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Article Review

Analysis of Environmental Risk Factors for Leprosy in Indonesian Society: A Meta-Analysis

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ABSTRACT

Indonesia is still the third largest contributor of new cases of leprosy in the world. The purpose of this study was to analyze the risk factors for the influence of humidity, occupancy density, and personal hygiene on the incidence of leprosy. Using the Meta-Analytic Method with the PICOS technique. Some of the data sources used are Google Scholar, Research Gate and Plos ONE by looking at keywords such as "Humidity", "Personal Hygiene", and "Occupancy Density". There were 71 articles. The Random Effect value with 95% CI variable humidity is 2.13 with a value range of 1.35 – 2.92. The forest plot results show the value of pooled PR = e2.13 = 8.415. The Random Effect value with 95% CI for the individual hygiene variable is 1.84 with a range value of 1.59-2.10. the results of the forest plot show the value of pooled PR = e1.84 = 6.926. The Random Effect value with 95% CI variable occupancy density is 1.75 with a value range of 1.36-2.14. forest plot results show the value of pooled PR = e1.75 = 5.754. Humidity has greates risk of causing leprosy. Meanwhile, Personal hygiene has a 6.926 times greater risk of causing leprosy. Residential density is at risk 5,754 times greater for experiencing leprosy. The factors that most influence the incidence of leprosy are humidity followed by personal hygiene and occupancy density. It is recommended that further research use qualitative data to look deeper into the intermediary factors that cause leprosy.

Keywords: Humidity, Personal Hygiene, Occupational Density, Leprosy.

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INTRODUCTION

Although the clinical manifestations of leprosy are not striking, it is known that leprosy is still an endemic disease in some areas [1]. This is due to poor knowledge about the transmission of leprosy and the main risk factors involved. People infected with leprosy have the potential to infect much more often than they show symptoms, due to the presence of low pathogenicity bacilli in people infected with leprosy[2,3,4]. Individuals may transmit the bacilli for a long time before the first symptoms begin, that is, in the subclinical incubation period. Therefore, prevention of transmission cannot only rely on early diagnosis from an early age.[5,6,7]. Contact that occurs at the household scale plays an important role in disease transmission [8,9,10,11]. Serologic tests can now identify potentially bacciferous individuals [12,13,14,15,16]. This test has potential for use in primary care, where it is used not only to classify

cases as paucibacillary or multibacillary but also to identify individuals at higher risk of disease[17,18,19]**.** On the other hand, PCR (Polymerase Chain Reaction) seems promising for identifying "appearing" healthy individuals[20,21,22,23,24].

In countries such as Ethiopia and Indonesia, where leprosy is an endemic disease and polychemotherapy schemes have been in place for around 15 years, it is more than 5%. identified population has Mycobacterium leprae DNA. This shows that this disease cannot be eliminated by PCT treatment alone[25,26]. There is evidence to suggest that local population, density and level of endemicity play a role in the emergence of leprosy[26,27]. Another factor that should receive more attention is the microenvironment, such as the number of people per household and per room of the house, poor sanitary conditions, genetic susceptibility, low education levels, local social and cultural dynamics and so on[28,29].

Early diagnosis is expected to help stop the leprosy transmission cycle[30,31,32]. High population densities may be linked to endemic disease, as contact is more common in such groups[33,34]. Several previous studies also stated that there was a significant relationship between the physical conditions of the house such as ceiling, floor type, humidity, and bedroom density ($p < \alpha$) with leprosy cases [35]. Several previous studies have proven that the physical condition of a house has a relationship with the incidence of leprosy. The house as a place to live must meet the requirements of a healthy home following regulations. Leprosy has a relationship with personal hygiene, socioeconomic factors, ventilation area and occupancy density [36]. According to [37] there is a significant relationship between housing sanitation and community characteristics with the incidence of leprosy.

The purpose of this study was to analyze the risk factors for humidity, personal hygiene, and occupancy density which affect the incidence of leprosy. Novelty The novelty of this study is that researchers are trying to combine all studies from 2012 to 2022 to see the interrelationships of factors that cause leprosy.

