Meta Analysis: Relationship Of Ventilation And Lighting With The Event Of Pulmonary Tuberculosis

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***Abstract*-Background:** Pulmonary tuberculosis is included in the top 10 diseases that cause death in the world. In 2018 pulmonary tuberculosis caused about 1.3 million people's deaths. Estimates of the death rate from pulmonary tuberculosis per 100,000 population were found in 30 high-burden countries. There are many risk factors that can affect the incidence of pulmonary tuberculosis, one of which is the physical environment of the house. Lighting and ventilation are factors associated with the spread of tuberculosis. Based on preliminary studies in several journals, there are inconsistencies or differences in research results on ventilation and lighting variables with the incidence of pulmonary tuberculosis.

Purpose: This study examines and analyzes the trend of articles describing the relationship between ventilation and lighting with the incidence of pulmonary tuberculosis.

Methods: This study uses a retrospective observational study, in the sense that the researcher makes a recapitulation of the facts without performing experimental manipulation. Effect sizes. The data source uses secondary data obtained from previous online studies. The data collection procedure uses Google Scholar, Pub Med and Garuda Portal which have been involved in the last 5 years. Data were analyzed using Review Manager Version 5.4 (RevMan 5.4).

Results: The results of the 104 studies obtained according to the inclusion and exclusion criteria, 10 studies were obtained which could be continued into the RevMan 5.4 analysis where for the ventilation variable 10 studies were used and the lighting variable was 10 studies. The results of data analysis showed that there was a relationship between ventilation and the incidence of pulmonary tuberculosis with p value < 0.05, namely p < 0.0006 and pooled odds ratio value of 5.80 (95% CI 2.14-15.77). The results of data analysis showed that there was a relationship between lighting and the incidence of tuberculosis with p < 0.05, namely p < 0.0001 and the pooled odds ratio value of 6.59 (95% CI 3.57-12.18).

Conclusion: There is a relationship between ventilation and lighting with the incidence of tuberculosis through a meta-analysis study.

***Index Terms*-** *Ventilation, Lighting, Tuberculosis Incidence.*

I. INTRODUCTION

Tuberculosis (TB) is a respiratory disease caused by Mycobacterium tuberculosis, which breeds in parts of the body where there is a lot of blood and oxygen flow. This bacterial infection usually spreads through the blood vessels and lymph nodes, but mainly affects the lungs. Pulmonary Tuberculosis (pulmonary TB) is still a public health problem in the world, although efforts to control pulmonary TB have been carried out in many countries since 1995. (PMK No. 67, 2016)

According to WHO, pulmonary tuberculosis is included in the top 10 diseases that cause death in the world. In 2018 pulmonary tuberculosis caused about 1.3 million deaths of non-HIV people and 300,000 deaths of HIV-positive people worldwide. Globally, the estimated death rate from pulmonary tuberculosis per 100,000 population is in 6 WHO regions and is mostly found in 30 high-burden countries. It is estimated that there are 10 million new cases of pulmonary tuberculosis, equivalent to 133 cases per 100,000 population. The number of cases of pulmonary tuberculosis in the world by 56% are in five countries namely India, China, Indonesia, the Philippines and Pakistan. Indonesia is in the third rank of cases of Tuberculosis (TBC) sufferers in the world, after India and China. (Global Tuberculosis Report, 2019).

Until now, pulmonary tuberculosis is still a health problem in Indonesia. Based on data in 2019 in Indonesia, the estimated number of cases of pulmonary tuberculosis was 845,000 people, the number of notified cases of pulmonary tuberculosis was 568,987 people and the number of cases of death due to pulmonary tuberculosis was 12,469 people. 75% of pulmonary tuberculosis patients are in the productive group, meaning those in the productive ages of 15 to 55 years. (Global Tuberculosis Report, 2020)

Pulmonary tuberculosis disease mostly occurs in adults who have received the primary infection as a child and were not treated properly. Pulmonary tuberculosis morbidity is mainly due to delay in treatment, not being detected early, not getting proper and adequate prevention information (Miller, 1982). Factors that are closely related to the incidence of pulmonary tuberculosis are the source of transmission, history of patient contact, socioeconomic level, level of exposure, bacillus virulence, low immune system related to genetics, nutritional status, physiological factors, age, nutrition, immunization, medical conditions. housing includes (temperature in the house, ventilation, lighting in the house, humidity, density of occupants

and the environment around the house) and work (Amir and Alsegaf, 1989).

HL Blum explained that there are four main factors that influence public health status. These four factors are determinant factors for the emergence of health problems. The four factors consist of behavioral/lifestyle factors, environmental factors (social, economic, political, cultural), health service factors (type of coverage and quality) and genetic factors (heredity). There are many risk factors that can affect the incidence of pulmonary tuberculosis, one of which is the physical environment.

The number of studies reporting different results on tuberculosis associated with ventilation and lighting factors, is the reason for researchers to review these studies. One of the methods used to combine the results of 2 or more studies in order to obtain a quantitative mix of data is to use meta-analysis. Meta-analysis is an analysis of several studies using a systematic approach and statistical techniques to identify, assess, and combine the results of relevant studies to reach a stronger conclusion (Glass, 1976; Stroup et al., 2000).

The results of the initial study by analyzing research journal articles as described above, from 104 research journal articles there were 75 articles which stated that there was a significant relationship between ventilation and the incidence of tuberculosis and there were 29 journal articles that had no significant relationship between ventilation and the incidence of tuberculosis. As for the lighting variable from 104 journal articles, there are journal articles which state that there is a significant relationship between lighting and the incidence of tuberculosis and journal articles that state that there is no significant relationship between lighting and the incidence of tuberculosis.

The facts of the research gap related to the relationship between ventilation and lighting with the incidence of pulmonary tuberculosis make prospective researchers interested in mapping the results of research through meta-analysis, because the results of the study stated that not all ventilation and lighting were associated with the incidence of pulmonary tuberculosis.

Research with meta-analysis is a technique used to summarize the findings of two or more studies with the aim of combining, reviewing and summarizing previous research. In addition, by using meta-analysis, various questions can be investigated based on data that has been found from the results of previous studies that have been published and one of the requirements needed in conducting a meta-analysis is an assessment of the results of similar research (Sriawan et al., 2015) . One of the advantages of meta-analysis is that a new study with a large number of subjects can be obtained so that more definitive conclusions can be drawn (Anwar R., 2005).

II. RESEARCH METHOD

The research design used is a systematic literature review (SLR) with the type of meta-analysis research. This Literature Review uses literature published in 2016-2020 which can be accessed in full text in pdf format. The search engines used in the form of PubMed, Portal Garuda, and Google Schoolar use the keywords "physical environmental factors, pulmonary tuberculosis, ventilation, lighting, incidence of pulmonary tuberculosis, pulmonary tuberculosis, ventilation, lighting". The criteria for the journals reviewed are research journal articles in Indonesian or English with the subject of physical factors in the home environment, types of journal research articles with the theme of the relationship between ventilation and lighting with the incidence of pulmonary tuberculosis in Indonesia. After a search, found more than 960 articles on ventilation and lighting with the incidence of pulmonary tuberculosis, then screening according to ventilation and lighting variables and adjusted to inclusion criteria. found 22 articles. After being reviewed and met the requirements for statistical tests, finally 17 articles were obtained to be analyzed. The literature search and selection process in this study will be described in the form of a Flow diagram in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA). After the literature search and selection process was carried out, data extraction was carried out, namely the name of the author, year of publication, variables studied, research subjects and the number of subjects, research results (according to SPIDER, namely sample, phenomenon of interest, design, evaluation, research type). The quality of research articles will be analyzed using Duffy's Research Appraisal Checklist Approach. This study will use Revman version 5.4. This study uses a spreadsheet and Kosinski's Time Reaction Software Program as a tool for data collection.

