The Effect of Nutritional Status and Lighting on the Incident Pulmonary Tuberculosis in Padangsidimpuan City

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Abstract. *Pulmonary tuberculosis (TB) is still a global health problem, this disease is directly transmitted caused by Mycobacterium tuberculosis. The purpose of this study was to analyze the effect of nutritional status and lighting on the incidence of pulmonary TB in Padangsidimpuan City. This study is an analytical observational study with a case-control design. The sample consisted of 56 cases and 56 controls. The analysis used simple logistic regression and multiple logistic regression tests. The results of the logistic regression test showed a significant effect between nutritional status (p = 0.041; OR = 2.906, 95% CI 1.045-8.081) and lighting (p = 0.048; OR = 2.995, 95% CI 1.008-8.902) on the incidence of pulmonary TB. It is recommended to maintain body health by consuming nutritious food and paying more attention to the physical environment of the house, especially lighting so that sunlight enters the house.*

Keywords: Nutritional Status, Lighting, Pulmonary Tuberculosis

1. INTRODUCTION

WHO data shows that in 2015 there were 10.4 million new cases of TB with 1.4 million deaths. Incidents occurred in 6 countries, namely India, Indonesia, China, Nigeria, Pakistan, and South Africa by 60% (WHO, 2016). The incidence of TB in Indonesia itself in 2017 was found to be 319 cases per 100,000 population or 842 incidents/year and deaths due to TB were 40 per 100,000 population or 107,000 deaths/year (WHO, 2017).

Data from the North Sumatra Provincial Health Office in 2016, the number of new TB cases found reached 105.02/100,000 population, the number of TB suspects was 114,060 people while the number of positive BTA TB was 14,892 people. The highest TB data sequence in Regency/City is in Medan City, which is 3,006/100,000 population, Deli Serdang Regency is 2,184 per 100,000 population, and Simalungun Regency is 962 per 100,000 population. Padangsidimpuan City is ranked 13th, which is 375/100,000 population, which has increased by 29% from 2015 which was 290/100,000 population (North Sumatra Provincial Health Office, 2017). In 2015, the number of positive BTA TB cases in Padangsidimpuan City was 301 patients, in 2016 it was 382 patients, and 351 patients in 2017. The Padangsidimpuan City Health Office's Working Area consists of 9 Community Health Centers (Padangsidimpuan City Health Office, 2017).

The causes of the increasing TB problem according to the Indonesian Ministry of Health are external factors (low levels of education and income, high unemployment

rates, inadequate sanitation, housing, clothing and food conditions), as well as other health problems such as HIV, malnutrition, diabetes mellitus, smoking, and increasing cases of Drug-Resistant TB (TB-RO) which influence the spread and transmission of TB (Permenkes RI, 2016).

Home and family are one of the environments where disease transmission can potentially occur due to interactions between family members and positive TB sufferers (Amin et al., 1989), meaning that those who live in the same house are at greater risk of infection because they have close contact with sufferers (Benerson, 1990 in Susilowati, 2011).

The impact that occurs forAdult TB sufferers lose 3 to 4 months of work time so that their annual household income is reduced by around 20 to 30%. If they die, they will lose their income for around 15 years, while socially the impact is that they are ostracized by society, while economically it is around 75%.TB is experienced by the productive age group (15 to 50 years)(Ministry of Health of the Republic of Indonesia, 2014).

Madhona et al.'s (2016) research in Tanjung Pinang City showed that residential density, lighting and humidity of the house affected the incidence of pulmonary TB. Similar findings were also found in Rohayu et al.'s (2016) research in South Buton Regency, which found risk factors for contact history, lighting, and residential density for positive BTA pulmonary TB.

Based on a preliminary survey at the Padangsidimpuan City Health Office in 2023, the number of positive BTA pulmonary TB cases was 351 people with a case proportion of 9.58%. Of the number of cases, the two highest numbers of positive BTA TB sufferers were in the Sadabuan Health Center with 93 people (7.24%) and the Padangmatinggi Health Center with 87 people (9.58%), while the two lowest were in the Pokenjior Health Center with 9 people (7.83%) and the Pintu Langit Health Center with 3 people (4.84%). From this problem, the researcher was interested in conducting a study entitled "The effect of nutritional status and lighting on the incidence of pulmonary tuberculosis in Padangsidimpuan City.

