Original Article

Prevalence of needlestick injuries among nursing interns: a systematic review and meta-analysis

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Background: The aim of the present study was to analyze the prevalence of needlestick injuries (NSI) of trainee nursing students and to understand the cause of injury and psychological reactions following injury, and take corresponding countermeasures to prevent adverse consequences.

Methods: Multiple databases were used to search for articles related to NSI among nursing interns. The selected literature was retrospectively evaluated by using Review Manager version 5.2.

Results: According to the analysis of 8 published studies, the lowest overall prevalence of NSI occupational exposure was 6% [95% confidence interval (CI): 3–9%], the highest was 51% (95% CI: 42–60%), and the total combined prevalence was 27% (95% CI: 18–37%). The overall prevalence rate of interns under 25 years old was 31% (95% CI: 7–69%), and that of interns over 25 years old was 26% (95% CI: 15–38%). The overall prevalence of interns was 38% (95% CI: 16–61%) in developing countries and 21% (95% CI: 11–31%) in developed countries. The overall prevalence of interns was 38% (95% CI: 16–61%) in Asian countries, 9% (95% CI: 3–15%) in the United States, and 30% (95% CI: 3–57%) in European countries.

Discussion: The results showed that interns over 25 years of age were more likely to have NSI, and interns in developing countries were more likely to have NSI than those in developed countries. Interns in Asia were more likely to have NSI than interns in Europe, and the lowest incidence of NSI was among interns in the USA.

Keywords: Prevalence; needlestick injuries (NSI); nursing interns

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Introduction

Clinical practice is the only way for nursing students to gain experience. However, given the special nature of hospital work, nursing students face various occupational hazards during clinical practice, among which needlestick injuries (NSI) are the most common (1-3). NSI usually occur in medical staff in hospitals, clinics and laboratories. If needles are not properly discarded, NSI can also happen at home or in the community. Used needles may contain blood or body fluids carrying HIV, hepatitis B virus (HBV) or hepatitis C virus (HCV). The virus can spread to people whose needles have stabbed in infected people (4,5). A number of studies have confirmed that nurses are a high-risk group of sharps injuries in the hospital. Due to unfamiliar environments, unfamiliar skills, and lack of clinical experience and professional knowledge of occupational protection, interns are more likely to have sharps injuries than in-service nurses (4,5).

An NSI is an accidental injury deep in the skin that can cause the injured person to bleed. It is the most common occupational injury in medical care. American surveys have found that 60–90% of NSI are caused by nursing staff.

More than 20 blood-borne diseases can be transmitted through NSI (6-8). Sharps injuries are caused by medical sharp instruments, such as syringe needles, stitches, various puncture needles, scalpels, and ampoules, causing skin injuries deep enough to cause bleeding (9).

Infected NSI and other sharp object injuries are occupational factors that can cause health workers to develop blood-borne diseases (9,10). Intern nurses are unskilled, lack clinical experience and professional knowledge of occupational protection, and have a greater chance of NSI. Stabbing by injection needles or other medical sharps in medical care is the most common occupational injury, which can lead to blood exposure of medical staff, and increase the risk of HBV, HCV, HIV, and other infections (11-13). Due to unfamiliar skills and lack of clinical experience and corresponding occupational protection knowledge, interns are more vulnerable to the danger of occupational infection than in-service nurses (14,15).

In order to explore the NSI protection knowledge of nursing students, analyze the incidence of NSI, and develop the safety awareness for nursing students, we conducted this meta-analysis. In this research, we divided data based on social-economic situation and development of country and conducted analysis in the subgroups. We present the following article in accordance with the PRISMA reporting checklist (available at https://dx.doi.org/10.21037/apm-21-703).

Methods

Literature search strategy

Studies published in English from 2002 to 2021 were reviewed, and 4 electronic databases (PubMed, Embase, Cochrane Library, and China Academic Journals Full-text Database) were searched with biological operators (and, or) to analyze the included literature.