III. FINDINGS

Research Characteristics

In the meta-analysis, the type of research that can be analyzed is research that has statistical measures, namely the results of tabulating data using or not utilizing which can be included in the Manager's Review 5.4 with a total (N) sample of 846 samples. The following is a description in tabular form for 10 ventilation studies.

a. Variable Ventilation

The number of studies combined to analyze the relationship between ventilation and the incidence of tuberculosis were 10 studies, all of which were case-control studies with a total sample of 1122. The following are the results of a meta-analysis of the relationship between ventilation and the incidence of pulmonary tuberculosis.(Table 1). For 5 research studies, there is a relationship between ventilation and the incidence of pulmonary tuberculosis with a total sample of 803 samples and for the other 5 studies, it is stated that there is no relationship between ventilation and the incidence of pulmonary tuberculosis with a total sample of 319 samples.

b. Social Support Variable

The number of studies that were combined to analyze the relationship between lighting and the incidence of tuberculosis were 9 studies, all of which were case-control studies. The following are the results of a meta-analysis of the relationship between lighting and the incidence of pulmonary tuberculosis (Table 2). For 7 research studies, there is a relationship between income and use of latrines with a total sample of 445 samples and for the other 2 studies there is no relationship between income and latrine utilization with a total sample of 157 samples.

Table 1 Research Characteristics of the Relationship between Ventilation and the Incidence of Pulmonary Tuberculosis

No	Researcher	Publication Year	Number of Samples	P Value	OR	95% CI
1	Indriyani	2016	70	0.811	1,257	0.492 – 3.215
2	Nurwanti	2016	32	1,000	1,000	0.123 – 8.128
3	Raditya	2017	60	0.472	2,250	0.507 – 9.993
4	Mariana	2017	93	0.461	1,492	0.576 – 3.863
5	Yuliani	2018	64	1,000	0.868	0.310 – 2.470
6	Prime	2018	100	0.000	12,660	4900 – 32,730
7	Shimeles	2019	520	0.028	2,130	1,430 – 3.170
8	Zulaikha	2019	80	0.000	5.560	1.120 14,650
9	Aditama	2019	39	0.020	14,930	2,600 – 84,900
10	Muhammad	2020	64	0.020	5.870	1,155 – 29,826
	Total Sample : 1.122		**(+) 803 (-) 319**			

Table 2 Research Characteristics of the Relationship of Lighting with the Incidence of Pulmonary Tuberculosis

No	Researcher	Publication Year	Number of samples	P Value	OR	95% CI
1	Indriyani	2016	70	0.031	3,273	1.224 – 8.748
2	Nurwanti	2016	32	0.083	9,000	0.936 – 86.552
3	Raditya	2017	60	0.038	3,455	1.195 – 9,990
4	Mariana	2017	93	0.056	6,471	0.795 – 52.60
5	Yuliani	2018	64	0.132	2,455	1,350 – 16,940
6	Prime	2018	100	0.000	16,150	6,030 – 43,200
7	Zulaikha	2019	80	0.001	4,890	1.8 – 12,670
8	Aditama	2019	39	0.040	4,300	1,100 – 17,900
9	Muhammad	2020	64	0.000	21,267	5,222 – 86.601
	Total Sample : 602		**(+) 445 (-) 157**			

Meta-analysis of the Relationship between Ventilation and the Incidence of Pulmonary Tuberculosis

The results of the calculation of the effect size of the study for the relationship between ventilation and the incidence of pulmonary tuberculosis are as follows. Analysis using Review Manager 5.4 (Revman 5.4) the number of studies that can be analyzed because it has complete data is 10 studies. Detailed analysis of the relationship between ventilation and the incidence of pulmonary tuberculosis can be seen in the forest plot below (Table 3).

Based on table 3, it shows that there are 5 research studies whose research results state that there is a significant relationship between ventilation and the incidence of pulmonary tuberculosis. The results of the heterogeneity test showed the p value = 0.0002, meaning that the p value < 0.05 so that the variation or diversity between studies was heterogeneous and the value of variation between studies (I2) was included in the very high category, which was 81%. If the research is heterogeneous, the model to calculate the combined effect is the random effect model.

The results of the combined analysis of research studies on the forest plot show that the p value in the test for overall effect is 0.0006, this means p <0.05, so there is a relationship between ventilation and the incidence of pulmonary tuberculosis. The pooled odds ratio value is 5.80 with a 95% confidence interval (2.14 - 14.65) so it can be concluded that the house without ventilation tends to increase the incidence of pulmonary tuberculosis 5.8 times.

Based on table 4 shows that there are 5 research studies whose research results state that there is no significant relationship between ventilation and the incidence of pulmonary tuberculosis. The results of the heterogeneity test showed the p value = 0.87, meaning that the p value > 0.05 so that the variation or diversity between studies was homogeneous and the value of variation between studies (I2) was in the low category, namely 0%. If the research is homogeneous, the model to calculate the combined effect is the fix effect model.

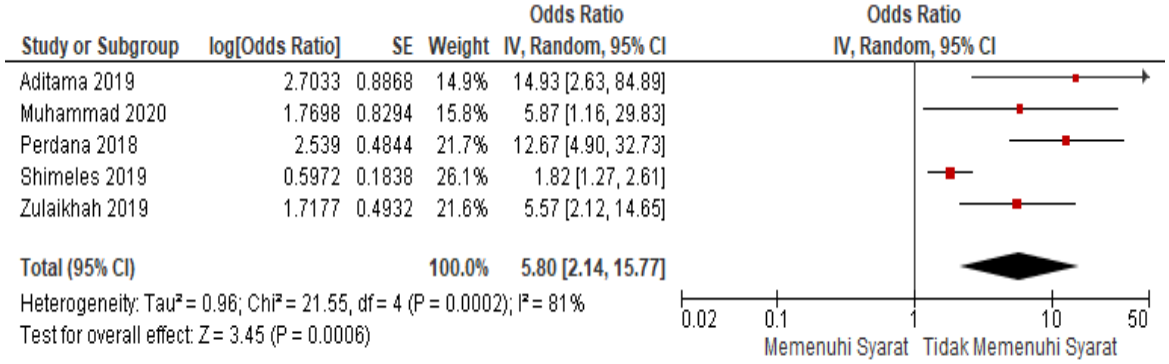
The results of the combined analysis of research studies on the forest plot show that the p value in the test for the overall effect is 0.35, this means that p> 0.05 so that there is no relationship between ventilation and the incidence of pulmonary tuberculosis. The pooled odds ratio value is 1.28 with a 95% confidence interval (0.77 - 2.13) so it can be concluded that the house without ventilation tends to increase the incidence of pulmonary tuberculosis 1.8 times.

Based on table 5 shows there are 10 research studies combined to analyze the trend of the relationship between ventilation and the incidence of pulmonary tuberculosis. The results of the

heterogeneity test showed that the value of p = 0.0006 means that the value of p <0.05 so that the variation or diversity between the studies is heterogeneous and the value of variation between studies (I2) is included in the very high category, which is 69%. If the research is heterogeneous, the model to calculate the combined effect is the random effect model.