METHOD

Sources of data from this study using Google Scholar, ResearchGate, and PlosONE. The keywords used in this study were "Humidity", "Personal Hygiene", and "Occupancy Density". Downloaded articles are articles that have an abstract and full text. The research articles found in this study are 71 journal articles. Then the articles were screened and sorted again using clear inclusion and exclusion criteria. Researchers used a cross-sectional study design to screen for the next stage. Variables Humidity, personal hygiene, and occupancy density are the selected variables that influence the incidence of leprosy in Indonesia. Secondary data types from selected articles are used in this study. The incidence of leprosy is the dependent variable, while humidity, personal hygiene, and occupancy density are the independent variables of this study. The following is a PRISMA flowchart from this study

The articles that have been collected are then extracted and synthesized to obtain data that can fulfill the objectives of this study. These data are compiled and analyzed in order to become material for solving problems that are carried out by the Meta-Analysis test. The following illustrates the literature search diagram for data collection through a flow chart (Prisma):

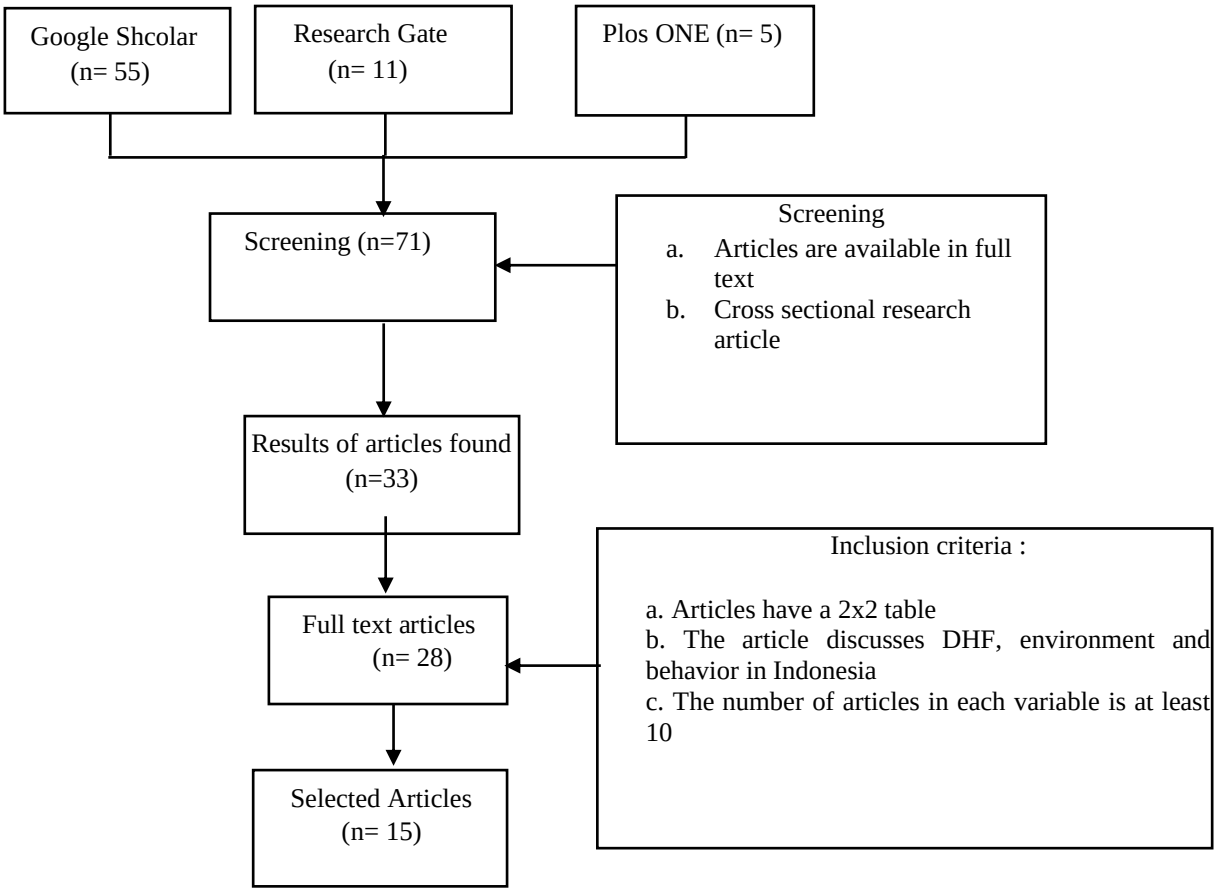
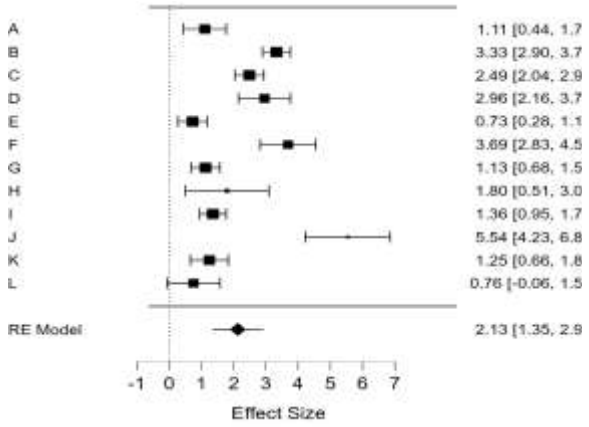


