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Risk of Pulmonary Tuberculosis Transmission Among Household Contacts

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Abstract

Tuberculosis is an infectious disease caused by the Mycobacterium tuberculosis bacillus. Pulmonary TB disease is transmitted through the air (droplet nuclei), when the patient coughs, sneezes, or talks, pulmonary TB germs in the form of droplets will be scattered in the air. Household contact with active tuberculosis people has higher risk of being infected compared to those who are not in contact. This study aims to determine the risk of pulmonary TB transmission in people who are in house contact, including length of contact and sleeping in the same room, in the working area of Puskesmas Perumnas II, West Pontianak District. This research is categorized as descriptive analytic with total sampling technique. The sample size was 77 respondents who lived in the same house with pulmonary TB patients who were still actively seeking treatment in the working area of Perumnas II Community Health Center. Sample criteria included inclusion and exclusion criteria. The research was conducted through direct interviews using questionnaires, observation sheets, and microscopic BTA data collection. The results showed that out of 77 respondents, 37 respondents (48.1%) had contact with patients ≥ 8 hours and 4 of them were BTA positive. The prevalence of transmission based on length of contact was 10.8% and based on sleeping in the same room was 36.3%. The study concluded that there was a prevalence of pulmonary TB transmission in people who were in contact with the patient.

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INTRODUCTION

Tuberculosis or known as TB is a type of infectious disease caused by the bacteria *Mycobacterium tuberculosis*. This bacteria is transmitted through droplets spread in the air. This causes people with TB to have great potential to become the main source of transmission of tuberculosis infection (Damayati et al., 2018). The process of spreading the disease can occur when people with pulmonary tuberculosis with positive BTA test results speak, sneeze, or cough. These activities will release sputum into the air which can carry more than 3,000 microorganisms that cause infection (Kristin,i & Hamidah, 2020). Based on the estimated incidence of tuberculosis (TB) which reaches 969,000 cases per year, it was noted that in 2022 there were 724,309 cases that had been identified and reported (about 75% of the total incidence). This suggests that about 25% of cases remain unreported. These unreported cases can be caused by several factors, such as individuals who have not been reached by health services, have not been detected through medical examinations, or have not been reported administratively (Kementerian Kesehatan Republik Indonesia, 2022).

According to data from the West Kalimantan Provincial Health Office in 2023, the number of tuberculosis cases reported in West Kalimantan in the January-August period was 6097 cases (Dinas Kesehatan Kalimantan Barat, 2023). Based on tuberculosis data in Pontianak City, tuberculosis cases in 2023 in the January-August period were 5,726 suspected cases, the number of notified patients was 1,596 and the number of patients treated was 1,240 (Dinas Kesehatan Kalimantan Barat, 2023). Data reports from Perumnas II health center in 2023 obtained the number of suspected tuberculosis patients as many as 446 people with the number of BTA positive tuberculosis patients 35 people and who are still actively seeking treatment at Perumnas II health center as many as 30 people. Pulmonary *tuberculosis* disease appears due to infection with *Mycobacterium tuberculosis* bacteria. These bacteria have the ability to survive in cool, humid, and minimal sunlight conditions for years. However, if the bacteria are exposed to sunlight for about 2 hours, these bacteria will die, because ultraviolet light has a damaging effect on the cell structure of these bacteria (Bunga, Umbul, and Basuki 2022) .

Pulmonary tuberculosis is an airborne disease. When a person talks, sneezes, or coughs, germs can spread into the air along with droplets. These tiny droplets dry quickly and turn into particles that contain pulmonary TB bacteria. These particles can remain in the air for several hours, increasing the risk of others inhaling them over a period of time (Masriadi, 2017). High-density housing is not considered to meet health standards because in addition to causing a decrease in oxygen consumption, it also has the potential to accelerate the spread of infectious diseases if one family member is infected. The high number of occupants in one room will cause the air to be polluted more quickly, and increase the number of bacteria contained in the air. This condition also has an impact on increasing humidity in the house, which can create an ideal environment for pathogenic microorganisms to multiply (Mardianti, 2020)

