

The Effect of Personal Protective Equipment Uptake on the Risk of Leprosy in Adults: Meta Analysis

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ABSTRACT

Background: Leptospirosis is an acute infectious disease that can attack humans and animals caused by the *Leptospira* bacteria. Leptospirosis contributes to morbidity and mortality in the high-risk group, namely adults. Compliance with the use of personal protective equipment and direct contact with animal tissue infected with *Leptospira sp.* bacteria increase the risk of leptospirosis. This study aims to analyze the magnitude of the effect of using personal protective equipment on the risk of leptospirosis with a meta-analysis.

Subjects and Method: This was a systematic review and meta-analysis carried out by following the PRISMA flow diagram. The process of searching for articles is through a journal database which includes: PubMed, Springer Link, Google Scholar and Science Direct by selecting articles published in 1999-2020. Keywords used "Leptospirosis AND Personal Protective Equipment", "leptospirosis" AND "risk factors", "leptospirosis AND adjusted odds ratio", "leptospirosis" AND "adults", "leptospirosis AND risk factors AND adjusted odds ratio". The inclusion criteria were full paper articles with observational study design, articles in English and Indonesian, multivariate analysis used with adjusted odds ratio. Articles that meet the requirements are analyzed using the Revmen 5.3 application.

Results: A total of 8 articles were reviewed in this study with a cross-sectional and case-control study design. Meta-analysis of 4 case-control studies showed that non-adherence to the use of personal protective equipment had a 2.77 times increased risk of leptospirosis compared with using personal protective equipment (aOR= 2.77, 95% CI= 1.76 to 4.36, p <0.001). A meta-analysis of 4 cross-sectional studies concluded that non-adherence to the use of personal protective equipment had a 2.73 times increased risk of leptospirosis compared with using personal protective equipment (aOR= 2.73, 95% CI= 1.99 to 3.74; p= <0.001).

Conclusion: Non-compliance with the use of personal protective equipment increases the risk of leptospirosis.

Keywords: leptospirosis, personal protective equipment, meta-analysis

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BACKGROUND

Leptospirosis is an acute infectious disease that can attack humans and animals (zoonosis) caused by the *Leptospira* bacteria. Countries with subtropical and tropical climates around the world that have high

rain intensity have a high potential for the spread of leptospirosis and become a serious public health problem (WHO, 2003). Leptospirosis is an endemic infectious disease. This type of disease is neglected or

Neglected Infectious Diseases (NIDs), its existence is widespread throughout the world except the arctic regions (Rusmini, 2011).

Each year there are more than 500,000 cases of leptospirosis worldwide, with a Case Fatality Rate (CFR) <5% to 30%. Significantly, the incidence of leptospirosis is also more common in tropical climates, which ranges from 10-100 incidents per 100,000 population per year, while for sub-tropical countries it is around 0.1-1 incidence per 100,000 population per year (WHO, 2011).

Leptospirosis can show various clinical manifestations, from mild leptospirosis to severe leptospirosis such as fever, chills, headache, malaise, vomiting, conjunctivitis (conjunctival suffusion), and pain in the muscles, especially the calf muscles (pain in the gastrocnemius area) and back muscles. This disease can attack organs such as the kidneys, brain, liver, uterus and eyes (WHO, 2003).

The people with the greatest risk of contracting leptospirosis are people who live in urban slum areas and farm laborers and livestock raisers in rural areas. Someone who has a habit of doing activities in lakes or rivers, such as swimming, also has a similar threat. The existence of standing water and the habit of bathing or washing in the river has a 4 to 7 times higher risk of developing leptospirosis because the river is polluted, especially from garbage where there are carcasses of rats in the river infected with leptospira (Riyaningsih, 2012).

The existence of vectors with high rodent populations and poor environmental sanitation conditions and slums due to flooding are the factors that cause leptospirosis cases. Based on the aspect of the cause, leptospirosis is a bacterial zoonosis, whereas from the transmission aspect,

leptospirosis is one of the direct zoonoses (host to host transmission) because transmission only requires one vertebrate (Ministry of Health, 2017).

