

## Meta-Analysis: Effects of Unsafe Action and Work Experience on Occupational Exposure to Needlestick Injury among Health Workers in the Hospital

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### ABSTRACT

**Background:** Needlestick injury is a dangerous work accident that causes blood contact with patients and is at risk of being infected with blood borne diseases such as hepatitis B virus (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV). The purpose of this study was to analyze the influence of unsafe behavior factors on the incidence of accidents due to needlestick injury to health workers in hospitals.

**Subjects and Method:** This research was conducted using a systematic review and meta-analysis study design using PICO, population: health workers, intervention: unsafe action and lack of work experience. Comparison: safe action and good work experience, Outcome: Needlestick Injury (NSI) incident. The articles used in this study came from 4 databases, namely Pubmed, ScienceDirect, ProQuest and Google scholar. The keywords of the article are ("Needle Stick Injury" or "Sharp Injury") AND aOR. The articles included in this study are full paper articles, observational study designs, 2011-2021 and the size of the relationship between Adj Odds Ratio

**Results:** A total of 19 observational studies (case-control and cross-sectional) with 28,487 health workers from the African Continent (Egypt and Ethiopia), the Asian Continent (Thailand, Taiwan, Malaysia and Indonesia) and the European Continent (Bosnia and Herzegovina) were analyzed. From data processing, it was found that unsafe action increased the incidence of Needlestick Injury (NSI) in health workers in hospitals by 2.79 times higher than health workers who behaved safely (safe action) and statistically significant (aOR= 2.79; 95% CI= 2.18 to 3.67; p<0.001). Work Experience increases the incidence of Needlestick Injury (NSI) in health workers in hospitals by 1.97 times higher than health workers who have good work experience and is statistically significant (aOR= 1.97; 95% CI= 1.16 to 3.34; p = 0.010) .

**Conclusion:** The influence of human factors, especially unsafe action, in increasing the incidence of needlestick injuries in health workers.

**Keywords:** needlestick injury, sharp injury, unsafe action

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### BACKGROUND

Hospitals are health service institutions that provide complete individual health services that provide inpatient, outpatient, and emer-

gency services (Kemenkes, 2020). The hospital is a place of work that has a high risk of safety and health of hospital human resources, patients, patient companions, visitors,

and the hospital environment and in the context of managing and controlling risks related to occupational safety and health in hospitals, safety needs to be carried out and occupational health in hospitals in order to create hospital conditions that are healthy, safe and comfortable (Kemenkes, 2016).

According to the World Health Organization (WHO) from the World Health Report in 2002, 2 million Health workers out of 35 million health workers are exposed to infectious diseases every year. Exposure of health workers to infection was found to be 37.6% for hepatitis B, 39% for hepatitis C, and 4.4% for HIV/AIDS due to needlestick injury (NSI) (WHO, 2002). The CDC in the Sharp Safety for Healthcare Setting Workbook also estimates that in 2015 every year there were 350,000 cases of Needlestick Injury and injuries related to sharp objects that occurred in health workers in the world (CDC, 2015).

Needlestick injury is one of the dangerous types of work-related accidents because it causes blood contact with patients and is at risk of being infected with blood-borne diseases such as hepatitis B virus (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV). In addition, there are also microorganisms that can be transmitted through blood contact, namely: cytomegalovirus (CMV), Epstein-Barr virus (EBV), parvovirus, treponema palladium, yersina, plasmodium. Needle-stick injuries are widely recognized as a source of exposure to blood-borne pathogens for healthcare workers. There are more than 20 pathogens that can be transmitted from contaminated needles or sharp objects, including hepatitis B (HBV), hepatitis C (HCV) and human immunodeficiency virus (HIV) (Rogers et al., 2019).

Various studies have been carried out to see the determinants of the causes of work-related accidents due to Needlestick

Injury, but the results of the research have not seen much from the management aspect of K3 management. Further analysis needs to be carried out to obtain convincing conclusions about the main causes of NSI so that appropriate recommendations can be obtained to prevent the occurrence of NSI. This study aims to analyze the influence of unsafe behavior factors (unsafe act) and work experience on the incidence of accidents due to needlestick injury to health workers in hospitals.

## SUBJECTS AND METHOD

### 1. Study Design

This was a systematic review and meta-analysis study design. The articles used in this study came from various sources. Article searches were carried out comprehensively through search engines with databases of "Pubmed", "ScienceDirect", "ProQuest" and "Google scholar". This research started from April 2022 and is the result of searching for data from previous studies. The articles used are articles published from 2011 to 2021. The selection of articles uses a flow chart, namely the PRISMA Flow Diagram. The keywords used in the article search were ("Needle Stick Injury" or "Sharp Injury") AND aOR.