Figure 1. PRISMA Flowchart Risk Factors of Humidity, Personal Hygiene, Occupational Density Against Leprosy in Indonesian Communities.

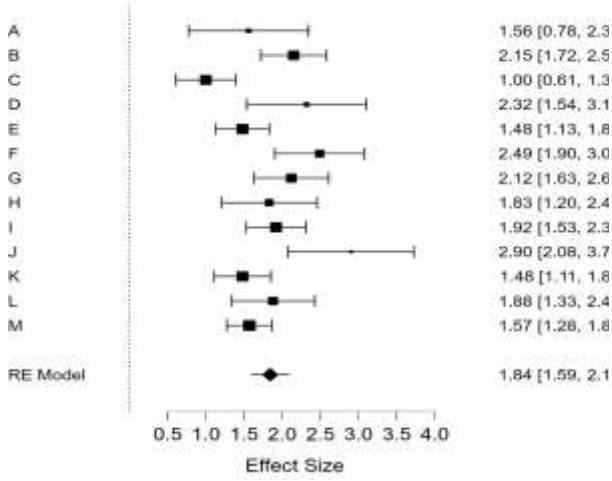
The articles obtained were then meta-analyzed by obtaining 15 research articles. Analysis was performed to obtain the value of the pooled odds ratio estimate using the Mentel – Haenszel method for the fixed effect model analysis and the DerSimonian-Laind method for the random effect model analysis. If the variation between variables is homogeneous or the p-value is heterogeneous and greater than 0.05, the analysis model used is the fixed effect model. Meanwhile, if the variation between variables is heterogeneous or the p-value is heterogeneous less than 0.05, then the random effect model is used. The meta-analysis calculates the Prevalence Ratio (PR) as follows:

1. If the estimated PR value is > 1 and the range of confidence intervals does not exceed 1, it means that this variable is a risk factor between humidity, occupancy density, personal hygiene and the incidence of leprosy in the community
2. If the estimated PR value is <1 and the range of confidence intervals does not exceed 1, it means that this variable is a protective factor between each variable that influences the incidence of leprosy in the community.
3. If the estimated value of PR = 1 and the range of confidence intervals does not exceed 1, it means that the independent variable has no relationship with the incidence of leprosy in the community

