

# Gema Lingkungan Kesehatan

Vol. 22, No. 2, 2024, pp 78-84

e-ISSN 2407-8948 p-ISSN 16933761

Doi: <https://doi.org/10.36568/gelinkes.v22i2.128>

Journal Homepage: <https://gelinkes.poltekkesdepkes-sby.ac.id/>

## Analysis of Environmental Sanitation Factors and Personal Hygiene on the Incidence of Tuberculosis in Jember Regency

Firjoun Ali Muhammad<sup>1\*</sup>, Al Munawir<sup>2</sup>, Isa Ma'rufi<sup>1</sup>

<sup>1</sup> Master of Public Health Study Program, University of Jember, Jember, Indonesia

<sup>2</sup> Pathology Laboratory, Faculty of Medicine, University of Jember, Jember, Indonesia

\*Correspondence: [firjonali@gmail.com](mailto:firjonali@gmail.com)

### ABSTRACT

Many risk factors can trigger tuberculosis, including environmental sanitation and personal hygiene. Personal hygiene is crucial because it involves actions taken by an individual to maintain their physical and psychological cleanliness and health. Meanwhile, environmental sanitation factors include the availability of clean water (whether clean water meets physical water quality standards is available) and solid waste management (mechanisms for providing trash bins and waste disposal). This study aims to analyze the relationship between environmental sanitation and personal hygiene on the incidence of tuberculosis in Jember Regency. This research method uses observational analytics with a case-control study design. The study sample consisted of 52 individuals in the control group and 52 in the case group. The sampling technique used was Cluster Random Sampling. The statistical tests used were bivariate (chi-square test) and multivariate (multiple linear regression). The findings revealed a significant relationship between environmental sanitation ( $p=0.004$ ) and no significant relationship with personal hygiene ( $p=0.282$ ). The results concluded that among all the independent variables suspected to influence the incidence of tuberculosis, environmental sanitation was the most influential factor.

**Keywords:** Environmental Sanitation, Personal Hygiene, Tuberculosis

### INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis*, which can attack various organs, primarily the lungs (Kemenkes RI, 2016). *Mycobacterium tuberculosis* is an Acid-Fast Bacillus (AFB) that is rod-shaped and lives in clusters. This bacterium can survive in humid environments at temperatures ranging from  $-25^{\circ}\text{C}$  to  $40^{\circ}\text{C}$  and die within minutes when exposed to direct sunlight. TB symptoms are usually marked by prolonged coughing for several weeks and accompanied by fever. Individuals with TB often experience a weakened immune system, reduced appetite, significant weight loss, fatigue, and persistent cough. The spread of TB is related to home sanitation conditions, behaviors that do not reflect health, and individual hygiene or personal hygiene (Permenkes, 2016).

According to WHO, (2023) the percentage of TB cases worldwide is as follows: India (27%), Indonesia (10%), China (7.1%), the Philippines (7.0%), Pakistan (5.7%), Nigeria (4.5%), Bangladesh (3.6%), and the Democratic Republic of the Congo (3.0%). The report indicates that TB cases increased from 10 million in 2020

to 10.3 million in 2021 and 10.6 million in 2022 (WHO, 2022). Tuberculosis remains among the top 10 deadliest diseases globally caused by a single infection. In 2019, 10 million people suffered from tuberculosis, and 1.4 million of them died (WHO, 2021).

In Southeast Asia, according to Prof. Tjandra Yoga Aditama of WHO, Indonesia saw 969,000 new TB cases and 144,000 deaths in 2022. These numbers are considered significant and pose a serious problem. Data on new case detection in 2023 show a 74% increase from the previous year. At least 86% of drug-sensitive TB and drug-resistant TB cases successfully received treatment (Kementerian Kesehatan RI, 2023). East Java Province ranked second in Indonesia for TB case detection in 2017. From 2015 to 2017, TB incidence rates were 112 in 2015, 127 in 2016, and increased to 139 in 2017. According to doctor diagnoses in East Java Province, TB prevalence was 0.1% in 2013, rising to 0.4% in 2018, nearly matching the TB prevalence in Indonesia (Riskesdas, 2018).