The use of personal protective equipment (PPE) is one of the precautions that can be done to reduce the risk of leptospirosis. Personal protective equipment (PPE) is used when working and doing activities according to work hazards and risks to maintain the safety of the workers themselves and those around them. Efforts to use personal protective equipment occupy the last level of prevention, but the application of personal protective equipment is highly recommended (Yulita, 2019). The habit of walking without footwear or personal protective equipment is also a risk factor for leptospirosis (Desvars et al, 2013). In addition, the type of work, life habits, climate and environment also affect the number of cases and the prevalence of leptospirosis (Victoriano et al, 2009).

Several primary studies have shown mixed results regarding the risk factors that most influence the incidence of leptospirosis. Risk factors for leptospirosis transmission include the presence of cuts or abrasions on the skin, daily living habits (disobedience to use personal protective equipment when working or doing activities and frequently crossing stagnant water), contact with rats or rat urine, and contact with other infected animal tissues. Leptospira (Sambasiva et al, 2003). The purpose of this study was to analyze the risk factors for leptospirosis in adults in various countries so that a summary of studies with mixed results that have been conducted can be obtained.

SUBJECTS AND METHOD

1. Study Design

This was a meta-analysis research. Search for articles was carried out for one month

systematically through PubMed, Springer Link, Google Scholar, and Science Direct databases. Key words used: "Leptospirosis AND Personal Protective Equipment", "leptospirosis" AND "risk factors", "leptospirosis AND adjusted odds ratio", "leptospirosis" AND "adults", "leptospirosis AND risk factors AND adjusted odds ratio".

2. Inclusion Criteria

The author developed the inclusion criteria, namely articles in English and in Indonesian, full text with a cross-sectional case-control study design. Research subjects were women and men aged (26-65 years) who suffered from leptospirosis based on laboratory test results or from medical records. The analysis used multivariate with adjusted odds ratio and outcomes was the incidence of leptospirosis.

3. Exclusion Criteria

The exclusion criteria in this study were a randomized control trial (RCT), a quasi experiment, study protocols, and non-full text. Published articles are not using English or Indonesian language, not a multivariate analysis study, and does not include the adjusted Odds Ratio (aOR).

4. Operational Definition of Variables

The article search was carried out by considering the eligibility criteria defined using the PICO model. The population in the study were women and men aged (26-65 years) with intervention in the form of non-compliance using personal protective equipment. Comparison, namely falling using personal protective equipment. Outcome was the incidence of leptospirosis.

Leptospirosis is a zoonotic disease caused by the *Leptospira* bacteria which can attack organs such as the kidneys, brain, liver, uterus and eyes. Severe and mild clinical

symptoms such as fever, headache, muscle pain, especially in the calf, thigh, and kidney failure. Leptospirosis is transmitted by contact with water, mud, plants that have been contaminated by urine from rodents (rats) and other animals that contain *Leptospira* bacteria.

Personal protective equipment is defined as equipment that is used when working or doing activities according to hazards and risks to maintain the safety of oneself and those around them. Examples of personal protective equipment such as footwear (sandals or shoes), gloves, masks, long-sleeved clothing, and head protection. The use of personal protective equipment can be completely used, one or several types at once.

5. Data Analysis

Articles are identified using the PRISMA diagram, and analyzed using the Review Manager 5.3 application by calculating the effect size and heterogeneity to determine the research model that is combined and forms the final meta-analysis result.

RESULTS

The process of reviewing articles can be seen in Figure 1. The PRISMA diagram This meta-analysis analyzes 8 primary studies conducted in the America, Asia, Africa, Europe.

The study quality assessment was carried out quantitatively. This research was conducted using an assessment of the quality of research studies for the design of Case Control Center for Evidence Based Management (CEBMa) and cross sectional Center for Evidence Based Management (CEBMa) in 2014.

