Meta-Analysis: Effects of Training and Needle Recapping on Needle Stick Injury in Health Workers

Shofia Andriyani[1]), Argyo Demartoto[2]), Bhisma Murti[1])

[1])Masters Program in Public Health, Universitas Sebelas Maret
[2])Faculty of Social and Political Sciences, Universitas Sebelas Maret

ABSTRACT

Background: Health Personnel are at risk of contracting diseases from blood/body fluids (blood-borne pathogens) in various ways, one of which is through needle stick injuries or what is known as needle stick injury. Recapping of needles and lack of training are factors in unsafe actions that can risk work accidents. This study aims to analyze the effect of training and recapping of needles on the incidence of needle stick injuries in Health personnal using meta analysis.

Subjects and Method: This study is a systematic review and meta-analysis study using the PRISMA diagram. Article searches were carried out based on eligibility criteria using the PICO Model. Population: Health personnal, Intervention: training and not recapping of needles, Comparison: no training and recapping of needles, Outcome: Occurrence of needle stick injury. The articles published in 2013 – 2023 collected from Google Scholar, PubMed, Science Direct, and ProQuest. The keywords used in the search were "Training OR Safety Training OR Infection Prevention Training AND Recapping of Needle AND Needle Stick Injury OR Needle Stick Injuries OR Needle Stick and Sharp Injury OR Percutaneous injuries AND Healthcare Workers OR Health Professionals". The inclusion criteria were full paper with cross-sectional studies. Pooled adjusted odds ratio were analyzed using Revman 5.3.

Results: 13 cross-sectional studies from African and Asian continents were selected for meta-analysis. Training reduced the risk of needle stick injury, but it was not statistically significant (aOR = 0.56; Cl 95% = 0.26 to 1.17; p = 0.120). Recapping the needles inappropriately increased the risk of needle stick injury (aOR=2.04; 95% CI = 1.50 to 2.78; p<0.001)

Conclusion: Training and recapping of needles inappropriately increase the risk of needle stick injuries in health worker.

Keywords: training, recapping of needle, needle stick injury, health personal.

Correspondence:
Shofia Andriyani. Master's Program in Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java. Email: shofiaandriyani@gmail.com. Mobile:085729859897.

BACKGROUND

Every workplace environment has potential dangers so that the occupational safety and health of every worker must be guaranteed. Potential hazards are anything that has the potential to cause loss, damage, injury, illness, accident or even death related to work processes and systems (Risana et al., 2022). Health personnal play a major role in providing health services (Iwan and Rahman,

2017). Thus, Health personnal are at risk of contracting diseases from blood/body fluids (bloodborne pathogens) in various ways, one of which is through needle stick injuries or what is known as needle stick injury (Puspitasari et al., 2019).

Globally, it is estimated that 32.4–44.5% of healthcare workers report at least one accidental needlestick or sharps injury every year (Bouya et al., 2020). In the United States, there are an estimated 385,000 annual incidents of NSI among hospital healthcare workers, while 1,000,000 cases of NSI are reported annually among hospital healthcare workers in Europe.

Needle and sharps injuries are one of the main risks for blood-borne infections in health care facilities. There are approximately 40% of HBV and HCV, and 2.5% of HIV/AIDS cases among healthcare workers (CDC, 2020). Many factors contribute to the spread of infections caused by needle stick injuries, including overuse of injections, lack of supply of disposable syringes, safer needle devices, sharps disposal containers, moving instruments from hand to hand when performing any procedure, and lack of awareness and adequate training. Three major factors that contribute to the incidence of NSI are technical factors related to the design of sharps, organizational factors related to tool availability and behavior such as recapping needles after use (Cho et al., 2013).

According to Abalkhail et al. (2022), the group most frequently affected by NSI incidents is doctors, followed by nurses, dentists and medical technologists. Study conducted by Bidira et al (2014) on one of the Health personnal, namely nurses, the cause of needle sticks occurring in nurses was due to a lack of knowledge, resources and training.

Another contributing factor is the recapping of needle behavior. Recapping of needles is a bad habit that is still carried out by nurses in health services, both in hospitals and in community health centers. There is a possibility that nurses who are still recapping needles do not understand the dangers of recapping needles, or already understand but have not abandoned the habit. NSI cases are described as like an iceberg phenomenon where the existing cases are smaller than the cases that actually occur. One of the reasons is that there is still little reporting of this incident.

Based on this background description, a comprehensive study is needed from various primary studies regarding the influence of training and recapping of needles on the incidence of needle stick injury work accidents in Health personnal. The aim of this study aims to analyze the influence of training and needle recapping behavior on the incidence of accidents due to needle stick injuries in Health personnal.

SUBJECTS AND METHOD

1. Study Design

This study is quantitative study with a meta-analysis study design. This review was systematically analyzed using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. The article search process was carried out systematically and comprehensively using electronic databases including Google Scholar, PubMed, Science Direct and ProQuest with a Randomized Control Trial research design published from 2013 to 2023. The search keywords used were Training OR Safety Training OR Infection Prevention Training AND Recapping of Needle AND Needle Stick Injury OR Needle Stick Injuries OR Needle Stick and Sharp Injury OR Percutaneous injuries AND Healthcare Workers OR Health Professionals".