The results of the combined analysis of research studies on the forest plot show that the p value in the test for overall effect is 0.0007, meaning p <0.05, so there is a relationship between ventilation and the incidence of pulmonary tuberculosis. The pooled odds ratio value is 2.76 with a 95% confidence interval (1.54 - 4.96) so it can be concluded that houses without ventilation tend to be 2.76 times increasing the incidence of pulmonary tuberculosis.

Table 3. Forest Plot Analysis of the Relationship of Ventilation to the Incidence of Pulmonary Tuberculosis (Significant Article)



Information :

: Odds Ratio of each study
: Combined Odds Ratio
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Table 4 Forest Plot Analysis of the Relationship of Ventilation to the Incidence of Pulmonary Tuberculosis (Article Not Significant)

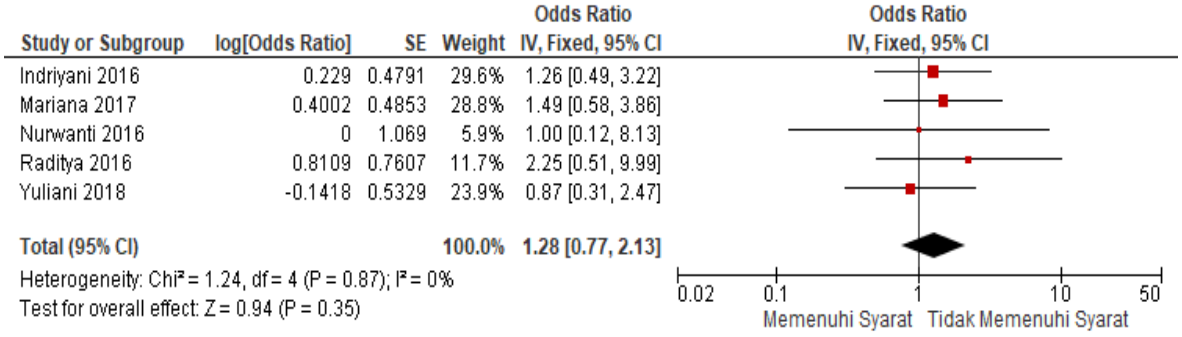

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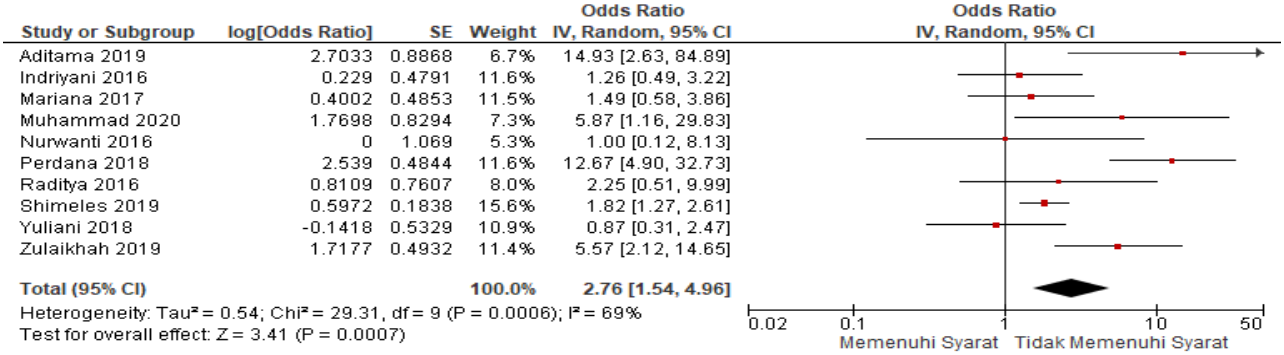
Table 5 Forest Plot Analysis of the Relationship of Ventilation to the Incidence of Pulmonary Tuberculosis (Combined Article)



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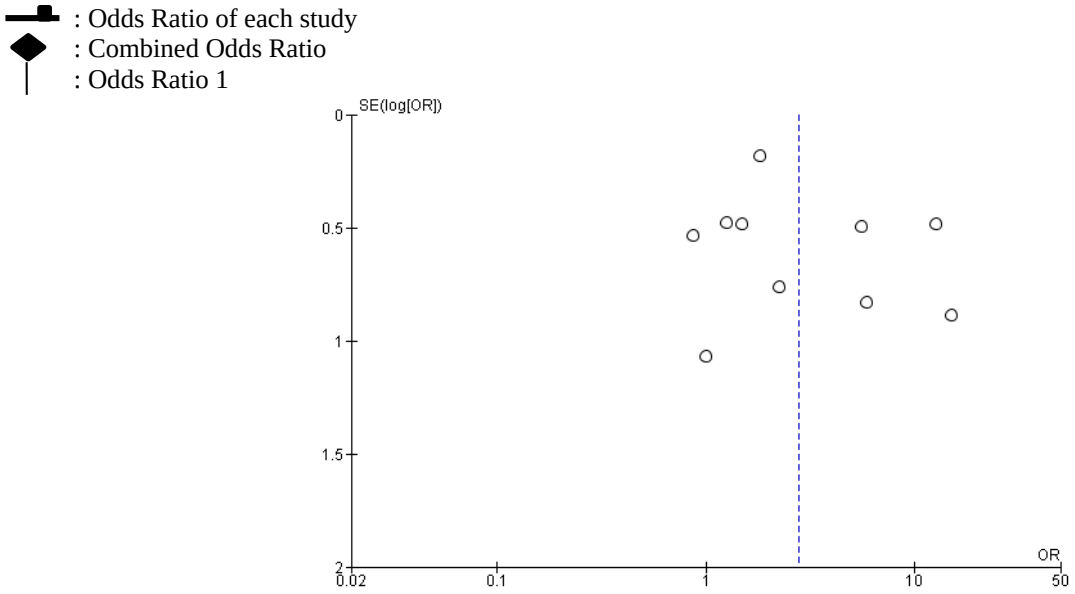


Picture 1. *Funnel Plot* The Relationship of Ventilation with the Incidence of Pulmonary Tuberculosis (Joint Article)

Based on Figure 1, the results of the funnel plot show that there is no publication bias indicated by the symmetry of the plots on the right and left of the vertical line where the number of plots on the left is 4 and the right is 5 and no plot touches the vertical line. Plots above the curve indicate that the study has a high ES while studies with plots below the curve indicate that the study has a low ES and plots that touch the vertical line indicate that the study is biased in the meta analysis.

Table 6 shows the comparison of the mean effect sizes between articles related to articles that are not related to the ventilation variable. The average value of the largest effect size is 0.8868 from the group of articles which state that there is a relationship between ventilation and the incidence of pulmonary tuberculosis, which means it has a big meaning. The average total effect size for ventilation is 0.6205 which shows a large significance for ventilation with the incidence of pulmonary tuberculosis.