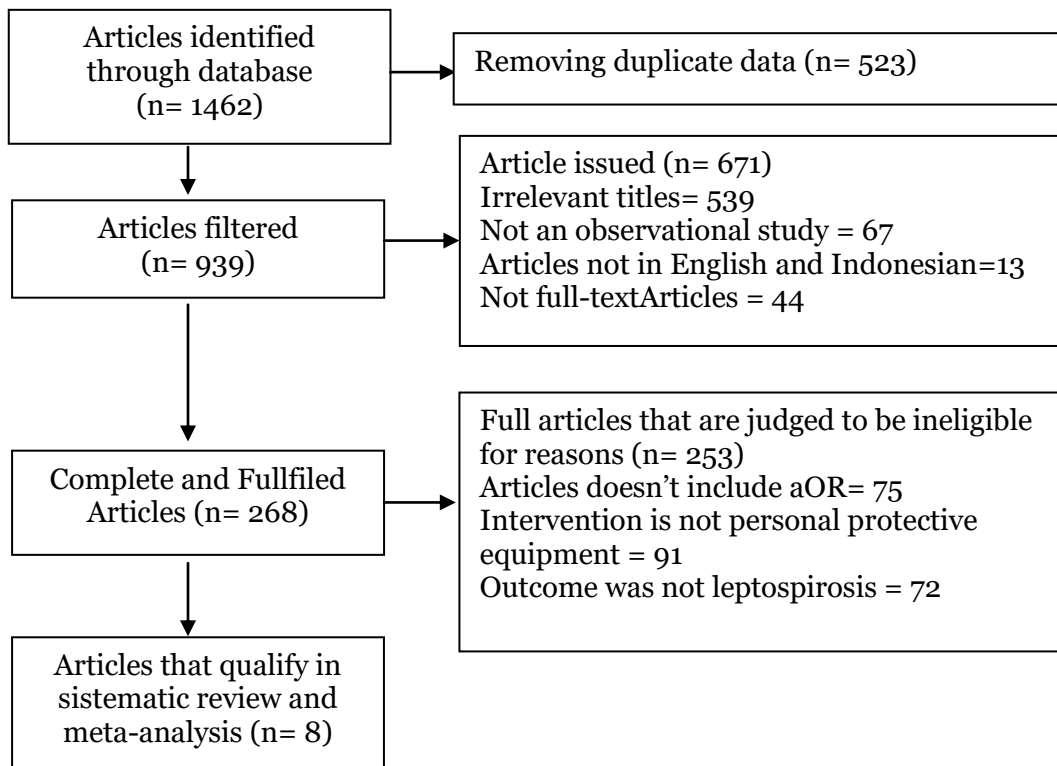


Figure 1. PRISMA Diagram

a. Forest plot

The effect between the use of personal protective equipment and the incidence of

leptospirosis is shown in the forest plot results in Figure 2.

