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HOUSE ENVIRONMENT AND PEOPLE BEHAVIOR ASSOCIATED WITH PULMONARY TUBERCULOSIS IN DEPOK CITY, INDONESIA

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ABSTRACT

West Java Province, which has the largest population in Indonesia, is estimated to have the highest number of tuberculosis cases. This province supports the capital city of Jakarta, which significantly affects the country. This study aimed to determine the relationship between the housing environment and people's behavior in cases of pulmonary tuberculosis in Depok City, a buffer zone for the capital city of Jakarta, Indonesia. This study used descriptive and analytical observational study was conducted in Depok City from July to October 2024, using a quantitative approach. Observational analytics used a retrospective case-control design, with 52 subjects and 52 controls. Univariate, bivariate, and multivariate analyses were performed using IBM SPSS Statistics software. Results: The results showed that house status (healthy/unhealthy) was not related to tuberculosis cases because almost all respondents' houses were classified as unhealthy. Sex differences, Body Mass Index (BMI), and the habit of opening house windows were significantly correlated with tuberculosis cases. Conclusions: Tuberculosis is a complex disease that involves many risk factors. Although household status was not significantly related to tuberculosis, the majority of the respondents were classified as unhealthy. These results indicate the need for follow-up by authorities to prevent other health problems in the future.

KEYWORDS: Tuberculosis; House Status, Body Mass Index; Immune Systems; Mycrobacterium tuberculosis.

1. INTRODUCTION

Tuberculosis remains fairly infectious and infecting approximately a quarter of the global population (Behr et al., 2019). It is one of the diseases with the highest mortality rates worldwide after COVID-19 (World Health Organization, 2022). The trend of tuberculosis cases in several countries has continued to increase since 2020, serving as a global health problem that should be resolved (World Health Organization, 2023). Indonesia has the second highest number of tuberculosis cases globally, contributing 8.5% of the global burden in the last two decades (Kementerian Kesehatan Republik Indonesia, 2022; World Health Organization, 2020). West Java Province, which has the largest population, is estimated to have the highest number of tuberculosis cases (Kementerian Kesehatan Republik Indonesia, 2023). This province is the capital city of Jakarta, which significantly affects the country.

Tuberculosis is Mycobacterium tuberculosis (Mtb), which is transmitted through air with droplet nuclei as a medium through coughing or sneezing (Migliori et al., 2021). After being exposed to Mtb, 20-25% of people will be infected, although each person's immunity will suppress the majority (Goletti et al., 2022). People infected with Mtb can develop active tuberculosis when the immune system is not strong enough to withstand the development of Mtb, thereby causing transmissible symptoms (Goletti et al., 2022). Latent tuberculosis infection occurs when Mtb infects humans (hosts); however, the immune system can still prevent the bacteria from developing. In this case, the host does not exhibit any symptoms and cannot be transmitted (Gong & Wu, 2021). The immune system is important for the development of latent tuberculosis infections in active cases (Gong & Wu, 2021).

Previous studies have shown that tuberculosis is a complex disease, with several risk factors. Although it is associated with immunity, there is no clear understanding of the mechanism of infection and its development to form an active case (Kudryavtsev et al., 2019). The immune system still plays an important role in the development of Mtb in the body (Goletti et al., 2022). Because of its significant correlation with the immune system, nutritional intake is essential for defending against the disease, as malnourished individuals tend to develop tuberculosis (Izudi et al., 2024). They are also closely related to social and environmental factors. Socioeconomic status, poor housing environment, food and alcohol consumption, and comorbidities play a role in the development of TB (Duarte et al., 2021).

Depok is one of the cities supporting the capital city of Indonesia and is part of West Java, with the highest number of tuberculosis cases (Kementerian Kesehatan Republik Indonesia, 2023). This dense urban area serves as a place of residence for people with permanent jobs in Jakarta (Sutisna, 2024). In 2023, there were more than 7000 active tuberculosis cases in Depok City, with a relatively low treatment rate of 81% compared to other cities in West Java (Dinkes Provinsi Jawa Barat, 2023). This condition is a concern because the city is a buffer area with very high mobility, showing the need to examine the prevalence of tuberculosis cases and influencing factors.

