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Abstract

Background: Needlestick injuries (NSIs) are one of the most serious occupational hazards for healthcare workers (HCWs).

Aims: The aim of this study was to evaluate the incidence and causes of NSIs globally.

Methods: A systematic review and meta-analysis of data from January 2000 to May 2020 collected from Scopus, PubMed, Embase, Web of Science, and Google Scholar. The Newcastle–Ottawa Scale was used to assess the quality of the included articles. The data obtained were analysed by R version 3/5/0, and 113 articles were retrieved.

Results: There were 113 studies with a total of 525 798 HCWs. The incidence of NSIs was 43%. Africa had the highest rate of these injuries of 51%, and the World Health Organization (WHO) African Region had the highest incidence among WHO regions of 52%. Women were more frequently affected by NSIs than men. Hepatitis C virus infection was the disease most commonly transmitted via NSIs (21%). The highest rates of NSIs according to causes, devices, hospital locations, occupations and procedures were for recapping of needles, needles, general wards, nurses and waste disposal, respectively.

Conclusion: The incidence of NSIs is gradually decreasing. The findings of this study can contribute to improving the decision-making process for reducing NSIs in HCWs.

Keywords: needle-stick injuries, healthcare providers, healthcare workers, hospitals, occupational harzard

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Introduction

Physicians, nurses and other members of the healthcare professions are increasingly exposed to a wide range of occupational risks, such as needlestick injuries (NSIs) (1). Globally, NSIs are one of the most serious occupational hazards among healthcare workers (HCWs), with > 2 million occupational exposures occurring among 35 million HCWs annually, according to the World Health Organization (WHO) (2).

NSI refers to a penetrating wound with an instrument potentially contaminated with another person's body fluid. According to the United States National Institute of Occupational Safety and Health (NIOSH), NSIs are caused by hypodermic needles, blood collection needles, intravenous (IV) stylets, and needles used to connect parts of IV delivery systems (3). HCWs at risk of NSIs, if injured, are at high risk of serious infections by blood-borne pathogens such as HIV/AIDS, hepatitis B virus (HBV) and hepatitis C virus (HCV). According to WHO, NSIs are responsible for the global incidence of

HBV (36.7%), HCV (39%) and HIV/AIDS (4.4%) . among HCWs for various reasons such as

fatigue, carelessness, stress, haste, and sudden movement of patients (4).

The incidence of NSIs varies depending on work conditions, area of specialization and workplace environment. Kebede and Gerensea reported that the incidence of NSIs in Ethiopia was 48.8% among 252 nurses, and most NSIs occurred in the medical and surgical departments (5). Makary et al. estimated that the incidence of NSIs in the United States of America was 83% among 699 surgical residents, with most injuries related to the operating room (6). Despite the high incidence of NSIs among HCWs, evidence suggests that HCWs often do not report their injuries or are not followed up for treatment and testing; possibly due to lack of time, lack of belief in NSI-transmitted infection, and other reasons (7).

Given the importance of NSIs among HCWs, and lack of knowledge, HCWs need to receive accurate and comprehensive information on incidence, control and prevention of NSIs. Although many preliminary studies have been conducted on the incidence of NSIs, there is no systematic review of all dimensions and factors (cause, procedure, device and location) related to the global incidence of NSIs. The results of this study provide valuable information for HCWs, hospitals and other medical centres to reduce the incidence of NSIs, as well as provide a safer atmosphere for HCWs to perform clinical tasks, and ultimately improve the quality of services.

Methods

The preregistration of this study took place on PROSPERO (International Database of Prospectively Registered Systematic Reviews in Health and Social Care) at the University of York (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020198842).

Search strategy

Two of the authors separately searched Web of Science, PubMed, Scopus and Embase for article published from January 2000 to May 2020, using the following keywords: Injury, Needle-stick OR Needle-stick Injury OR Needle-sticks OR Needle-stick OR Needle-Sticks OR Needle Sticks OR Needle-Stick OR Injuries, Needle-stick OR Needle-Stick Injuries OR Injuries, Needle-Stick[Title]) OR Injury, Needle-Stick OR NSIs OR Needle-Stick Injury OR Sharps Injuries OR Injuries, Sharps OR Injury, Sharps OR Sharps Injury. The initial search resulted in 4981 relevant articles. In addition, we searched Google Scholar (additional sources) resulting in 41 studies. The duplicates were omitted using EndNote software, and 1624 articles remained for review.