Study selection

After primary selection of the studies, studies that were potentially relevant were reviewed. The inclusion criteria were nursing interns and NSI.

Data extraction and quality assessment

Two reviewers independently scanned the full text of the articles, and the following data were retrieved from each eligible study: first author's name, year of publication, language of included articles, country of origin, sample age, sample size, and study period of each article. A risk-of-bias assessment was conducted using the Cochrane Collaboration tool for assessing risk of bias.

Statistical analysis

Statistical analyses were performed using Review Manager (version 5.2, Cochrane Collaboration, Copenhagen, Denmark, 2011) and STATA 12.0 (StataCorp LP, College Station, TX, USA). In brief, to measure the consistency of the effect size (OR and MD), pairwise meta-analyses were performed with a DerSimonian and Laird random effects model to calculate the pooled estimates of OR and MD with 95% CIs of direct comparisons. A χ^2-based homogeneity test was performed and the inconsistency index (I^2) statistic was determined. Fixed-effects models were used in the absence of heterogeneity, otherwise random-effects models were used. Begg's test was performed to assess potential publication bias. In addition, further sensitivity analyses were performed.

Results

Search process

The electronic search ended with 840 articles. After careful reading, 85 papers were considered to have met the preliminary standard. After further screening, 77 articles were excluded due to unclear objectives and non-compliant. Finally, 8 papers were selected for analysis. *Figure 1* was a flowchart which included identification, inclusion and exclusion with reasons and it reflected the search process.

Characteristics of the included studies

The detailed characteristics of the included studies are shown in *Table 1*. These included the first author, publication year, language, country of origin, sample age, sample size, and research period of each article (16-23). All of the studies were published from 1999 to 2017, with sample sizes ranging from 180 to 1,403 participants.

Results of the quality assessment

The included articles were evaluated by the Cochrane risk of bias assessment tool to assess their quality (*Figures 2,3*). From the quality assessment results, we found that only 1 article had selection bias and 1 had reporting bias while

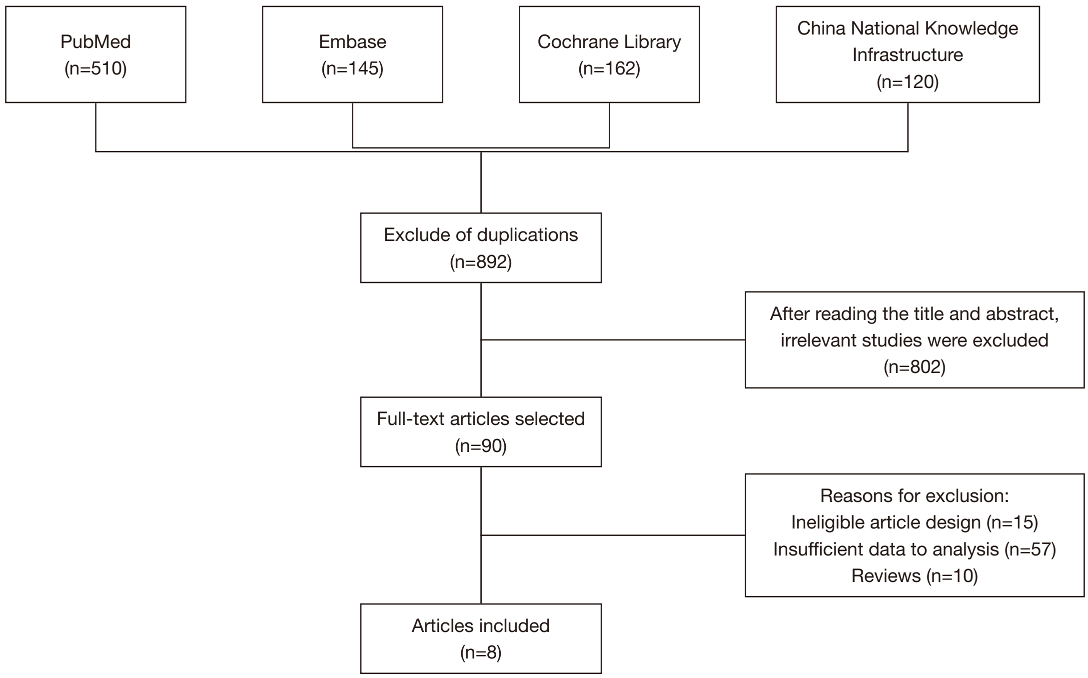

Figure 1 Flow diagram of studies for inclusion in the systematic review and meta-analysis.