Table 6 Big Mean*Effect Size* Combined Research on the Relationship of Ventilation with the Incidence of Pulmonary Tuberculosis

No	Researcher	Category	N	ICE P-OR	ES Max	ES Min
1	Aditama, 2019	Related	5	0.8868	0.8868	0.1838
2	Muhammad, 2020			0.8294		
3	Prime, 2018			0.4844		
4	Shimeles, 2019			0.1838		
5	Zulaikha, 2019			0.4932		
Average Effect Size Corresponding				**0.5754**		
6	Indriyani, 2016	Not related	5	0.4791	1.069	0.4791
7	Mariana, 2017			0.4853		
8	Nurwanti, 2016			1.069		
9	Raditya, 2016			0.7607		
10	Yuliani, 2018			0.5329		
Average Effect Size Is Not Correlated				**0.6654**		
Average Overall Effect Size				**0.6205**		

Meta-analysis of the Relationship of Lighting with the Incidence of Pulmonary Tuberculosis

The results of the calculation of the effect size of the study for the relationship between lighting and the incidence of pulmonary tuberculosis are as follows. In the analysis using Review Manager 5.4 (Revman) the number of studies that can be analyzed because it has complete data is 9 studies. Details of the analysis of the relationship between lighting and the incidence of pulmonary tuberculosis can be seen in the forest plot below (Table 7).

Based on table 7, it shows that there are 7 research studies whose research results state that there is a significant relationship between lighting and the incidence of pulmonary tuberculosis. The results of the heterogeneity test showed p value = 0.04 meaning p value < 0.05 so that the variation or diversity between studies was heterogeneous and the value of variation between studies (I2) was included in the fairly high category, which was 54%. If the research is heterogeneous, the model to calculate the combined effect is the random effect model.

The results of the combined analysis of research studies on the forest plot show that the p value in the test for overall effect is 0.0001, this means p <0.05, so there is a relationship between lighting and the incidence of pulmonary tuberculosis. The pooled odds ratio value is 6.59 with a 95% confidence interval (3.57 – 12.18) so it can be concluded that houses with no lighting tend to be 6.59 times more likely to increase the incidence of pulmonary tuberculosis compared to houses with lighting.

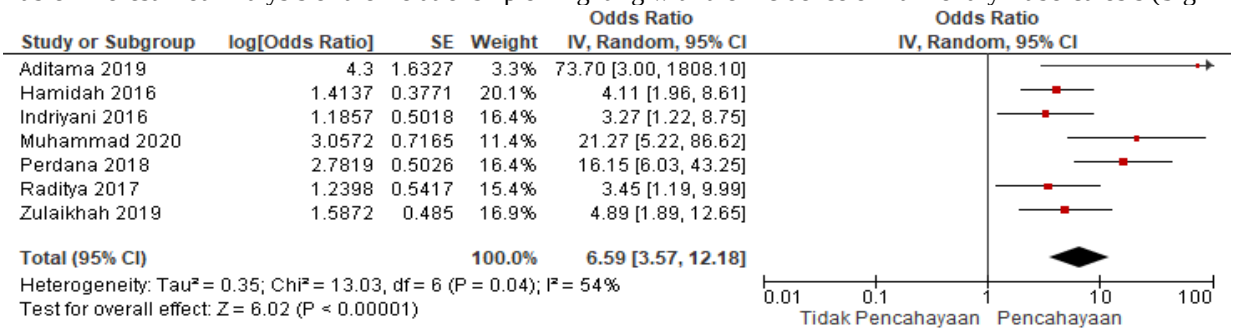
Based on table 8, it shows that there are 3 research studies whose research results state that there is no significant relationship between lighting and the incidence of pulmonary tuberculosis. The results of the heterogeneity test showed p value = 0.68, meaning that the p value > 0.05 so that the variation or diversity between the studies was homogeneous and the value of variation between studies (I2) was in the low category, namely 0%. If the research is homogeneous, the model to calculate the combined effect is the fix effect model.

The results of the combined analysis of research studies on the forest plot show that the p value in the test for overall effect is 0.01, this means p <0.05, so there is a relationship between lighting and the incidence of pulmonary tuberculosis. The pooled odds ratio value is 5.06 with a 95% confidence interval (1.47 – 17.37) so it can be concluded that houses without lighting tend to be 7.54 times increasing the incidence of pulmonary tuberculosis.

Based on table 9 shows that there are 10 research studies combined to analyze the trend of the relationship between lighting and the incidence of pulmonary tuberculosis. The results of the heterogeneity test showed p value = 0.24 meaning p value > 0.05 so that the variation or diversity between the studies was homogeneous and the value of variation between studies (I2) was in the low category, which was 22%. If the research is homogeneous, the model to calculate the combined effect is the fixed effect model.

The results of the combined analysis of research studies on the forest plot show that the p value in the test for overall effect is 0.0001, meaning p <0.05, so there is a relationship between lighting and the incidence of pulmonary tuberculosis. The pooled odds ratio value is 5.50 with a 95% confidence interval (3.82 – 7.90) so it can be concluded that houses with no lighting tend to be 5.50 times more likely to increase the incidence of pulmonary tuberculosis.

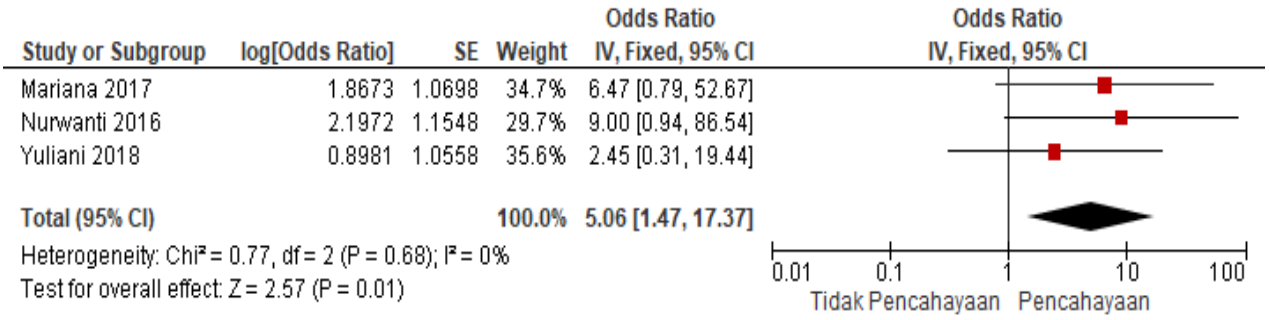
Table 7 Forest Plot Analysis of the Relationship of Lighting with the Incidence of Pulmonary Tuberculosis (Significant Article)



Information :

: Odds Ratio of each study
: Combined Odds Ratio
: Odds Ratio 1

Table 8 Forest Plot Analysis of the Relationship of Lighting with the Incidence of Pulmonary Tuberculosis (Article Not Significant)



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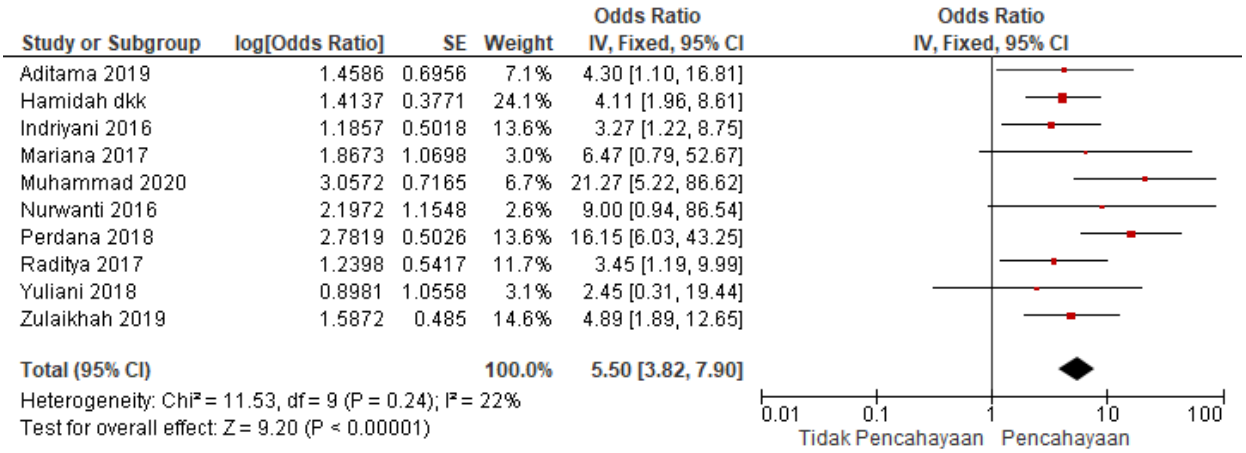
: Odds Ratio of each study
: Combined Odds Ratio
: Odds Ratio 1