### 2. Inclusion Criteria

The inclusion criteria in this study were articles in the form of full papers, observational study designs, in English and Indonesian, the analysis used must be multivariate with the size of the Adjusted Odds Ratio relationship, the research subjects were health workers who worked in hospitals, articles published between 2011-2021. Subjects in the study were health workers. The intervention studied is a risk factor that causes Needlestick Injury. The outcome that will be studied is the incident of Needlestick Injury.

### 3. Exclusion Criteria

The exclusion criteria in this study were duplication of articles, articles published other than in English before 2011, the intervention was carried out not in the hospital.

### 4. Variable of Study

Research for articles was conducted by considering the eligibility criteria determined using the PICO model. Population: Health Workers, Intervention: Risk Factors for unsafe action. Comparison: safe action, Outcome: Needlestick Injury Genesis.

### 5. Operational Definition of Variables

**Unsafe action** is defined as unsafe behavior, behavior or actions that will cause work accidents, namely recapping needles, rushing, not using PPE and not according to standard procedures.

**Work experience** is defined as knowledge or skills that have been known and mastered by a person through the process of carrying out actions or work that have been carried out for a certain period of time with a standard of 5 years of work experience.

**Needlestick injury** is defined as a sharp stab wound from a needle (or other sharp object) that can result in exposure to blood or other body fluids.

### 6. Study Instrument

The instrument in this study uses the PRISMA Flow diagram by using a research quality assessment using predetermined criteria, namely using the Critical Appraisal Checklist with a checklist as follows:

- 1) Does the objective clearly address the research focus/problem?
- 2) Is the research method (research design) suitable to answer the research question?
- 3) Is the research subject selection method clearly written?
- 4) Can the sampling method lead to bias (selection)?
- 5) Does the research sample taken represent the designated population?

- 6) Was the sample size based on pre-study considerations?
- 7) Was a satisfactory response achieved?
- 8) Are the research instruments valid and reliable?
- 9) Was statistical significance assessed?
- 10) Was a confidence interval given for the main outcome?
- 11) Are there any confounding factors that have not been taken into account?
- 12) Are the results applicable to your research?

The criteria for evaluating articles with Case-Control study designs are as follows:

- 1) Does this research have a clear research focus?
- 2) Did the writer use an appropriate method to answer the research question?
- 3) Was the case selected in the right way?
- 4) Were the controls selected the right way?
- 5) Is exposure measured accurately (correctly) to prevent/minimize bias?
- 6) Apart from the exposure under study, did the researcher take into account the influence of all potential confounding factors in this study?
- 7) Has the researcher controlled for the influence of all potential confounding factors in the design and/or analysis of the data?
- 8) How big is the effect of the treatment?
- 9) How precise is the estimation of the effect of exposure?
- 10) Are the research results reliable?
- 11) Can the results of the study be applied to the local population?
- 12) Are the results of this study compatible with other available evidence?

