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The Relationship between Adequate Housing and Household Sanitation with the Success of Tuberculosis Patient Treatment in Semarang City

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Abstract

Tuberculosis is a global health problem, including in Semarang City. There were 7,844 cases in 2023 in Semarang City. The success rate of treatment in Semarang City is still at 85%. Tuberculosis is closely related to environmental factors and housing quality. This study examined how adequate housing and household sanitation conditions for Tuberculosis patients are linked to their treatment success. Data on the housing and household sanitation of the patients were taken in the first quarter of 2024 based on home visits to drug-sensitive Tuberculosis patients domiciled in Semarang City who were diagnosed in 2023 and 2024 who were still undergoing treatment and the final results of their treatment were seen in the last quarter of 2024. The data were analyzed using linear regression to examine the relationship between adequate housing and patient treatment success and the link between household sanitation and the treatment outcomes of Tuberculosis patients in Semarang City. Of the 2,007 samples, 789 patients, or 39.3%, were children (aged <15 years), and 1,119, or 55.8%, were male. It was found that 1,023 (50.9%) patients had inadequate houses, and 1,113 (55.5%) patients had poor household sanitation. The results showed that 119 (5.9%) patients recovered, 873 (43.5%) patients completed treatment, 27 (1.3%) patients died, 96 (4.8%) patients dropped out of treatment (lost to follow-up), and 4 (0.2%) patients failed. There was a significant association between housing adequacy and patient treatment outcomes (p = 0.042). Household sanitation does not show a significant relationship with treatment success (p-value = 0.564). There are still other factors that can affect the recovery of Tuberculosis patients. It is better to involve political, social, economic, and cultural sectors in addition to the health sector to carry out interventions to improve the adequacy of housing for Tuberculosis patients.

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Introduction

Tuberculosis continues to be a major public health challenge worldwide, including in Indonesia, with particular concerns in the city of Semarang. According to the World Health Organization's 2023 Global Tuberculosis Report, an estimated 10.6 million new cases were recorded in 2022, with Indonesia ranking second among the countries with the highest Tuberculosis burden (World Health Organization, 2023). Tuberculosis as an infectious disease caused by *Mycobacterium tuberculosis* has transmission characteristics that are greatly influenced by environmental and residential conditions (Gelaw et al., 2019; Narasimhan et al., 2013; Saunders & Datta, 2016; Saunders et al., 2017; Sumpter & Chandramohan, 2013). Semarang City, as a large city that continues to grow, faces many Tuberculosis cases. In 2023, The Semarang City Health Office recorded 7,844 new cases in the National Tuberculosis Information System (SITB). This figure confirms that Tuberculosis is still a severe threat in urban communities.

Globally, the treatment success rate is still at 88%, while in Semarang City, the success rate is lower, at 85%. This suboptimal success rate of treatment highlights the need for a thorough examination of factors that impact patient recovery, such as the quality of their living environment and sanitation. The condition and cleanliness of a home play a crucial role in health and can significantly aid patients in completing their treatment (Haines et al., 2013; Krieger & Higgins, 2002). A decent place to live with good sanitation conditions can create an environment that supports patient recovery, thereby improving the chances of successful treatment.

This study aims to investigate how the adequacy of housing and household sanitation among Tuberculosis patients in Semarang City is linked to the success of their treatment.

Methods

This study uses primary data collected by the Semarang City Health Office through home visits to drug-sensitive Tuberculosis patients domiciled in Semarang City. Visits were conducted in the first quarter of 2024 to patients diagnosed in 2023 and 2024 who were still undergoing treatment. The final treatment results for these patients were then evaluated in the last quarter of 2024. From all patients visited, data were taken only from patients who had completed treatment to be further explored in this study.

The indicators of adequate housing are based on the condition of the ceilings, walls, floors, bedroom and living room windows, ventilation, chimney, and lighting in the patient's home. Then, the household sanitation indicators consist of data on clean water, toilets, wastewater, and garbage from the patient's house. Housing adequacy and household sanitation are each divided into two categories: adequate houses and inadequate houses, followed by good sanitation and poor sanitation. The Semarang City Health Office classifies housing and household sanitation adequacy using data collected for both indicators, following the Indonesian Minister of Health Regulation Number 2 of 2023 about implementing Government Regulation 66 of 2014 on Environmental Health.

The outcome of treatment for Tuberculosis patients is generally divided into cured, complete treatment, died, lost to follow-up, and failed. This study measured treatment outcomes by scoring from the best to the worst, with a higher score as the treatment outcome level worsened. The order is: 1) cured, 2) complete treatment, 3) died, 4) lost to follow up, and 5) failed.

Before being processed, the data was cleaned by removing incomplete patient visit data. After that, the data was processed descriptively to see the demographic picture of the patients, as well as the housing adequacy, household sanitation, and treatment results of tuberculosis patients included in the research sample. This descriptive analysis can explain the general picture of the Tuberculosis patients observed. The data was then processed analytically using the linear regression method to test the relationship between the adequacy of housing and household sanitation with the success rate of treatment of Tuberculosis patients. The strength of each relationship between the adequacy of housing and sanitation and changes in the success rate of treatment is seen through the *r-square value* obtained from the test.