2. METHODOLOGY

2.1. Study Design

This descriptive and analytical observational study was conducted by using quantitative methods. A descriptive study was conducted to identify pictures of the house environment and people's tuberculosis-related behaviors. Observational analytics used a case-control design to determine the relationship between influencing factors and tuberculosis. This study was conducted retrospectively, observing previous conditions before the tuberculosis incident.

2.2. Location and Time of Study

This study was conducted in Depok City, with Tapos District as the sample point. The experiment was conducted from July to October 2024, starting with preparation and ending with data collection in the field.

2.3. Sample

This study included 52 patients and 52 controls. The inclusion criteria for the case sample consisted of people who were declared positive for tuberculosis based on data from the Public Health Center (Puskesmas), had lived in their house for more than two years, and were willing to be interviewed and observe their house environment. The control samples were respondents living close to the cases, without tuberculosis symptoms, who had lived in their house for more than two years, showing a willingness to be interviewed, and observing their home environment. The exclusion criterion for cases and controls was respondents who were unwilling to have their houses observed.

2.4. Instruments

This study used the Healthy Home

Environmental Health Inspection Form, issued by the Indonesian Ministry of Health. This form was used by the Community Health Center to assess the condition of people's homes. The results of the assessment would lead to a conclusion regarding whether houses are healthy or unhealthy.

2.5. Data Collection

Both primary and secondary data were obtained directly through questionnaires as well as data from the Health Center and observations of the house environment. The required data comprised of 104 samples, including 52 cases and 52 controls. The dependent variable was the tuberculosis case, whereas the independent variables were sociodemographic factors, environment, and people's behavior. Students or enumerators conducted interviews through initial arrangement perceptions, while tuberculosis cases were obtained from data held by the Health Center.

2.6. Data Processing and Analysis

The collected data were checked for completeness and ensured to be complete according to the objectives of this study. Furthermore, the data were coded and categorized for analysis, followed by inputs from the sampling results and interviews. The information obtained was entered into IBM SPSS Statistics and verified for completeness prior to analysis. Data analysis was performed using IBM SPSS Statistics software. A univariate analysis was conducted to determine the frequency distribution and percentage of each dependent and independent variable. Bivariate analysis was performed to determine the relationship between the independent and dependent variables with a significance level of 0.05 and a confidence interval of 95%. Bivariate analysis was performed using the chi-square test to determine p-values. When the p-value was less than 0.05, there was a relationship between the two variables.

3. RESULTS

This study included 104 respondents living in Depok. The obtained information is presented in Table 1. Respondents were predominantly females over 42 years old, unemployed or casual workers, married, and had a low to middle income. Observations of the house environment and people's behavior were also conducted, and the results are shown in Table 2.

Table 1: Overview Respondent.

Variable	f(n=104)	%
Respondents		
Cases	52	50.0
Control	52	50.0
Age		
≥ 42 years old	53	51.0
< 42 years old	51	49.0
Gender		
Male	30	28.8
Female	74	71.2
Education		
Primary School	38	36.5
Junior High School	30	28.8
Senior High School	34	32.7
Bachelor	2	1.9
Occupation		
Employed	39	63.5
Unemployed	65	37.5
Marital Status		
Married	86	82.7
Not Married	18	17.3
Diabetes Melitus Status		
With Diabetes	12	11.5
Without Diabetes	92	88.5
Income		
Low	54	51.9
Middle	50	48.1
Duration of Stay		
≥ 26 years	52	50.0
< 26 years	52	50.0
Knowledge		
Good	83	79.8
Poor	21	20.2
Body Mass Index		
Obese	26	25.0
Normal	78	75.0
Smoke Exposure		
Exposed	93	89.4
Not Exposed	11	10.6
Housing Status		
Good	4	3.8
Poor	100	96.2
Vaccination Status (BCG)		
Vaccinated	48	46.2
Not Vaccinated	56	53.8

Table 2: Overview of House Conditions and People's Behavior Associated with Pulmonary Tuberculosis. Cases.