In Jember Regency, the number of TB patients in 2021 reached 1,732 positive cases; in 2022, there was a decrease to 898 positive cases. The areas with the highest

numbers were Kalisat District, with 44 cases, Ajung District, with 37 cases, and Mayang District, with 34 cases (Dinas Jember, 2022).

Factors contributing to pulmonary TB include low immunity due to inadequate nutrition and poor living environment conditions such as ventilation, humidity levels, lighting, residential density, and non-compliant wastewater disposal systems. Clean living behavior and individual hygiene also influence recovery, preventing infection and the spread of *Mycobacterium tuberculosis* (Silalahi and Pratiwi, 2021).

The physical condition of a house plays a crucial role in transmitting pulmonary tuberculosis bacteria to healthy individuals. The disease spreads through the saliva or sputum of infected individuals containing *Mycobacterium tuberculosis*. When the patient coughs or sneezes, saliva droplets disperse into the air and remain viable for several hours, especially in humid and poorly lit environments. Pulmonary tuberculosis bacteria spread more rapidly to healthy individuals in dark, humid, and poorly lit homes (Sahadewa & Luh, 2019).

Environmental sanitation encompasses more than just basic sanitation, such as latrines, provision of clean water, waste disposal, and drainage systems. It also includes ventilation, air humidity, and housing density. Maintaining good sanitation conditions, especially at home, can help prevent the spread of diseases (Butarbutar, 2018).

Personal hygiene is essential for individuals to maintain their health, enhance and improve their health status, and prevent disease. Personal hygiene should be a daily practice, but it is sometimes considered less important by some people. This is due to a lack of awareness about the importance of personal hygiene. Poor personal hygiene practices can facilitate the spread of infectious diseases such as pulmonary tuberculosis, upper respiratory tract infections, diarrhea, and others. Conversely, good personal hygiene can improve the health needed for individual comfort (Caesar, 2019).

Personal hygiene includes skin, hand, foot, nail, oral and dental hygiene, hair and ear, and eye and nose. The benefits of practicing personal hygiene include improving health status, maintaining personal cleanliness, correcting poor hygiene practices, preventing disease, and boosting an individual's self-confidence (Kurniatiningsih et al., 2022). Statistically, variables related to personal hygiene (habits like spitting, coughing, and smoking) and environmental sanitation significantly influence the incidence of pulmonary tuberculosis (Masdalena, 2018)

A study by Kurniatiningsih et al., (2022) on basic home sanitation and personal hygiene among TB patients in the Driyorejo Health Center Work Area, Gresik Regency, found that 27 homes (64%) did not meet sanitation standards, and 28 individuals (67%) had adequate personal hygiene. Another study by Nadya (2021) on environmental sanitation, personal hygiene, and STH co-infection in TB patients found that more households had negative categories for latrine ownership (25), used well/PDAM water sources (26), and had ceramic floors

(24). Regarding personal hygiene, 23 respondents (72%) had proper handwashing habits, and 23 (72%) regularly cut their nails, indicating good nail hygiene.

Mariana et al., (2020) found that 92 homes (60.93%) had unhealthy sanitation conditions, and 73 individuals (48.34%) had poor personal hygiene.

Previous studies have shown that the analysis of environmental sanitation and personal hygiene factors among TB patients indicates that patients generally practice good personal hygiene, such as washing hands with soap, covering their mouths when sneezing/coughing, opening bedroom windows in the morning, and sleeping separately from family members when sick. However, TB patients' knowledge about tuberculosis, personal hygiene, and the relationship between personal hygiene and tuberculosis is still lacking. TB patients generally agree on the importance of good personal hygiene but may not always practice it.

Therefore, this study aims to investigate the relationship between environmental sanitation and personal hygiene and the incidence of tuberculosis in Jember Regency. The high poverty rate in Jember Regency correlates with poor sanitation and personal hygiene practices among TB patients, and there is a lack of research on these variables in this area. This study employs a case-control design, which differs from previous studies and mostly uses literature reviews.