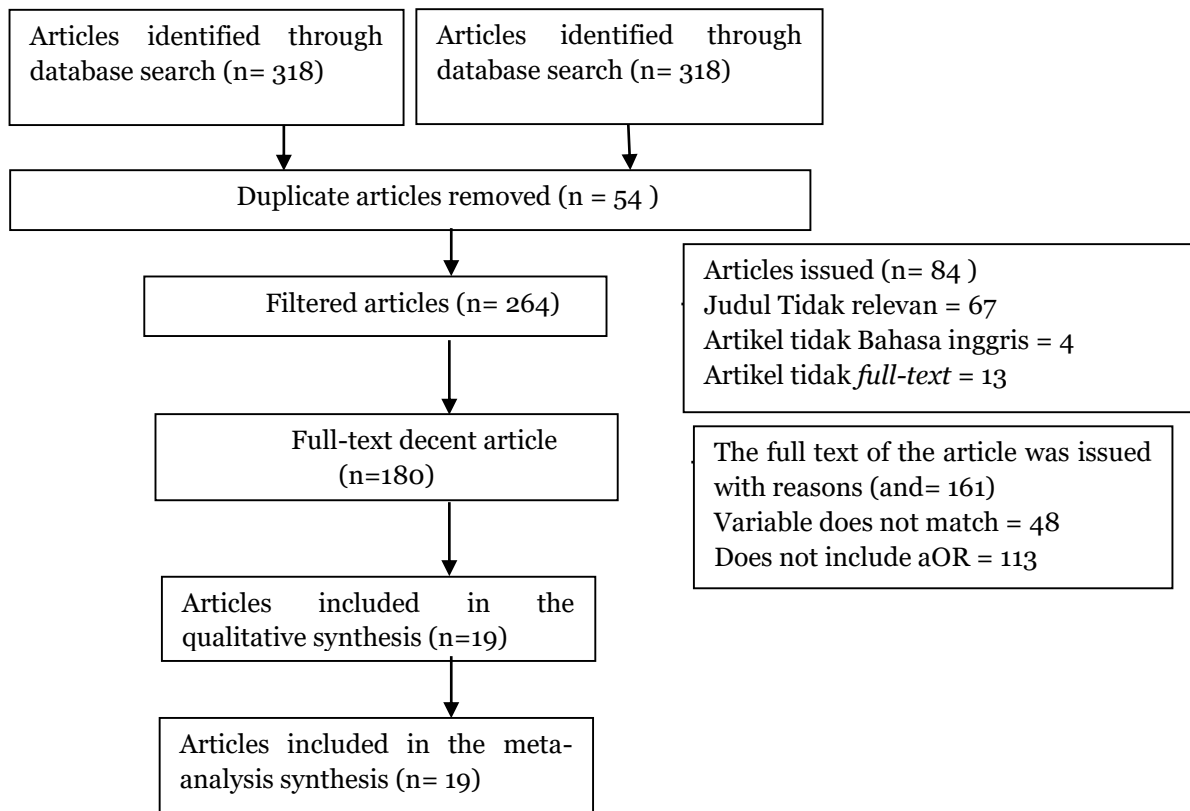
### 7. Data Analysis

From the articles that have been collected, data processing is carried out using the Review Manager application (RevMan 5.3) issued by the Cochrane Collaboraton. Data processing is done by calculating the value of effect size and heterogeneity.

**RESULTS**

Research related to Risk Factors related to Needlestick Injury in health workers consisted of 19 articles from the initial search process yielded 318 articles, after deletion of duplication articles resulted in 264 articles, then after the process of eliminating duplication of articles, further checking the relevance of the title and study design used

resulted 180 article. After that, the articles were checked according to the inclusion criteria and the exclusion criteria were obtained as many as 19 articles. From the filtered articles, an assessment of the quality of the research was carried out and 19 articles that met the assessment of research quality were then included in the quantitative synthesis using meta-analysis.



**Figure 1. PRISMA FLOW Diagram**

Based on Figure 2, it can be seen that the research came from 3 continents, namely the African continent, the Asian continent and

the European continent. Table 1 shows the results of the research quality assessment process.

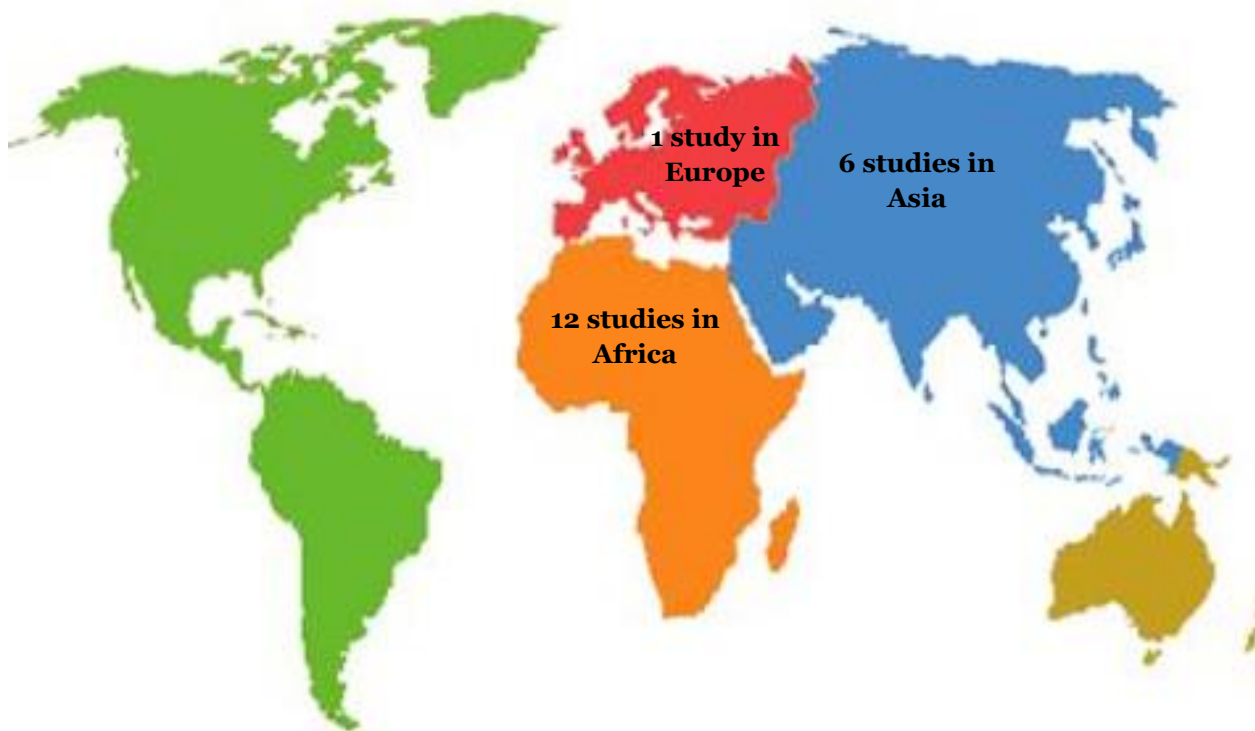


Figure 2. Research Distribution Map

Table 1. Research Quality Assessment with Cross-Sectional Critical Appraisal Skills Program (CASP)

