RESEARCH ARTICLE **Open Access**

Gema Lingkungan Kesehatan
Vol. 23, No. 2 (2025), pp 232-237
e-ISSN 2407-8948 p-ISSN 16933761
Doi: https://doi.org/10.36568/gelinkes.v23i2.223 *Journal Hompage: https://gelinkes.poltekkesdepkes-sby.ac.id*

Analysis of Risk Factors for Tuberculosis Incidence in the Awaru Awangpone Public Health Center Working Area, Bone: An Analytical Observational Study

Ronny*[1], Zulfikar Ali Hasan[2], Jasman[3], RH. Kristina[4], Albina Bare[5]

[1]Departemen of Environmental Health, Poltekkes Kemenkes Makassar, Makassar, Indonesia
[2]Departemen of Medical Laboratory Technology, Poltekkes Kemenkes Makassar, Makassar, Indonesia
[3]Department of Environmental, Poltekkes Kemenkes Manado, Manado, Indonesia
[4,5]Department of Environmental, Poltekkes Kemenkes Kupang, Kupang, Indonesia

*Correspondence: ronnymuntu@gmail.com

ABSTRACT

Tuberculosis (TB) remains a global health challenge, particularly in regions with inadequate environmental conditions. This study aims to analyze the association between lighting, humidity, ventilation area, and residential density with TB incidence in the working area of Awaru Awangpone Public Health Center, Bone Regency. This analytical observational study used a cross-sectional design. Data were collected through direct observation and interviews, and statistical analysis was conducted using the Chi-Square test with a 95% confidence level (α = 0.05). The relationship between risk factors and TB incidence was measured using the Odds Ratio (OR) and 95% Confidence Interval (CI). The result show inadequate lighting was significantly associated with TB incidence (p = 0.032, OR = 1.10, 95% CI: 0.55–2.22). Ventilation area also showed a significant relationship with TB incidence (p = 0.031, OR = 5.25, 95% CI: 1.17–26.02). However, no significant association was found between humidity and TB incidence (p = 0.946, OR = 0.97, 95% CI: 0.45–2.11). Residential density was significantly related to TB incidence (p = 0.038, OR = 0.44, 95% CI: 0.76–3.08). Environmental factors, particularly lighting, ventilation, and residential density, play a crucial role in TB transmission. These findings highlight the need for targeted interventions to improve living environments in high risk areas.

Keywords: Tuberculosis, Lighting, Humidity, Ventilation area, Residential density

INTRODUCTION

Health development is an effort carried out to increase awareness, willingness, and ability to live a healthy life for everyone to realize the highest public health status (Wikurendra et al., 2021). In addition, health status is influenced by several factors, namely environment, behavior, health services and heredity. The biggest factors affecting the degree of health are environmental factors and people's own behavior that can harm health (Faizal et al., 2021). Tuberculosis is an environmentally based disease. Tuberculosis is a disease that has been around for a long time and remains one of the major health issues to this day (Tunggal et al., 2024).

Tuberculosis (TB) is an infectious disease caused by the bacterium Mycobacterium tuberculosis (Azzahra Hasan et al., 2023). Mycrobacterium Tuberculosis bacteria are rod-shaped with a size of 1 - 4 microns and 0.3 - 0.6 microns thick, resistant to acid staining so it is known as Acid Resistant Bacteria (BTA) (Amelia et al., 2021). This bacterium typically enters the human body through inhalation into the lungs and can spread to other organs through the circulatory system, lymphatic system, bronchi, or direct contact. Mycobacterium tuberculosis often attacks the lungs but also attacks other body organs, such as the lymph nodes, pleura, bones, and extra lungs (Jannah et al., 2023). Transmission occurs through small droplets of sputum from TB-positive patients, and if not promptly or adequately treated, this disease can be fatal (Siregar et al., 2023). TB control and elimination relies on early detection of active TB cases, prompt anti-TB treatment, identification of people at risk of exposure and infection and prevention of secondary TB cases (Syam et al., 2021).