Table 9 Forest Plot Analysis of the Relationship of Lighting with the Incidence of Pulmonary Tuberculosis (Combined)



Information :

: Odds Ratio of each study
: Combined Odds Ratio
: Odds Ratio 1

Based on Figure 2, the results of the funnel plot show that there is a publication bias marked by the asymmetry of the plots on the right and left of the vertical line where the number of plots on the left is 6 and the right is 4 but none of the plots touches the vertical line. Plots above the curve indicate that the study has a high ES while studies with plots below the curve indicate that the study has a low ES and plots that touch the vertical line indicate that the study is biased in the meta analysis.

Table 10 shows the comparison of the mean effect size between related articles and unrelated articles for the lighting variable. The average value of the largest effect size is 1.6327 from the group of articles which state that there is a relationship between lighting and the incidence of pulmonary tuberculosis, which means it has a big meaning. The average total effect size for lighting is 0.8037 which shows a large meaning for lighting with the incidence of pulmonary tuberculosis.

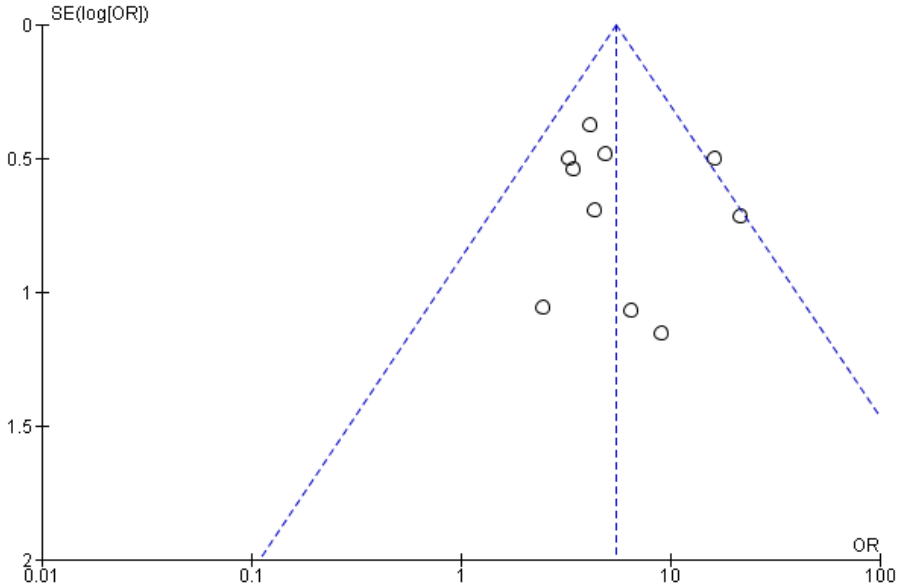


Figure 2. Funnel plot of the relationship between lighting and the incidence of pulmonary tuberculosis

Table 10 Big Average *Effect Size* Combined Research on the Relationship of Lighting with Pulmonary Tuberculosis

No	Researcher	Category	N	ICE P-OR	ES Max	ES Min
1	Aditama, 2019	Related	7	1.6327	1.6327	0.3771
2	Hamidah, 2016			0.3771		
3	Indriyani, 2016			0.5018		
4	Muhammad, 2020			0.7164		
5	Prime, 2018			0.5026		
6	Raditya, 2016			0.5417		
7	Zulaikha, 2019			0.485		
Average Effect Size Corresponding				**0.6796**		
8	Mariana, 2017	Not related	3	1.0698	1.1548	1.0558
9	Nurwanti, 2016			1.1548		
10	Yuliani, 2018			1.0558		
Average Effect Size Is Not Correlated				**1.0934**		
Average Overall Effect Size				**0.8037**		

Meta-analysis of factors most related to the incidence of pulmonary tuberculosis

Table 11 explains that there is a relationship between ventilation and the incidence of pulmonary tuberculosis. There are 5 studies that analyzed the relationship between ventilation and the incidence of pulmonary tuberculosis. It has high heterogeneity with a pooled odds ratio of 5.80 (95% CI 2.14 – 15.77), so it can be concluded that unventilated houses increase risk or tend to be 5.80 times the occurrence of pulmonary tuberculosis compared to houses with ventilation. Meanwhile, 5 studies that analyzed no relationship between ventilation and the incidence of tuberculosis had moderate heterogeneity with a pooled odds ratio of 1.28 (95% CI 0.77 – 2.13), so it can be concluded that ventilation increases the risk or tends to be 1.28 times with the incidence of pulmonary tuberculosis.

The table above explains that there is a relationship between lighting and the incidence of tuberculosis, there are 7 studies that analyze the relationship between lighting and the incidence of pulmonary tuberculosis which has a fairly high heterogeneity with a pooled odds ratio of 6.59 (95% CI 3.57 – 12.18), so it can be concluded that houses with poor lighting meet the increased risk or tend to be 6.59 times with the incidence of pulmonary tuberculosis. Meanwhile, the 3 studies that analyzed no relationship between lighting and the incidence of tuberculosis

had homogeneity with a pooled odds ratio value of 5.06 (95% CI 1.47–17.37), so it can be concluded that houses with inadequate lighting can increase the risk or tend to be 5.06 times with the incidence of tuberculosis. compared to houses with inadequate lighting.

Table 11 Comparison of Research Results, whether or not there is a relationship between Research Variables and the Incidence of Pulmonary Tuberculosis

	There's a Relationship			No connection		
Research variable	**Heterogeneity Test**	**Overall Effect Results**	**Average Effect *Size***	**Heterogeneity Test**	**Overall Effect Results**	**Average Effect *Size***
Ventilation	p = 0.0002 I2 = 81% (Heterogeneous)	p = 0.0006 p-OR= 5.80 (95%CI = 2.14 – 15.77)	**0.5754**	p = 0.87 I2 = 0% (Homogeneous)	p = 0.35 p-OR= 1.28 (95%CI = 0.77-2.13)	**0.6654**
Lighting	p =0.04 I2 = 54% (Heterogeneous)	p = 0.0001 p-OR= 6.59 (95%CI = 3.57 – 12.18)	**0.6796**	p = 0.68 I2 = 0% (Homogeneous)	p = 0.01 p-OR= 5.06 (95%CI = 1.47-17.37)	**1.0934**

IV. DISCUSSION

Relationship between Ventilation and Pulmonary Tuberculosis

a. Research variation and heterogeneity

The results of the analysis show different values of variance and weights. The theory expressed by Dahlan (2012) that the weight in a study is directly proportional to the number of research subjects (research samples). Research with 100 subjects will have a greater weight than research with 50 subjects. In addition to the number of subjects, the weight is also influenced by variations in the data. The weights are inversely proportional to the variation of the data. Research with more varied data will have a smaller weight than research with smaller variations.