Primary Study	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Honda et al. (2011)	2	2	2	2	2	2	2	2	2	2	2	2	24
Cheng et al. (2012)	2	2	2	2	2	2	2	2	2	2	2	2	24
Bidira et al. (2014)	2	2	2	2	2	2	2	2	2	2	2	2	24
Musa et al. (2014)	2	2	2	2	2	2	2	2	2	2	2	2	24
Kasatpibal et al. (2015)	2	2	2	2	2	2	2	2	2	2	2	2	24
Lo et al. (2016)	2	2	2	2	2	2	2	2	2	2	2	2	24
Abebe et al. (2018)	2	2	2	2	2	2	2	2	2	2	2	2	24
Gabr et al. (2018)	2	2	2	2	2	2	2	2	2	2	2	2	24
Yasin et al. (2019)	2	2	2	2	2	2	2	2	2	2	2	2	24
Weldesamuel et al. (2019)	2	2	2	2	2	2	2	2	2	2	2	2	24
Assen et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Bazie (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Zenbaba et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Getie et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Abadiga et al. (2020)	2	2	2	2	2	2	2	2	2	2	2	2	24
Ahmad et al. (2021)	2	2	2	2	2	2	2	2	2	2	2	2	24
Reda et al. (2021)	2	2	2	2	2	2	2	2	2	2	2	2	24
Atmadja(2021)	2	2	2	2	2	2	2	2	2	2	2	2	24
Behan et al. (2021)	2	2	2	2	2	2	2	2	2	2	2	2	24

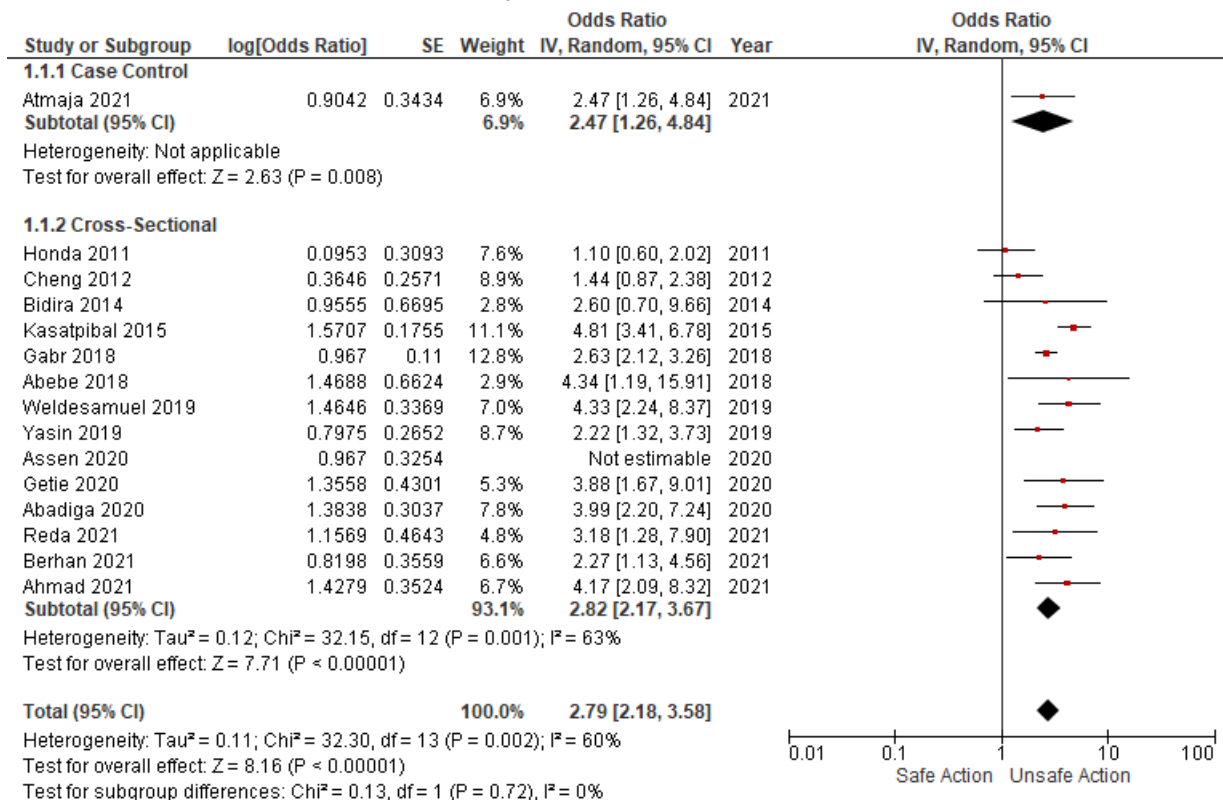
Note: 2 : Yes, 1 : Hesitant, 0 : No

The results in the meta-analysis process can be seen through the interpreta-

tion of the Forest plot. The interpretation of the forest plot related to the effect of unsafe