Table 1 Characteristics of the studies included in the meta-analysis

Study	Year	Language	Country	Age range (mean)	No. researchers	Years of onset
Cheung	2010	English	China	21.14±1.36	267	January 2002 to December 2006
Jonczyk	2018	English	Poland	45±5.2	107	March 2017 to April 2017
Katsevman	2020	English	USA	26±5.5	289	May 2007 to July 2009
Reid	2014	English	USA	21±1.2	180	June 2007 to August 2013
Rubbi	2018	English	Italy	20±2.5	1,403	December 2009 to March 2017
Unver	2012	English	Turkey	20.75±1.04	218	June 2007 to June 2009
Wang	2003	English	China	18±3	106	September 2000 to April 2001
Yang	2007	English	China	17.8±0.6	107	July 1999 to December 1999

other 6 researches had no bias. Overall, the quality of included articles was good.

Results of the heterogeneity test

Among the 8 articles included in the present study, the lowest overall prevalence of occupational exposure to NSI was 6% (95% CI: 3–9%), the highest was 51% (95% CI: 42–60%), and the total combined prevalence was 27% (95% CI: 18–37%, P=0.000) (*Figure 4*).

In terms of age, the lowest and highest prevalence were 12% (95% CI: 8–16%) and 51% (95% CI: 42–60%) among medical staff over 25 years of age, respectively. The lowest and highest prevalence was 6% (95% CI: 3–9%) and 50% (95% CI: 41–59%) among medical staff under 25 years of age, respectively. The overall prevalence was 27% (95% CI: 18–37%, P=0.000) (*Figure 5*).

According to socio-economic situation, the lowest prevalence of medical staff in developed countries exposed to NSI in their careers was 19% (95% CI: 14–24%), and the highest prevalence was 50% (95% CI: 41–59%). The lowest prevalence of medical staff in developing countries