Variable	F f (n=104)	%
Home Components		
Wall		
Permanent	91	12.5
Not Permanent	13	87.5
Floor		
Ground	4	3.8
Plastered	100	96.2
Bedroom Windows		
Yes	67	64.4
No	37	35.6
Family Room Windows		
Yes	91	12.5
No	13	87.5
Ventilation		
Inadequate	50	48.1
Adequate	54	51.9
Kitchen Hood		
Yes	75	72.1
No	29	27.9
Lighting		
Insufficient	49	47.1
Sufficient	55	52.9
Temperature		
Normal	13	87.5
Abnormal (>31^{o}C)	91	12.5
Humidity		
Normal	74	71.2
Abnormal (>60RH)	30	28.8
House Density		
$\leq$ 8 m^2/people	9	8.7
> 8 m^2/people	95	91.3
People Behavior		
Habit of Opening Windows		
Yes	50	48.1
No	54	51.9
Habit of Cleaning the Yard		
Often	73	70.2
Rarely	31	29.8
Habit of Burning Garbage		
Yes	64	61.5
No	40	38.5
The habit of Taking Vitamins		
Yes	25	24.0
No	79	76.0
Physical Activity		
Yes	39	37.5
No	65	62.5

Table 2 shows that the condition of the respondents' houses is not very good and is classified as unhealthy. This condition is obtained from the results of the Healthy Home Environmental Health Inspection, which is often carried out by the Health Center, as shown in Table 2. There are many respondents' houses without sufficient ventilation and windows. Opening the windows every day has also not been carried out properly. Furthermore, respondents tend to burn their garbage, which causes air pollution in their environment. A categorical analysis is carried out to determine the relationship between environmental factors, behavior, people, and sociodemographic factors with tuberculosis.

Table 3: Bivariate Analysis Results.

The bivariate analysis results in Table 3 show that several variables, such as sex, Body Mass Index (BMI), alcohol consumption, and the habit of opening windows, had a significant relationship with tuberculosis. The alcohol variable had one cell with a value of zero; thus, the odds ratio could not be determined. Subsequently, multivariate analysis was conducted to determine the dominant factors of tuberculosis, and the results are presented in Table 4

Table 4: Binary Logistic Regression Analysis Results.

Variable	β	Sig	Exp (β)	95% CI for Exp (β)	
				Lower	Upper
Gender (Male)	2.088	0.000	8.065	2.258	25.731
BMI (Normal)	1.378	0.022	3.965	1.226	12.839
Habit of Opening Windows (No)	1.243	0.010	3.466	1.345	8.935
Constant	-2.445	0.000	0.087		

The results in Table 4 show that sex was the most influential variable in tuberculosis. Males have an eight times greater chance of contracting tuberculosis than females after controlling for BMI and the habit of opening house windows. The cases in this study were active tuberculosis cases that already had symptoms and could be transmitted, and the results are shown in Table 5.

Table 5: Transmission of Tuberculosis Cases in the House.

Variable	f (n=52)	%
Transmission at the house		
Yes	17	32.7
No	35	67.3

active TB transmitted tuberculosis to their family members. This percentage indicated a high transmission rate, which immediately required a

