Jurnal Kesehatan dr. Soebandi
ISSN : 2302-7932 (Print)
ISSN : 2527-7529 (OnLine)

Analysis of Indoor Environmental Health Factors Related to the Incidence of Tuberculosis in Children in Jember District

Zidni Imanial Bathista[1], Ancah Caesarina Novi M [2], Leersia Yusi R [3], Zidni Nuris Yuhbaba [4]
[1]Master Of Public Health, University of Jember
[2]Faculty of Medicine University Of Jember
[3]Faculty Of Public Health University Of Jember
[4]Faculty Of Nursing, University dr. Soebandi Jember
Correspondence author: *zidniimanial@gmail.com

Submited : 23 July 2024 ; Accepted : 23 April 2025
Doi : https://doi.org/10.36858/jkds.v13i1.782

ABSTRACT

The environment of a house that is not clean can lead to the onset of diseases, including pulmonary TB. Environmental factors affecting TB incidence may include cleanliness of the house, ventilation, lighting, air temperature, humidity levels, and occupancy density. The purpose of this study was to analysis the relationship between indoor environmental health and the incidence of tuberculosis in children in Jember Regency. This research used an analytical observational study design with a case-control approach. The study included 68 TB-positive and 68 TB-negative respondents selected through simple random sampling. Statistical analysis involved bivariate tests such as chi-square and multivariate analysis using logistic regression. The findings revealed a significant relationship between environmental health and childhood tuberculosis incidence (p=0.030). Factors such as room temperature, humidity, ventilation, lighting, wall type, and occupancy density were identified as risk factors for childhood tuberculosis in Jember. The government is encouraged to support and empower local communities through mutual cooperation activities to create a healthier physical environment at home.

Keyword: Indoor Environmental Health, Tuberculosis, Chilhood

ABSTRAK

Lingkungan fisik rumah yang tidak bersih dapat mengakibatkan timbulnya suatu penyakit antara lain TB paru. Kesehatan lingkungan yang memengaruhi kejadian TB dapat berupa kebersihan rumah, jumlah ventilasi, jumlah pencahayaan, suhu udara, tingkat kelembaban serta kepadatan hunian. Tujuan penelitian ini adalah Menganalisis hubungan Kesehatan Lingkungan Indoor Terhadap Kejadian Tuberkulosis Pada Anak Di Kabupaten Jember. Metode penelitian ini menggunakan observasional analitik dengan menggunakan desain case control study. Sampel pada penelitian berjumlah 68 responden pasien positif TB dan 68 pasien negatif TB. Teknik sampling yang digunakan simple Random Sampling. Pada uji statistik menggunakan uji bivariate yaitu chi-square dan multivariate menggunakan Analisis Regresi Logistik. Temuan mengungkapkan adanya hubungan antara kesehatan lingkungan dengan kejadian tuberculosis anak (p=0,030), Lingkungan fisik rumah (suhu kamar, kelembaban kamar, ventilasi kamar, pencahayaan kamar, jenis dinding kamar serta kepadatan hunian kamar) , riwayat kontak anak dengan penderita BTA+ merupakan faktor risiko kejadian tuberkulosis anak di Kabupaten Jember. Pemerintah diharapkan memfasilitasi dan memberdayakan masyarakat setempat sebagai wadah dalam kegiatan gotong royong guna menciptakan lingkungan fisik rumah yang lebih sehat..

Kata Kunci: *Kesehatan Lingkungan Indoor (dalam rumah), Tuberkulosis, Anak*

*Correspondence author: *zidniimanial@gmail.com*

How to Cite : zidni, zidni imanial batistha, Yuhbaba, Z. N., Novi M, A. C., & Yusi R, L. Analysis of Indoor Environmental Health Factors Related to the Incidence of Tuberculosis in Children in Jember District. *Jurnal Kesehatan Dr. Soebandi*, *13*(1). https://doi.org/10.36858/jkds.v13i1.782

Jurnal Kesehatan dr. Soebandi
ISSN : 2302-7932 (Print)
ISSN : 2527-7529 (OnLine

Introduction:

Tuberculosis (TB) remains a significant public health issue in both Indonesia and globally, making it a focus of sustainable health development goals (SDGs) (Kemenkes RI, 2019). TB is a chronic infectious disease caused by the bacterium Mycobacterium tuberculosis, characterized by its rod-shaped morphology and acid resistance, often referred to as acid-fast bacilli (AFB). Most TB infections primarily affect the lungs (pulmonary TB), but Mycobacterium tuberculosis can also infect other organs (extra-pulmonary TB) such as the pleura, lymph nodes, bones, and other extrapulmonary sites (Kemenkes RI, 2019).

TB among children is increasingly recognized, with at least 500,000 children affected worldwide annually (Setyaningsih & Setyobroto, n.d., 2016). In Indonesia, TB cases have been reported in children under 1 year at 2%, ages 1-4 years at 4%, and ages 5-14 years at 0.30% (Kemenkes RI, 2021). Globally, nearly a quarter of the population is infected with Mycobacterium tuberculosis, with 89% of cases affecting adults and 11% affecting children. It was estimated that by 2019, 10 million people would be affected by TB, with Indonesia reporting 397,377 cases by 2021, an increase from 351,936 in 2020. The highest numbers of cases were found in densely populated provinces such as West Java, East Java, and Central Java (Kemenkes RI, 2022).