action on the incidence of Needlestick injury (NSI) can be seen in Figure 3. The figure shows that Health workers who take unsafe action increase the incidence of Needlestick Injury (NSI) by 2.79 times compared to Health workers who do not take unsafe action and statistically significant ( $p < 0.001$ ). The heterogeneity test in research with unsafe action risk factors with Needlestick injury (NSI) incidence shows  $I^2 = 60\%$  so that the distribution of data is declared heterogeneous Random Effect Model. The results of the Funnel Plot show that there is a possibility of publication bias by showing an asymmetrical distribution between the distributions on the right and left sides. There are 7 plots on the right, 5 plots on the left and 2 plots that touch the vertical line. The plot on the right side of the graph has a standard error (SE) between 0.2 and 0.8. The plot on the left side of the graph has a standard error (SE) between 0.2 and 0.4.

Figure 5 shows that Health workers who have less work experience increase the incidence of Needlestick Injury (NSI) by 1.97 times compared to Health workers who have good work experience and are statistically significant ( $p = 0.010$ ). In the heterogeneity test in the study with the risk factor of work experience with the incidence of Needlestick injury (NSI) it showed  $I^2 = 93\%$  so that the distribution of the data was declared as heterogeneous Random Effect Model. In Figure 6 the results of the Funnel Plot show that there is a possibility of publication bias by showing an asymmetric distribution between the distributions on the right and left sides. There are 5 plots on the right, 4 plots on the left and no plots that touch the vertical line. The plot on the right side of the graph has a standard error (SE) between 0 and 0.6. The plot on the left side of the graph has a standard error (SE) between 0 and 1.



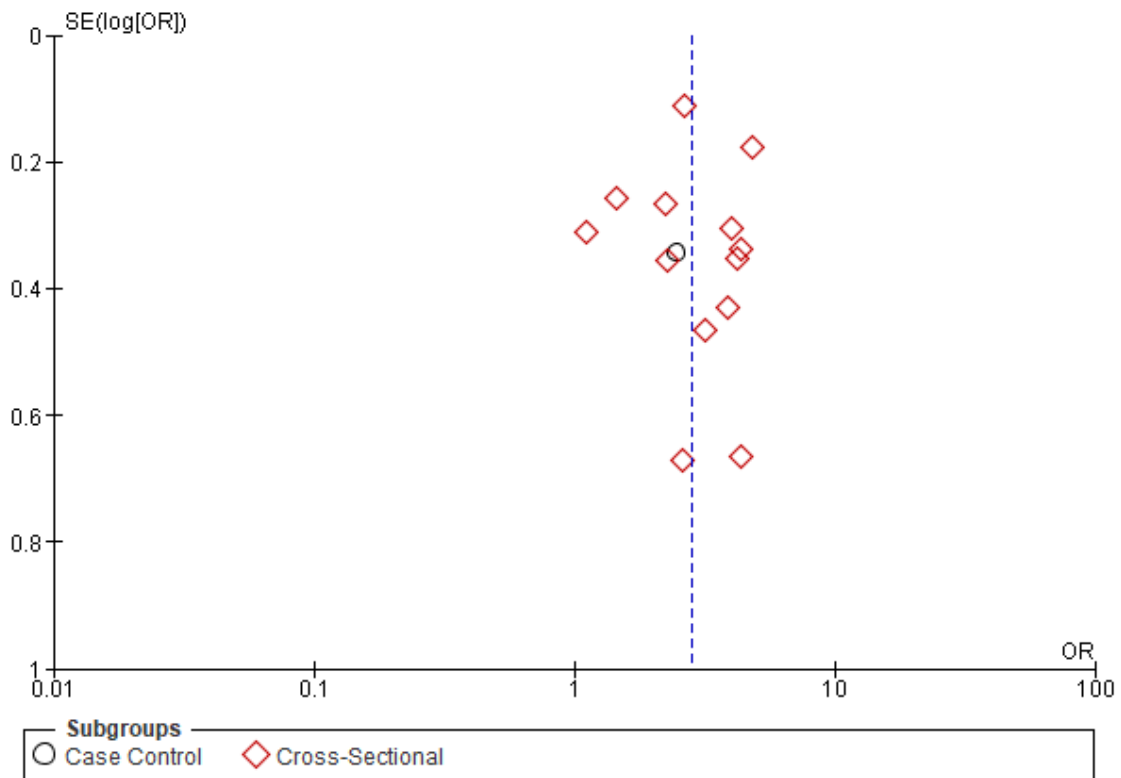
**Figure 3. Forest Plot Effect of Unsafe Action with events Needlestick Injury (NSI) for Health Workers**