Objectively, determining the role of variation between studies was tested by heterogeneity test. If the results show p > 0.05 then it is declared homogeneous, meaning that the variation between studies does not play a role in the total variation, on the contrary if the heterogeneity test results show p < 0.05, it is declared heterogeneous, which means that the variation between studies has a role in the total variation. In addition to the p value, the data variation also looks at the value of the variation between studies (I2). If there is a result of 50% below it can be categorized as homogeneous variation and if it is above 50% it is considered heterogeneous. The null hypothesis is rejected if the p value in the heterogeneity test is greater than 0.05 (Dahlan, 2012).

The results of heterogeneity test on 5 research studies which stated that the relationship between ventilation and the incidence of pulmonary tuberculosis was p value = 0.0002 and the value I2 = 81% expressed high heterogeneity. The variation of the five research studies had no effect on the total variation after the combined effect.

Five studies which stated that there was a relationship between ventilation and the incidence of tuberculosis had different characteristics with variations in the number of samples whose size did not match the population, which in turn gave an effect after the combination. The test results show high heterogeneity so that they use random effect models in measuring the combined effect of the data in the data input model in the Review Manager 5.40 application. The results obtained were p-OR= 5.80 with 95% confidence interval 2.14 to 15.77. The combined effect also produces a Z value of 3.45 and a p value of 0.0006. Statistically, the combined effect is significant if the p value <0.05 and this means that the null hypothesis is rejected,

Five studies analyzed using Manager's Review 5.40 can be seen that based on the funnel plot there is a high level of heterogeneity bias value. This explains that the analyzed studies have a not too wide variation of data where in the study it can be seen that the highest effect size is 14.93 (95% CI 2.63 – 84.89) and the lowest is 1.82 (95% CI 1.27 – 2.61), this explains that the variation in the data in the analyzed studies shows no significant difference. The higher the heterogeneity, the wider the confidence interval, and conversely, the lower the heterogeneity, the narrower the confidence interval.

Meanwhile, the heterogeneity test of 5 research studies which stated that there was no relationship between ventilation and the incidence of pulmonary tuberculosis showed a p value = 0.87 and a value of I2 = 0% was declared homogeneous. The variation of the 5 research studies had no effect on the total variation after the combined effect was performed. These five studies have almost the same characteristics with variations in the number of samples whose size does not match the population but does not provide a significant effect after the merger.

The results of the heterogeneity test show a homogeneous value so that the analysis uses fixed effect models in measuring the combined effect of the data in the data input model in the Review Manager 5.40 application. The results obtained were p-OR= 1.28 with 95% confidence interval: 0.77 to 2.31. The combined effect also produces a Z value of 0.94 and a p value of 0.35. Statistically, the combined effect is not significant if the p

value > 0.05 and this means that the null hypothesis is accepted, in other words there is no relationship between ventilation and the incidence of tuberculosis with a tendency for homes that have inadequate ventilation to increase the risk of 1.28 times compared to a house with adequate ventilation.
Five studies analyzed using Revman 5.40 can be seen that based on the funnel plot there is a moderate level of heterogeneity bias. This explains that the analyzed studies have data variations that are not too wide where in the study it can be seen that the highest effect size is 2.25 (95% CI 0.51 – 9.99) and the lowest is 0.87 (95% CI 0.31 – 2.47), this explains that the variation in the data in the analyzed studies shows no significant difference. The higher the heterogeneity, the wider the confidence interval, and conversely, the lower the heterogeneity, the narrower the confidence interval.

b. Analysis of research results

Many studies have analyzed the ventilation associated with the incidence of tuberculosis. For this reason, statistical analysis was carried out using meta-analysis to prove the quality of each study so that new data that was quantitative in nature and more accurate conclusions could be drawn.
The results of searching journals from various sources ultimately resulted in 104 studies relevant to the title, 37 full texts and 17 studies that matched the inclusion criteria for review and in the end there were 10 studies that could be analyzed into meta-analysis with the Revman 5.4 application. Although in the end only ten studies were obtained, the research could be continued by using meta-analysis because according to Sastroasmoro (2011) in his book states that meta-analysis is a combination of two or more studies. So it can be concluded that with a minimum of two studies, quantitative analysis can be carried out with meta-analysis.
These ten studies were analyzed by involving 1,122 research samples from the total number of samples in each research study. For 5 research studies which stated that there was a relationship between ventilation and the incidence of pulmonary tuberculosis, the total sample was 803 samples. The combined effect results concluded that ventilation was associated with the incidence of pulmonary tuberculosis with p < 0.0006 and p OR = 5.80 and a 95% confidence interval (2.14 – 15.77) in the funnel plot. It can be concluded that ventilation has a relationship with the incidence of pulmonary tuberculosis with a moderate level of relationship, where houses with ventilation that do not meet the requirements have a tendency to increase the risk 5.80 times compared to houses that have adequate ventilation.
For the five research studies which stated that there was no relationship between ventilation and the incidence of pulmonary tuberculosis, the total sample was 319 samples. The results of the combined effect concluded that ventilation was not associated with the incidence of pulmonary tuberculosis with p value = 0.35 and pOR = 1.28 and 95% confidence interval (0.31 – 2.47) in the forest plot. The results of the five research studies each stated that the results had no relationship, and after a combined analysis, the results still showed no relationship with a p value > 0.05, namely p = 0.35. It can be concluded that ventilation is not associated with the incidence of tuberculosis, where houses that have ventilation that do not meet the requirements have a tendency to increase the risk of 1.28 times with the incidence of pulmonary tuberculosis compared to houses that have ventilation that meet the requirements.
The results of the analysis for 5 research studies which stated that there was a relationship between ventilation and the incidence of pulmonary tuberculosis after a combined analysis showed that there was a relationship with high heterogeneity of data variation as well as 5 studies which stated that there was no relationship after the combined analysis still showed no relationship with heterogeneity of the data. low.

c. Comparison of Meta Analysis Results

There were 5 studies which stated that there was a relationship between ventilation and the incidence of tuberculosis, namely the Aditama study (2019) with an OR value of 14.93; Muhammad (2020) with an OR value of 5.87; Prime (2018) with an OR value of 12.67; research by Shimeles (2019) with an OR value of 1.82; Zulaikhah (2019) with an OR value of 5.57. The largest OR figure is owned by Aditama's research (2019) with a value of 14.93 which means that a house with ventilation that does not meet the requirements has a 14.93 times chance of causing pulmonary tuberculosis compared to a house that has ventilation that meets the requirements, while the smallest OR value which states There is a relationship between ventilation and the incidence of tuberculosis is a study by Shimeles (2019) with a value of 1.82 which means that a house that has ventilation that does not meet the requirements has a chance of 1,

Table 12. Comparison of Research that states There is or No Relationship between Ventilation and the Incidence of Pulmonary Tuberculosis

	There's a Relationship		**No connection**	
Research variable	**Heterogeneity Test**	**Overall Effect Results**	**Heterogeneity Test**	**Overall Effect Results**
Ventilation	p = 0.0002 I2 = 81% (high heterogeneous)	p = 0.0006 p-OR= 5.80 (95%CI = 2.14 – 15.77)	p = 0.87 I2 = 0% (Homogeneous)	p = 0.35 p-OR= 1.28 (95%CI = 0.77- 2.13)

After combining in the meta-analysis, research studies that stated that there was a relationship between ventilation and the incidence of tuberculosis were found to have p < 0.0006 and a pooled odds ratio of 5.80 (95% CI 2.14 – 15.77), which indicates that the house which has ventilation that does not meet the requirements has a 5.80 times chance of causing tuberculosis

compared to houses that have ventilation that meet the requirements.