TB remains a serious global public health issue. According to the latest WHO report, in 2022, there were approximately 10.6 million new TB cases worldwide, with a mortality rate reaching 1.3 million deaths. Indonesia is among the top five countries with the highest TB burden, reporting more than 900,000 TB cases in 2022 (WHO, 2022). Meanwhile, according to the 2023 Global TB Report published by WHO, Indonesia ranks second after

India, with 1,060,000 cases and 134,000 deaths. Approximately 15 people die from TB every hour in Indonesia (Indonesia, 2024).

As part of efforts to reduce TB incidence, Indonesia has set a target to eliminate TB by lowering the incidence rate to 65 per 100,000 population by 2030. To support this goal, the Ministry of Health of the Republic of Indonesia developed the Tuberculosis Elimination Roadmap 2020-2030, which focuses on improving case detection, strengthening treatment systems, and implementing community-based prevention efforts (Kemenkes RI, 2020). Increasing age raises the risk of Tuberculosis (TB) (Cheng et al., 2020). This figure has increased over the year before, namely 351,936 cases in 2020. Most of tuberculosis cases were found in the age group of 45–54 years with a proportion of 17.5% of the total national case. Followed by the age group 25–34 years with a proportion of 17.1%, and the age group of 15–24 years with 16.9% (Masrizal et al., 2023).

Data from the Provincial Health Office of South Sulawesi reported that in 2022, there were an estimated 35,000 TB cases, with notification rates still below the target. Makassar City, Gowa Regency, and Bone Regency were identified as areas with the highest TB incidence rates (Aswi et al., 2021). Previous studies have shown that environmental factors such as poor lighting, inadequate ventilation, and high humidity are significantly correlated with an increased risk of TB (Febriyanti, 2020; Pralambang & Setiawan, 2021; Rohmawati et al., 2023). In 2023, Public health center Awaru Awangpone reported 232 TB cases, consisting of 23 confirmed patients and 209 suspected cases across eight villages and one sub-district. Environmental factors such as lighting, humidity, ventilation, and housing density are suspected to play a role in TB transmission in this area. Given that Awaru Awangpone includes coastal, lowland, rural, and suburban areas, this study is essential in providing a comprehensive understanding of the impact of environmental factors on TB risk in Bone Regency.

Elevated tuberculosis incidence rates serve as a compelling indicator of the substantial public health burden, necessitating focused efforts and interventions to effectively control and prevent the transmission of the disease (Jiang et al., 2024). Tuberculosis is one of the diseases that is influenced by the environment. For environmental factors as a factor in the transmission of Pulmonary Tuberculosis, including the environment and behavioral factors, environmental factors include, housing density, lighting, ventilation, temperature, and humidity (Mauliyana & Hadrikaselma, 2021). Several previous studies have demonstrated that the physical condition of the home environment has a significant impact on the incidence of tuberculosis (TB). Safitri et al. (2024) showed that houses with inadequate lighting had a 5.6 times higher risk of TB, while Aryani et al. (2022) reported that poor lighting increased the risk up to 9.57 times. Zuraidah & Ali (2020) found that substandard ventilation increased the risk of TB by 9.19 times, and Nopita et al. (2023) noted that inadequate ventilation was associated with a 5.21 times higher risk. Meanwhile, housing density was also examined by Mardianti et al. (2020), who found that high residential density increased the risk of TB by up to 18 times. Sabila et al. (2024) similarly reported 2.98 times increase in TB risk associated with overcrowded housing.

Although these studies have made valuable contributions to understanding TB risk from an environmental perspective, most were conducted in areas with homogeneous geographical characteristics, such as densely populated urban zones or highland regions. In addition, many of the previous studies relied on questionnaires or interviews for data collection, which are prone to subjective bias. This study has a distinct value as it was conducted in the working area of the Awaru Awangpone Public Health Center, Bone Regency, which encompasses coastal areas, lowlands, rural villages, and suburban zones. This geographical and socio-cultural diversity has not been widely explored in previous research. Moreover, the present study applied direct observation and objective measurements of environmental variables such as lighting, humidity, ventilation area, and housing density using standardized tools like lux meters and hygrometers, which enhance data validity and reduce the potential for information bias.