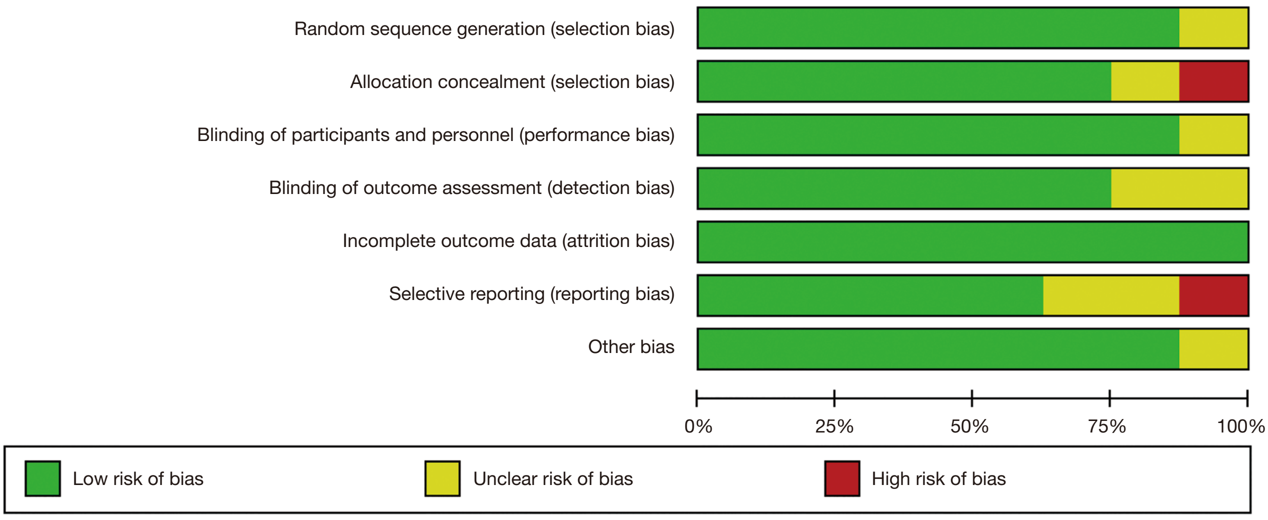

Figure 2 Assessment of the quality of the included studies: low risk of bias (green), unclear risk of bias (yellow), and high risk of bias (red).

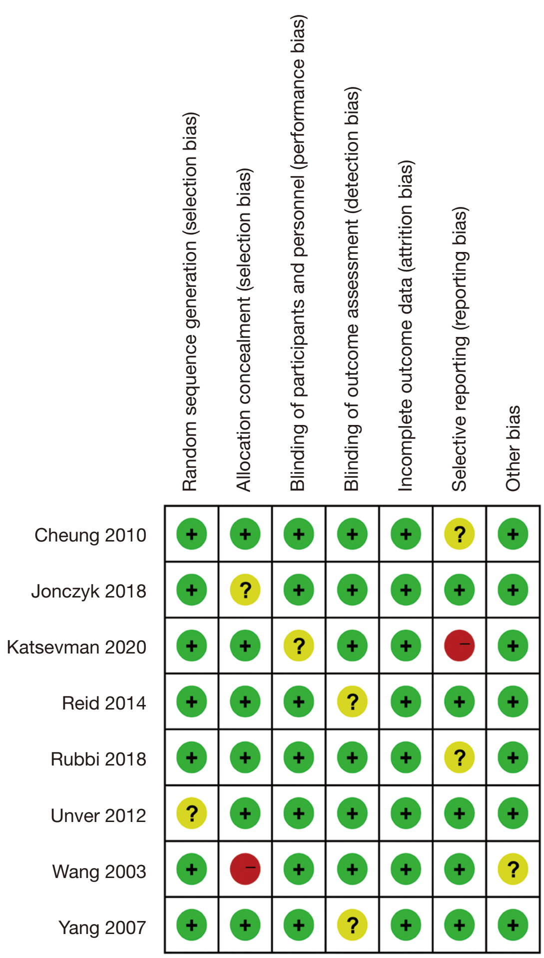

Figure 3 Quality assessment of included studies: low risk of bias (green), unclear risk of bias (yellow), and high risk of bias (red).

exposed to NSI in their careers was 6% (95% CI: 3–9%), and the highest prevalence was 51% (95% CI: 42–60%). The overall combined prevalence of medical staff's career exposure to NSI was 27% (95% CI: 18–37%, P=0.000) (*Figure 6*).

From a regional point of view, the lowest prevalence of Asian medical staff occupationally exposed to NSI was 19% (95% CI: 14–24%), and the highest prevalence was 50% (95% CI: 41–59%). The lowest prevalence of medical workers in the USA with occupational exposure to NSI was 6% (95% CI: 3–9%), and the highest collective prevalence was 12% (95% CI: 8–16%). The lowest prevalence of medical workers in Europe with occupational exposure to NSI was 6% (95% CI: 5–7%), and the highest collective prevalence was 51% (95% CI: 42–60%). The overall comprehensive prevalence of medical personnel's occupational exposure to NSI was 27% (95% CI: 18–37%, P=0.000) (*Figure 7*).

Discussion

Medical sharp instrument injuries are one of the most common occupational injuries in nursing. A variety of blood-borne diseases can be transmitted via this method (24-26). Studies have shown that nurses are a high-risk group for medical sharp instrument injuries and blood-borne diseases. Due to lack of practical experience, knowledge of protection, and unfamiliar skills, the risk probability of sharp instrument injuries is greater.