Overcrowding in a house can trigger the risk of transmission of germs that cause pulmonary tuberculosis from one family member to another. Cramped and poorly ventilated homes allow the bacteria that cause the disease to survive longer in the air, increasing the chance of infection transmission. An overcrowded environment will further exacerbate this situation, as non-optimal air circulation allows lung germs to spread easily and infect other family members (Rheegandono, & Indasah, 2013). 71.4% of respondents had contact intensity with tuberculosis patients for more than 8 hours per day. This prolonged contact usually occurs when respondents spend time with patients, such as watching TV, cooking, doing homework, having conversations without wearing masks, and sleeping and eating in the same room. Such intense, long-term interaction increases the risk of exposure to TB germs, especially when contact is made for more than 8 hours per day.

According to the study of Butiop et al, (2015), there was a significant correlation between living in the same house with patients with pulmonary tuberculosis and an increased risk of contracting the disease, with a value of p=0.016. Meanwhile, other variables such as room temperature and ventilation area did not show a significant relationship with the incidence of pulmonary tuberculosis, with p=0.677 and p=0.278, respectively. This study was conducted in Wori village. Research conducted by Simatupang, et al (2019) found that out of 73 people who lived in the same house with TB patients, 26% or 19 of them showed symptoms of tuberculosis. In addition, around 19.2% of respondents had the habit of sleeping in the same room as the patient. This causes the frequency and duration of contact with patients to increase, thus increasing the risk of tuberculosis transmission.

METHOD

This research uses descriptive analytic method, this method emphasizes the presentation of information without conducting in-depth analysis to produce conclusions that can be applied in general (Sugiyono, 2013). The population in this study were people who had at least one household member diagnosed with pulmonary tuberculosis. The patient was actively treated at the Perumnas II Health Center Work Area, which is the focus location of this study. The determination of the sample in this study follows the inclusion criteria that have been determined by the researcher, the sample will be taken with a total sampling technique of 30 houses.

The data used in the study were primary data, namely information obtained through questionnaires, focus group discussions, and interviews conducted by researchers with relevant resource persons. Then the secondary data of this study was taken from the report of Perumnas II Community Health Center, West Pontianak District, especially those related to pulmonary tuberculosis. The data obtained will then be analyzed with univariate. Researchers used descriptive tests processed in the form of frequencies and percentages in this study.

RESULTS AND DISCUSSION

Puskesmas Perumnas II is located in Kelurahan Sungai Beliung, West Pontianak District, with the same working area as Kelurahan Sungai Beliung, which is 567 hectares. There are 16,820 households, with an average number of members per household of 4.28. With a constant area, the population density in 2022 reached 129 people per hectare.