2. LITERATURE REVIEW

Tuberculosis (TB), particularly pulmonary TB, remains a major global health issue and is prevalent in Indonesia. This disease is influenced by several health and environmental factors, including nutrition and living conditions. Padangsidimpuan City, like many other urban areas, faces specific challenges with high TB incidence due to

factors such as population density, limited health resources, and varying socio-economic conditions. This review explores how nutritional status and environmental lighting, particularly exposure to natural light, impact TB transmission in the city.

Research consistently links malnutrition with an increased susceptibility to TB infection. Individuals with low body mass index (BMI) and poor nutritional status are more likely to contract TB due to weakened immune systems, which cannot effectively resist infections. Protein-energy malnutrition impairs immune cell production, further reducing the body's ability to combat the Mycobacterium tuberculosis bacteria. Micronutrient deficiencies, including vitamin A, D, C, and zinc, also play crucial roles in immune function, with studies highlighting that low levels of vitamin D, for instance, correlate with higher TB reactivation rates. Proper nutrition is thus essential not only for general health but also as a frontline defense against TB.

Lighting and ventilation also have significant effects on TB transmission, as TB bacteria thrive in dark, poorly ventilated spaces. Ultraviolet (UV) rays from natural sunlight are known for their bactericidal properties, helping to inactivate TB bacteria in the environment and reduce infection rates. In poorly lit and ventilated areas, however, airborne TB bacteria can linger and spread more easily, especially in densely populated urban settings. Research shows that increased exposure to natural light and good ventilation practices, such as using open windows and direct sunlight, can effectively reduce TB incidence by enhancing air quality and eliminating bacteria from indoor air.

The interaction between nutritional status and lighting reveals a compounded effect on TB susceptibility. Poor nutrition weakens immune defenses, making individuals more vulnerable, while inadequate lighting increases bacterial loads in the environment. In cities with high population density and lower housing quality, these factors are often interrelated, where individuals with limited resources may live in poorly lit and ventilated conditions while also lacking access to nutritious food. Addressing both nutritional deficits and lighting improvements could therefore play a critical role in reducing TB incidence in Padangsidimpuan.

Studies from other densely populated regions in Southeast Asia, including Indonesia, indicate that programs addressing both nutrition and environmental conditions help to lower TB rates. For example, community-based nutrition support and public health initiatives promoting better lighting and ventilation in homes have been associated with decreased TB cases. Socioeconomic disparities exacerbate these issues in Padangsidimpuan, where poorer communities often face both inadequate diets and

substandard housing conditions. Tackling these determinants holistically offers a path toward effective TB prevention.

3. METHODS

This type of research is observational analytic using an unmatching case control study design. This sample consists of 56 respondents in the case group and 56 respondents in the control group with the sampling technique used is purposive sampling. Data analysis is univariate analysis, bivariate analysis with simple logistic regression statistical test and multivariate analysis with multiple logistic regression test. The location of the study was carried out in 4 Padangsidimpuan City Health Centers, namely Sadabuan Health Center, Padangmatinggi Health Center, Pokenjior Health Center, and Pintu Langit Health Center and the time of the study was carried out from August 2023 until completion. There are three variables in this study, namely, nutritional status and lighting as independent variables (X) and the incidence of pulmonary tuberculosis as the dependent variable (Y). The materials and instruments of this study are questionnaires and measurements.

4. RESULTS

Results

Univariate Analysis

In the nutritional status variable of 56 cases whose nutritional status is poor, it is 55.4%. While from 56 controls whose nutritional status is good, it is 75.0%. In the lighting variable of 56 cases whose home lighting does not meet the requirements, it is 82.1%. While from 56 controls, each house has adequate and inadequate lighting of 50.0%. The percentage of nutritional status and lighting is shown in Figures 1 and 2.
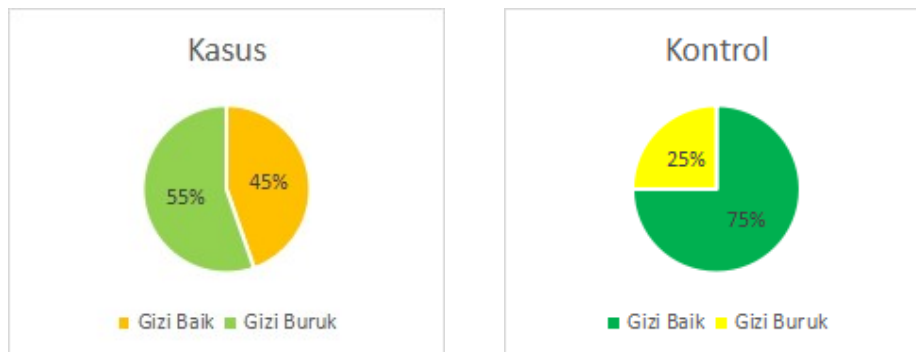