This study aims to analyze the environmental conditions of TB patients homes in the working area of Awaru Awangpone Health Center and identify key risk factors contributing to TB transmission. The variables examined include natural and artificial lighting, humidity conditions, roof ventilation, and housing density. By understanding these factors, the study is expected to provide evidence-based recommendations for improving residential environments to reduce TB transmission and support national efforts in TB elimination.

METHODS

This study is an analytical observational study with a cross-sectional design to examine the relationship between risk factors and tuberculosis (TB) incidence by collecting data at a single point in time. The research was conducted in the working area of the Aweru Awangpone Community Health Center, Bone Regency, covering one village and one sub-district.

The study population consisted of individuals officially registered as TB patients at the Awarue Awangpone Community Health Center in 2023. Inclusion Criteria: individuals diagnosed with TB based on clinical and laboratory confirmation, individuals suspected of having TB based on clinical symptoms and diagnostic tests, respondents who had lived in the study area for at least six months prior to data collection, willingness to participate in the study, as indicated by informed consent. Exclusion Criteria: individuals with incomplete or missing medical records, individuals with a history of other chronic respiratory diseases (e.g., asthma or chronic obstructive pulmonary disease) that could confound TB diagnosis, respondents who were unable or unwilling to participate in interviews and observations. A total of 147 respondents

met the inclusion criteria, consisting of 46 confirmed TB patients and 101 suspected TB cases. The sampling technique used was total sampling, in which all eligible individuals were included to ensure comprehensive data representation.

Primary data were obtained through direct interviews and structured observations at the respondents' residences to assess environmental risk factors, including lighting, humidity, ventilation area, and residential density. Secondary data were collected from medical records and TB incident reports at the Awarue Awangpone Community Health Center. Each variable in this study was operationally defined: Lighting was measured using a lux meter to assess whether the illumination met health standards. Humidity was assessed using a hygrometer, with an optimal humidity range defined based on environmental health standards. Ventilation area was determined by measuring the total ventilation surface area relative to room size. Residential density was evaluated by calculating the ratio of the number of residents to the available living space in square meters per person.

To ensure validity and reliability, instrument calibration was conducted for measuring tools (lux meter and hygrometer), and inter-observer reliability was checked to minimize subjective bias in direct observations. The questionnaire used for interviews was pre-tested on a small sample to verify clarity and consistency. Data were analyzed using the Chi-Square test with a 95% confidence level (α = 0.05). The association between risk factors and TB incidence was assessed using the Odds Ratio (OR) with a 95% Confidence Interval (CI). Interpretation of OR and CI values was explicitly stated to identify the strength and direction of each risk factors association with TB incidence.

RESULT AND DISCUSSION

Relationship between lighting, humidity, ventilation, residential density and the incidence of tuberculosis in the working area of Awaru Awangpone Health Center, Bone Regency.

Table 1.
Relationship between Lighting, Humidity, Ventilation, Residential Density and the Incidence of Tuberculosis in the Working Area of Awaru Awangpone Health Center, Bone Regency.

Respondent Characteristics	Group				*P*	OR	95%CI
	Case (n = 46)		Control (n = 101)				
	N	%	n	%			
Lighting							
a. Not Qualified	23	50	53	52.48	0.032	1,104	0.550-2.218
b. Qualified	23	50	48	47.52			
Humidity							
a. Not Qualified	13	28.26	28	27.7	0.946	0.974	0.448-2.115
b. Qualified	3	71.74	73	72.3			
Ventilation							
a. Not Qualified	19	41.3	26	25.7	0.048	0.493	0.236-1.030
b. Qualified	27	58.7	75	74.3			
Residential Density							
a. Not Qualified	23	50	61	60.4	0.038	0.443	0.756-3.078
b. Qualified	23	50	40	39.6			

In the working area of Public health center Awarue Awangpone, inadequate lighting was found in 50% of homes, both in the case and control groups. Among the case group, 51.6% of TB patients lived in homes with insufficient lighting. Based on the Chi-Square test with continuity correction, a p-value of 0.032 (< 0.05) was obtained, indicating a significant relationship between lighting and TB incidence. Homes with inadequate lighting had a 1.104 times higher risk of TB compared to homes with sufficient lighting (95% CI: 0.550 - 2.218).