This study aims to determine the relationship between environmental sanitation and personal hygiene and the incidence of tuberculosis in Jember Regency.

## METHODS

This observational analytic study uses a case-control study design to analyze the relationship between exposure and disease by comparing case and control groups based on their exposure status. The sample size for this study includes 52 respondents in the case group and 52 in the control group. The research locations are the work areas of Kalisat, Mayang, and Ajung health centers in Jember Regency. The sampling technique used by the researcher is Cluster Random Sampling. The study locations include Ajung, Mayang, and Kalisat districts in Jember Regency. The study was conducted in two hamlets in the Ajung district: Ajung and Pancakarya. In Mayang district, the study took place in Seputih and Mayang hamlets. In Kalisat district, the research was conducted in Kalisat and Ajung hamlets. This study was conducted from September to November 2023.

The inclusion criteria for the case group are respondents who are recorded or have medical records diagnosing them as positive for tuberculosis, patients undergoing tuberculosis treatment, residing in the selected districts, and willing to participate as respondents. The exclusion criteria for the case group include respondents who tested negative for tuberculosis via sputum examination (using TCM tests) at the three health centers in 2023, patients who could not complete the questionnaire, and uncooperative patients. The inclusion criteria for the control group are respondents

without medical records of tuberculosis and those living in areas close to tuberculosis patients. The exclusion criteria include respondents who could not complete the questionnaire and uncooperative respondents.

This research collected data using an environmental sanitation questionnaire and a personal hygiene

questionnaire. The data analysis involved bivariate analysis using the chi-square test and multivariate analysis using multiple linear regression.

## RESULTS AND DISCUSSION

**Table 1**  
Respondents Characteristics

Characteristics	Category		Tuberculosis	Non-Tuberculosis	Total
Gender	Male	n	28	30	58
		%	48.3%	51.7%	100%
	Female	n	24	22	46
		%	52.1%	47.8%	100%
	Total		52	52	104
				100%	100%
Age	<20 Years	n	3	4	7
		%	42.8%	57.2%	100%
	20-30 Years	n	16	19	35
		%	45.7%	54.3%	100%
	>30 Years	n	33	29	62
		%	53.2%	46.8%	100%
Total		52	52	104	
			100%	100%	100%
Education	Primary/Junior High School	n	5	8	13
		%	38.5%	61.5%	100%
	Senior High School	n	43	42	85
		%	50.5%	49.5%	100%
	Diploma/University	n	4	2	6
		%	66.6%	33.4%	100%
Total		52	52	104	
			100%	100%	100%
Occupation	Unemployed	n	23	31	54
		%	42.5%	57.5%	100%
	Entrepreneur	n	27	19	46
		%	58.6%	41.4%	100%
	Farmer	n	2	2	4
		%	50.0%	50.0%	100%
Total		52	52	104	
			100%	100%	100%

Based on the data presented in Table 1, the characteristics of respondents with and without tuberculosis are analyzed. In terms of gender, the majority of respondents are male, with 48.3% (28 individuals) having tuberculosis and 51.7% (30 individuals) not having tuberculosis. Regarding age distribution, most respondents are over 30 years old, with 53.2% (33 individuals) having tuberculosis and 46.8% (29 individuals) not having tuberculosis. Concerning education, almost all respondents have completed senior high school or an equivalent level, with 50.5% (43 individuals) having tuberculosis and 49.5% (42 individuals) not having tuberculosis. For occupation, most respondents are entrepreneurs, with 58.6% (27 individuals) having tuberculosis and 57.5% (31 individuals) not having tuberculosis.