Study selection process

The selection process was accomplished in 2 steps. First, the title and abstract of searched articles were checked by 2 individual reviewers to select the relevant studies based on the exclusion and inclusion criteria of this study, which resulted in 348 articles. Subsequently, full-text analysis led to 113 eligible articles (Figure 1).

Inclusion criteria

Inclusion criteria were original English-language articles published between January 2000 and May 2020 with full text, having cross-sectional, descriptive, prospective, case study or cohort designs.

Exclusion criteria

Exclusion criteria were articles in languages other than English, published after May 2020 or before January 2000, in addition to randomized controlled trials, theses, case–control studies, commentaries, book chapters, books, editorials, expert opinions, letters to the editor, brief reports and reviews, assessments of treatment approaches, follow-up studies, interventional studies, clinical decision-making, studies with invalid tables or figures, or difficulty in calculating quality of life.

Quality assessment of included articles

The Newcastle–Ottawa Scale (NOS) was used to assess the quality of included articles in this systematic review by 2 separate reviewers to mitigate bias, and any disagreements were resolved by a third reviewer. The articles were assessed by NOS in terms of the following domains and related subdomains: (A) selection process (1 – definition of case; 2 – representativeness of cases; 3 – selection of controls; and 4 – definition of controls); (B) comparability (comparability of cases and controls on the basis of design or analysis); and (C) exposure (1 – ascertainment of exposure; 2 – same method of ascertainment for cases and controls; and 3 – non response rate). Scores were displayed as 0 and 1 points for unreported and referenced items, respectively. The total quality score was calculated through the sum of the points calculated for the reported items, indicating a score of 10 as the best quality and a score of 0 as the lowest quality. Low quality was considered for articles with a score less than the mean score (**Process of data extraction**

The required data were extracted by 3 of the authors in a predesigned form containing name of author, place of research, date of publication, quality of research, WHO region, sample size, number of participating men and women, number of NSIs, number of men and women with NSIs, infection, job status, causes of NSIs, NSI site, instruments and procedures that caused NSIs (Supplementary File 1).

Data analysis by statistical methods

A random-effects model meta-analysis, the conventional DerSimonian–Laird estimator, was used to calculate the means by 4 authors who were experienced in this area. The results were presented in a forest plot at 95% confidence interval (CI). Publication date and sample size were selected as criteria for measuring heterogeneity (I2) of included articles and meta-regression analysis. Sensitivity analysis was performed to verify stability of the results. Sample size, place of research, date of publication, sex, procedures and instruments that caused NSIs, NSI site, causes of NSIs and job status were parameters for subgroup analysis. Cumulative meta-analysis was performed on the basis of date of publication and sample size. Publication bias was evaluated by Egger test. R version 3/5/0 was used for data analysis.

Results

The findings of this study were based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement, and using the meta-regression analysis of data from 113 articles published from January 2000 to May 2020. Total incidence of NSIs was 43% (95% CI = 37–49%; n = 226 093) among 525 798 HCWs (Figure 2).

Meta-regression based on WHO regions

Analysis of WHO regions showed that the incidence of NSIs in the African Region was higher than in other regions (51%, 95% CI = 40–61%) (Table 1). The lowest incidence of NSIs (31%, 95% CI = 19–46%) was in the Western Pacific Region.

Meta-regression based on continent

The incidence of NSIs in Africa was higher than in other continents (52%, 95% CI = 41–62%) (Table 1). The lowest incidence of NSIs (21%, 95% CI = 9–41%) was in Oceania.

Meta-regression based on gender

The incidence of NSIs was higher in female than in male HCWs. A total of 93 959 women had a 39% incidence of NSIs (95% CI = 26–54%) compared with 27% (95% CI = 18–38) among 76 504 men.

Meta-regression based on transmitted diseases

The 6 most frequent NSI-transmitted diseases are shown in Table 1 , including HCV (21%, 95% CI = 7–38%), HBV (18%, 95% CI = 14–25%) and HIV (17%, 95% CI = 14–32%) in the first to

third places, respectively.