This study aligns with the findings of Safitri et al. (2024), which demonstrated a significant relationship between lighting and pulmonary tuberculosis incidence, with a p-value of 0.000 and OR of 5.596, indicating that houses with poor lighting have a 5.6 times higher risk of TB compared to houses with adequate lighting. This result is also supported by Aryani et al. (2022), who found that individuals living in houses with inadequate lighting had a 9.57 times higher risk of developing pulmonary tuberculosis than those living in houses that meet health lighting standards. These findings further reinforce that inadequate lighting is a major risk factor for TB transmission and highlight the importance of implementing minimum lighting standards in public health

policies. Adequate exposure to sunlight has a natural disinfectant effect that can kill Mycobacterium tuberculosis bacteria. This is supported by the regulation of the Minister of Health No. 2 of 2023 which sets a minimum indoor lighting standard of 60 lux. Therefore, public health policies should promote increased natural lighting in homes, for example, through house designs that allow (Kemenkes RI, 2023).

The percentage of houses with inadequate humidity in the case group was 28.26%, slightly higher than in the control group (27.7%). However, the Chi-Square test with continuity correction showed a p-value of 0.946 (> 0.05), indicating no significant association between humidity and TB incidence. The risk of TB in the group with inadequate humidity was 0.974 times higher than in the control group (95% CI: 0.448 - 2.115). This study differs from the findings of Rahmawati et al. (2021), which demonstrated a significant association between humidity and tuberculosis incidence in the working area of Pekalongan Health Center, with a p-value of 0.000 (< 0.05). Similarly, Mahawati et al. (2023) found that humidity had a partial relationship with tuberculosis incidence, as TB cases were more prevalent among individuals living in houses with inadequate humidity levels.

The inconsistency in findings may be attributed to other factors, such as adequate ventilation and the residents' habit of opening windows, which help maintain humidity within a normal range. Therefore, public health interventions should focus more on improving natural ventilation and educating residents about the importance of opening windows to enhance indoor air circulation.The percentage of houses with inadequate ventilation in the case group was 41.3%, higher than in the control group (25.7%). The Chi-Square test with continuity correction showed a p-value of 0.048 (< 0.05), indicating a significant association between ventilation area and TB incidence. Houses with inadequate ventilation had a 0.493 times higher risk of developing TB compared to the control group (95% CI: 0.236 - 1.030). The study by Zuraidah & Ali (2020) found that individuals living in houses with inadequate ventilation had a 9.194 times higher risk of developing TB compared to those living in houses with adequate ventilation (p-value 0.000). This finding is consistent with our study, which found that houses with inadequate ventilation had a 0.493 times higher risk of developing TB compared to the control group (p-value 0.048).

The findings of this study indicate that inadequate ventilation, poor lighting, and high residential density are significantly associated with the incidence of tuberculosis (TB), whereas indoor humidity did not appear to have a substantial influence. Compared to previous studies, these results simultaneously confirm and challenge existing evidence, thereby offering novel insights particularly relevant to semi-rural and coastal settings. With regard to ventilation, the results are consistent with those of Nopita et al. (2023) and Zuraidah & Ali (2020), who reported a strong association between poor ventilation and increased TB risk. However, the effect size observed in this study is notably lower. This discrepancy may reflect the unique architectural and behavioral characteristics of homes in the Awaru Awangpone region, where natural ventilation is often facilitated through semi-open structures and the regular habit of opening windows conditions that may mitigate the adverse impacts of substandard ventilation typically captured by conventional measurement tools. Such contextual variations underscore the complexity of interpreting ventilation as a uniform risk factor across diverse environments.

Similarly, inadequate lighting was identified as a contributing factor to TB incidence, aligning with the findings of Safitri et al. (2024) and Aryani et al. (2022). However, the manner in which sunlight enters traditional homes in the study area typically through wall or roof openings rather than standard windows may compromise the accuracy of lux meter readings in reflecting actual indoor lighting exposure. Susanti et al. (2022) suggested that lighting conditions in the bedroom, especially from direct sunlight, can reduce the presence of Mycobacterium tuberculosis in the indoor environment due to its antibacterial and antiviral properties. This highlights the importance of incorporating complementary qualitative or spatial assessments when evaluating environmental exposures in non-urban housing contexts. A particularly striking contrast emerged in the analysis of residential density. While prior studies, such as Mardianti et al. (2020), reported extremely high odds ratios, the association found in this study was more moderate. This suggests that while residential density remains a relevant factor, it may not serve as an independent determinant of TB risk in rural or coastal areas. Rather, it likely interacts with other variables such as ventilation, hygiene practices, and social behaviors. The lower effect size observed may be attributable to the open architectural designs of local dwellings and the residents tendency to spend more time outdoors, thereby reducing the potential impact of indoor crowding. These contextual differences contrast sharply with findings from urban based studies and emphasize the importance of geographically sensitive interpretations.