Variable	Category	Cases (n=52)		Control (n=52)		p-value	OR (95%CI)
		f	%	f	%		
Age	≥ 42 years	28	53.8	25	48.1	0.695	1.260 (0.583 – 2.722)
	< 42 years	24	46.2	27	51.9		
Gender	Male	25	48.1	5	9.6	0.0001*	8.704 (2.984-25.387)
	Female	27	51.9	47	90.4		
Job	Unemployed	30	57.7	35	67.3	0.418	0.662 (0.298-1.473)
	Employed	22	42.3	17	32.7		
Income	Low	30	57.7	24	46.2	0.326	1.591 (0.733-3.452)
	Middle	22	42.3	28	53.8		
Drinking Alcohol	Yes	7	13.5	0	0.0	0.013*	#
	No	45	86.5	52	100		
BMI	Normal	47	90.4	31	59.6	0.0001*	6.368 (2.172-18.668)
	Obese (≥27)	5	9.6	21	40.4		
Diabetes	Yes	7	13.5	5	9.6	0.759	1.462 (0.432-4.944)
	No	45	86.5	47	90.4		
Knowledge	Poor	10	19.2	11	21.2	1.000	0.887 (0.340-2.314)
	Good	42	80.8	41	78.8		
Air Temperature	Abnormal		86.5	46	88.5	1.000	0.839 (0.261-2.689)
	Normal	7	13.5	6	11.5		
Air Humidity	Abnormal	16	30.8	14	26.9	0.829	1.206 0.516-2.822)
	Normal	36	69.2	38	73.1		
Lighting	Insufficient	24	46.2	25	48.1	1.000	0.926 (0.492-2.000)
	Sufficient	28	53.8	27	51.9		
Housing Status	Poor	50	96.2	50	96.2	1.000	1.000 (0.136-7.380)
	Good	2	3.8	2	3.8		
House Density	≤ 8 m²/people	5	9.6	4	7.7	1.000	1.277 (0.323-5.049)
	> 8 m²/people	47	90.4	48	92.3		
Wall	Non-permanent	9	17.3	4	7.7	0.236	2.512 (0.721-8.746)
	Permanent	43	82.7	48	92.3		
Floor	Ground	3	5.8	1	1.9	0.618	3.122 (0.314-31.047)
	Plastered	49	94.2	51	98.1		
Air vent	Inadequate	27	51.9	23	44.2	0.556	1.362 (0.629-2.946)
	Adequate	25	48.1	29	55.8		
Living Room Window	No	6	11.5	7	13.5	1.000	0.839 (0.261-2.689)
	Yes	46	88.5	45	86.5		
Bedroom Window	No	18	34.6	19	36.5	1.000	0.920 (0.412-2.053)
	Yes	34	65.4	33	63.5		
Chimney/Exhaust Hood/Kitchen Vent	No	14	26.9	15	28.8	1.000	0.909 (0.385-2.142)
	Yes	38	73.1	37	71.2		
Habit of Opening Windows	Yes	34	65.4	20	38.5	0.011*	3.022 (1.359-6.720)
	No	18	34.6	32	61.5		
Habit of Burning Garbage	Yes	32	61.5	32	61.5	1.000	1.000 (0.454-2.204)
	No	22	38.5	22	38.5		
The habit of Taking Vitamins	No	38	73.1	41	78.8	0.646	0.728 (0.295-1.799)
	Yes	14	26.9	11	21.2		
Habit of Cleaning the Terrace	Rarely	16	30.8	15	28.8	1.000	1.096 (0.473-2.541)
	Often	36	69.2	37	71.2		
Physical Activity	No	21	40.4	18	34.6	0.685	1.280 (0.577-2.836)
	Yes	31	59.6	34	65.4		
BCG Vaccination	No	29	55.8	27	51.9	0.844	1.167 (0.540-2.526)
	Yes	23	44.2	25	48.1		
Cigarette Exposure	Exposed	46	88.5	47	90.4	1.000	0.816 (0.233-2.860)
	Not Exposed	6	11.5	5	9.6		

significant handling strategy.

4. DISCUSSION

Active tuberculosis is more common in males, with twice as many cases as in females (World Health Organization, 2020). Similarly, this study showed that males had an eight-fold greater chance of suffering from tuberculosis than females. This phenomenon occurred because males were more exposed to several risk factors for tuberculosis, such as diabetes, smoking, alcohol consumption, and low awareness of seeking treatment (Chidambaram et al., 2021). Previous studies using mice as test materials showed that male samples showed more severe results when infected with Mtb than did female samples (Chidambaram et al., 2021).

Sex differences showed variations in the infections caused by various diseases. Sex could be attributed to variations in behavior towards exposure to pathogens and immune responses in the body that are influenced by sex chromosomes and steroid hormones (Dias et al., 2022). Generally, males are more susceptible to infectious diseases (Gay et al., 2021). The two X-chromosomes in females have more complete components, forming the immune system to fight pathogenic infections (Jacobsen & Klein, 2021). The X chromosome encodes more immune system gene regulations that are important for warding off infections than the Y chromosome in males (Jacobsen & Klein, 2021). Sex hormones such as oestrogen affect the immune system of females and protect them from pathogenic infections or the severity of the infection. Although oestrogen is anti-inflammatory, progesterone suppresses the innate immune system (Gay et al., 2021; Harding & Heaton, 2022). However, testosterone levels in males are related to high pathogen virulence, which increases the in vivo pathogenesis (Luo et al., 2024). Regardless of the genetic condition, there is a need to avoid risk factors that cause tuberculosis infection. Therefore, strengthening the screening system for close contacts and high-risk groups should be performed to reduce the rate of tuberculosis infection (World Health Organization, 2020).