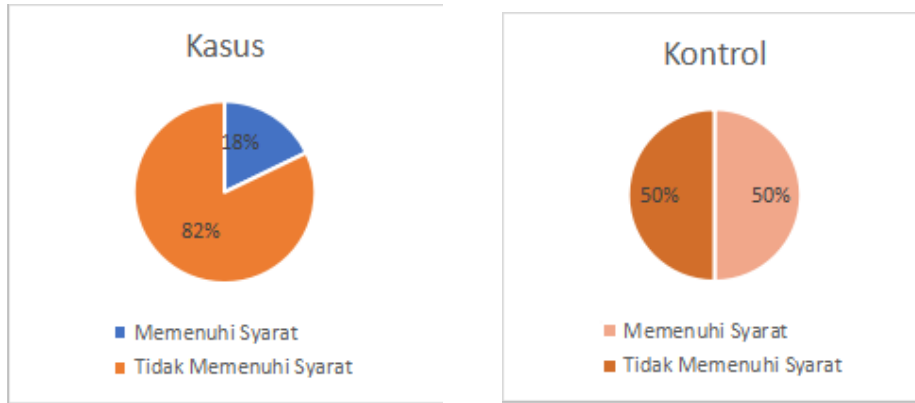**Figure 1. Nutritional Status Variables**

Figure 2. Lighting Variables

Bivariate Analysis

The results of a simple logistic regression test prove that there is a relationship between nutritional status (P= 0.001; OR= 3.720 (95% CI 1.668-8.297) and lighting (P= 0.001; OR= 4,600 (95% CI 1,944-10,886) with the incidence of pulmonary tuberculosis, shown in table 1.

Table 1 : Relationship between Nutritional Status and Ventilation with
the Incidence of Pulmonary Tuberculosis

Variables	Pulmonary TB		Not Pulmonary TB	
	n	%	n	%
Nutritional status				
Good	25	44.6	42	75.0
Bad	31	55.4	14	25.0
P= 0.001; OR= 3.720 (95% CI 1.668-8.297)				
Lighting				
Qualify	10	17.9	28	50.0
Not eligible	46	82.1	28	50.0
P= 0.001; OR= 4,600 (95% CI 1,944-10,886)				

Multivariate Analysis

The results of the study showed that two research variables, namely nutritional status and lighting, had an effect on the incidence of pulmonary tuberculosis. The most dominant variable influencing the incidence of pulmonary tuberculosis in Padangsidimpuan City was lighting with an OR value of 2.995 (95% CI 1.008-8.902), meaningRespondents living in houses with inadequate lighting are at risk of contracting pulmonary tuberculosis 2.995 times compared to respondents living in houses with adequate lighting., shown in table 2.

Table 2: Effect of Nutritional Status and Lighting on the

Incidence of Pulmonary Tuberculosis

Variables	B	Sig.	OR	95% CI
Nutritional status	1,067	0.041	2,906	1,045 - 8,081
Lighting	1,097	0.048	2,995	1,008 - 8,902
Constants	-4,569	-	-	-

5. DISCUSSION

The Influence of Nutritional Status on the Incidence of Pulmonary Tuberculosis

Nutritional status affects the occurrence of pulmonary TB where in the case group the majority of respondents had poor nutritional status of 55.4% and in the control group the majority of respondents had good nutritional status of 75.0%. The results of the simple logistic regression test analysis showed that there was an effect of nutritional status on the incidence of positive BTA pulmonary TB with the values obtained p = 0.041; OR = 2.906; 95% CI 1.045-8.081 meaning that people with poor nutritional status have a 2.906 times risk of suffering from positive BTA pulmonary TB compared to people with good nutritional status.