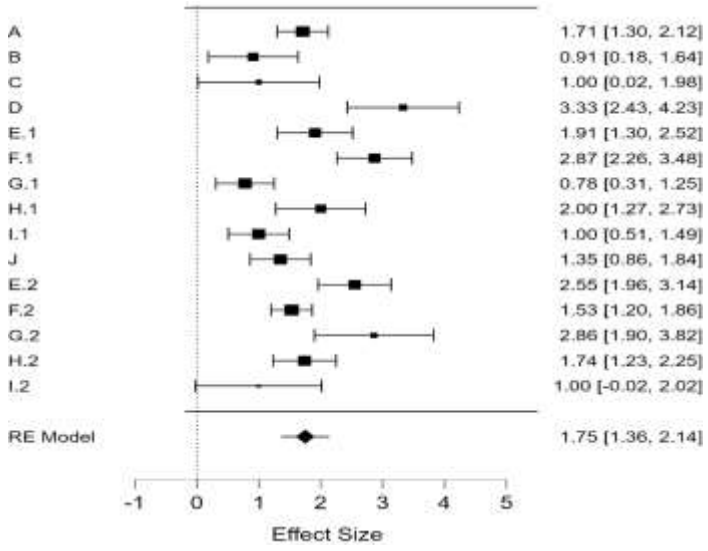
RESULTS AND DISCUSSION



Humidity Against Leprosy in Indonesia



Personal Hygiene Against Leprosy



Occupancy Density Against Leprosy

Figure 2. Forest plot of risk factors for humidity, hygiene, and occupancy density for leprosy

The findings show that in the forest plot the humidity on the incidence of leprosy has a Random Effect Value (RE) The model shows an estimated Prevalence Ratio (PR) showing a 95% CI of 2.13 with a value range of 1.35 – 2.92. The results of the forest plot show the value of pooled PR = $e^{2.13}$ = 8,415. So it was concluded that humidity has a 8.415 times greater risk of causing leprosy to occur in the community. As for individual hygiene forest plots, the Random Effect (RE) Model shows an estimated Prevalence Ratio (PR) with a 95% CI of 1.84 with a range of 1.59-2.10. forest plot results show the value of pooled PR = $e^{1,84}$ = 6,926. It can be concluded that individual hygiene variables have a 6.926 times greater risk of causing leprosy to occur in the community. In line with the other two variables, forest plot occupancy density has a Random Effect Value (RE) Model showing an estimated Prevalence Ratio (PR) with a 95% CI of 1.75 with a value range of 1.36-2.14. forest plot results show the value of pooled PR = $e^{1,75}$ = 5,754. It can be concluded that the residential density variable is 5.754 times more likely to experience leprosy in Indonesian society.

Table 1. Meta-Analytic Heterogeneity Test and Egger's Test Table for Risk Factors of Humidity, Individual Hygiene, and Occupational Density Against Leprosy in Indonesian Communities

Moisture Heterogeneity Test

	Q	df	p
Omnibus test of Model Coefficients	28.311	1	< .001
Test of Residual Heterogeneity	162.562	11	< .001

Egger Table Humidity Test

	z	P
Sei	1.796	0.072

Individual Hygiene Heterogeneity Test

	Q	df	p
Omnibus test of Model Coefficients	196.613	1	< .001
Test of Residual Heterogeneity	42.020	12	< .001

Table Egger Test Personal Hygiene

	z	p
Sei	2.533	0.011

Occupancy Density Heterogeneity Test

	Q	df	p
Omnibus test of Model Coefficients	77.907	1	< .001
Test of Residual Heterogeneity	74.807	14	< .001

Table Egger Occupancy Density Test

	z	p
Sei	0.885	0.376

Note. p -values are approximate

Note. The model was estimated using Restricted ML method

The findings show that the p-value in the heterogeneity test for each independent variable on the incidence of leprosy is less than α (0.05), namely p = 0.001, which means that the variation between studies is heterogeneous, so this analysis uses a random effect model. The findings show that the test results for the p value of the Egger's Test on the humidity variable are > α (0.05), so there is no publication bias on the humidity variable for Leprosy Incidence in Indonesia. The results of the meta-analysis showed that the humidity variable had a 8.415 times greater risk of experiencing leprosy. From the results of the study, it was shown that humidity in a house with leprosy sufferers allowed the entry of M. leprae bacteria into the bodies of respondents who were not sick, then these bacteria grew optimally in homes with unhealthy environmental conditions. and bacteria continue to multiply in the patient's body.