**Table 2. Primary Research Thesis included in the Meta-Analysis**

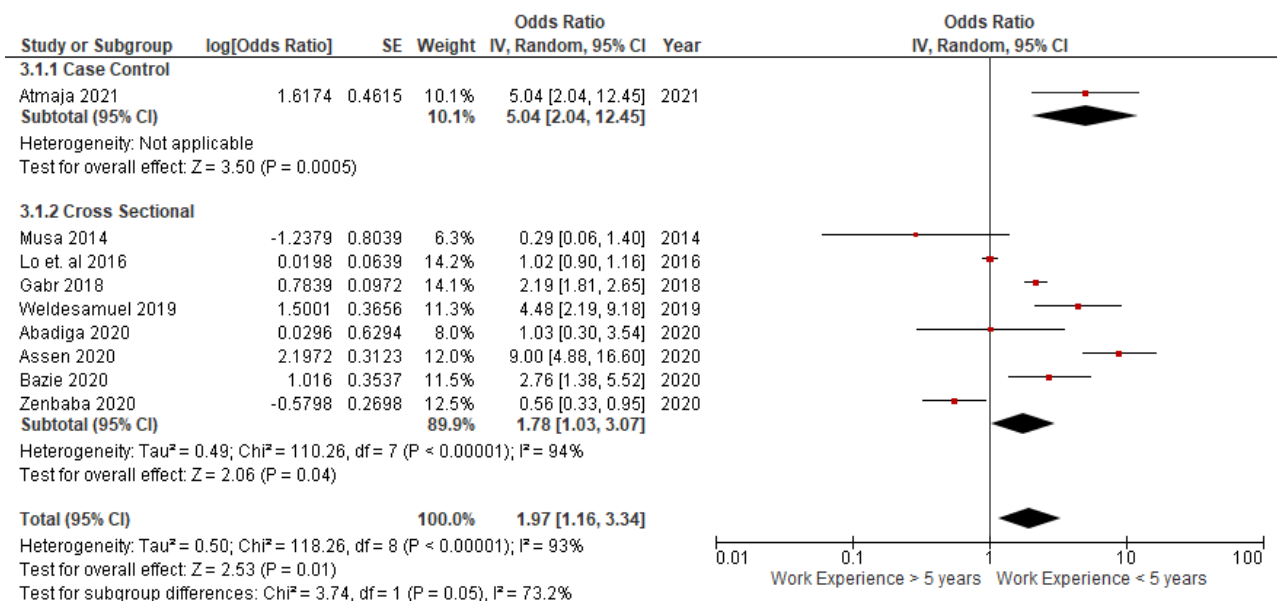
Author (Year)	Country	Study Design	Sample	P (Population)	I (Intervention)	C (Comparisons)	O (Outcome)	aOR (CI 95%)
Honda et al. (2011)	Thailand	Cross-Sectional	261	Health Workers (Nurses)	Unsafe action	Safe Action	NSI	1.10 (0.60 to 2.02)
Cheng et al. (2012)	Taiwan	Cross-Sectional	434	Health Personnel (Dentist)	Unsafe action	Safe Action	NSI	1.44 (0.87 to 2.39)
Bidira et al. (2014)	Ethiopia	Cross-Sectional	211	Health Workers (Nurses)	Unsafe Action (Recapping)	Safe Action	NSI	2.60 (0.70 to 9.50)
Musa et al. (2014)	Bosnia and Herzegovina	Cross-Sectional	248	Health workers	Less work experience	Good work experience	NSI	3.54 (0.27 to 46.24)
Kasatpibal et al. (2015)	Thailand	Cross-Sectional	2,031	Health Workers (Nurses)	Unsafe action (haste)	Safe Action	NSI	4.81 (3.41 to 6.79)
Lo et al. (2016)	Taiwan	Cross-Sectional	19,386	Health Workers (Nurses)	Less work experience	Good work experience	NSI	1.02 (0.90 to 1.16)
Abebe et al. (2018)	Ethiopia	Cross-Sectional	151	Health Workers (nurses)	Unsafe action (Recapping)	Safe Action	NSI	4.34 (1.18 to 15.90)
Gabr et al. (2018)	Mesir	Cross-Sectional	2,260	Health workers	1) Unsafe Action (Recapping) 2) Less work experience	1) Safe Action 2) Good work experience	NSI	1) 2.63 (2.12 to 3.26) 2) 2.19 (1.81 to 2.66)
Yasin et al. (2019)	Ethiopia	Cross-Sectional	282	Health workers	Unsafe Action (Recapping)	Safe Action	NSI	2.22 (1.32 to 3.74)
Weldesamuel et al. (2019)	Ethiopia	Cross-Sectional	444	Health workers	1) Unsafe action (Recapping) 2) Less work experience	1) Safe Action 2) Good work experience	NSI	1) 4.32 (2.23 to 8.37) 2) 4.48 (2.18 to 9.17)
Assen et al. (2020)		Cross-Sectional	438	Health workers	Less work experience	Good work experience	NSI	9.00 (4.88 to 16.60)
Bazie (2020)	Ethiopia	Cross-Sectional	362	Health workers	Less work experience	Good work experience	NSI	2.76 (1.38 to 4.52)