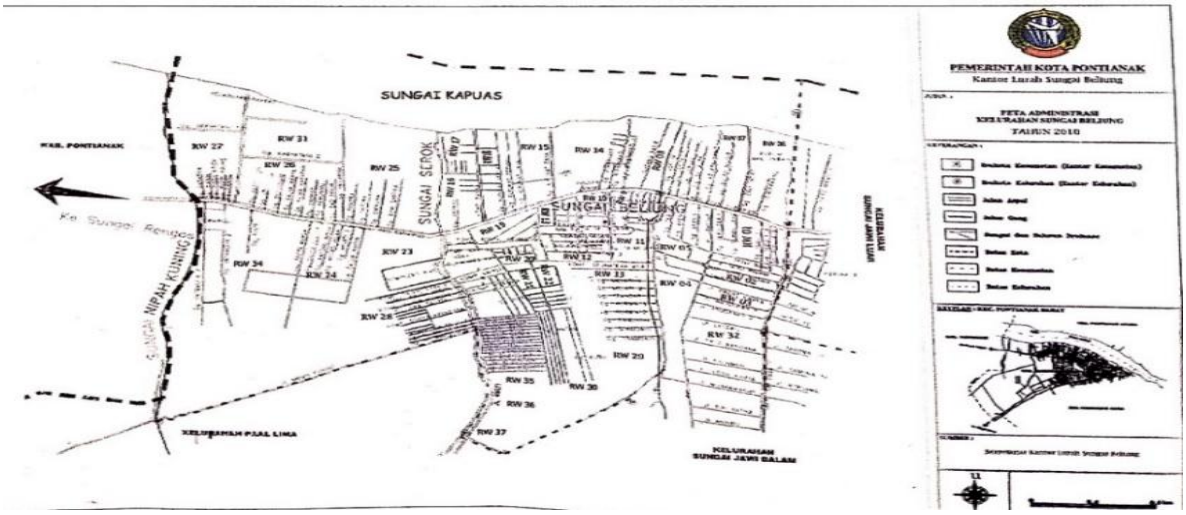

Figure 1. Work Area of Perumnas II Health Center

The majority of people in this area have traditional socio-cultural conditions, where around 3,096 people come from weak or underprivileged economic circles. This of course has an impact on limitations in health care, both individually and in groups. The community in Sungai Beliung generally belongs to the lower-middle economic group, while the number of individuals from the upper-middle class is very limited. Thus, the poorer sections of the community are encouraged to utilize and apply for BPJS cards in an effort to gain access to better health services. KSP is still widely used by patients visiting the Puskesmas Perumnas II.

Table 1. Frequency Distribution of Respondents Based on Gender in the Work Area of Perumnas II Health Center, West Pontianak District

Gender	Frequency	BTA (+)
Male	33 (42.9%)	3 (75%)
Female	44 (57.1%)	1 (25%)
Total	77 (100%)	100%

According to Table 1, the number of male respondents reached 33 people, accounting for 42.9% of the total, while female respondents totalled 44 people, equivalent to 57.1%. There were 3 (75%) male BTA+ respondents and 1 (25%) female respondent.

Table 2. Frequency Distribution of Respondents Based on Sleeping Habits in the Work Area of Perumnas II Health Center, West Pontianak District

Sleeping in the same room	Frequency	BTA (+)
Roommate	11 (14.3%)	4 (36.3%)
Not Roommates	66 (85.7%)	0

The table 2 shows that respondents who slept in the same room with the patient were 11 respondents (14.3%) and those who did not sleep in the same room with the patient were 66 respondents (85.7%). BTA + respondents who slept in the same room with the patient were 4 (36.3%) respondents.

Table 3. Frequency Distribution of Respondents Based on Length of Contact in the Working Area of Perumnas II Health Center, West Pontianak Subdistrict

Length of Contact	Frequency	BTA (+)
≥ 8 hours	37 (48,1%)	4 (10,8%)
≤ 8 hours	40 (51,9%)	0

The table 3 shows that respondents who had contact with patients ≥ 8 hours were 37 respondents (48.1%) and those who had contact ≤ 8 hours were 40 respondents (51.9%). BTA + respondents with contact ≥ 8 hours were 4 (10.8%) respondents.

Table 4. Frequency Distribution of Respondents Based on BTA Examination Results in the Work Area of Perumnas II Health Center, West Pontianak District

BTA Test Result	Frequency	Percentage
Positive	4	5.2%
Negative	73	94.8%
Total	77	100%

The table 4 shows that there were about 4 respondents (5.2%) with positive BTA results while 73 respondents (94.8%) with negative BTA results.

DISCUSSION

Microscopic examination of the sputum of family members who were household contacts showed that 4 people had BTA positive sputum examination results, which is equivalent to 5.2%, while the remaining 73 people showed negative results, which is 94.8%. The high number of negative results may indicate that the quality of sputum samples may

not be optimal. The quality of the sputum sample is very important as it affects the result of the examination, which is the main focus of the tuberculosis control program. To obtain accurate results, good sputum quality needs to consider several aspects, such as volume, color, and viscosity. However, in this study, sputum quality was not analyzed in depth because this study did not focus on these aspects. the number of respondents who were confirmed BTA positive was greater for men than women. One factor that may influence the difference in the frequency of pulmonary TB disease between the two genders is the difference in life habits. Among these habits, smoking is a significant one, where men tend to smoke more than women (Damayati et al., 2018).