2. Steps of Meta-Analysis

Meta-analysis analysis was carried out through 5 steps as follows:

1) Formulate research questions in PICO (Population, Intervention, Comparison, Outcome). Population: Health personnal, Intervention: training and not recapping of needles, Comparison: no training and recapping of needles, Outcome: Occurrence of needle stick injury.
2) Search for articles from various databases including Google Scholar, Pubmed, and Science Direct.
3) Conduct screening and critical appraisal of primary studies using the Critical Appraisal Checklist for Cross-sectional Studies from the Center for Evidence Management
4) Perform data extraction and enter the effect size of each primary study into the RevMan 5.3 application
5) Interpret the results of the research analysis and draw conclusions

3. Inclusion Criteria

Full-text paper study articles use cross-sectional study designs. The analysis used in the article is multivariate by ensuring the adjusted odds ratio (aOR). The study subjects were Health personnal. Intervention in the form of training and not recapping of needles. Outcome is the incidence of needle stick injury work accidents.

4. Exclusion Criteria

Exclusion criteria for articles used in this study were articles published in languages other than English, articles published before 2013, duplicate articles.

5. Operational Definition

Training A process that aims to help Health personnal improve their skills, knowledge, attitudes and safe actions at work.

Recapping of Needle re-capping the syringe by hand.

Needle Stick Injury puncture wounds from needles (or other sharp objects) that cause exposure to blood or other body fluids.

6. Istrument

This article used the PRISMA flowchart guide and assessed article quality using the Critical Appraisal Skills Programme Crossectional Checklist (CASP for Crossectional).

7. Data Analysis

The data in this study was analyzed using the Review Manager application (RevMan 5.3). Forest plots and funnel plots are commonly used to determine the effect size and heterogeneity data. Data processing is carried out based on variations between studies by determining the use of analysis models, namely the Fixed Effect Model or Random Effect Model.

RESULTS

The meta analysis process begins with determining study questions or what are usually called study questions. The question in this study is whether training and recapping of needles have an effect on the incidence of needle stick injury work accidents. Formulating PICO aims to be used as a reference for searching for relevant articles. Article searches were carried out comprehensively through several electronic databases, including: MEDLINE or PubMed, Google Scholar, Cochrane Library, and Science Direct. There are 13 articles originating from Southeast Ethiopia, South Ethiopia, East Ethiopia, North Ethiopia, North Ethiopia, northwest Ethiopia, west China. The article review process can be seen on the Prisma flow chart as follows.

The article selection process is shown by the prism flow chart which can be seen in Figure 1. Showing the results of searching for articles from several databases, 771 articles were identified, then duplicate data was removed for 23 articles so that there were 748 articles filtered. Based on the filtered articles, there were 707 articles that had to be excluded and 13 articles were found that met the inclusion criteria. Assessment of learning

quality using the Critical Appraisal Skills Program Crosssectional Checklist (CASP for Crosssectional) in a study on the effect of

training and recapping of needles on the incidence of needle stick injury work accidents (see Table 1).
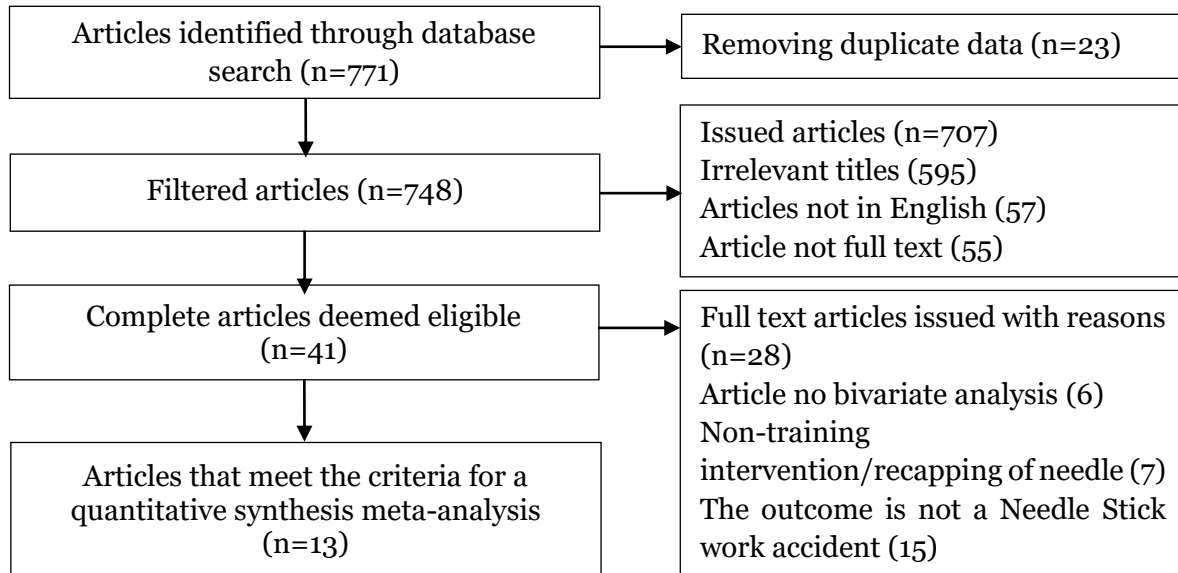
```
┌─────────────────────────────────┐        ┌─────────────────────────────────┐
│ Articles identified through     │ ─────> │ Removing duplicate data (n=23)  │
│ database search (n=771)         │        │                                 │
└─────────────────────────────────┘        └─────────────────────────────────┘
              │
              ▼
┌─────────────────────────────────┐        ┌─────────────────────────────────┐
│ Filtered articles (n=748)       │ ─────> │ Issued articles (n=707)         │
│                                 │        │ Irrelevant titles (595)         │
│                                 │        │ Articles not in English (57)    │
│                                 │        │ Article not full text (55)      │
└─────────────────────────────────┘        └─────────────────────────────────┘
              │
              ▼
┌─────────────────────────────────┐        ┌─────────────────────────────────┐
│ Complete articles deemed        │ ─────> │ Full text articles issued with  │
│ eligible (n=41)                 │        │ reasons (n=28)                  │
│                                 │        │ Article no bivariate analysis   │
│                                 │        │ (6)                             │
│                                 │        │ Non-training                    │
│                                 │        │ intervention/recapping of       │
│                                 │        │ needle (7)                      │
│                                 │        │ The outcome is not a Needle     │
│                                 │        │ Stick work accident (15)        │
└─────────────────────────────────┘        └─────────────────────────────────┘
              │
              ▼
┌─────────────────────────────────┐
│ Articles that meet the criteria │
│ for a quantitative synthesis    │
│ meta-analysis (n=13)            │
└─────────────────────────────────┘
```