Low Body Mass Index (BMI) and uncontrolled Diabetes Mellitus (DM) increase the risk and severity of tuberculosis (Kornfeld et al., 2020). Malnutrition or undernutrition also increases the risk of tuberculosis in people with a low BMI (Kornfeld et al., 2020). This is because low BMI and HbA1C are associated with a high possibility of poor outcomes or severity, such as symptoms, radiographic severity, and time to sputum conversion (Kornfeld et al., 2020). The results indicate that people with BMI <27 kg/m2 are more likely to suffer from tuberculosis than those with BMI>27 kg/m2. This result is consistent with those of previous studies, where a low BMI showed a higher tendency to develop tuberculosis (Kornfeld et al., 2020; Obels et al., 2022). For patients with active tuberculosis who have experienced weight loss, BMI can be a factor in increasing severity and is an indication of undernutrition associated with death (Bhargava & Bhargava, 2020).

Nutritional status is closely related to immunity and resistance to infection (Yang et al., 2021). Insufficient food intake causes weight loss, weakens the immune system, causes mucosal damage and pathogen invasion, and inhibits growth in children (Yang et al., 2021). Food intake is important for the prevention and treatment of infections including tuberculosis. Micronutrients, such as vitamins and zinc, are important in the immune system of the body (Téllez-Navarrete et al., 2021). Severe malnutrition in children causes systemic inflammation, although there is no obvious infection (Patterson et al., 2021). Nutritional status and infection are closely related, as malnutrition increases the risk of infection (Yang et al., 2021). Infectious conditions such as tuberculosis require good and maintained nutritional intake to avoid malnutrition, worsening the infection, and slowing the healing process (Yang et al., 2021). In patients with active tuberculosis, nutritional intake is important for reducing the severity, recovery efforts, and supporting drug treatment (Ockenga et al., 2023). Patients are advised to undergo personal nutritional assessments and management to prevent treatment failure (Ockenga et al., 2023). Therefore, nutritional intake must be maintained to suppress tuberculosis transmission.

This study showed that the habit of opening windows was related to tuberculosis cases. People who are not used to opening their windows are three times more likely to suffer from tuberculosis. Similarly, previous studies have reported that insufficient ventilation for air exchange increases the risk of developing tuberculosis (Jannah et al., 2023). Opening windows is related to ventilation as well as the exchange of outdoor and indoor air, thereby reducing pollutants that are harmful to humans (Howden-Chapman et al., 2023; Jannah et al., 2023). Poor air exchange and ventilation increase the risk of transmission of respiratory infectious diseases regardless of physical distance (Li et al., 2021).

The status or structure of a house affects the transmission of respiratory disease transmission (Wimalasena et al., 2021). In this study, the overall status of the house was not significantly correlated with tuberculosis. This relationship occurred because most respondents had unhealthy houses because of their location in a densely populated settlement and lower-middle economic status. The condition of the home environment significantly affects the respiratory health of humans who spend a lot of time indoors (Wimalasena et al., 2021).

Poor doors, windows, and ventilation conditions inhibit air exchange and increase bacterial growth, particularly with poor lighting, temperature, and humidity (Wulandari et al., 2023). Furthermore, inadequate ventilation, cold surface temperature, and high humidity are favorable conditions for mold growth (Wimalasena et al., 2021). Houses with mold are often found in low-income families (Wimalasena et al., 2021). Most of the respondents' houses in this study did not have windows in their bedrooms or

family rooms, and they lacked ventilation for air exchange (Table 1). This study reported that the density of the house did not show significant results for tuberculosis. High house density is associated with an increased risk of disease transmission, including tuberculosis (Wulandari et al., 2023).

Furthermore, houses with more than four people were three times more likely to develop tuberculosis than those with fewer people. This is because crowded spaces increase the risk of disease transmission (Jannah et al., 2023). The density conditions of the houses were appropriate according to the standards issued by the Indonesian Ministry of Health, comprising 8 m2/person (Decree of the Minister of Health Number 829 of 1999 concerning Residential Health Requirements, 1999).