Based on the data presented in Table 2, the relationship between environmental sanitation and tuberculosis incidence shows that the majority of respondents with tuberculosis had inadequate environmental sanitation (51.9%, 27 respondents), and almost half of the respondents without tuberculosis also had inadequate environmental sanitation (63.5%, 33 respondents). The Chi-Square statistical test resulted in  $p=0.234$  ( $\rho = 0.234$ ),  $p=0.234$ , indicating that  $p>0.05$  ( $\rho > 0.05$ ), which means there is no significant relationship between environmental sanitation and tuberculosis incidence in Jember Regency.

**Table 2**  
Frequency Distribution of Environmental Sanitation and Personal Hygiene

Variable	Category	Tuberculosis	Non-Tuberculosis	Total	
Environmental Sanitation	Inadequate	n	27	33	
		%	51.9%	63.5%	
	Adequate	n	25	19	
		%	48.1%	36.5%	
	Total		52	52	104
			100.0%	100.0%	100.0%
Variable	Category	Tuberculosis	Non-Tuberculosis	Total	
Personal Hygiene	Poor	n	32	25	
		%	61.5%	48.1%	
	Good	n	20	27	
		%	38.5%	51.9%	
	Total		52	52	104
			100.0%	100.0%	100.0%
Chi-Square	Environmental Sanitation P=0,234 Personal Hygiene P=0,168				

The relationship between personal hygiene and tuberculosis incidence indicates that a majority of respondents with tuberculosis had poor personal hygiene (61.5%, 32 respondents), and almost half of the respondents without tuberculosis had good personal hygiene (51.9%, 27 respondents). The Chi-Square statistical test resulted in  $p=0.168$ , indicating that  $p > 0.05$ , which means there is no significant relationship between personal hygiene and tuberculosis incidence in Jember Regency. However, there appears to be a strong correlation between environmental sanitation and pulmonary tuberculosis patients.

**Table 3**  
Multivariate Analysis

	Exp(B)	Sig
Environmental Sanitation	0.280	0.004
Personal Hygiene	1.613	0.282

Based on the data in Table 3, the variable with the dominant influence on tuberculosis incidence is identified by a significance value (Sig < 0.05) and the largest  $\beta$  value. According to Table 3, the environmental sanitation variable has an  $\alpha$  value of 0.004 (< 0.05), but the  $p$  value is the highest at 1.613, suggesting that personal hygiene is the most influential factor.

The analysis concludes that among all the independent variables suspected of influencing tuberculosis incidence, one variable (environmental sanitation) has the most significant impact on tuberculosis incidence, with a p-value of 0.004 (< 0.05). The OR value is 0.280, indicating a significant relationship between environmental sanitation and tuberculosis incidence in Jember Regency.

## DISCUSSION

The results of this study indicate that environmental sanitation is closely related to the incidence of tuberculosis. Most of the respondents with tuberculosis had inadequate environmental sanitation (27 respondents, 45.0%), while nearly half of the respondents without tuberculosis also had inadequate environmental sanitation (33 respondents, 55.5%).

Good housing conditions are important for creating a healthy society. A house is considered healthy if it meets four basic requirements: fulfilling physiological needs such as adequate lighting, ventilation, sufficient living space, and protection from disruptive noise; fulfilling psychological needs such as adequate privacy and good communication among household members; meeting requirements for preventing infectious diseases, including the provision of clean water, proper disposal of human waste and household wastewater, freedom from disease vectors and rodents, non-overcrowded living conditions, sufficient sunlight, protection of food and drink from contamination, and adequate lighting and ventilation; and fulfilling requirements for preventing accidents both inside and outside the house, according to Indonesian Ministry of Health regulation No. 829, 1999. TB can spread in crowded houses with insufficient sunlight and poor or damp ventilation because Mycobacterium tuberculosis bacteria can survive and multiply in these conditions. However, with adequate air circulation, sunlight, and good ventilation, the bacteria will not survive long, about 1-2 hours (Butarbutar, 2018).