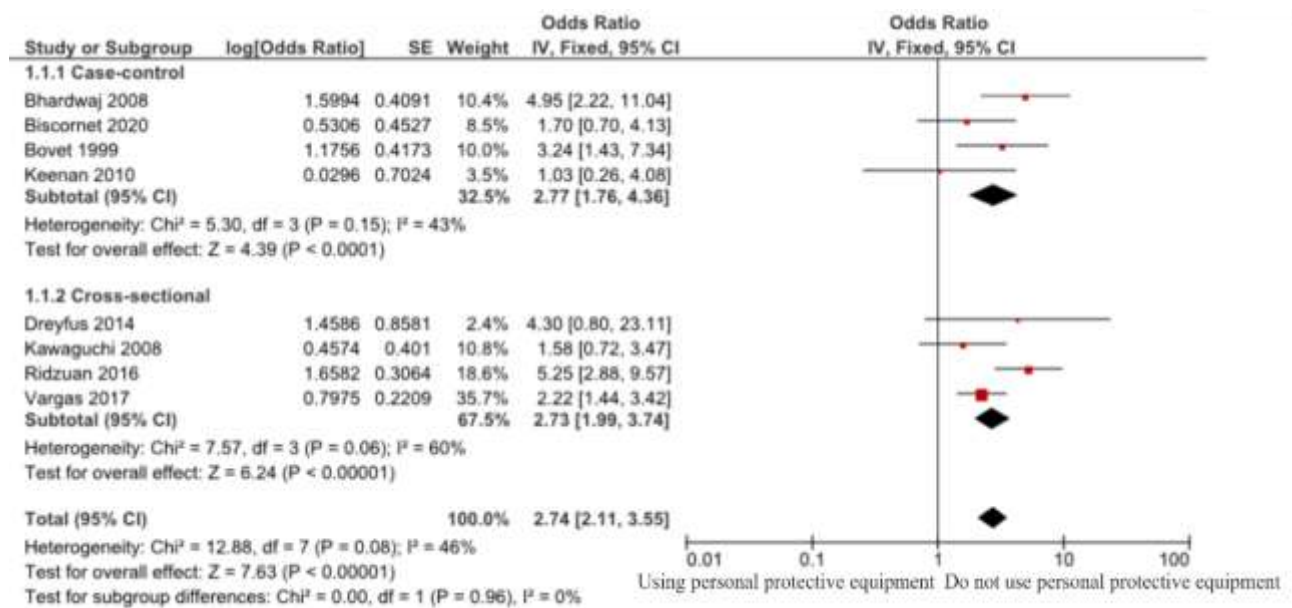


Figure 2. Forest plot the effect of using personal protective equipment on the risk of leptospirosis

Table 1. Research Quality Assessment Case control studies

Primary Study	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Biscornetet al. (2020)	1	1	1	1	1	1	0	1	1	1	0	1	10
Keenanet al. (2010).	1	1	1	1	1	1	0	1	1	1	0	1	10
Bhardwajet al(2008).	1	1	1	1	1	1	0	1	1	1	0	1	10
Bovetet al. (1999).	1	1	1	1	1	1	0	1	1	1	0	1	10

Table 2. Research Quality Assessment Cross sectional Study

Primary Study	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Kawaguchi et al. (2008)	1	1	1	1	1	1	0	1	1	1	0	1	10
Ridzuanet al. (2016).	1	1	1	1	1	1	0	1	1	1	0	1	10
Dreyfus et al.(2014).	1	1	1	1	1	1	0	1	1	1	0	1	10
Vargaset al. (2017).	1	1	1	1	1	1	0	1	1	1	0	1	10

Tabel 3. Deskripsi penelitian primer yang dimasukkan dalam meta-analisis

Author (Year)	Country	Study Design	Sample	P Population	I Intervention	C Comparison	O Output
Biscornet et al. (2020)	Seychelles	Case Control	219	Leptospirosis confirmed patients with a mean age of 36 years	Do not use complete personal protective equipment as protection	Use complete personal protective equipment as protection	Leptospirosis disease
Keenan et al. (2018)	Jamaica	Case Control	89	Leptospirosis confirmed patients with a mean age of 38 years	Walking and doing activities without using personal protective equipment (footwear)	Walk and do activities using personal protective equipment (footwear)	Leptospirosis disease
Bhardwaj et al. (2008)	India	Case Control	62	The patients confirmed leptospirosis with a mean age of 29 years	Walking and doing activities without using personal protective equipment (footwear)	Walk and do activities using personal protective equipment (footwear)	Leptospirosis disease
Bovet et al. (1999)	India	Case Control	75	The patient was diagnosed with leptospirosis	Walk barefoot	Walk in footwear	Leptospirosis disease
Kawaguchi et al. (2008)	Laos	Cross Sectional	406	Leptospirosis confirmed patients with a mean age of 35 years	Walk barefoot	Walk in footwear	Leptospirosis disease
Ridzuan et al. (2016)	Malaysia	Cross Sectional	350	Oil palm plantation workers infected with	Work not using personal protective equipment (hand	Work using personal protective equipment	Leptospirosis disease

Author (Year)	Country	Study Design	Sample	P Population	I Intervention	C Comparison	O Output
				leptospirosis have an average age of 31 years	protection)	(hand protection)	
Dreyfus et al. (2014)	New Zealand	Cross Sectional	567	Slaughterhouse workers infected with leptospirosis	Never or occasionally use masks and protective goggles	Often or always use masks and protective glasses	Leptospirosis disease
Vargas et al. (2019)	Colombia	Cross Sectional	353	Leptospirosis confirmed patients with a mean age of 41 years	Walk barefoot	Walk in footwear	Leptospirosis disease