In addition, the number of family members in 1 house is at high risk of contracting pulmonary TB. This is because other family members play a role in caring for and maintaining pulmonary TB sufferers, so they are at greater risk of contracting it. However, prevention of transmission of this disease can be done by maintaining cleanliness, adequate ventilation, wearing masks, and covering the mouth when coughing (Hasnita et al., 2019). explained that people over 30 years old and 35 years old are more susceptible to tuberculosis. This happens because that age is the productive age where the majority of people work and interact with others who may contract Tuberculosis, especially health workers who are at high

risk of exposure to tuberculosis at work (Abdi & Erwandi, 2023).

These divergences collectively highlight the novelty of this study, which lies not only in the variables assessed but also in the geographical, architectural, and socio cultural context of the researchan area that has been underrepresented in the literature. By employing objective environmental measurements in a semi coastal, rural setting, this study contributes a localized evidence base that can inform more context-appropriate public health interventions. Nevertheless, several methodological limitations should be acknowledged. The cross-sectional design limits causal inference between environmental conditions and TB incidence. Additionally, single point environmental measurements may not accurately represent long-term exposure, particularly for variables such as humidity and ventilation, which are affected by weather and occupant behavior. The study was conducted in a single subdistrict, thus limiting the generalizability of the findings. Furthermore, important potential confounders such as smoking habits, socioeconomic status, nutritional deficiencies, and access to healthcare services were not incorporated into the analysis, despite their relevance to TB risk.

Despite these limitations, the implications of the findings are significant. They support the integration of environmental health interventions into TB control strategies, particularly in high-risk areas characterized by non-urban housing. Policy recommendations include strengthening regulations regarding minimum housing standards related to ventilation and occupancy, and promoting architectural designs that enhance airflow and natural lighting. Community-based health education programs should address the importance of maintaining a healthy home environment, while housing improvement initiatives can benefit from multisectoral collaboration involving health, housing, and spatial planning authorities. Future research should adopt longitudinal and multi-site study designs to validate these findings across different geographic and cultural contexts. Moreover, the integration of environmental, behavioral, and social determinants into a comprehensive analytical framework would enhance our understanding of TB risk and improve the precision of public health interventions.

CONCLUSION

The findings of this study demonstrate that inadequate lighting, insufficient ventilation area, and high residential density in housing environments are closely linked to increased tuberculosis incidence in the Awaru Awangpone area. These conditions likely contribute to the persistence of TB transmission by limiting air circulation, reducing sunlight exposure, and creating overcrowded indoor spaces that facilitate the spread of airborne pathogens. In contrast, humidity was not found to have a substantial influence in this setting. These results underscore the importance of improving physical housing conditions as part of TB prevention efforts, particularly in semi-rural and coastal communities. Future studies should explore the role of behavioral and socioeconomic factors, as well as conduct longitudinal assessments to better capture the long-term impact of environmental improvements on TB control.

SUGGESTION

Efforts to improve housing conditions are crucial in reducing the risk of tuberculosis (TB) transmission. The community is encouraged to enhance housing quality by increasing ventilation and installing glass roof tiles to improve natural lighting, enhance air circulation, and reduce high humidity levels, which are known risk factors for TB. Healthcare professionals play a vital role in strengthening public education on home improvements that meet health standards and promoting community-based programs. Collaboration between health institutions, local governments, and community organizations is also essential in designing policies that support healthy living environments, particularly in high-risk areas. Future research should involve larger populations and sample sizes to improve result accuracy and explore other risk factors that have not yet been studied, such as indoor air quality, exposure to environmental pollutants, socioeconomic conditions, and access to healthcare services. Longitudinal studies are also recommended to assess the long-term impact of housing improvements on reducing TB cases, ensuring that interventions are more effective and sustainable.