Meta-regression based on causes

Recapping of needles was the most frequent cause of NSIs among HCWs (n = 6070, 30.5% of the total) (Figure 3), followed by mental distraction (n = 3566, 17.96%). Carelessness had the lowest rate (n = 170, 0.2%).

Meta-regression based on devices

Needles were the most common cause of NSIs (n = 32 325, 68.46% of the total), followed by scalpels (n = 9189, 19.46%) (Figure 3)while 0.12% of NSIs were related to scissors, which was the lowest rate.

Meta-regression based on hospital wards

Most NSIs occurred in general wards (n = 16 592, 34.67% of the total), followed by operating rooms (n = 11 508, 24.04%) (Figure 3). The radiology ward had the lowest number of NSIs (0.03%).

Meta-regression based on occupation

Nurses had the highest number of NSIs (n = 26 840, 56.28% of the total), followed by physicians (n = 9874, 20.28%), and operating room technicians (n = 45, 0.9%) had the lowest number (Figure 3).

Meta-regression based on type of procedures

Disposing of waste accounted for most NSIs (n = 9405, 37.17% of the total), followed by injections (n = 8583, 33.92%) and suturing (n = 1828, 7.22%) (Figure 3).

Meta-regression based on publication year

The results of meta-regression, based on the year of study, showed that an increase of 1 year of study publication date caused a lower incidence of NSIs by 0.84 units (β = 0.84, 95% CI = 0.837–0.842, P Figure 4).

Discussion

The present systematic review and meta-analysis was conducted to estimate the overall prevalence of NSIs among HCWs. Based on the results of our study, the global incidence of NSIs in HCWs was 43%, which is a significant rate in terms of WHO policies. WHO reported in 2002 that about 6.5% of all HCWs had experienced such events. In the systematic review by Bouya et al. (2020) of 87 articles with a total of 50 916 participants, the incidence was 44.5%, which is in line with our study (9). Comparison of the incidence in our study and the 2020 study with that of the WHO report in 2002 shows that the incidence of NSIs has increased, and that presently about half of all HCWs experience these events at least once (10). Considering the annual trend identified in our study, the incidence of NSIs is decreasing based on publication year. This could be an appropriate subject for future studies. We think that increases in the ratio of patient to medical staff numbers and workload could be the main reason for the incremental incidence of NSIs.

Our study showed that Africa and the WHO African Region had the highest incidence of NSIs among other continents and regions. For example, in a study of 72 people in Nigeria in 2009, 86.6% (n = 65) had experienced NSIs (11). In studies conducted in Cameroon, Uganda and Ethiopia, this rate was reported to be > 55%, which is significantly different from other regions, and is in line with our study. We believe that the large workload of medical centres imposes a high risk of experiencing NSIs by the medical staff, and inadequate, unsafe facilities in African countries should be taken into consideration (12).

We found a significant difference in incidence between women and men. Zhang et al. (13) reported that the incidence of NSIs was higher in women, which is consistent with our findings. In contrast, a study by Lee and Hassim found that the incidence of NSIs was higher in men (14). Unfortunately, no specific study has been conducted on this topic, and there is no information on why the incidence of such NSIs is low or high in men and women. However, we believe that one of the main reasons for the higher incidence of NSIs in women is that they account for the bulk of the nursing staff and that they deal with sharp and cutting-edged instrumentsmore than staff in other departments.

We found that the most common cause of NSIs was recapping of needles. The incidence of these NSIs was also highest in other studies. For example, in a study of 600 people in the Islamic Republic of Iran, needle recapping accounted for > 50% of NSIs (15). In another study of 223 149 people in China, the main cause of NSIs was recapping of needles by nursing staff (16). The results of these two studies are consistent with ours, and we included nurses in the list of most at-risk individuals for NSIs. Based on group discussions with experts, we think that nurses have a higher incidence of NSIs caused by recapping of needles because nurses deal with needles and ampoules to perform their daily tasks more than other healthcare staff.