b. Funnel plot

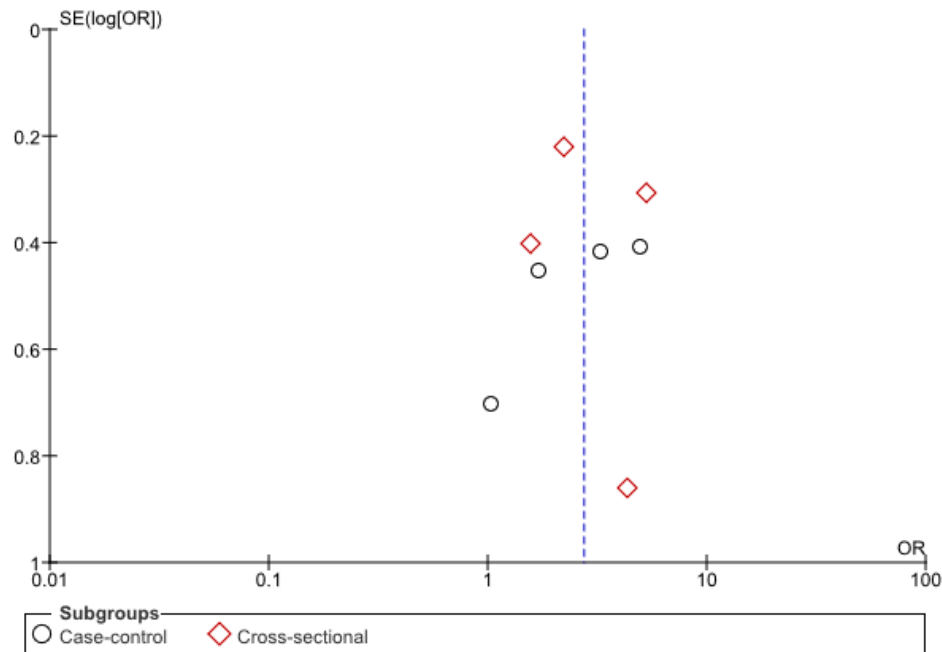


Figure 3. Funnel plot of the effect of using personal protective equipment on the risk of leptospirosis

Figure 3 shows that there is no publication bias due to the symmetrical distribution of the plot.

Interpretation of the results from the meta-analysis process can be seen from the forest plot. Figure 3 case-control study shows that not using personal protective equipment increases the incidence of leptospirosis by 2.77 times compared to using personal protective equipment (aOR= 2.77, 95% CI= 1.76-4.36, $p < 0.001$) and 4 cross-sectional studies show that not using personal protective equipment increased the incidence of leptospirosis 2.73 times compared to using personal protective equipment (aOR= 2.73, 95% CI= 1.99 to 3.74, $p < 0.001$). The heterogeneity of the research data shows $I^2 = 46\%$ so that the data distribution is stated to be homogeneous (fixed effect model).

The funnel plot in Figure 3 shows that there is no publication bias due to the plotymetric distribution. On the left side of the diagram there are 4 plots with standard errors between 0.2 and 0.8. On the right side there are 4 plots with standard errors between 0.2 and 1.

DISCUSSION

This study is a systematic review and meta-analysis taking the topic of risk factors that cause leptospirosis in adult men and women aged 26-65 years. The factor used as an independent variable in this study is the use of personal protective equipment. The outcome which became the dependent variable in this study was the incidence of leptospirosis. Research with the aim of knowing the magnitude of the effect of the use of personal protective equipment used a meta-analysis study design.

The primary research results used for meta-data analysis were collected from various countries and in a large sample size, so as to increase the heterogeneity of rese-

arch results. In addition, the meta-analysis research process has gone through the PRISMA stage which is a series of processes for identifying articles using database searches, filtering articles by determining inclusion and exclusion criteria, assessing the feasibility of primary studies and selecting articles used for meta-analysis.

Articles that have been compiled through database searches are then included in the Mendeley program to make identification easier. This study collected 1,462 articles in the early stages of the PRISMA process. Subsequently, 523 articles were deleted. 939 articles that have been filtered are then reissued using the criteria determined by the researcher. The exclusion criteria determined by the researcher were descriptive articles/systematic review/ meta-analysis, did not have PDF files, research titles were irrelevant, articles were not full text and articles did not use a case control or cross sectional study design.