Sharp instrument injuries are the main cause of

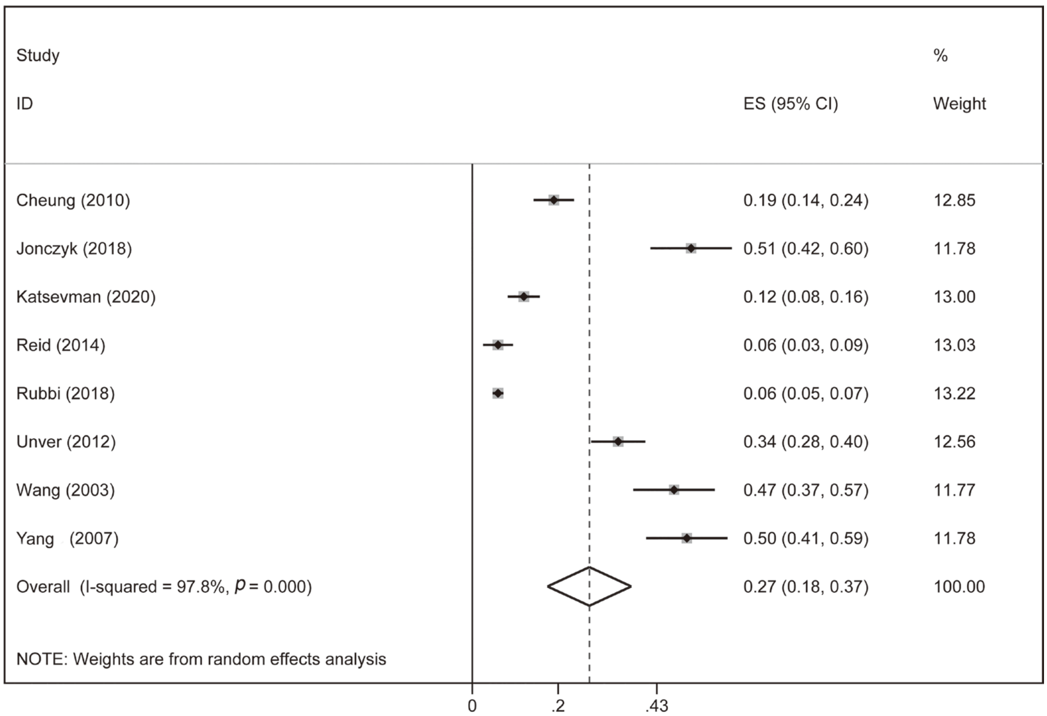

Figure 4 Forest map of the overall prevalence of needlestick injuries. CI, confidence interval; ES, effect size.