REFERENCES

Abdi, D. N., & Erwandi, D. (2023). Literature Review: Risk Factors For Tuberculosis Incidence In Health Workers In Indonesia. *Riwayat: Educational Journal of History and Humanities*, *6*(4), 2345–2351. [Crossref], [Publisher]

Amelia, S., Rahayu, S. R., & Wijayanti, Y. (2021). Analysis of Physical Environmental Factors Affecting the Incidence of Pulmonary Tuberculosis in Magelang City. *Public Health Perspective Journal*, *6*(1), 2021–2083. [Publisher]

Aryani, A. A., Wardani, F. L. K., & Rahardjo, S. (2022). Lingkungan Fisik Rumah Sebagai Faktor Risiko Kejadian Tuberkulosis Paru di Kecamatan Kebasen, Kabupaten Banyumas. *Jurnal Ilmiah Kesehatan Masyarakat : Media Komunikasi Komunitas Kesehatan Masyarakat*, *14*(2), 56–62. [Crossref], [Publisher]

Azzahra Hasan, F., Nurmaladewi, & Ode Ahmad Saktiansyah, L. (2023). Pengaruh Lingkungan Fisik Rumah Dan Perilaku Terhadap Kejadian Tuberkulosis Paru Bta Positif: Sebuah Studi Kasus Kontrol. *Jurnal Ilmu Kesehatan Masyarakat*, *19*(1), 38–47. [Crossref], [Publisher]

Cheng, J., Sun, Y. N., Zhang, C. Y., Yu, Y. L., Tang, L. H., Peng, H., Peng, Y., Yao, Y. X., Hou, S. Y., Li, J. W., Zhao, J. M., Xia, L., Xu, L., Xia, Y. Y., Zhao, F., Wang, L. X., & Zhang, H. (2020). Incidence and risk

factors of tuberculosis among the elderly population in China: A prospective cohort study. *Infectious Diseases of Poverty*, *9*(1), 1–13. [Crossref], [Publisher]

Faizal, I. A., Pangesti, I., & Setia P, D. A. (2021). House Environments As Risk Factors of Tuberculosis in Cilacap District. *Jurnal Riset Kesehatan*, *10*(1), 65–70. [Crossref], [Publisher]

Hasnita, N., Ichwansyah, F., Abdurrahman, F. Bin, Usman, S., & Zahara, M. (2019). Analysis of Risk Factors Fotr Pulmonary Tuberculosis Incidence. *Indonesian Journal of Global Health Research*, *2*(4), 219–234. [Crossref], [Publisher]

Indonesia, T. (2024). Kegiatan Puncak Hari Tuberkulosis Sedunia 2024: Gerakan Indonesia Akhiri Tuberkulosis. *TB Indonesia*. [Publisher]

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. [Crossref], [Publisher]

Jiang, H., Chen, X., Lv, J., Dai, B., Liu, Q., Ding, X., Pan, J., Ding, H., Lu, W., Zhu, L., & Lu, P. (2024). Prospective cohort study on tuberculosis incidence and risk factors in the elderly population of eastern China. *Heliyon*, *10*(3), e24507. [Crossref], [Publisher]

Kemenkes RI. (2023). Permenkes No. 2 Tahun 2023. *Kemenkes Republik Indonesia*, *55*, 1–175. [Publisher]

Mahawati, E., Surjati, E., Saputra, M. K. F., Sudasman, F. H., & Pertiwi, I. (2023). Hubungan Lingkungan Fisik Rumah Dengan Kejadian Tuberkulosis Paru The Relationship Physical Environment Of The Home With The Incidence Of Pulmonary Tuberculosis. *The Indonesian Journal Of Infectious Disease*, *9*(1), 1–12. [Crossref], [Publisher]

Mardianti, R., Muslim, C., & Setyowati, N. (2020). Hubungan Faktor Kesehatan Lingkungan Rumah Terhadap Kejadian Tuberkulosis Paru (Studi Kasus di Kecamatan Sukaraja Kabupaten Seluma). *Naturalis: Jurnal Penelitian Pengelolaan Sumber Daya Alam Dan Lingkungan*, *9*(2), 23–31. [Crossref], [Publisher]