The percentage of pulmonary tuberculosis cases among male individuals is higher than that of female individuals. This phenomenon can be explained by men's lack of attention to personal health care and their high level of exposure to various risk factors that can trigger infection. In addition, smoking and alcohol consumption, which are more common among men, can lower their immune system, making them more susceptible to pulmonary tuberculosis infection (Siregar et al., 2023). The findings in this study are consistent with a study conducted in the Tegal Sari Health Center working area, Medan Denai District, by Sikumbang et al. (2018), which identified gender as a risk factor for pulmonary TB with a p-value=0.006. These results indicate a significant relationship between gender and the incidence of pulmonary TB in the Tegal Sari Health Center work area. Contact with individuals suffering from pulmonary TB refers to direct interaction between respondents and patients. Close contact or close interaction with spouses or parents of active TB patients often provides a greater opportunity for transmission of Mycobacterium tuberculosis. This is due to the high frequency and duration of interaction between them. Therefore, these individuals are at greater risk of TB infection compared to daughters, sons, or nephews, both female and male. This finding suggests that the level of proximity to active TB patients plays an important role in the development of the disease (Karbito, 2023).

The findings of this study are in line with the results obtained from a study conducted at the Kedungmundu Health Center by Karbito and Maisaroh (2023). In the study, it was found that the type of contact variable had a significant relationship as a risk factor for latent TB infection with a p=0.027 value and a 95% confidence interval (95%CI=1.17-5.18). The proportion of latent TB infection in the close contact category reached 75.4%, which was much higher than the non-closely contact category which was only 55.6%. In addition, the risk of latent TB infection in individuals with close contact was 2.46 times higher (95%CI=1.17-5.18) compared to those with non-closely contacted individuals. All respondents diagnosed with BTA+ pulmonary TB had the habit of sleeping in the same room as individuals with pulmonary TB. This causes the frequency and duration of contact with patients to be more frequent and last longer. The risk of pulmonary tuberculosis (TB) transmission increases with the duration, frequency, and proximity of contact with infected individuals. Therefore, it is strongly recommended that family members who live in the same house with TB patients do not sleep in the same room. When sleeping, people with TB tend not to cover their mouths when coughing or sneezing, and often do not use respiratory protective equipment. This has the potential to allow TB-causing bacteria to spread through the air, especially at night when household contacts may be exposed without protection, increasing the likelihood of infection (Simatupang et al., 2019).

The risk of tuberculosis (TB) transmission is influenced by a number of factors, including the concentration of TB germs present in the air, air circulation, duration of contact, and an individual's level of susceptibility to infection. Among these factors, the environment plays a significant role, particularly in relation to the intensity of exposure received by individuals. Therefore, to reduce the risk of transmission of TB germs, the World Health Organization (WHO) recommends that the sleeping space of patients be separated from

other family members (Simatupang et al., 2019). A study showed that many TB patients live in very crowded conditions, where some households do not have separate sleeping quarters. This has implications for the inability to implement measures to prevent the spread of the disease, such as separating sleeping spaces between patients and household contacts (Simatupang et al., 2019). The findings of this study are consistent with the results obtained in a study conducted in Kaliangkrik sub-district, Magelang, by Susilowati (2011). The study showed an association between the habit of sleeping in one room and the incidence of pulmonary tuberculosis, which was shown through statistical tests with a prevalence ratio (RP) of 3.839. The 95% confidence interval showed a range of 1.390 < RP < 10.605, with a ρ value of 0.020 indicating statistical significance. In the context of epidemiology, this means that respondents who live in the same house and have a history of sleeping in the same room with people with TB have a 3.839 times higher risk of infection.