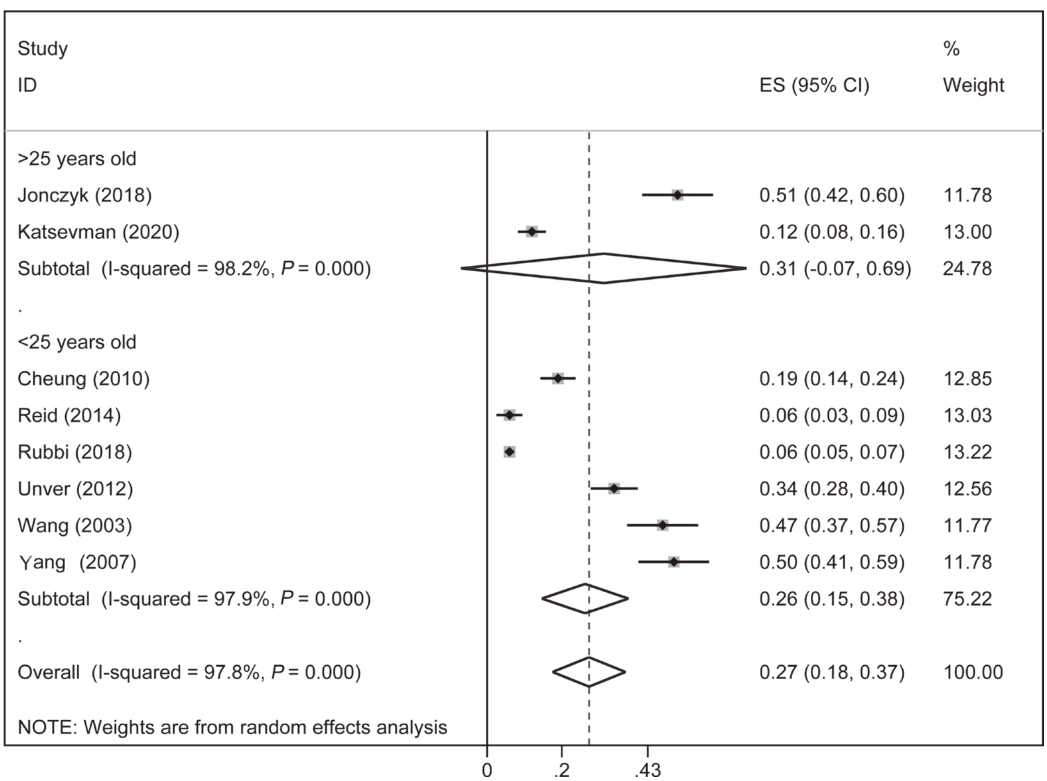

Figure 5 Forest map of the prevalence of needlestick injuries by age. CI, confidence interval; ES, effect size.

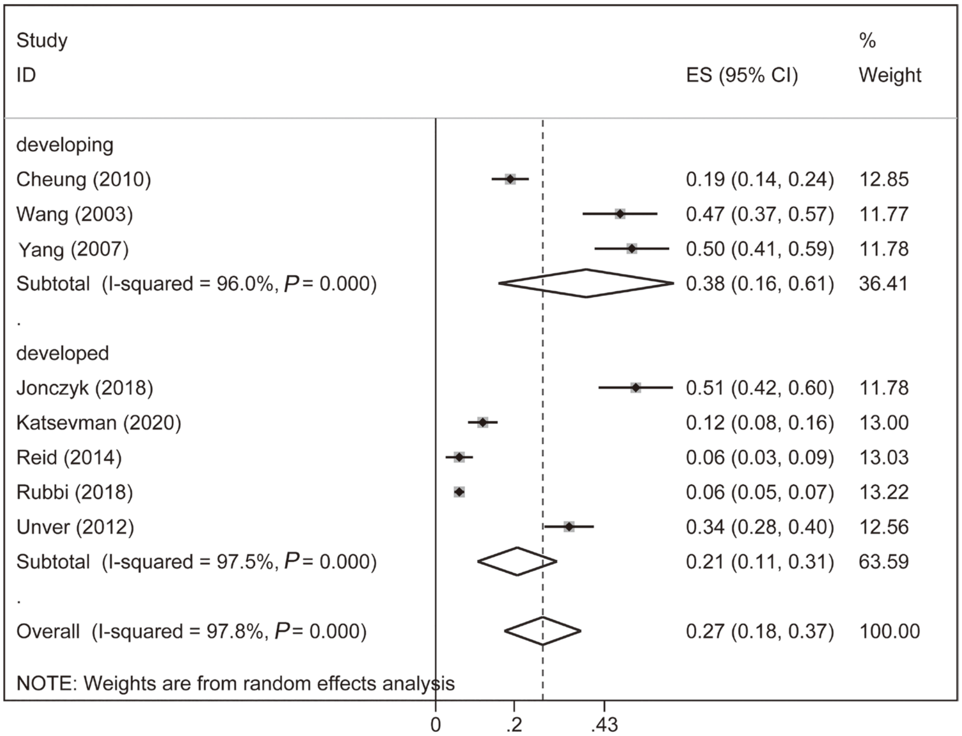

Figure 6 Forest map of the prevalence of needlestick injuries by socioeconomic development. CI, confidence interval; ES, effect size.