Humidity in the house has a correlation with the incidence of leprosy, therefore it is necessary to condition the house so that it is not damp in order to minimize the incidence of leprosy in the community. This research is also in line with research conducted by [35] there is a significant relationship between the physical condition of the house such as ceiling, type of floor, humidity, and bedroom density (p < α) with leprosy cases. High humidity has the potential for the development of M. leprae bacteria, so that with these unfit housing conditions, there is a risk of leprosy[38]. Previous studies also found environmental factors such as soil, humidity, vegetation, and thermal-hydrological climate also contribute as sources of leprosy transmission[39,2,40,41,42].

It is known that the p-value of Egger's Test on the hygiene variable for the incidence of leprosy is <α (0.05), so the individual hygiene variable for the incidence of leprosy in Indonesia has a publication bias. Individual hygiene has a 6.926 times greater risk of experiencing leprosy in the community. This research is in line with previous studies [43] who argue that there are still many respondents who have poor personal hygiene. they did not know that the habit of sharing personal items (towels and soap) is a means of transmitting leprosy. In addition, there were also many respondents who washed clothes together, there were also respondents who showered without using soap and there were respondents whose beds were made of divans/wood without any ground. Thus it can be concluded that the statistical test

results for the relationship between personal hygiene and the incidence of leprosy obtained a p-value of 0.001 which means there is a significant relationship between the two variables.

The occupancy density variable has a risk of 5.754 times the incidence of leprosy. It is also known that the p-value of Egger's Test for occupancy density for leprosy is > α (0.05), so it is concluded that there is no publication bias. According to Winarsih, overcrowding in a house can cause leprosy to occur in the community so that in the end there will be transmission of leprosy to the community. The variable occupancy density has a significant relationship with the incidence of leprosy. According to the researchers, respondents who live in houses that are densely populated and where there are leprosy sufferers are at risk of developing leprosy. The results of the analysis prove that bedroom density has a significant relationship with the incidence of leprosy. The density of bedrooms that are not suitable for healthy homes has an effect on the transmission of infectious diseases. Crowded bedroom conditions can increase contact between individuals, lack of oxygen and facilitate the transmission of leprosy to other family members[44]. The incidence of leprosy is related to direct contact of a person with leprosy to a healthy person. [45] In this study, 52.6% of the bedrooms of respondents with leprosy were occupied by more than two adults.

Sensitivity Test of Humidity Risk Factors and Factors Influencing the Incidence of Leprosy in Indonesian Society

The sensitivity test is used to identify heterogeneity, interpret the effect of research quality and prove the results of the meta-analysis are relatively stable. The sensitivity test that can be done is to compare the pooled prevalence ratio fixed effect model and the random effect model. Sensitivity tests were performed according to the least number of meta-studies.

Table 2. Comparison Sensitivity Test of Pooled Prevalence Ratio Fixed Model and Random Model

No	Research variable	N	*Heterogenity (p-value)*	*Fixed effect Models*		*Random Effect Model*	
				PR	**95% CI**	**PR**	**95% CI**
1.	Risk Factors of Humidity for Leprosy	11	<0,001	1,86	1,70 – 2,03	2,13	1,35 – 2,92
2.	Risk Factors of Personal Hygiene for Leprosy	14	< 0,001	1,73	1,60-1,86	1,84	1,59 – 2,102
3.	Risk Factors of Occupancy Density for Leprosy	15	< 0,001	1,64	1,50 – 1,79	1,75	1,36 –2,14

Table 2, it can be seen that there are variations in the independent variables between studies, with an increase in the pooled PR value from the fixed effect model to the random effect model and the wider Confident Interval. The humidity variable has a pooled PR value from the fixed effect model to the random effect model and the confidence interval is quite different. Meanwhile, the individual hygiene and occupancy density variables varied between studies conducted by meta-analysis, as seen by the significant increase in the value of pooled PR from the fixed effect model to the random effect model and the widening of the Confident Interval range of 95%.

CONCLUSION

Humidity has an 8.415 times greater risk of causing leprosy to occur in the community. Personal hygiene has a 6.926 times greater risk of causing leprosy to occur in the community. Residential density is at risk 5,754 times greater for experiencing leprosy in Indonesian society. It is recommended that further research use qualitative data to look deeper into the intermediary factors that cause leprosy.

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CONFLICTS OF INTEREST:

The authors declare no conflict of interest.

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