The findings in this study were also reinforced by a study conducted in Mamasa Sub-district, West Sulawesi, by Pratama, et al (2024). In that study, a p-value of 0.004 was obtained, which showed a result below the threshold of 0.05. From the results of this analysis, it can be concluded that there is a significant relationship between the habit of sleeping in the same room (house contact) and the incidence of tuberculosis. In addition, the study also revealed that the habit of sleeping in the same room with other family members can increase the risk of contracting tuberculosis by 0.608 times when compared to individuals who do not sleep in the same room. All respondents diagnosed with BTA-positive pulmonary tuberculosis had daily contact intensity with TB patients that exceeded 8 hours. This contact intensity refers to the amount of time spent by respondents interacting with people with BTA-positive pulmonary TB, who are usually family members. The duration of this interaction can be measured from various activities carried out together, such as watching television, cooking, completing homework, chatting without using a mask, and eating and sleeping in the same room for more than 8 hours per day (Kristini and Hamidah, 2020). The level of proximity and frequency of sustained contact with infected individuals is the most significant environmental factor in the transmission of pulmonary tuberculosis (TB). Frequent coughing throughout the night can increase the risk of transmission among household contacts, as micro particles (droplet nuclei) containing *Mycobacterium tuberculosis* can survive in the air for a long period of time (Simatupang et al., 2019).

Contact with individuals infected with BTA-positive pulmonary tuberculosis (TB) generally indicates a higher intensity and frequency of exposure. The risk of transmission even increases up to four times in households with more than one TB patient compared to households with only one patient. This phenomenon occurs due to the presence of multiple individuals with *tuberculosis* in the same household, which in turn increases the frequency and duration of contact with *Mycobacterium tuberculosis* germs, a very important factor in the pathogenesis of the disease (Sari, 2014). Infection by *Mycobacterium tuberculosis* occurs based on the concentration of airborne droplets and the duration of inhalation of contaminated air. If the individual's immune system is in good condition, the bacteria can remain dormant in the lung tissue for several months to years. However, when health conditions decline, the bacteria can reactivate and cause disease known as post-primary infection (Samsugito and Hambyah, 2018). A person with pulmonary tuberculosis who sneezes once can release between 20,000 and 40,000 droplets. Therefore, individuals most at risk of contracting TB are family members and people who frequently interact with the patient (Sari, 2014).

The findings in this study are in line with the results of a study conducted by Karbito and Maisaroh (2023), which showed that the proportion of latent tuberculosis infection was higher, at 67.2%, in subjects who had prolonged contact with active tuberculosis patients for 5 hours or more per day. In contrast, the proportion of infection in subjects with less than 5 hours of contact per day was only 37.5%. In addition, the risk of latent tuberculosis infection

in individuals with ≥ 5 hours of contact per day was 3.42 times higher (95% CI = 1.16-10.06) compared to those with less than 5 hours of contact. The findings in this study were also reinforced by a study conducted by Butiop, et al (2015) in Wori Village. In that study, statistical analysis showed a p value of 0.016 with an odds ratio (OR) of 3.848 and a 95% confidence interval ranging from 1.231 to 12.029. This indicates that the risk of tuberculosis transmission in individuals who have contact with patients is three times greater than those who do not interact with patients. From observations at the respondents' homes, there were some other causes that influenced the results of this study, namely housing conditions and socioeconomic conditions. One of the respondents who was BTA positive had a fairly low socio-economic condition. Respondents sleep in the same room with BTA positive patients because the house only has one bedroom. It was the socioeconomic factor that caused the respondent to sleep in the same room with the patient. Another factor is the condition of the living environment. One of the respondents who was diagnosed BTA positive lived in a fairly dense environment.

CONCLUSION

Based on the results of the study, it was found that respondents who had contact with patients ≥ 8 hours were 37 respondents (48.1%). Of the 77 respondents studied, 4 respondents were found to have BTA (+) results in the Perumnas II Health Center working area. From the research that has been done, there is a prevalence of pulmonary tuberculosis transmission in people who are in contact with patients in the Perumnas II Health Center Work Area, West Pontianak District.

REFERENCE

Bunga, E., & Basuki, H. (2022). Pengaruh lingkungan fisik rumah, riwayat kontak dan status gizi terhadap kejadian tuberkulosis anak di kota kupang. *Jurnal Pangan Gizi dan Kesehatan,* 11(2), 81-96. https://doi.org/10.51556/ejpazih.v11i2.215

Butiop, H. M., Kandou, G. D., & Palandeng, H. M. (2015). Hubungan kontak serumah, luas ventilasi, dan suhu ruangan dengan kejadian tuberkulosis paru di desa wori. *Jurnal Kedokteran Komunitas dan Tropik*, 3(4), 241-248.