As a place to live, a house poses a threat to infectious diseases when the conditions do not meet health standards. A high density of housing, poor indoor air quality, sanitation facilities, and waste disposal have contributed to the burden of disease transmission (Howden-Chapman et al., 2023). Second-hand Smoke (SHS) is also a threat to the house when there are family members who smoke, as cigarette ash pollutes the environment and is related to non-communicable diseases such as heart disease and lung cancer (Howden-Chapman et al., 2023). The safest method is to create a smoke-free environment through mitigation, to prevent the transmission of diseases in the house caused by home conditions. Efforts have been made to use environmentally friendly fuels for stoves and vehicles (electricity and LPG) with proper ventilation in the kitchen, improve indoor ventilation, and reduce exposure to cigarettes, both direct smoke and SHS (Wimalasena et al., 2021).

Poor personal hygiene and environmental sanitation contribute to tuberculosis, indicating the need to socialize people to suppress transmission (Mariana et al., 2020). Spitting sputum can increase the risk of careless transmission because Mtb can survive in the environment for several hours (Sary et al., 2021). The sputum of patients with tuberculosis who have received intensive treatment for three months is still highly contagious and requires appropriate protection (Calderwood et al., 2021). These habits should be halted to reduce the rate of tuberculosis transmission in Indonesia. Risk factors for tuberculosis include genetics, environment, housing, nutritional status, and personal hygiene behavior. Based on this study, the influencing factors included sex, BMI, and the habit of opening windows related to air circulation.

This study had limitations such as bias during data collection due to the respondent's memory factor (forgetting). The experiment was conducted retrospectively, although efforts were made to adjust the questionnaires and questions in order to facilitate recall. This study did not measure the exact rate of air exchange and tuberculosis transmission in the neighbouring environment (random testing and screening were not conducted), which could enrich the discussion. Further investigation is recommended to measure these variables, allowing the government to identify the main problems of tuberculosis transmission in the family environment.

5. CONCLUSION

In conclusion, this study showed that tuberculosis transmission includes many factors, such as genetics, housing environment, sanitation hygiene, and people's behavior. The results showed that the house was not significantly related to tuberculosis in Depok City as a buffer zone for the capital city. In contrast, sex, BMI, and the habit of opening the windows showed a substantial correlation. Furthermore, the condition of the house was still below health standards, showing the need for improvement through environmentally friendly fuels (from electricity or other energy forms). Hygiene and sanitation behaviors should also be improved, including maintaining nutritional intake, to prevent wider transmission of tuberculosis. The government should increase socialization and education regarding tuberculosis and accelerate the screening process, particularly among people with close contact and high risk. The tuberculosis problem should be addressed collectively to achieve the highest level of public health.

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REFERENCES

Behr, M. A., Edelstein, P. H., & Ramakrishnan, L. (2019). Is Mycobacterium tuberculosis infection life long? The BMJ, 367(October), 1–7. https://doi.org/10.1136/bmj.l5770

Bhargava, A., & Bhargava, M. (2020). Tuberculosis deaths are predictable and preventable: Comprehensive assessment and clinical care is the key. Journal of Clinical Tuberculosis and Other Mycobacterial Diseases, 19, 100155. https://doi.org/10.1016/j.jctube.2020.100155

Calderwood, C. J., Wilson, J. P., Fielding, K. L., Harris, R. C., Karat, A. S., Mansukhani, R., Falconer, J., Bergstrom, M., Johnson, S. M., McCreesh, N., Monk, E. J. M., Odayar, J., Scott, P. J., Stokes, S. A., Theodorou, H., & Moore, D. A. J. (2021). Dynamics of sputum conversion during effective tuberculosis treatment: A systematic review and meta-analysis. PLoS Medicine, 18(4 April 2021), 1–25. https://doi.org/10.1371/journal.pmed.1003566

Chidambaram, V., Tun, N. L., Majella, M. G., Ruelas Castillo, J., Ayeh, S. K., Kumar, A., Neupane, P., Sivakumar, R. K., Win, E. P., Abbey, E. J., Wang, S., Zimmerman, A., Blanck, J., Gupte, A., Wang, J. Y., & Karakousis, P. C. (2021). Male sex is associated with worse microbiological and clinical outcomes following tuberculosis treatment: A retrospective cohort study, a systematic review of the literature, and meta-analysis. Clinical Infectious Diseases, 73(9), 1580–1588. https://doi.org/10.1093/cid/ciab527

Decree of the Minister of Health Number 829 of 1999 concerning Residential Health Requirements, Pub. L. No. 829 (1999).