Figure 1. PRISMA Flow diagram of the effect of training and recapping of needles on the risk of needle stick injury in health personnel

Figure 2. Map of the the study area of training and needles recapping on the risk of needle stick injury in health personnel

Figure 2 shows a map of the distribution of research on the influence of training and recapping of needles on the incidence of needle stick injury work accidents to Health

personnel. Based on 13 research articles obtained from 2 continents, 3 studies was obtained from Asia and 10 studies from Africa.

Table 1. Quality assessment of cross sectional study studies included in the analysis.

Primary Study	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Abalkhail et al. (2022)	1	1	1	1	1	1	1	1	1	1	1	1	12
Munye et al. (2019)	1	1	1	1	0	1	1	1	1	1	1	1	11
Liyew et al. (2020)	1	1	1	1	1	1	1	1	1	1	1	1	12
Bekele et al. (2015)	1	1	1	0	1	1	1	1	1	1	1	1	11
Mekonnen et al. (2018)	1	1	1	1	1	1	1	1	1	1	1	0	11
Alemayehu et al. (2022)	1	1	1	1	1	1	1	1	1	1	1	1	12
Al-Dakhil et al. (2019)	1	1	1	1	0	1	1	1	1	1	1	1	11
Li et al. (2021)	1	1	1	1	0	1	1	1	1	1	1	1	11
Tedesse et al. (2016)	1	1	1	1	1	1	1	1	1	1	1	1	12
Mekonnen et al. (2018)	1	1	1	1	1	1	1	1	1	1	1	1	12
Weldesamuel et al. (2019)	1	1	1	1	1	1	1	1	1	1	1	1	12
Kaweti & Teferi., (2016)	1	1	1	0	1	1	1	1	1	1	1	1	11
Feleke (2013)	1	1	1	1	1	1	1	1	1	1	1	1	12
Assen et al. (2020)	1	1	1	1	1	1	1	1	1	1	1	1	12

Description of the answer score:
- 1 = Yes
- 0 = No

Question criteria descriptions:

1 = Does the aim clearly discuss the focus/problem of the study?
2 = Is the study method (study design) suitable for answering the study questions?
3 = Is the method for selecting study subjects written clearly?
4 = Can the sampling method give rise to bias (selection)?
5 = Does the study sample taken represent the designated population?
6 = Is the sample size based on pre-study considerations?
7 = Was a satisfactory response achieved?
8 = Is the study instrument valid and reliable?
9 = Was statistical significance assessed?
10 = Are confidence intervals provided for the main outcome?
11 = Are there confounding factors that have not been taken into account?
12 = Are the results applicable?

Table 2. Table PICO summary of cross-sectional study the effect of training and needle recapping on needle stick injury in health workers

Author (Year)	Country	P	I	C	O
Bekele et al. (2015)	Southeast Ethiopia	Health personal and health workers	Infection prevention training and not recapping of needle	Not following infection prevention training and recapping of needles	Accidents due to work needle stick injury
Mekonnen et al. (2018)	East Ethiopia	Health personal and health workers	Follow Safety training and not recapping of needles	Not following safety training and recapping of needles	Accidents due to work needle stick injury
Weldesamuel et al. (2019)	North Ethiopia	Health personnal	Attend K3 Training and not	Not taking training and	Work-related accidents of