The study shows that most respondents always had an adequate supply of clean water, primarily sourced from their wells, with the least being from neighbors' wells. Most water is used from wells and the local water company (PAM) for drinking purposes. Additionally, some respondents used bottled or branded refill water, with a minority using neighbors' wells. Most respondents boiled

their water before drinking it, while those who did not boil it used bottled or refilled water (Paendong et al., 2021). Sustainable management of wastewater, clean water, and waste disposal is crucial. Waste management aligns with the Tomohon Mayor Regulation No. 30 of 2019 concerning policies and strategies for managing household and similar waste at the national level, aiming for integrated and sustainable waste management (Paendong et al., 2021).

Every living being needs water as a source of life to carry out their daily activities. Adequate water supply and provision of clean water can maintain health and prevent health problems. Conversely, inadequate clean water facilities can impact health and lead to diseases, one of which is Tuberculosis (Adwiyah, 2021).

According to the World Health Organization (WHO), waste results from discarded items that are no longer used, wanted, or needed, originating from human activities (Dobiki, 2018). Sayogi (2015), in his study on the relationship between environmental sanitation and the spread of pulmonary tuberculosis at the Andong Community Health Center in Boyolali Regency, found a significant relationship between environmental sanitation and the provision of clean water. Efforts to control physical environmental factors that may harm human physical development, health, and survival include providing clean water at home.

The living environment influences a person's health status. Dirty and crowded environments and poor solid waste management tend to arise in densely populated areas and can accelerate the transmission and proliferation of diseases. Field surveys revealed that a significant amount of waste is disposed of on roadsides, left open and scattered (Sayogi, 2015).

This study found a relationship between clean water facilities and pulmonary tuberculosis (TB) incidence in Jember Regency. A lack of clean water can cause several dangerous diseases, as water is used for various daily needs. The lack of clean water and unmet health requirements can negatively impact life, especially health. If the clean water facilities are shared with others, it can lead to quicker disease transmission. Diseases related to the lack of clean water are considered major health problems worldwide. Observations and interviews revealed that 34 houses (41.5%) had inadequate clean water facilities, such as cloudy or smelly well water, and shared clean water facilities with neighbors. This situation facilitates disease transmission, as shared facilities with TB patients can lead to the spread of the disease to others. Some respondents stated they could not build their wells due to cost issues, living in rented houses, and inadequate land for a healthy family well.

This study aligns with Armiatin (2023), who found a relationship between clean water facilities and the incidence of pulmonary tuberculosis (TB) in the working area of the Kuala Community Health Center in Bireuen Regency in 2021. This study is also consistent with Adnani (2019), who stated that there is a relationship between

clean water facilities and the incidence of pulmonary tuberculosis (TB).

Personal hygiene is categorized into two groups, poor and good, and includes five sub-variables: hand and nail hygiene, clothing hygiene, towel hygiene, bed hygiene, and smoking habits. Personal hygiene is necessary for maintaining self-health, improving health standards, and preventing diseases. Although it should be a daily practice, some people still consider it less important due to a lack of awareness about its significance. Poor personal hygiene practices can spread contagious diseases, such as pulmonary tuberculosis, upper respiratory infections, diarrhea, and others. Conversely, good personal hygiene can enhance health and comfort (Mustikawati, 2017).

Failing to maintain hand cleanliness can cause diseases. Keeping hands and nails clean is a habit that must be maintained since hands are used daily for eating, preparing food, and working. Hand and nail hygiene is crucial to prevent diseases (Rabiatul Adwiyah, 2021).

Preventive measures significantly impact TB transmission within families. Measures such as washing hands with soap, not smoking, covering the mouth when sneezing or coughing, spitting in containers with disinfectants, opening bedroom windows every morning, sleeping separately from family members when ill, maintaining environmental sanitation, and consuming clean water are vital. Preventive actions are crucial factors in influencing TB transmission within families.

The analysis concluded that among all the independent variables suspected to influence the incidence of tuberculosis, one variable (environmental sanitation) was the most influential, with a p-value of  $0.004 < 0.05$ . The obtained OR value of 0.280 indicates a relationship between environmental sanitation and the incidence of tuberculosis in Jember Regency.