Lack of nutritional intake results in weight loss or BMI <18.5 so that low immunity acts as a risk factor for TB infection. Therefore, it is necessary to have good nutritional status in the body to attack the bacteria (Achmadi, 2010). Increasing the socio-economic level, and increasing immunity by eating balanced nutritious food can improve a person's nutritional status so that they can avoid infectious diseases, especially pulmonary TB.

Oktavia et al.'s research (2016) showed that there was a relationship between nutritional status and the incidence of pulmonary TB, this study found that the risk of contracting pulmonary TB was 16.7 times in people with poor nutritional status compared to people with normal/excessive nutritional status. This is also in line with Siahaan's research (2015) that poor nutritional status has a 16 times greater risk of contracting TB compared to good nutritional status.

The Effect of Lighting on the Incidence of Pulmonary Tuberculosis

The results of the logistic regression test showed that there was a significant influence between lighting on the incidence of positive BTA pulmonary TB with a value of p = 0.048; OR = 2.995; 95% CI 1.008-8.902, meaning that respondents living in houses with inadequate lighting will be at risk of developing positive BTA

pulmonary TB 2.995 times compared to respondents living in houses with adequate lighting.

Lack of sunlight in the house will facilitate the growth of germs, such as TB germs, so that the germs survive for years. TB germs survive at temperatures between 4 0C - minus 70 0C (Ministry of Health of the Republic of Indonesia, 2014). A good time to get effective sunlight is at 08.00 WIB–16.00 WIB (KepmenPUPR, 2002).

TB patients often have lower vitamin D levels than the general population, because vitamin D deficiency is caused by a lack of sun-induced vitamin D synthesis. So to prevent vitamin D deficiency can be done by exposing the body to sunlight for 15-30 minutes for 2-3 times / week or 2 hours / week. When the body is exposed to sufficient sunlight, vitamin D levels in the blood increase equivalent to consuming vitamin D 10,000-25,000 IU orally. The intensity of UV-B sunlight is low at 07.00 in the morning, increasing in the following hours until 11.00; after 11.00 this intensity is relatively stable and high until 14.00 then decreases, and at 16.00 it reaches the same intensity as at 07.00 (Rimahardika, 2016).

In line with Perdana and Putra's research (2018) which stated that respondents with poor lighting (<60 lux) were at risk of contracting pulmonary TB 25.32 times (95% CI 4.06-143.1) compared to respondents with good lighting (>60 lux). Madhona et al.'s research (2016) also showed that there was a significant relationship between lighting and TB incidence where lighting that did not meet the requirements had a risk of contracting TB 3.222 times compared to lighting that met the requirements (p=0.034 and OR=3.222)The results section summarizes the data collected for the study using descriptive statistics and reports the outcomes of relevant inferential statistical analyses (e.g., hypothesis tests) conducted on the data. Report the results in sufficient detail so that the reader can understand which statistical analyses were performed, why they were conducted, and to justify your conclusions. Mention all relevant results, including those that contradict the stated hypotheses.

There is no fixed formula for presenting the findings of a study. Therefore, we will first consider general guidelines and then focus on options for reporting descriptive statistics and the results of hypothesis tests.

Present your findings as concisely as possible while providing enough detail to justify your conclusions and enable the reader to understand exactly what you did in terms of data analysis and why. Figures and tables, detached from the main body of the manuscript, often allow for clear and concise presentation of findings.

6. CONCLUSION

Nutritional status and lighting affect the incidence of pulmonary tuberculosis. Lighting is the most dominant variable affecting the incidence of pulmonary tuberculosis. To increase public awareness of pulmonary tuberculosis, it is necessary to provide health education on lighting requirements and nutritional status

7. LIMITATION

It is inevitable that your research will have some limitations, and this is normal. However, it is critically important to strive to minimize the scope of these limitations throughout the research process. Additionally, you need to acknowledge your research limitations honestly in the conclusions chapter.

Identifying and acknowledging the shortcomings of your work is preferable to having them pointed out by your final work assessor. While discussing your research limitations, do not merely list and describe them. It is also crucial to explain how these limitations have impacted your research findings.

Your research may have multiple limitations, but you should discuss only those that directly relate to your research problems. For example, if conducting a meta-analysis of secondary data was not stated as your research objective, there is no need to mention it as a limitation of your research.

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