Author (Year)	Country	P	I	C	O
		and health workers	recapping needles	recapping of needles	needle stick injury
Assen et al. (2020)	Northeast Ethiopia	Health personal and health workers	Attend OSH training and not recapping of needles	Did not attend OSH training and recapping of needles	Work-related accidents of needle stick injury
Alemayehu et al. (2022)	Northwest Ethiopia	Health personnal	Participate in sharps injury training	Did not attend sharps injury training	Accidents due to work needle stick injury
Abalkhail et al. (2022)	Saudi Arabia	Health personnal	Participate in sharp object handling training	Did not take training in handling sharp objects	Accidents due to work needle stick injury
Munye et al. (2019)	Eastern Ethiopia	Health personnal (nurses)	Attend infection prevention training	Not following infection prevention training	Accidents due to work needle stick injury
Liyew et al. (2020)	Ethiopia	Health personnal (nurses)	Attend infection prevention training	Not following infection prevention training	Accidents due to work needle stick injury
Tadesse et al. (2016)	South Ethiopia	Health workers	Not recapping of needle	Recapping of needles	Accidents due to work needle stick injury
Kaweti & Teferi (2016)	South Ethiopia	Health workers	Not recapping of needle	Recapping of needles	Accidents due to work needle stick injury
Feleke (2013)	Ethiopia	Health workers	Not recapping of needles	Recapping of needles	Accidents due to work needle stick injury
Li et al. (2021)	West China	Health workers (nurses)	Not recapping of needle	Recapping of needles	Accidents due to work needle stick injury
AlDakhil et al (2019)	Saudi Arabia	Health workers	Not recapping of needle	Recapping of needles	Accidents due to work needle stick injury

Table 3. Values AOR influence training on the incidence of needle stick injury work accidents among Health personal, cross-sectional study (N=4,080)

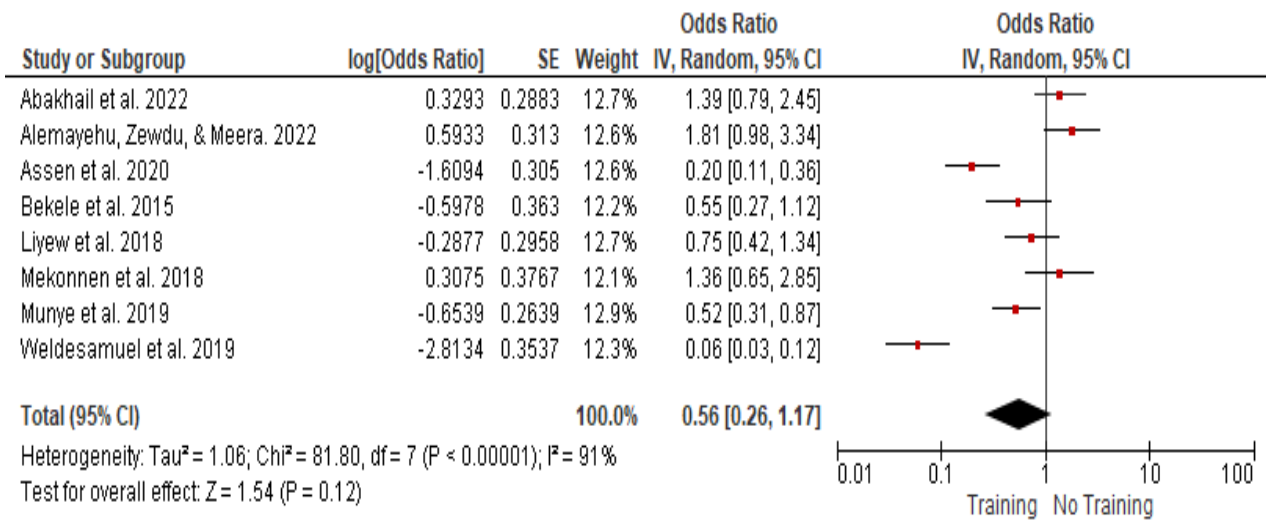| Writer (Year)	AOR	Lower limit	Upper limit
Liyew et al. (2018)	0.75	0.42	1.32
Bekele et al. (2015)	0.55	0. 27	1.14
Abakhail et al. (2022)	1.39	0.79	2.47
Assen et al. (2020)	0.20	0.36	0.11
Alemayehu et al. (2022)	1.81	0.98	3.33
Mekonnen et al. (2018)	1.36	2.84	0.65
Weldesamuel et al. (2019)	0.06	0.03	0.14
Munye et al. (2019)	0.52	0.31	0.89

Figure 3. Forest Plot of the effect of training on the incidence of needle stick injury work accidents among Health personnal

a. Forest plot

Forest plot Figure 3 shows that health workers with high workloads reduce job satisfaction 0.47 times compared to health workers with low workloads (aOR=0.47; 95% CI= 0.24 to 0.92; p=0.03). Heterogeneity in the studies showed (I²=94%; p<0.001). Thus the calculation of the average effect estimate is carried out using the random effect model approacThe forest plot in Figure 4.3 shows that training influences the incidence of NSI in Health personnal. Health personnal who receive training have a risk of experiencing NSI 0.56 times compared to those without training. Although this relationship was not statistically significant (aOR = 0.56; Cl 95%= 0.26 to 1.17; p = 0.120). The foresplot also shows that the estimated effect between studies is highly heterogeneous (I² = 91%, p 0<0.001, thus calculating the average estimated effect using the Random Effect Model approach.
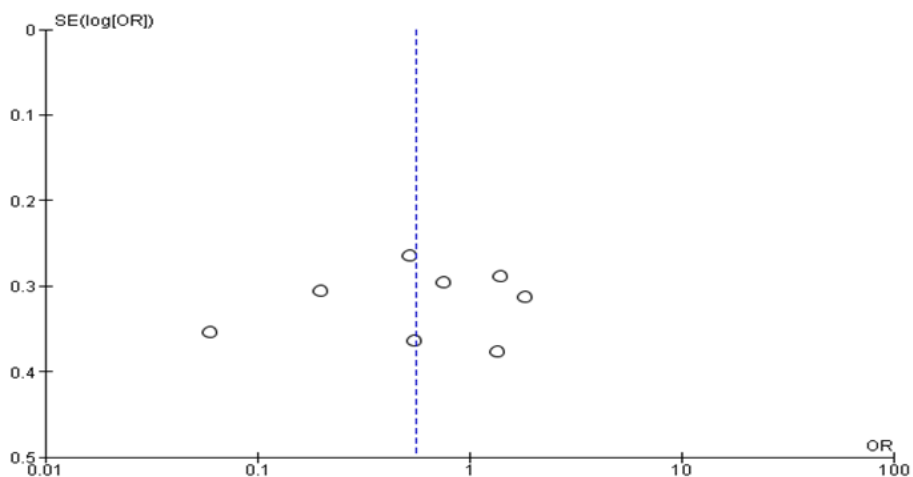