Environmental sanitation is a significant factor affecting the health status of an environment, encompassing housing, waste disposal, and clean water provision. According to WHO, a house is a physical structure or building for shelter where the environment supports physical and mental health and social well-being for families and individuals. Therefore, a healthy house is a place for shelter and rest and a facility for fostering a healthy family life physically, mentally, and socially, allowing all family members to work productively (Indonesian Law No. 4 of 1992). Besides being a physical environment for human residence, a house can also become a disease source if healthy home criteria are not met (Indonesian Law No. 4 of 1992). Poor environmental sanitation in homes affects the household's health behavior and public health (Magfirah, 2022).

Disease prevention involves directing activities to protect individuals from potential health threats. The pulmonary tuberculosis prevention program is implemented in stages, starting with primary prevention, then secondary and tertiary prevention (Magfirah, 2022).

## CONCLUSION

The research concluded that environmental sanitation factors have no relationship with the incidence of tuberculosis in Jember Regency. Similarly, personal hygiene factors have no relationship with the incidence of tuberculosis in Jember Regency. This research will be reported to the local health centers (Puskesmas) and relevant agencies for follow-up activities regarding the socialization of environmental sanitation and personal hygiene to ensure the success of preventing tuberculosis transmission within households.

## SUGGESTIONS

Further research on housing environmental sanitation is needed, including biological and chemical sanitation checks. Patients should also better understand healthy homes and maintain their hygiene to ensure cleanliness. Future research on environmental sanitation should emphasize or include aspects of latrines and housing. For personal hygiene, future studies should add points about coughing and sneezing among TB respondents.