Damayati, D. S., Susilawaty, A., & Maqfirah, M. (2018). Risiko kejadian TB paru di wilayah kerja puskesmas Liukang Tupabbiring Kabupaten Pangkep. *Higiene: Jurnal Kesehatan Lingkungan,* 4(2), 121-130.

Dinas Kesehatan Kalimantan Barat. (2023). *Program Tuberkulosis*. Pontianak: Dinas Kesehatan Kalimantan Barat.

Rheegandono, A., & Indasah, I. (2013). Gradasi basil tahan asam (BTA) positif dengan resiko penularan anggota keluarga dalam satu rumah (kontak serumah) penderita TBC paru. *STRADA: Jurnal Ilmiah Kesehatan*, 2(1), 69-76.

Karbito, K., & Maisaroh, S. (2023). Prevalensi dan Faktor Risiko Infeksi TB Laten pada Anggota Keluarga Kontak Serumah dengan Pasien TB Aktif. *Jurnal Kesehatan Lingkungan Indonesia,* 22(3), 351-358. https://doi.org/10.14710/jkli.22.3.351-358

Kementerian Kesehatan Republik Indonesia. (2022) *Laporan Kinerja 2022*. Jakarta: Kementerian Kesehatan Republik Indonesia.

Kristini, T., & Hamidah, R. (2020). Potensi penularan tuberculosis paru pada anggota keluarga penderita. *Jurnal Kesehatan Masyarakat Indonesia*, 15(1), 24-28.https://doi.org/10.26714/jkmi.15.1.2020.24-28

Masriadi. (2017) *Epidemiologi Penyakit Menular*. Cetakan Kedua. Depok: PT RajaGrafindo Persada.

Pratama, D. P., Julyani, S., Rasfayanah, R., Nasruddin, H., & Anggita, D. (2024). Hubungan Lingkungan Fisik Rumah Dan Perilaku Kesehatan Terhadap Kejadian TB Paru di Wilayah Kec. Mamasa, Sulawesi Barat. *Jurnal Kesehatan Tambusai*, 5(1), 1697-1709.

Samsugito, I. (2020). Hubungan Jenis Kelamin dan Lama Kontak Dengan Kejadian Tuberkulosis Paru Di Rumah Sakit A. Wahab Sjahranie Samarinda. *Jurnal Kesehatan Pasak Bumi Kalimantan,* 1(1), 28-39.

Sari, R. M. (2014). The Relationship Between Contact Characteristics with TB Symptoms Presence in Patient's Contact of Pumonary TB BTA+. *Jurnal Berkala Epidemiologi*, 2(2), 274-285.

Sikumbang, R. H., Eyanoer, P. C., & Siregar, N. P. (2022). Faktor-faktor yang berhubungan dengan kejadian TB paru pada usia produktif di wilayah kerja Puskesmas Tegal Sari Kecamatan Medan Denai. *Ibnu Sina: Jurnal Kedokteran Dan Kesehatan-Fakultas Kedokteran Universitas Islam Sumatera Utara*, 21(1), 32-43. https://doi.org/10.30743/ibnusina.v21i1.196

Simatupang, M. M., Utami, S. T. B., & Hermawati, E. (2019). Analisis Pengaruh Berbagi Ruangan Tidur Terhadap Gejala Tb Pada Kontak Serumah Penderita. *Jurnal Bidang Ilmu Kesehatan*, 9(2), 176-190.

Siregar, P. A., Farashati, J. I., Syafira, A. C., & Febrina, D. (2023). Konsep epidemiologi terjadinya penyakit tuberkulosis. *Zahra: Journal of Health and Medical Researches*, 3(3), 462-470.

Sugiyono. (2013) *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta.

Susilowati, T. (2011). Faktor-faktor yang berpengaruh terhadap Kejadian Tuberculosis di Kecamatan Kaliangkrik Magelang (Studi tentang kontak langsung dengan pasien BTA Positif Tuberculosis). *Jurnal Komunikasi Kesehatan*, 2(2).