The exclusion of articles at this stage were 671 files. Furthermore, articles that had complete data were 268, the exclusion process was carried out again with the criteria for a sample of non-women and adult men, case control and cross-sectional studies did not include aOR values and the study outcome was not the incidence of leptospirosis. The results of the second exclusion were 253 articles, so the articles to be used for the meta-analysis were 8 articles. The quality of 8 articles was assessed using the 2014 CEBMa Critical Appraisal Checklist specifically for case control and cross sectional studies.

Primary articles that have met the requirements are then analyzed using the Review Manager 5.3 program. Data analysis was carried out one by one to find out the influence of the use of personal protective equipment on the risk of leptospirosis.

1. Effect of use of personal protective equipment on the risk of leptospirosis in adults

The primary research used in the meta-analysis was 8 articles from Jamaica, India, Laos, Malaysia, Seychelles, Colombia and New Zealand. The study design was an observational case control and cross sectional study. Analyzes were performed with each subgroup of observational study designs. The results of the case-control study subgroup meta-analysis showed that not using personal protective equipment increased the risk of leptospirosis by 2.77 times compared to those using personal protective equipment (aOR= 2.77, 95% CI= 1.76-4.36, $p < 0.001$). Meanwhile, a cross-sectional study using subgroup analysis showed that not using personal protective equipment increased the risk of leptospirosis by 2.73 times compared to using personal protective equipment (aOR= 2.73, 95% CI= 1.99-3.74, $p < 0.001$).

The use of personal protective equipment is important and needs to be considered for use, especially when working or doing activities outside the home. *Leptospira* bacteria have the potential to easily enter the patient's body if the feet, hands or body parts are not properly protected. Personal protective equipment will provide adequate protection if the protective equipment is chosen appropriately and comfortably when worn by the worker concerned (Buntarto, 2015).

The risk of humans becoming infected depends on exposure to risk factors. Some humans are at high risk of exposure to leptospirosis because of their work, the environment in which they live or their lifestyle. The main occupational groups at risk are farmers or plantation workers, pet shop clerks, ranchers, sewer cleaners, slaughter workers, meat processors, and the military. Humans can become infected

with leptospirosis due to direct or indirect contact with the urine of animals infected with *Leptospira*. The habit of walking without footwear or personal protective equipment is also a risk factor for leptospirosis (Desvars et al, 2013). In addition, the type of work, life habits, climate and environment also affect the number of cases and the prevalence of leptospirosis (Victoriano et al, 2009).

Other groups that have a high risk of being infected with leptospirosis are areas or populations affected by natural disasters such as floods and an increase in the number of people who engage in recreational water sports. Not using personal protective equipment (footwear) increases the risk of leptospirosis 4.59 times (aOR= 4.95, 95% CI= 2.22 to 11.06, $p < 0.001$) in the city of Surat, India during flooding (Bhardwaj et al, 2008).

Non-compliance with the use of personal protective equipment can affect the risk of leptospirosis caused by the *leptospira* bacteria that can enter the patient's body tissue through wounds on the skin or mucous membranes. *Leptospira* sp. Bacteria. those that successfully infect humans, will enter the circulatory system, then spread to various organs and reproduce, especially in the liver, kidneys and mammary glands and the lining of the brain (Faine et al, 1999).

Exposure to standing water from rice fields when experiencing skin scratches or wounds, washing your face with other water sources such as springs, flowing river water, and pond water are not recognized as risk factors for leptospirosis. From the independent variables studied as a preventive factor, only wearing personal protective equipment (boots) when exposed to a puddle of rice field (OR= 0.07, 95% CI= 0.02, $p = 0.22$) had a significant impact on reducing

the risk of leptospirosis (Sahneh et al, 2019).

AUTHOR CONTRIBUTION

Rizki Kurniawan Saputra is the principal researcher who selects topics, explores and collects research data. Setyo Sri Rahardjo and Bhisma Murti played a role in analyzing data and reviewing research documents.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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