## REFERENCES

- Adnani, H. dan A. M. (2019). Hubungan Kondisi Rumah dengan Penyakit TBC Paru di Wilayah Kerja Puskesmas Karangmojo II Kabupaten Gunungkidul Yogyakarta. *Jurnal Kesehatan S urya Medika*. [[Crossref](#)], [[Publisher](#)]
- Afdalul Magfirah, N. H. (2022). Hubungan Perilaku Hidup Bersih Dan Sehat dengan Pencegahan TB Paru di Wilayah Kerja UPTD Puskesmas Lampahan Kecamatan Timang Gajah Kabupaten Bener Meriah. *Jurnal Kesehatan Saelmakers PERDANA*, 5(2), 267–272. [[Crossref](#)], [[Publisher](#)]
- Armiatin. (2023). Hubungan Kondisi Fisik Rumah Dengan Kejadian Tuberkulosis Paru (Tb Paru) Di Wilayah Kerja Puskesmas Kuala Kecamatan Kuala Kabupaten Bireuen Tahun 2021. *Jurnal Cakrawala Ilmiah*, 2(7), 3037–3042. [[Crossref](#)], [[Publisher](#)]
- Butarbutar, M. H. (2018). Hubungan Perilaku Dan Sanitasi Lingkungan Dengan Pasien Tb Paru. *Journal of Borneo Holistic Health*, 1(1), 51–61. [[Publisher](#)]
- Caesar, D. L., & Hakim, A. R. (2019). Perilaku Personal Hygiene Penderita Penyakit Tuberkulosis Di Wilayah Kerja Puskesmas Gondosari. *Jurnal Kesehatan Masyarakat*. [[Crossref](#)], [[Publisher](#)]
- Dinas Jember, K. K. (2022). *Profil Kesehatan Kabupaten Jember 2022*.
- Dobiki, J. (2018). *Analisis Ketersediaan Prasarana Persampahan Di Pulau Kumo Dan Pulau Kakara Di Kabupaten Halmahera Utara*. 5(2), 220–228. [[Crossref](#)], [[Publisher](#)]
- Kemenkes RI. (2016). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 67 Tahun 2016 tentang Penanggulangan Tuberkulosis*.
- Kementerian Kesehatan RI. (2023). *Deteksi TBC Capai Rekor Tertinggi di Tahun 2022*.
- 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. [[Crossref](#)], [[Publisher](#)]
- Masdalena, Wirsal Hasan, H. (2018). Pengaruh Hygiene Dan Sanitasi Lingkungan Terhadap Penyakit Tuberculosis Paru Pada Warga Binaan Pemasyarakatan Di Blok D Rumah Tananan Negara Kelas 1 Medan. *PRIMER (Prima Medical Journal)*, 1(1), 12–24. [[Publisher](#)]
- Menteri Kesehatan. (2016). *Peraturan Menteri Kesehatan Nomor 67 Tahun 2016 Tentang Penganggulangan Tuberkulosis*.
- Mustikawati, I. S. (2017). Determinan Perilaku Personal Hygiene Pada Orang Lanjut Usia ( Lansia ) di Panti Wredha Wisma Mulia , Jakarta Barat. *Forum Ilmiah*, 14(3), 236–249. [[Publisher](#)]
- Nadya Eka Fitri, Diana Chusna Mufida, Bagus Hermansyah, Y. A. (2021). Environmental Sanitation, Personal Hygiene, STH Co-infection in TB Patients. *Jurnal Kesehatan Masyarakat*, 16(3), 402–410. [[Crossref](#)], [[Publisher](#)]
- Paendong, W. H. G., Maddusa, S. S., & Warouw, F. (2021). Gambaran Sanitasi Lingkungan pada Masyarakat Di Wilayah Kerja Puskesmas Kakaskasen Kecamatan Tomohon Utara Kota Tomohon. *KESMAS*, 10(8), 84–93. [[Publisher](#)]
- Rabiatul Adwiyah. (2021). *Hubungan Personal Hygiene Dan Sanitasi Lingkungan Dengan Keluhan Penyakit Kulit Di Desa Rambung Merah Kecamatan Siantar Kabupaten Simalungun*. Universitas Islam Negeri Sumatera Utara Medan. [[Crossref](#)], [[Publisher](#)]
- Riskesdas. (2018). *Hasil Riset Kesehatan Dasar (Riskesdas) 2018*.
- Sahadewa, S., & Luh, N. (2019). Hubungan Tingkat Pencahayaan, Kelembaban Udara, dan Ventilasi udara dengan Faktor Risiko Kejadian TB Paru BTA Positif di Desa Jaticalang Kecamatan Krian Kabupaten Sidoarjo. *Jurnal Ilmiah Kedokteran Wijaya Kusuma*, 8(2), 118–130. [[Crossref](#)], [[Publisher](#)]
- Sayogi. (2015). *Hubungan Sanitasi Lingkungan Penderita Tb Paru Dengan Tingkat Penyebaran Penyakit Tb Paru Di Puskesmas Andong Kabupaten Boyolali*. Stikes Kusuma Husada Surakarta.
- Silalahi, N., & Pratiwi, S. S. (2021). Analisis Regresi Logistik Faktor Kejadian Tuberkulosis Paru terhadap Kesehatan Lingkungan Masa Pandemi Covid-19 di Desa Penen Kabupaten Deli Serdang. *Jurnal*

Firjoun Ali Muhammad, Al Munawir, & Isa Ma'rufi. (2024). Analysis of Environmental Sanitation Factors and Personal Hygiene on the Incidence of Tuberculosis in Jember Regency. *Gema Lingkungan Kesehatan*, 22(2), 78–84. <https://doi.org/10.36568/gelinkes.v22i2.128>

*Kesehatan Komunitas*, 7(3), 277–282. [[Crossref](#)], [[Publisher](#)]

WHO. (2023). *Global Tuberculosis Report*. [[Publisher](#)]

WHO (2021). *Global tuberculosis report 2020*.

Yeti Kurniatiningsih, Fitri Rokhmalia, & Suprijandani. (2022). Gambaran Sanitasi Dasar Rumah Dan

Personal Hygiene Pada Penderita Tb Di Wilayah Kerja Puskesmas Driyorejo Kabupaten Gresik. In *Gema Lingkungan Kesehatan* (Vol. 20, Nomor 2, hal. 132–137). [[Crossref](#)], [[Publisher](#)]