According to Rustono (2019), the proportion of non-standard bedroom ventilation (98.1%) is greater than the non-TB group (75.5%). The results of statistical analysis showed a significant relationship with the obtained odds ratio (OR) of 16.9 with 95% Confidence Interval (CI) 2.121 – 134.641, with p value = 0.001.

The results of this study also show conformity with the research conducted by Subagyo (2016). Statistical analysis results show p = 0.038 and OR = 3.455 with 95% CI = 1.195 <OR < 0.05. Pulmonary Tuberculosis or there is a relationship between lighting and the incidence of Pulmonary Tuberculosis The bad effect of reduced ventilation is reduced oxygen levels, increased levels of CO2 gas, musty odors, room air temperature increases, and room air humidity increases (Mukono, 2000:156). This can be a risk factor for tuberculosis because tuberculosis bacteria can survive for a long time in a dark and humid place (Th. Erlien, 2008: 42). Based on the results of research in the field, it was found that (15%) the ventilation area of the respondent's house did not meet the requirements. This is because the ventilation in the respondent's house is not used properly, for example the window is left closed and is not accustomed to opening the window every morning.

The researcher considered that the inconsistent results of the relationship between ventilation and the incidence of tuberculosis apart from the weight and power of the study which were not ideal, were also related to differences in place and socio-culture, where the habits of people living in the plains and hills had different habits and had different ventilation. .

According to the researcher's assessment, low ventilation in people's homes does not understand the dangers of tuberculosis, people do not have awareness for healthy homes at home and prefer to accept improvised sanitation facilities at home, this is because people do not have good knowledge about tuberculosis.

The Relationship of Lighting with Tuberculosis Incidence

a. Research Variation and Heterogeneity

The results of the heterogeneity test on 7 research studies which stated that there was a relationship between lighting and the incidence of pulmonary tuberculosis was the p value = 0.04 and the I2 value = 54% expressed a high degree of heterogeneity. The variation of the seven research studies had no effect on the total variation after the combined effect was performed.

Seven studies which state that there is a relationship between lighting and the incidence of tuberculosis have characteristics that are not the same as the variation in the number of samples whose size does not match the population, which in turn gives an effect after the merger. The test results show high heterogeneity so that they use random effect models in measuring the combined effect of the data in the data input model in the Review Manager 5.40 application. The results obtained were p-OR= 6.59 with 95% confidence interval 3.57 to 12.18. The combined effect also produces a Z value of 6.02 and a p value of 0.0001. Statistically, the combined effect is significant if the p value <0.05 and this means that the null hypothesis is rejected,

Seven studies analyzed using Manager's Review 5.40 can be seen that based on the funnel plot there is a high level of heterogeneity bias. This explains that the analyzed studies have not too wide variations in data where in the study it can be seen that the highest effect size is 21.27 (95% CI 5.22 – 86.62) and the lowest is 3.27 (95% CI 1.22 – 8.75). explained that the variation in the data in the analyzed studies showed no significant difference. The higher the heterogeneity, the wider the confidence interval, and conversely, the lower the heterogeneity, the narrower the confidence interval.

Meanwhile, the heterogeneity test of three research studies which stated that there was no relationship between lighting and the incidence of pulmonary tuberculosis showed the p value = 0.68 and the I2 = 0% value was declared homogeneous. The variation of the 3 research studies has no effect on the total variation after the combined effect. These three studies have almost the same characteristics with variations in the number of samples whose size does not match the population but does not provide a significant effect after the merger.

The results of the heterogeneity test show homogeneous values, so the analysis uses fixed effect models in measuring the combined effect of the data in the data input model in the Review Manager 5.40 application. The results obtained were p-OR= 5.06 with 95% confidence interval: 1.47 to 17.37. The combined effect also produces a Z value of 2.57 and a p value of 0.01. Statistically, the combined effect is significant if the p value < 0.05 and this means that the null hypothesis is rejected, in other words there is a relationship between lighting and the incidence of tuberculosis with a tendency for houses that have inadequate lighting to increase the risk 5.06 times compared to houses that have ventilation. eligible.

Three studies analyzed using Revman 5.40 can be seen that based on the funnel plot there is a low level of heterogeneity bias value. This explains that the analyzed studies have data variations that are not too wide where in the study it can be seen that the highest effect size is 9.00 (95% CI 0.94 - 86.54) and the lowest is 2.45 (95% CI 0.31 - 19.44), this explains that the variation in the data in the analyzed studies shows no significant difference. The higher the heterogeneity, the wider the confidence interval, and conversely, the lower the heterogeneity, the narrower the confidence interval.

b. Analysis of Research Results

Many studies have analyzed the lighting associated with the incidence of tuberculosis. For this reason, statistical analysis was carried out using meta-analysis to prove the quality of each study so that new data that was quantitative in nature and more accurate conclusions could be drawn.

The results of searching journals from various sources ultimately resulted in 104 studies relevant to the title, 37 full texts and 17 studies that matched the inclusion criteria for review and in the end there were 10 studies that could be analyzed into meta-analysis with the Revman 5.4 application. Although in the end only ten studies were obtained, the research could be continued by using meta-analysis because according to Sastroasmoro (2011) in his book states that meta-analysis is a combination of two or more studies. So it can be concluded that with a minimum of two studies, quantitative analysis can be carried out with meta-analysis.

These ten studies were analyzed by involving 602 research samples from the total number of samples in each research study. For seven research studies which stated that there was a

relationship between lighting and the incidence of pulmonary tuberculosis, the total sample was 445 samples. The results of the combined effect concluded that lighting was associated with the incidence of pulmonary tuberculosis with p value < 0.0001 and p OR = 6.59 and 95% confidence interval (3.57 – 12.18) in the funnel plot. It can be concluded that lighting has a relationship with the incidence of pulmonary tuberculosis with a moderate level of relationship, where houses with lighting that do not meet the requirements have a tendency to increase the risk 6.59 times compared to houses that have lighting that meets the requirements.

For the three research studies which stated that there was no relationship between lighting and the incidence of pulmonary tuberculosis, the total sample was 157 samples. The results of the combined effect concluded that lighting was associated with the incidence of pulmonary tuberculosis with p value = 0.01 and pOR = 5.06 and 95% confidence interval (1.47 – 17.37) in the funnel plot. The results of the three research studies each stated that there was no relationship, and after a combined analysis, the results showed that there was a relationship with the p value < 0.05, namely p = 0.01. It can be concluded that lighting is associated with the incidence of tuberculosis, where houses that have lighting that do not meet the requirements have a tendency to increase the risk of 5.06 times with the incidence of pulmonary tuberculosis compared to houses that have lighting that meets the requirements.

The results of the analysis for the seven research studies which stated that there was a relationship between ventilation and the incidence of pulmonary tuberculosis after a combined analysis showed that there was a relationship with high heterogeneity of the data, but the three studies which stated that there was no relationship after the combined analysis showed that there was a relationship with low heterogeneity of the data. .

c. Comparison of Meta Analysis Results

There are three studies which state that there is a relationship between lighting and the incidence of tuberculosis, namely Mariana's research (2017) with an OR value of 6.07; Nurwanti (2016) with an OR value of 9,000; Yuliani (2018) with an OR value of 2.45. The largest OR figure is owned by Nurwanti's research (2016) with a value of 9.00 which means that a house that has lighting that does not meet the requirements has a 5.06 times chance of causing pulmonary tuberculosis compared to a house that has lighting that meets the requirements, while the smallest OR value which states no The existence of a relationship between lighting and the incidence of tuberculosis is a study by Yuliani (2019) with a value of 2.45 which means that a house that has lighting that does not meet the requirements has a chance of 2.