Figure 4. Funnel Plot of the effect of training on the incidence of needle stick injury work accidents among Health personnal

b. Funnel plot

The funnel plot in Figure 4 shows a more or less equal distribution of effect estimates to the right and left of the vertical line of average estimates. Thus, the funnel plot does not indicate publication bias.

Table 6. AOR value effect of recapping of needles on the incidence of needle stick injuries in health workers in a cross-sectional study (N=11,463)

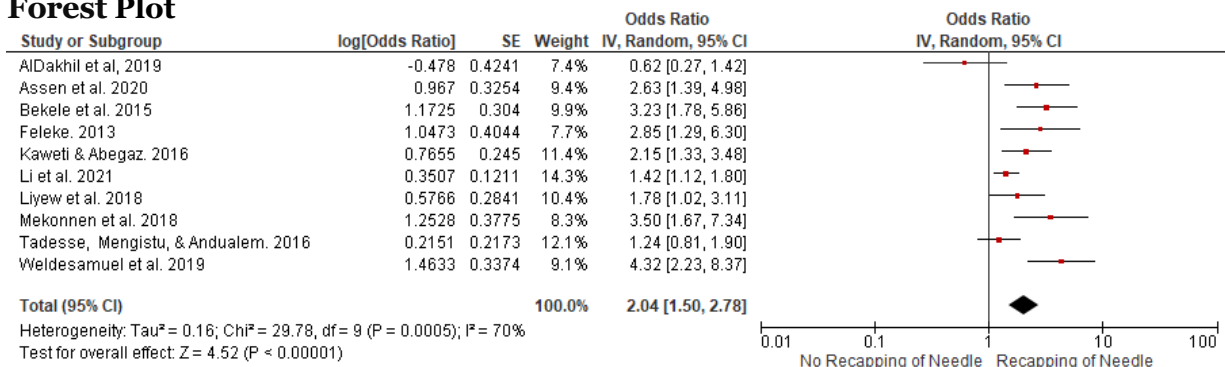| Author (Year)	AOR	Lower limit	Upper limit
Liyew et al. (2018)	1.78	1.02	3.09
Bekele et al. (2015)	3.23	1.78	5.84
Feleke. (2013)	2.85	1. 29	6. 25
Tadesse et al. (2016)	1.24	0.81	1.88
Assen et al. (2020)	2.63	1.39	4.99
Mekonnen et al. (2018)	3.50	1.67	7.57
Weldesamuel et al. (2019)	4.32	2.23	8.37
Kaweti & Abegaz. (2016)	2.15	1.33	3.49
AlDakhil et al, (2019)	0.62	0.27	1.44
Li et al. (2021)	1.42	1.12	1.81

c. **Forest Plot**

Figure 5. Forest Plot of the effect of recapping of needles on the incidence of needle stick injury work accidents among health workers

The forest plot in Figure 5 shows that recapping of needles has an effect on the incidence of NSI in health workers. Health workers who carry out needle recapping are at risk of causing NSI events 2.04 times compared to health workers who do not carry out needle recapping and this result is close to statistically significant (aOR= 2.04; 95% CI= 1.50 to 2.78; p < 0.001). The foresplot also shows that the effect estimates between studies are highly heterogeneous (I^2 = 70%, p = 0<0.001, thus calculating the average effect estimate using the Random Effect Model approach.
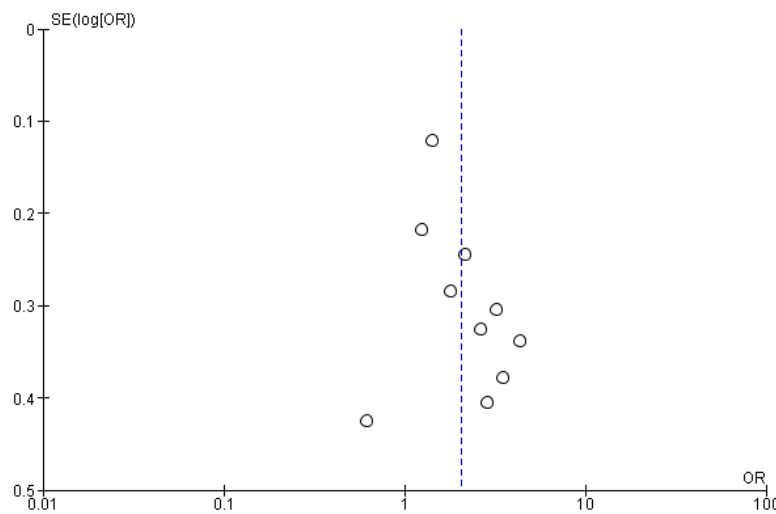
d. **Funnel Plot**

Figure 6. Funnel Plot of the effect of recapping of needles on the incidence of needle stick injury work accidents among health workers

The funnel plot in Figure 6 shows that the distribution of effect estimates is more to the right than to the left of the vertical line of the mean especially for studies with small sample sizes. Thus, the funnel plot indicates publication bias because the effect distribution is more to the right of the vertical line, the average estimate is the same as the location of the diamond shape in the forest plot in Figure 4.5 and also on the right. So, the publication bias tends to exaggerate the actual effect (overestimate).