We found that, among all hospital procedures, waste disposal and administering injections were the main causes of NSIs. Al-Dabbas et al. reported that many people experience these injuries due to problems with and incorrect injection procedures (17), which is consistent with our study. In another study, waste disposal was the most dangerous among all other procedures because the relevant protocols were not followed properly, leading to NSIs caused by incorrect disposal of sharp instruments (18). We suggest that training on how to properly dispose of waste materials should be held continuously for HCWs, as disposing of waste according to principles and guidelines can have a significant impact on reducing the incidence of NSIs.

One of the most important limitations of this study was the small number of articles available in some countries, continents and WHO regions, especially the Americas and South-East Asia; thus, further research is suggested in these regions. In addition, a limited number of studies have addressed the relationship between gender and NSIs, which could be another topic for future studies. Other limitations of this study included lack of free access to some articles, lack of access to the full-text of some articles, and the poor quality of some articles.

Conclusion

The current study aimed to comprehensively investigate NSIs worldwide. This was the first systematic review to analyse various factors such as the global prevalence of NSIs, annual trends, the association of NSIs with gender among medical staff, the main causes and other important issues. According to our findings, the incidence of NSIs is gradually decreasing. Healthcare decision-makers and policy-makers can take several steps to reduce the incidence among HCWs. When HCWs have NSIs, concerns about the diseases that may be transmitted can have a negative psychological impact, and the cost of any treatment may be high. We suggest that continuous education programmes addressing this issue be held for HCWs. These programmes could train HCWs to perform their duties in accordance with WHO guidelines on prevention of NSIs, make them aware of the consequences of NSIs, and the processes required after wounding, and help them prevent and decrease the risk of the NSIs. We assume that the high workload of medical staff in high-risk regions could be the main cause of NSIs. Reducing this workload, exploiting various strategies such as training more staff and establishing a health network to organize patients, could have a huge impact on reducing the incidence of NSIs among medical staff. Our findings could help those responsible for controlling NSIs to make decisions that could reduce the prevalence of such injuries.

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Competing interests: None declared.

WHO EMRO | Global, regional and national incidence and causes of needlestick injuries: a systematic rev

Incidence et causes des blessures par piqûre d'aiguille aux niveaux mondial, régional et national : revue systématique et méta-analyse

Résumé

Contexte : Les blessures par piqûre d'aiguille constituent l'un des risques professionnels les plus graves pour les agents de santé.

Objectifs : L'objectif de la présente étude était d'évaluer l'incidence et les causes des blessures par piqûre d'aiguille à l'échelle mondiale.

Méthodes : Nous avons réalisé une analyse systématique et une méta-analyse des données recueillies dans Scopus, PubMed, Embase, Web of Science et Google Scholar de janvier 2000 à mai 2020. L'échelle de Newcastle-Ottawa a été utilisée pour évaluer la qualité des articles inclus. Les données obtenues ont été analysées au moyen du logiciel R version 3/5/0 et 113 articles ont été récupérés.

Résultats : Il y avait 113 études incluant un total de 525 798 agents de santé. L'incidence des blessures par piqûre d'aiguille était de 43 %. Le continent africain affichait le taux le plus élevé de ces traumatismes, soit 51 %, tandis que la Région africaine de l'Organisation mondiale de la Santé (OMS) présentait l'incidence la plus élevée parmi les régions de l'OMS, soit 52 %. Les femmes étaient plus souvent touchées par les blessures par piqûre d'aiguille que les hommes. L'infection par le virus de l'hépatite C était la maladie la plus souvent transmise par les blessures par piqûre d'aiguille (21 %). Les taux les plus élevés de blessures par piqûre d'aiguille selon les causes, les dispositifs, les sites hospitaliers, les professions et les procédures concernaient respectivement le recapuchonnage des aiguilles, les aiguilles, les services de médecine générale, les personnels infirmiers et l'élimination des déchets.

Conclusion : L'incidence des blessures par piqûre d'aiguille diminue progressivement. Les résultats de la présente étude peuvent contribuer à améliorer le processus de prise de décision pour la réduction des blessures par piqûre d'aiguille chez les agents de santé.

معدل الإصابة بالإصابات الناجمة عن وخز الإبر وأسبابها على الأصعدة العالمية والإقليمية والوطنية : استعراض منهجي وتحليل تلوي

زهرة حسيني بالانجي، زهرة غول محمدي، أحمد غاشجي، نيلوفار أحمدي، حسين حسيني فارد،

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