Results

After going through the data cleaning process from the results of home visits, a total of 2,007 patients who were still undergoing Tuberculosis treatment met the criteria for inclusion in this study. An initial

analysis of the characteristics of this sample provides insight into the distribution of age and gender. Specifically, 789 patients, or 39.3% of the total sample, were children under the age of 15 years. This suggests that nearly 40% of the Tuberculosis patients observed were in an age group that is more susceptible to experiencing health complications due to Tuberculosis, as children tend to have an underdeveloped immune system compared to adults, which can affect their body's response to the disease (Basu Roy et al., 2019; Centers for Disease Control and Prevention, 2022).

Table 1. Frequency Distribution of Respondent Characteristics (n=2007)

Respondent	F (%)
Age	
<15 years old	789 (39.3)
≥15 years old	1218 (60.7)
Sex	
Male	1119 (55.8)
Female	888 (44.2)
Adequate houses	
Adequate	984 (49.0)
Inadequate	1023 (51.0)
Sanitation	
Good	894 (44.5)
Poor	1113 (55.5)

Regarding gender, 1,119 patients, or around 55.8%, were male. The predominance of men in this sample aligns with the global epidemiological trend of tuberculosis, where infection rates are typically higher in men than in women. The World Health Organization reports that an estimated 10.8 million cases of tuberculosis occurred worldwide, with around 6 million of these affecting men (World Health Organization, 2023).

After categorizing adequate houses and good sanitation, it was found that more patients lived in houses with inadequate conditions and poor sanitation from the total samples observed. Of the total 2,007 patients analyzed, 1,023 patients (50.9%) lived in houses that were considered inadequate, while 1,113 patients (55.5%) were in houses with poor sanitation, 1,023 (51.0%). These results indicate that the living conditions of patients vary greatly, and most patients live in environments that may be at risk of increasing the spread of Tuberculosis.

For the final treatment outcome, from a total of 2,007 patients observed, 119 patients (5.9%) were declared cured, while 873 patients (43.5%) completed their treatment. However, some patients experienced poor conditions related to treatment, with 27 patients (1.3%) dying, 96 patients (4.8%) dropping out of treatment, and four patients (0.2%) failing treatment. These figures illustrate the highly variable results of tuberculosis treatment. This can be influenced by many factors, including the possibility of conditions in the home and living environment of patients that do not support the recovery process, the relationship of which was tested in this study.

Table 2. The Relationship between Adequate Housing and Household Sanitation with the Success of Tuberculosis Patient Treatment

Housing Status	p-value
Adequate Housing	0.042*
Household Sanitation	0.564

After ranking treatment outcomes from best to worst—cured, treatment completed, death, lost to follow-up, and failed—the analysis revealed a significant change in treatment outcome levels associated with inadequate housing. This is reflected in the p-value of 0.042 (p-value <0.05), which indicates a statistically significant relationship between housing adequacy and treatment success. However, although this relationship is significant, the change in treatment success rate explained by housing adequacy is only 0.3 % (*r-square* value). This means that although inadequate housing conditions contribute to treatment success, the effect is relatively small, and other unidentified factors may also affect patient treatment outcomes.

On the other hand, the analysis results related to household sanitation showed no significant relationship with the success of treating tuberculosis patients. The p-value for the relationship between household sanitation and treatment outcomes was 0.564 (p-value>0.05).

Discussion

After going through the data cleaning process from the results of home visits, a total of 2,007 patients who were still undergoing Tuberculosis treatment met the criteria for inclusion in this study. An initial analysis of the characteristics of this sample provides insight into the distribution of age and gender. Specifically, 789 patients, or 39.3% of the total sample, were children under the age of 15 years. This suggests that nearly 40% of the Tuberculosis patients observed were in an age group that is more susceptible to experiencing health complications due to Tuberculosis, as children tend to have an underdeveloped immune system compared to adults, which can affect their body's response to the disease (Basu Roy et al., 2019; Centers for Disease Control and Prevention, 2022).

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On the other hand, the analysis results related to household sanitation showed no significant relationship between household sanitation and the success of treating tuberculosis patients. The p-value for the relationship between household sanitation and treatment outcomes was 0.564 (p-value>0.05).

Conclusion

The results of this study highlight the critical role that adequate housing conditions play in supporting successful treatment outcomes for Tuberculosis patients. Thus, improving the quality of housing in Semarang City can significantly contribute to the success of the Tuberculosis control program. Policies that promote housing improvement should be integrated into the city's Tuberculosis control strategy.

Conversely, while household sanitation did not demonstrate a significant link with the success rate of Tuberculosis treatment, enhancing sanitation access remains crucial for broader public health. Government initiatives to expand access to safe water and sanitation should be consistently reinforced to mitigate the risk of other infectious diseases in communities vulnerable to Tuberculosis.

Overall, these results indicate that a multidimensional approach is essential for the success of the Tuberculosis program in Semarang City. This study also opens up opportunities for further research to

explore the relationship between sanitation, other infectious diseases, and other environmental factors that may affect the health conditions of Tuberculosis patients.

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