Dias, S. P., Brouwer, M. C., & Van De Beek, D. (2022). Sex and Gender Differences in Bacterial Infections. Infection and Immunity, 90(10). https://doi.org/10.1128/iai.00283-22

Dinkes Provinsi Jawa Barat. (2023). Profil Kesehatan Jawa Barat 2023. In Dinas Kesehatan Provinsi Jawa Barat.

Duarte, R., Aguiar, A., Pinto, M., Furtado, I., Tiberi, S., Lönnroth, K., & Migliori, G. B. (2021). Different disease, same challenges: Social determinants of tuberculosis and COVID-19. Pulmonology, 27(4), 338–344. https://doi.org/10.1016/j.pulmoe.2021.02.002

Gay, L., Melenotte, C., Lakbar, I., Mezouar, S., Devaux, C., Raoult, D., Bendiane, M. K., Leone, M., & Mège, J. L. (2021). Sexual Dimorphism and Gender in Infectious Diseases. Frontiers in Immunology, 12(July), 1–16. https://doi.org/10.3389/fimmu.2021.698121

Goletti, D., Delogu, G., Matteelli, A., & Migliori, G. B. (2022). The role of IGRA in the diagnosis of tuberculosis infection, differentiating from active tuberculosis, and decision making for initiating treatment or preventive therapy of tuberculosis infection. International Journal of Infectious Diseases, 124, S12--S19. https://doi.org/10.1016/j.ijid.2022.02.047

Gong, W., & Wu, X. (2021). Differential Diagnosis of Latent Tuberculosis Infection and Active Tuberculosis: A Key to a Successful Tuberculosis Control Strategy. Frontiers in Microbiology, 12(October), 1–23. https://doi.org/10.3389/fmicb.2021.745592

Harding, A. T., & Heaton, N. S. (2022). The Impact of Estrogens and Their Receptors on Immunity and Inflammation during Infection. Cancers, 14(4), 1–16. https://doi.org/10.3390/cancers14040909

Howden-Chapman, P., Bennett, J., Edwards, R., Jacobs, D., Nathan, K., & Ormandy, D. (2023). Review of the Impact of Housing Quality on Inequalities in Health and Well-Being. Annual Review of Public Health, 44, 233–254. https://doi.org/10.1146/annurev-publhealth-071521-111836

Izudi, J., Engoru, S., & Bajunirwe, F. (2024). Malnutrition is a risk factor for tuberculosis disease among household contacts: A case-control study in Uganda. IJID Regions, 12(July), 100409. https://doi.org/10.1016/j.ijregi.2024.100409

Jacobsen, H., & Klein, S. L. (2021). Sex Differences in Immunity to Viral Infections. Frontiers in Immunology, 12(August), 26–29. https://doi.org/10.3389/fimmu.2021.720952

Jannah, R. Z., Azizah, R., Jalaludin, J. B., Sulistyorini, L., & Lestari, K. S. (2023). Meta-Analysis Study: Environmental Risk Factors of Tuberculosis (Tb). Jurnal Kesehatan Lingkungan, 15(2), 84–91. https://doi.org/10.20473/jkl.v15i2.2023.84-91

Kementerian Kesehatan Republik Indonesia. (2022). TOSS TBC.

Kementerian Kesehatan Republik Indonesia. (2023). Data Pengendalian Penyakit.

Kornfeld, H., Sahukar, S. B., Procter-Gray, E., Kumar, N. P., West, K., Kane, K., Natarajan, M., Li, W., Babu, S., & Viswanathan, V. (2020). Impact of Diabetes and Low Body Mass Index on Tuberculosis Treatment

Outcomes. Clinical Infectious Diseases, 71(9), E392--E398. https://doi.org/10.1093/cid/ciaa054

Kudryavtsev, I., Starshinova, A., Kulpina, A., & Ling, H. (2019). The role of the immune response in developing tuberculosis infection : from latent infection to active tuberculosis. 2.