DISCUSSION

Health care workers are at greater risk than other people due to the nature of their work as they handle sharp devices or equipment (Qozi et al., 2016). Needle sticks are caused more by unsafe needle devices than by carelessness by health workers (Ghosh, 2013). The highest rates of occupational exposure injuries occur when recapping needles, during transfusion of patient body fluids from syringes to test tubes and improper disposal of used needles. Another factor is training. Such as a lack of training and education in infection control and occupational health principles which can increase

the risk of needle stick injuries (Dulon et al., 2020).

1. The influence of training on the incidence of needle stick injury work accidents in health workers

The results of meta-analysis from 8 articles related to the effect of training on the incidence of needle stick injury work accidents in health workers who took training can reduce the incidence of NSI 0.56 times compared to health workers without training, and these results are not statistically significant (SMD= 0.56; CI 95 recapping of needle %= 0. 26 to 1.17; p = 0.12).

In one of the primary studies, Cui et al (2018) "Sharp injuries: a cross-sectional study among health care workers in a provincial teaching hospital in China". Training program is a risk factor associated with the occurrence of sharp injuries. Health care workers who infrequently attend training programs are associated with an increased risk of such incidents from sharp injuries. Health workers who rarely attend training programs are more likely to experience work accidents from sharp instruments. An effective occupational safety training program is

essential, as its implementation will reduce the overall rate of sharps injuries.

The research results are supported by other research, one of which is Chalya et. al (2015) entitled "Needle-stick injuries and splash exposures among healthcare workers at tertiary care hospitals in north-western Tanzania" in this research involving 436 health workers with the aim of determining the frequency and factors that contribute to NSI and splash exposure as well as post-exposure practice among health workers at the Central Hospital. Health care workers who are not trained on issues related to infection prevention and occupational risk reduction are more likely to suffer from all types of work injuries studied. All healthcare workers should be trained on issues related to preventing infections and reducing occupational risks such as Needle Stick Injury.

Joukar et al. (2018) in their research, training related to needle stick injuries was received by 544 health workers. NSI prevention strategies are a very serious part of workplace prevention programs and training of health workers requires ongoing activities in hospitals. As for other research conducted by Persaud & Amber (2021), part of worker training requires an explanation of appropriate engineering controls, work practices, and personal protective equipment as they relate to preventing or reducing exposure to blood-borne pathogens. Higher needle stick rates have been contributed to by higher rates of vaccinations administered by health care workers, use of non-hospital settings, and lack of training. Workplace safety and health training can be used to increase awareness and skill levels of workers, such as health workers dealing with needle stick accidents. Needle and sharps injury prevention training Training to develop strategies related to innovative devices can further help health workers use and dispose of syringes.

2. The effect of recapping of needles on the incidence of needle stick injury work accidents in health workers

The results of a meta-analysis of 10 articles related to the effect of recapping of needles on the incidence of needle stick injury work accidents in health workers who carry out the risk of causing NSI incidents 2.04 times compared to health workers who do not carry out recapping of needles, and these results are close to being statistically significant (aOR= 2.04; 95% CI= 1.50 to 2.78; p < 0.001).

The research results are supported by other research, one of which is Afridi et al. (2013) entitled "Needle Stick Injuries – Risk and Preventive Factors: A Study among Health Care Workers in Tertiary Care Hospitals in Pakistan" with subjects of 182 health workers who had perform recapping of needles. Needle recap was found to be the second most common procedure resulting in 37% of NSIs. So it is one of the factors that influences accidents resulting from Needle Stick Injury work.

In one of Amira & JO's (2018) primary studies "Needle-Stick Injury among Health Care Workers in Hemodialysis Units in Nigeria: A Multi-Center Study" the most common activity that led to NSI was needle recap (45%). Recapping of needles behavior among health workers is considered normal. In general, needle recapping by health workers although prohibited, is still common in many developing countries and remains an important cause of NSI.

Several studies have shown related factors among health workers with the incidence of Needle Stick Injury carried out by Isara et al. (2015) there were 33 health workers who had carried out needle recapping. Needle recapping and patient aggression was the most common circumstance leading to NSI in this study. Needle recapping is a

long-standing tradition that continues to pose a significant danger to health workers as has been shown in many studies in Nigeria.

Bhardwaj et al. (2014) in their research, there were 141 health workers related to universal precautions who had knowledge that recapping needles was an unsafe practice. Knowledge of standard precautionary practices that will prevent healthcare workers from the risk of needle stick injuries and accompanied by adequate reporting that will benefit them through timely intervention. Research by Andriani et al. (2022) shows that unsafe actions greatly influence the incidence of needle stick injuries (NSI). Unsafe actions identified in this study included re-capping the syringe, rushing, not using PPE and not following standard procedures.