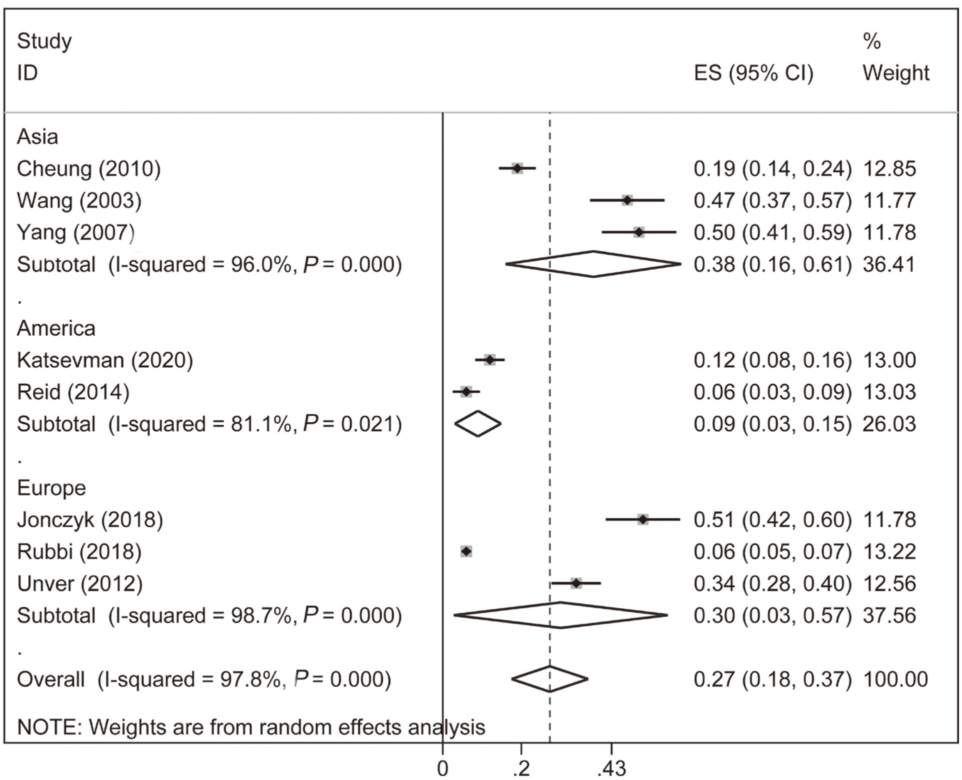

Figure 7 Forest map of the prevalence of needlestick injuries in different geographical areas. CI, confidence interval; ES, effect size.

occupational injury among nurses (27,28). More than 20 blood-borne diseases, including AIDS, hepatitis B, and hepatitis C, can be caused by at least 1 million accidental NSI worldwide (29-31). The risk of blood- and body fluid-borne diseases after sharp instrument injury is much higher than that of skin and mucous membrane contact. Therefore, medical staff, particularly nursing interns, are at high risk of severe occupational exposure (32-34).

We should strengthen the training of safe operation skills, do a good job in the guidance of occupational protection; prevent NSI and glass injuries, strictly manage medical waste, prevent NSI and glass injuries should be put in the first place of occupational protection education; establish and improve the registration and reporting system of interns after injury; reasonably arrange working hours, add occupational protection courses, cultivate occupational protection skills, and strengthen occupational protection, education, and strengthen the awareness of occupational safety (35,36). To prevent NSI, we also need to follow these rules: always use gloves when you handle needles that are exposed to blood or other body fluids; do not recap needles after use and throw away needles in a safe container.

In conclusion, our findings indicated that interns aged over 25 years were more prone to NSI and faced serious occupational exposure risk than interns under the age of 25, which was consistent with the literature (17,18). However, the present study has some limitations. First, the comparison between Africa and Oceania was not taken into account and should be evaluated in further studies. Second, more indicators evaluating NSI of nursing interns should be included in future studies.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at https://dx.doi.org/10.21037/apm-21-703

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/apm-21-703). Both authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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