Masrizal, M., Fritiara, F., Salsabila, A., Lukman, E., Mardhiyah, I., & Al Ghani, M. P. (2023). Meta-Analysis: Risk Factor Analysis of Tuberculosis Incidence. *Contagion: Scientific Periodical Journal of Public Health and Coastal Health*, *5*(2), 574. [Crossref], [Publisher]

Mauliyana, A., & Hadrikaselma, E. (2021). Risk Factors of Pulmonary Tuberculosis in the Working Area of Perumnas Public Health Center Kendari City. *MIRACLE Journal Of Public Health*, *4*(2), 202–213. [Crossref], [Publisher]

Nopita, E., Suryani, L., & Siringoringo, H. E. (2023). Analisis Kejadian Tuberkulosis (TB) Paru. *Jurnal Kesehatan Saelmakers PERDANA*, *6*(1), 201–212. [Crossref], [Publisher]

Rahmawati, S., Ekasari, F., Yuliani, V., Studi Kesehatan Masyarakat Fakultas Kesehatan Masyarakat, P., & Malahayati Bandar Lampung, U. (2021). Hubungan Lingkungan Fisik rumah Dengan Kejadian Tuberkulosis di Wilayah Kerja Puskesmas Pekalongan Kabupaten Lampung timur Tahun 2020. In *Indonesian Journal Of Healath and Medical* (Vol. 1). [Publisher]

Sabila, M. S., Maywati, S., & Setiyono, A. (2024). Hubungan Faktor Lingkungan Rumah dengan Kejadian Tuberkulosis Paru pada Usia Produktif di Wilayah Kerja UPTD Puskesmas Cigeureung Kota Tasikmalaya. *Jurnal Kesehatan Komunitas Indonesia*, *20*(1), 20–30. [Publisher]

Safitri, D. N. L., Putri, D. F., Amirus, K., Nuryani, D. D., & Ekasari, F. (2024). Pengaruh Faktor Lingkungan terhadap Kejadian Tuberkulosis Paru di Wilayah Kerja Puskesmas Kedaton Bandar Lampung. *MAHESA : Malahayati Health Student Journal*, *4*(4), 1507–1522. [Crossref], [Publisher]

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. [Publisher]

Susanti, N., Ashar, Y. K., Siregar, P. A., Rezebri, M., Adinda, D., Iqbal, M., Islam, U., Sumatera, N., Tapanuli, K., Health, T., & Ahqaff, U. Al. (2022). Risk Factors for the Home Physical Environment and the Incidence of Childhood Tuberculosis. *Contagion : Scientific Periodical of Public Health and Coastal Health*, *6*(2), 1510–1518. [Crossref], [Publisher]

Syam, D. M., Arianty, R., Sulaeman, D. S., & Subagyo, I. (2021). Risk factors for tuberculosis in the work area community health center sabang, dampelas district, donggala regency. *Open Access Macedonian Journal of Medical Sciences*, *9*, 530–534. [Crossref], [Publisher]

Tunggal, I. D., Sriatmi, A., & Martini. (2024). The Role of Environmental Factors in The Incidence of Tuberculosis and Stunting in Children. *Indonesian Journal of Global Health Research*, *6*(6), 721–726. [Crossref], [Publisher]

WHO. (2022). Tuberculosis Deaths and Disease Increase During The COVID-19 Pandemic. *WHO*. [Publisher]

Wikurendra, E. A., Nurika, G., Tarigan, Y. G., & Kurnianto, A. A. (2021). Risk factors of pulmonary tuberculosis and countermeasures: A literature review. *Open Access Macedonian Journal of Medical Sciences*, *9*, 549–555. [Crossref], [Publisher]

Zuraidah, A., & Ali, H. (2020). Hubungan Faktor Lingkungan Rumah Terhadap Kejadian Tb Paru Bta Positif Di Wilayah Puskesmas Nusa Indah Kota Bengkulu. *Journal of Nursing and Public Health*, *8*(1), 1–10. [Crossref], [Publisher]