A limitation in the research is that there is language bias because the articles used in this research are articles published in English, thus ignoring articles that use other languages. And there is publication bias shown in the funnel plot in cross-sectional studies on the recapping of needles variable.

AUTHOR CONTRIBUTION

Shofia Andriyani as the main researcher chose the topic, carried out searches, and collected data in this research. Argyo Demartoto and Bhisma Murti analyzed the data and reviewed research documents.

CONFLICT OF INTEREST

There was no conflict of interest in the study.

FUNDING AND SPONSORSHIP

ACKNOWLEDGEMENT

REFERENCE

Abalkhail A, Russel K, Yousif ME, Ameen SS, Fahad AA, Thamer A, Khalid AA, et al. (2022). Needle-Stick and sharp injuries among hospital healthcare workers in Saudi Arabia: a cross-sectional survey. Int J Environ Res Public Health. 19(10): 6342. https://-doi.org/10.1016/j.ijnurstu.2012.07.0-09.

Afridi AAK, Kumar A, Sayani R (2013). Needle stick injuries–risk and preventive factors: a study among health care workers in tertiary care hospitals in Pakistan. Glob J Health Sci. 5(4): 85. https://doi.org/10.5539%2Fgjhs.-v5n4p85.

Al Dakhil L, Yenugadhati N, Al-Seraihi, O, Al-Zoughool M (2019). Prevalence and associated factors for needlestick and sharp injuries (NSIs) among dental assistants in Jeddah, Saudi Arabia. Environ Health Prev Med. 24(1): 1-7. https://doi.org/10.1186/s121990108-15-7.

Alemayehu A, Baye Z, Indracanti M (2022). Prevalence of Sharp Injuries and Associated Factors among Healthcare Workers in North Gondar (Debark), West Gondar (Metema), and South Gondar (Addis Zemen) Primary Hospitals, Northwest Ethiopia. Indian J Sci Technol, 15(39), 1987-1996. https:-//doi.org/10.17485/IJST/v15i39.1615

Amira CO, Awobusuyi JO (2014). Needle-stick injury among health care workers in hemodialysis units in Nigeria: a multi-center study. Int J Occup Environ Med. 5(1): 1. http://www.ncbi.-nlm.nih.gov/pmc/articles/pmc776758 8/.

Andriani ND, Sumardiyono S, Murti B (2022). Meta-Analysis: Effects of unsafe action and work experience on occupational exposure to needlestick

injury among health workers in the hospital. J Health Policy Manage. 7(1): 58-71. https://doi.org/10.26911/the-jhpm.2022.07.01.06.

Assen S, Wubshet M, Kifle M, Wubayehu T, Aregawi BG (2020). Magnitude and associated factors of needle stick and sharps injuries among health care workers in Dessie City Hospitals, north east Ethiopia. BMC nursing. 19: 1-8. https://doi.org/10.1186/s1291202000 422-0.

Bhardwaj A, Sivapathasundaram N, Yusof MF, Minghat AH, Swe KMM, Sinha NK (2014). The prevalence of accidental needle stick injury and their reporting among healthcare workers in ortho-paedic wards in general hospital Melaka, Malaysia. Malays. Orthop J. 8(2): 6. https://doi.org/10.5704/moj.-1407.009.

Bekele T, Gebremariam A, Kaso M, Ahmed K (2015) Factors Associated with Occupational Needle Stick and Sharps Injuries among Hospital Healthcare Workers in Bale Zone, Southeast Ethiopia. PLoS ONE 10(10): e01403-82. doi:10.1371/ journal.pone.014-0382.

Bidira K, Mirkuzie W, Gugsa N (2014). Pre-valence and predictors of needlestick injury among nurses in public hos-pitals of Jimma Zone, South West Ethiopia. Int J Nurs Midwifery. 6(7). http://dx.doi.org/10.5897/IJNM20-14.0135

Bouya S, Balouchi A, Rafiemanesh H, Amirshahi M, Dastres M, Mogha-dam, MP, Daley KA (2020). Global prevalence and device related causes of needle stick injuries among health care workers: a systematic review and meta-analysis. Ann Glob. Health. 86:(1). https://doi.org/10.5334/aog-h.2698.

CDC (2020). Testing and clinical manage-ment of health care personnel poten-tially exposed to hepatitis C virus—CDC guidance, United States, 2020. MMWR Recommendations and Re-ports. 69(6): 1. https://www.cdc.gov/-mmwr/volumes/69/rr/rr6906a1.htm.

Chalya PL, Seni J, Mushi MF, Mirambo MM, Jaka H, Rambau PF, Kapesa A, Ngallaba SE, Massinde AN, Kalluvya SE (2015). Needle-stick injuries and splash exposures among health-care workers at a tertiary care hospital in north-western Tanzania. TJHR. 17(2). https://doi.org/10.4314/thrb.v17i2.3.

Cho E, Hyeonkyeong L, Miyoung C, Su HP, Il YY, Linda HA (2013). Factors associated with needlestick and sharp injuries among hospital nurses: a cross- sectional questionnaire survey. Int J Nurs Stud. 50(8): 1025-1032. https://doi.org/10.1016/j.ijnurstu.201 2.07.009.