Author (Year)	Country	Study Design	Sample	P (Population)	I (Intervention)	C (Comparisons)	O (Outcome)	aOR (CI 95%)
Zenbaba <i>et al.</i> (2020)	Ethiopia	Cross-Sectional	394	Health workers	Less work experience	Good work experience	NSI	0.56 (0.33 to 0.96)
Getie <i>et al.</i> (2020)	Ethiopia	Cross-Sectional	147	Health workers	Unsafe action (Recapping)	Safe action	NSI	3.88 (1.67 to 9.04)
Abadiga <i>et al.</i> (2020)	Ethiopia	Cross-Sectional	297	Health Workers (Nurses)	1) Unsafe Action (Recapping) 2) Less work experience	1) Safe Action 2) Good work experience	NSI	1) 3.99 (2.20 to 7.21) 2) 1.03 (0.30 to 3.51)
Ahmad <i>et al.</i> (2021)	Malaysia	Cross-Sectional	334	Health workers	Unsafe Action (Recapping)	Safe Action	NSI	4.17 (2.09 to 8.33)
Reda <i>et al.</i> (2021)	Ethiopia	Cross-Sectional	318	Health workers	Unsafe action (Recapping)	Safe Action	NSI	3.18 (1.28 to 8.83)
Atmaja <i>et al.</i> (2021)	Indonesia	Case-Control	171	Health workers	1) Unsafe Action (inappropriate) 2) Less work experience	1) Safe Action 2) Good work experience	NSI	1) 2.47 (1.26 to 4.82) 2) 5.04 (2.04 to 12.42)
Berhan <i>et al.</i> (2021)	Ethiopia	Cross-Sectional	318	Health workers	Unsafe Action (Recapping)	Safe action	NSI	2.27 (1.13 to 4.56)

