China. *Journal of Advanced Nursing (Wiley-Blackwell)*, *41*(2), 187–194. https://doi.org/10.1046/j.1365-2648.2003.02519.x

Weldesamuel, E., Gebreyesus, H., Beyene, B., Teweldemedhin, M., Welegebriel, Z., & Tetemke, D. (2019). Assessment of needle stick and sharp injuries among health care workers in central zone of Tigray, northern Ethiopia. *BMC Research Notes*, *12*(1), 654. https://doi.org/10.1186/s13104-019-4683-4

Wicker, S., Jung, J., Allwinn, R., Gottschalk, R., & Rabenau, H. F. (2008). Prevalence and prevention of needlestick injuries among health care workers in a German university hospital. *International Archives of Occupational and Environmental Health*, *81*(3), 347–354. https://doi.org/10.1007/s00420-007-0219-7

World Health Organization. (2012). *The world health report*. WHO.

Yazie, T. D., Chufa, K. A., & Tebeje, M. G. (2019). Prevalence of needlestick injury among healthcare workers in Ethiopia: A systematic review and meta-analysis. *Environmental Health and Preventive Medicine*, *24*(1), 52. https://doi.org/10.1186/s12199-019-0807-7

Zhang, M., Wang, H., Miao, J., Du, X., Li, T., & Wu, Z. (2009). Occupational exposure to blood and body fluids among health care workers in a general hospital, China. *American Journal of Industrial Medicine*, *52*(2), 89–98. https://doi.org/10.1002/ajim.20645

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