Li, Y., Cheng, P., & Jia, W. (2021). Poor ventilation worsens short-range airborne transmission of respiratory infection. Wiley online library, 32(1), 1–10. https://doi.org/https://doi.org/10.1111/ina.12946

Luo, Z., Xi, H., Huang, W., Liu, M. F., Yuan, L., Chen, Q., Xiao, Y., Zhu, Q., Zhao, R., & Sheng, Y. Y. (2024). The role of male hormones in bacterial infections: enhancing Staphylococcus aureus virulence through testosterone-induced Agr activation. Archives of Microbiology, 206(10). https://doi.org/10.1007/s00203-024-04130-0

Mariana, M., Novita, E., Pariyana, P., Haryani, A. M., & Trikurnia, R. (2020). Analysis Of Personal Hygiene, Household Sanitation Status Of Lungs Tuberculosis Nutrition. Majalah Kedokteran Sriwijaya, 52(1), 275–282.

Migliori, G. B., Ong, C. W. M., Petrone, L., D'ambrosio, L., Centis, R., & Goletti, D. (2021). The definition of tuberculosis infection based on the spectrum of tuberculosis disease. Breathe, 17(3), 1–12. https://doi.org/10.1183/20734735.0079-2021

Obels, I., Ninsiima, S., Critchley, J. A., & Huangfu, P. (2022). Tuberculosis risk among people with diabetes mellitus in Sub-Saharan Africa: A systematic review. Tropical Medicine and International Health, 27(4), 369–386. https://doi.org/10.1111/tmi.13733

Ockenga, J., Fuhse, K., Chatterjee, S., Malykh, R., Rippin, H., Pirlich, M., Yedilbayev, A., Wickramasinghe, K., & Barazzoni, R. (2023). Tuberculosis and malnutrition: The European perspective. Clinical Nutrition, 42(4), 486–492. https://doi.org/10.1016/j.clnu.2023.01.016

Patterson, G. T., Manthi, D., Osuna, F., Muia, A., Olack, B., Mbuchi, M., Saldarriaga, O. A., Ouma, L., Inziani, M., Yu, X., Otieno, P., & Melby, P. C. (2021). Environmental, metabolic, and inflammatory factors converge in the pathogenesis of moderate acute malnutrition in children: An observational cohort study. American Journal of Tropical Medicine and Hygiene, 104(5), 1877–1888. https://doi.org/10.4269/ajtmh.20-0963

Sary, A. N., Vevilina, E., & Fitri, W. E. (2021). Environmental Risk Factors and Behavior Analysis of Pulmonary Tuberculosis in South Pesisir Regency. 2nd Syedza Saintika International Conference on Nursing, Midwifery, Medical Laboratory Technology, Public Health, and Health Information Management (SeSICNiMPH 2021), 39(SeSICNiMPH), 291–294.

Sutisna, M. (2024). Perencanaan tata ruang perkotaan di wilayah Kota Tangerang dalam merespon pengembangan pembangunan di wilayah Provinsi DKI Jakarta dalam perspektif transit oriented development. Sustainable Transportation and Urban Mobility STUM, 1(1), 14–20.

Téllez-Navarrete, N. A., Ramón-Luing, L. A., Munõz-Torric, M., Osuna-Padilla, I. A., & Chávez-Galán, L. (2021). Malnutrition and tuberculosis: The gap between basic research and clinical trials. Journal of Infection in Developing Countries, 15(3), 310–319. https://doi.org/10.3855/jidc.12821

Wimalasena, N. N., Chang-Richards, A., Wang, K. I. K., & Dirks, K. N. (2021). Housing risk factors associated with respiratory disease: A systematic review. International Journal of Environmental Research and Public Health, 18(6), 1–26. https://doi.org/10.3390/ijerph18062815

World Health Organization. (2020). Global Tuberculosis Report 2020.

World Health Organization. (2022). Tuberculosis. In Tuberculosis Fact Sheets.

World Health Organization. (2023). Global Tuberculosis Report 2023. In January: Vol. t/malaria/ (Nomor March).

Wulandari, R., Budiyono, B., Sulistiyani, S., & Wahyuningsih, E. (2023). the Relationship Between Ventilation and Physical Quality of Houses With Pulmonary Tuberculosis Cases in the Working Area of Sragen Primary Healthcare Center, Sragen Regency. Jurnal Kesehatan Lingkungan, 15(1), 76–83. https://doi.org/10.20473/jkl.v15i1.2023.76-83

Yang, F., Yang, Y., Zeng, L., Chen, Y., & Zeng, G. (2021). Nutrition Metabolism and Infections. Infectious Microbes and Diseases, 3(3), 134–141. https://doi.org/10.1097/IM9.0000000000000061