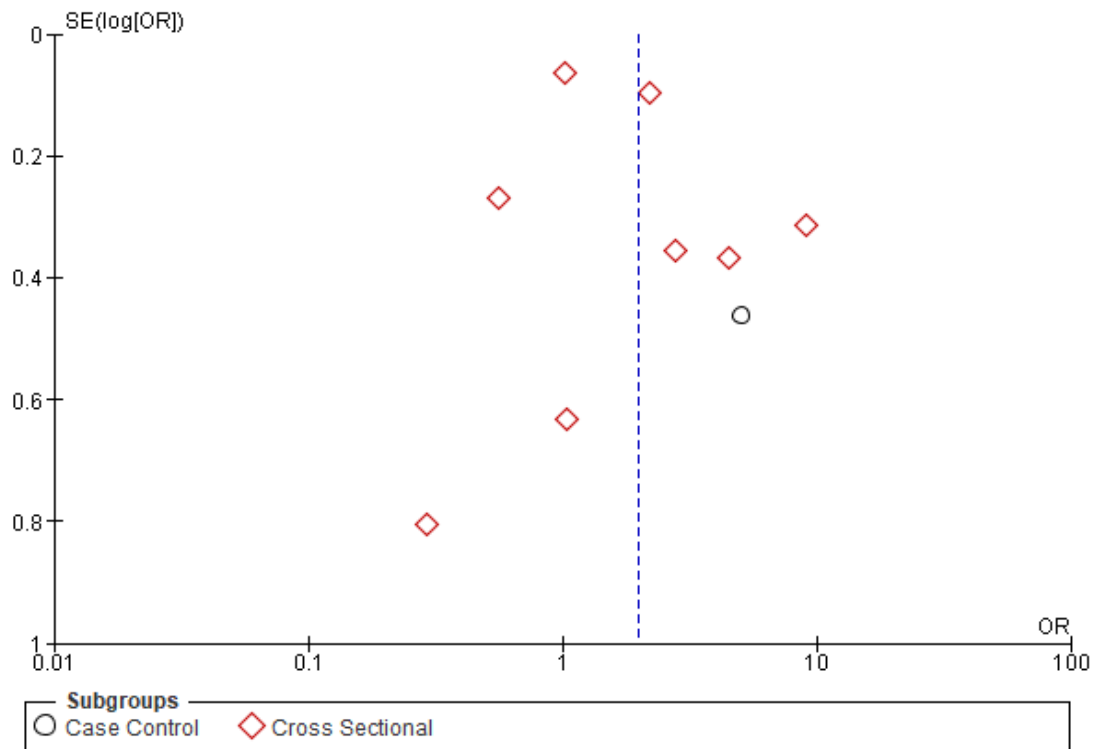




**Figure 4. Funnel Plot Effect of Work Experience with Events Needlestick Injury (NSI) for Health Workers**



**Figure 5. Forest Plot Effect of Work Experience with Events Needlestick Injury (NSI) for Health Workers**



**Figure 6. Funnel Plot Effect of Work Experience with Events Needlestick Injury (NSI) for Health Workers**

### DISCUSSION

In a research with a systematic review study design and a meta-analysis that has been carried out with the theme of the effect of unsafe action, workload and work experience on the incidence of needlestick injuries in health workers in hospitals. The independent variables used in the analysis of this research are unsafe action, workload and work experience. This research is important because it strengthens the evidence for finding the cause of work accidents in health workers, especially related to NSI where NSI is at high risk for exposure to infectious blood or body fluids from patients to health workers.

The number of relevant studies published and accessible is quite a lot, but most of the statistical results reported and published are still in the form of percent and the results of the analysis are still in the form of Odds Ratio where the research does

not control for confounding factors. These confounding factors affect the relationship or effect of exposure to the studied output (Murti, 2018).

In this study, there were 14 studies identified worldwide from 2011 to 2021. This study analyzed articles that used the adjusted odds ratio (aOR) relationship measure. The results of the Systematic Review and meta-analysis are presented in the form of forest plots and funnel plots. Forest plots are diagrams that interpret information from the studied studies in a meta-analysis and provide estimates of overall results. In addition, the forest plot also displays the magnitude of variation (heterogeneity) between research results (Murti, 2018).

There are 14 research articles with an observational study design as a source of synthesis of meta-analysis of the effect of unsafe action on the incidence of Needle-

stick Injury (NSI) work accidents. The results of the forest plot illustrate that unsafe action has an effect on increasing the incidence of Needlestick Injury (NSI) in health workers in hospitals by 2.79 times higher than health workers who behave safely (safe action) and significantly (aOR= 2.79; 95% CI = 2.18 to 3.67,  $p < 0.001$ ). The results of this meta-analysis prove that unsafe action is very influential on events. Needlestick Injury (NSI). Unsafe actions identified in this study were in the form of recapping syringes, rushing, not using PPE and not according to standard procedures.

This result is in accordance with the results of previous research conducted by Putra et al (2020) conducted in Indonesia which stated that in a multivariate analysis it was shown that unsafe action affects the incidence of Needlestick Injury (NSI). In this study, it was stated that nurses who performed activities that were dangerous (unsafe action) were 4 (four) times more likely to experience NSI than nurses who worked with names (safe action).

In addition, Bekele et al. (2015) research conducted in Ethiopia at 4 hospitals with a total of 362 samples of health workers stated that the main cause of accidents due to needle stick injuries (NSI) experienced by 69.8% of the total sample was the practice of recapping needles or closing syringes. Returned after 12 months of use (aOR = 3.23, 95% CI: 1.78 to 5.84). In that study, 1 in 5 respondents had experienced NSI. Recapping needle / unsafe action is the main behavior that can be carried out by the NSI incident prevention program. Hospital management must develop health policies and strategies to improve occupational health and safety and the compliance of health workers with occupational safety. Liyew et al. (2020) stated that one of the causes of NSI is recapping after use (aOR = 1.780, 95% CI 1.025 to 3.091).

Causes of Needlestick Injury (NSI) based on data from a systematic review conducted by Motaarefi et al (2016) the results of the analysis show that the highest incidence that occurs in nurses in the form of NSI is caused by age, education level, number of shifts per month, history of recapping needle training. The highest incidence of NSI occurred during instrument preparation and needle recapping activities. Based on the Centers for Disease Control and Prevention (CDC, 2021) research has shown that most injuries due to NSI are caused by not using a needle that is designed safely or by using it incorrectly (not according to the procedure), recapping the needle or re-closing the needle. used syringes, when transferring body fluids between containers, do not throw used syringes into puncture-resistant sharps containers.

There are 9 research articles with an observational study design as a source of meta-analysis of the effect of work experience on the incidence of Needlestick Injury (NSI) work accidents. The results of the forest plot illustrate that work experience  $< 5$  years has an effect on increasing the incidence of Needlestick Injury (NSI) in health workers in hospitals by 1.97 times higher than health workers who have work experience  $> 5$  years and significantly (aOR= 1.97; 95% CI= 1.16 to 3.34;  $p= 0.010$ ). The results of this meta-analysis prove that work experience  $<5$  years greatly influences the incidence of Needlestick Injury (NSI).

These results are in accordance with Beker and Bamlie (2015) on 170 samples of nurses stating that this study identified that work experience was significantly related to the incidence of Needlestick Injury.

### **AUTHOR CONTRIBUTION**

Nurul Dwi Andriani is the main researcher in selecting topics, finding and collecting and processing data.

### **CONFLICT OF INTEREST**

We declare that there was no conflict of interest.

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