Cui Z, Zhu J, Zhang X, Wang B, Li X (2018). Sharp injuries: a cross-sectional study among health care workers in a provincial teaching hospital in China. Environ Health Prev Med. 23(1): 1-7. DOI:10.1186/s12199-017-0691-y.

Dulon M, Stranzinger J, Wendeler D, Nien-haus A (2020). Causes of needlestick and sharps injuries when using devices with and without safety features. Int J Environ Res. 17(23): 8721. https://doi.org/10.3390/ijerp-h17238721.

Feleke BE (2013). Prevalence and determi-nant factors for sharp injuries among Addis Ababa hospitals health pro-fessionals. Sci J Public Health. 1(5): 189-193. doi: 10.11648/j.sjph.201301-05.11

Ghosh T (2013). Occupational health and

hazards among health care workers. IJOSH. 3(1) : 1-4.

Hosseinipalangi Z, Golmohammadi Z, Ghashghaee A, Ahmadi N, Hosseinifard, H, Mejareh ZN, Kan FP (2022). Global, Regional and National Incidence and Causes of Needlestick Injuries: A Systematic Review and Meta-Analysis. EMJH. 28(3): 233–241. https://doi.org/10.26719/emhj.22.031.

Isara AR, Oguzie KE, Okpogoro OE (2015). Prevalence of needlestick injuries among healthcare workers in the accident and emergency department of a teaching hospital in Nigeria. Ann med health sci res. 5(6): 392-396. https://doi.org/10.4103/21419248.177973.

Iwan MR, Rahman A (2017). Analisis risiko Kesehatan dan Keselamatan Kerja (K3) pada perawat. JKP. 5(3): 229-241. https://doi.org/10.24198/jkp.v5-i3.645.

Joukar F, Mansour-Ghanaei F, Naghipour M, Asgharnezhad M (2018). Needlestick injuries among healthcare workers: Why they do not report their incidence. Iran J Nurs Midwifery Res. 23(5): 382. https://doi.org/10.4103%-2Fijnmr.IJNMR7417.

Kaweti G, Abegaz T (2015). Prevalence of Percutaneous Injuries and Associated Factors Among Health Care Workers in Hawassa Referral and Adare District Hospitals, Hawassa, Ethiopia, January 2014. BMC public health. 16: 1-7. DOI 10.1186/s12889-015-2642-0.

Li M, Huo L, Du F, Li W, Zhang H, Shi B (2022). Prevalence, emotional and follow-up burden of insulin injection-related needle-stick injuries among clinical nurses in Shaanxi Province, West of China: A cross-sectional study.

Nurs Open. 9(4): 1984-1994. https://-doi.org/10.1002/nop2.1200.

Liyew B, Sultan M, Michael M, Tilahun AD, Kassew T (2020). Magnitude and determinants of needlestick and sharp injuries among nurses working in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. Biomed Res Int. 2020: 1-14. https://doi.org/10.-1155/2020/6295841.

Mekonnen R, Yosef H, Teklegiorgis K, Tesfaye F, Dagne I (2018). Magnitude and Impact of Occupational Related Needle Stick and Sharp Injuries and Associated Factors among Health Care Workers in Dire Dawa, Eastern Ethiopia. Med Saf Glob Heal. 7: 141. doi: 10.4172/2574-0407/1000141.

Minyahil T, Mengistu M, Andualem TB (2016). Needle-stick and sharps injuries among health care workers in Wolaita Zone, Southern Ethiopia. Med Safe Glo Heal. 5: 130. doi: 10.4172/25-74-0407/1000130.

Munye T, Mengistie B, Mesfin F, Demis S. (2019). Needle stick and sharp injuries and associated factors among nurses working in Dire Dawa City Administration Public Health Facilities, Eastern Ethiopia: a facility based cross-sectional study. Int J Adv Res Med Surg Nurs. 2(1): 33-39. https://-doi.org/10.33545/surgicalnursing.2020.v2.i1a.33.

Persaud E, Mitchell A (2021). Needlestick injuries among healthcare workers administering COVID-19 vaccinations in the United States. New Solutions. J Environ Occup Health. 31(1): 16-19. https://doi.org/10.1177/10482911211-001483.

Puspitasari S, Supriyanto, Rubi G (2019). Factors associated with work accidents from being pricked by syringes or other sharp objects in nurses at

Leuwiliang Regional Hospital, Bogor Regency in 2018. Jurnal Kesehatan Masyarakat. 2(2): 16.

Qazi AR, Siddiqui FA, Faridi S, Nadeem U, Umer NI, Mohsini ZS, Khan M (2016). Comparison of awareness about precautions for needle stick injuries: A survey among health care workers at a tertiary care center in Pakistan. Patient Saf Surg. 10(1): 19. https://doi.org/-10.1186/s13037-016-0108-7.

Risana NE, Nur UM, Andi N (2022). Use of Personal Protective Equipment with Unsafe Measures for Medical Personnel During the Covid-19 Pandemic at the Makassar City Hajj Hospital).

Window Of Public Health. 3(1). https://doi.org/10.33096/woph.v3i-3.119.

Tadesse M, Meskele M, Tadesse AB (2016). Needle-stick and Sharps Injuries among Health Care Workers in Wolaita Zone, Southern Ethiopia. Med Saf Glob Health, 5: 2-7.

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. MC Res Notes. 12(1): 1-6. https://doi.org-/10.1186/s13104019.