Table 13. Comparison of Research that states There is or No Relationship of Lighting with the Incidence of Pulmonary Tuberculosis

	There's a Relationship		No connection	
Research variable	**Heterogeneity Test**	**Overall Effect Results**	**Heterogeneity Test**	**Overall Effect Results**
Lighting	p = 0.0002 I2 = 81% (Heterogeneous)	p = 0.0006 p-OR= 5.80 (95%CI = 2.14 – 15.77)	p = 0.87 I2 = 0% (Homogeneous)	p = 0.35 p-OR= 1.28 (95%CI = 0.77-2.13)

After merging in the meta-analysis test, research studies which stated that there was a relationship between lighting and the incidence of tuberculosis were found to have a p value of 0.0001 and a pooled odds ratio of 6.59 (95% CI 3.57 – 12.18), which indicates that houses with lighting that does not meet the requirements has a 6.59 times chance of causing tuberculosis compared to a house that has lighting that meets the requirements.

Research conducted by Rustono (2020) showed that the proportion of bedroom lighting in the pulmonary tuberculosis group (58.5%) was greater than the non-tuberculosis group (15.1%). The results of inferential statistical analysis showed that there was a significant difference with p value = 0001, after being categorically carried out there was also a significant relationship with the odds ratio (OR) value of 7.926 with 95% Confidence Interval (CI) 3.129 - 20,080.

Subagyo's research (2016) in his research, the proportion of cases that have a house with lighting that does not meet the requirements (120Lux) in the case group (63.3%) is greater than in the control group (33.3%). Statistically the results of the analysis showed p = 0.038 and OR = 3.455 with 95% CI = 1.195 <OR < 0.05. Thus, it was stated that house lighting was a risk factor for the incidence of pulmonary tuberculosis or there was a relationship between lighting and the incidence of pulmonary tuberculosis and the respondent's house with tuberculosis. BTA (+) lungs that have lighting conditions that do not meet the requirements have a risk of 3,455 times contracting Pulmonary Tuberculosis compared to the respondent's house that has good lighting.

Home lighting is a supporting variable, this is influenced by lighting that enters a certain medium, some of the waves are reflected by the surface, the rest will penetrate the medium and some of those that penetrate will be absorbed and some will be forwarded according to the first law of thermodynamics (Aris Santjaka, 2013). Sunlight entering the room can increase the temperature and lower the humidity. Like the principle of thermodynamics, temperature changes occur due to changes in heat flow and work done (Aris Santjaka, 2013).

The researchers considered that the inconsistent results of the relationship between lighting and the incidence of pulmonary tuberculosis apart from the weight and power of the study which were not ideal, were also related to differences in place and socio-cultural and work backgrounds, where the habits of people living in highland areas or areas lowlands have different habits

in the presence or absence of ventilation and lighting in the house.

According to the researcher's assessment, the low level of community income causes the community's inability to build latrines at home because on average people live in rural areas who have jobs as farmers or fishermen with uncertain incomes, people tend to fulfill their daily needs compared to having to build facilities at home related to ventilation and lighting

Meta-analysis of the factors most associated with the incidence of pulmonary tuberculosis

Based on the results obtained in the meta-analysis, it can be seen that the risk factor/trend that is associated with the largest incidence of pulmonary tuberculosis from the 2 variables studied is lighting because lighting that does not meet the requirements has a tendency to increase the risk of 6.59 times the incidence of pulmonary tuberculosis compared to lighting that meets the requirements and after that ventilation that does not meet the requirements increases the risk or tends to be 5.80 times the incidence of tuberculosis compared to ventilation that meets the requirements.

The analysis based on the average value of the effect size of the research study for each research variable shows that the lighting variable has the highest average effect size value, which is 6.59 and the ventilation variable is 5.80. Seen from the average value of the effect size of the two variables, it shows that lighting is the variable that has the strongest relationship tendency with the independent variable, namely the incidence of pulmonary tuberculosis with a wide range of effect size between 3.57 and 12.18.

Comparison between these two variables can be done but it must be remembered that the comparison is not proportional because there is no similarity in the number of samples and characteristics in the research study of each variable studied in the meta-analysis and differences in the level of heterogeneity in each variable, causing differences in the selection of the analytical model used. .

Comparison of 10 Studies in Meta-Analysis Research

There are 5 studies that analyzed the relationship between ventilation and the incidence of pulmonary tuberculosis which had high heterogeneity with a pooled odds ratio value of 5.80 (95% CI 2.14 – 15.77), so it can be concluded that houses that have ventilation do not meet the requirements to increase risk or tend to 5.80 times the incidence of pulmonary tuberculosis compared to homes that have adequate ventilation. Meanwhile, 5 studies that analyzed no relationship between ventilation and the incidence of tuberculosis had moderate heterogeneity with a pooled odds ratio of 1.28 (95% CI 0.77 – 2.13), so it can be concluded that houses that have ventilation do not meet the requirements to increase risk or tend to be 5. 80 times the incidence of pulmonary tuberculosis compared to homes that have adequate ventilation. meaning that it has a very high tendency and there is a relationship.

The relationship between lighting and the incidence of pulmonary tuberculosis, there are seven studies that analyzed the relationship between lighting and the incidence of tuberculosis which has a fairly high heterogeneity with a pooled odds ratio value of 6.59 (95% CI 3.57 – 12.18), so it can be concluded that houses that have inadequate lighting increase the risk or tend to be 6.59 times the incidence of pulmonary tuberculosis compared to houses that have lighting that meets the requirements. Meanwhile, 3 studies that analyzed no relationship between lighting and the incidence of pulmonary tuberculosis had low heterogeneity with a pooled odds ratio of 5.06 (95% CI 1.47 – 17.37), so it can be concluded that houses that have lighting that do not meet the requirements increase risk or tend to be 5.

Analysis of the 12 research studies in this meta-analysis also analyzed various independent variables associated with the incidence of pulmonary tuberculosis. The more variables studied, the better the quality of the research. However, the variables studied must also be right on target (Ratnasari, 2016)

V. CONCLUSION

1. There is a significant relationship between ventilation and the incidence of tuberculosis through an analysis of 5 journals that meet the requirements with a relationship between ventilation and the incidence of tuberculosis with a p value <0.05, namely p = 0.0006 and a pooled odds ratio value of 5.80 (95% CI 2.14-15.77), so it can be concluded that houses with ventilation that do not meet the requirements have a risk of 5.80 times the incidence of pulmonary tuberculosis compared to houses that have ventilation that meet the requirements.
2. There is a significant relationship between lighting and the incidence of tuberculosis through an analysis of 7 journals that meet the requirements with the existence of a relationship between lighting and the incidence of tuberculosis with p value < 0.05, namely p = 0.0001 and pooled odds ratio value of 6.59 (95% CI 3.57 - 12.18), so it can be concluded that houses that have lighting that do not meet the requirements increase the risk or tend to be 6.59 times the incidence of pulmonary tuberculosis compared to houses that have lighting that meets the requirements.

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