In East Java, according to Riskesdas data for 2021, 43,247 TB cases were detected, a decrease from 44,947 cases in 2020. The districts/cities with the highest number of child TB cases included Surabaya City, Jember District, and Sidoarjo District, with Surabaya City reporting the most cases at 241, followed by Jember District at 164 cases (Dinas Kesehatan Jawa Timur, 2021). The spread of TB is closely linked to environmental conditions and population behaviors related to health, hygiene, and the environment, contributing to disease incidence. Environmental factors include housing density, ventilation, humidity, flooring and wall materials, temperature, and lighting (Setyaningsih & Setyobroto, n.d., 2016). Indoor environmental factors, especially indoor air quality parameters like humidity (40-60%), temperature (18-30°C), and lighting (60 Lux), play critical roles in TB transmission. Mycobacterium tuberculosis thrives at temperatures between 25°C and 40°C, with optimal growth at 31-37°C. Humidity levels below 40% or above 70% are suboptimal for health and can sustain Mycobacterium tuberculosis in indoor air (Nur'aini, Suhartono, & Raharjo, 2022).

The occurrence of pulmonary TB cases can be influenced by various factors, including the physical condition of the home environment. Unhealthy home environments, characterized by insufficient sunlight, poor ventilation leading to high humidity and darkness, can support the survival of Mycobacterium tuberculosis for extended periods. Risk factors such as occupant density, humidity, ventilation area, lighting, and house construction materials contribute to the interaction between hosts and agents in TB transmission (Agustian & Mahesa, 2014).

In addition to environmental factors, behaviors such as coughing without covering the mouth, air circulation within rooms, improper disposal of sputum, irregular medication adherence, lack of window ventilation, and failure to wear masks also influence TB incidence (Indri Yosua, 2022).

TB infection has profound physical, mental, and social consequences for individuals, including persistent coughing, shortness of breath, chest pain, weight loss, reduced appetite, and night sweats, leading to debilitation. Therefore, based on evidence showing the impact of indoor environmental factors on TB transmission, this study aims to analyze the relationship between indoor environmental health and childhood TB incidence in Jember district

Methods:

This study is an analytical observational study using the design case control study or control case study that analyzes the relationship between exposure and disease by comparing groups of cases and groups. Controls based on exposure status The sample number in the study consisted of 68 respondents with TB positive and 68 patients with TB negative. Research locations are in 10 districts in jember jember district:

Jurnal Kesehatan dr. Soebandi
ISSN : 2302-7932 (Print)
ISSN : 2527-7529 (OnLine)

mayang, sukorambi, kaliwates, rambipuji, ajung, jenggawah, bangsalsari, balung, jelbuk and sumbersari. On sampling techniques, researchers use Simple Random Sampling.

The criteria for the inclusion of the case group are children aged 1 – 14 years, TB positive, treatment lasted at least 3 months, residing in the district of Jember, home conditions have not changed in the last 1 year, and are willing to be respondents. The exclusion criteria for the group of cases is to have a comorbid disease (recurrent diarrhea occurring in one to three months), the patient cannot complete the questionnaire and is not cooperative. The inclusion criterion for the control group is that the child is of the same age and sex as the child of the case. Resides near the child, does not suffer from tuberculosis, resides in the puskesmas area of Jember district and the home condition has not changed in the last 1 year.

This research data is collected with the measurements of the device from temperature (Thermohygrometer), humidity (Termohygrometer), Residential Density (Roll Meter), Lighting (Lux Meter), Ventilation (Roll Meter). The analysis in this study uses bivariate analysis using Chi-square testing, then in multivariate using logistical regression.

Results:

Table 1 Results of Characteristic Analysis of Respondents

Respondent Characteristics	Tuberculosis		Non Tuberculosis	
	n	%	n	%
Gender Genre				
Male	33	48,5	31	45,6
Female	35	51,5	37	54,4
Total	**68**	**100,0**	**68**	**100,0**
UsiAge				
< 6 years	59	86,8	53	77,9
6 – 10 years	7	10,3	13	19,1
> 10 years	2	2,9	2	2,9
Total	**68**	**100,0**	**68**	**100,0**

Based on the proportion of data in table 1, the study characterizes respondents with tuberculosis incidence and no incidence of TB by gender, with the majority of respondents being female (51.5%) (35 children) for TB incidence, and most of the respondents having female incidence 54.4 per cent (37 children). For no tuberculosis incidence, in the distribution of respondents based on the age of almost all respondents < 6 years of age 86.8% (59 children) for any tubercle incidence and 77.9% (53 kids) for no TB incidence.

Table 2 Results of Distribution of Indoor Environmental Health

Variabel		Tuberculosis		Non Tuberculosis	
		f	%	f	%
Indoor Environmental Health	Not fulfilling	42	61,8	18	26,5
	Completed	26	38,2	50	73,5
Kresidential Density	Not fulfilling	40	58,9	18	26,4
	Completed	28	41,1	50	73,6
Ventilation	Not fulfilling	36	53,0	15	22,0
	Completed	32	47,0	53	78,0
Humidity	Not fulfilling	35	51,4	28	41,2
	Completed	33	49,4	40	58,8
Temperature	Not fulfilling	38	55,8	38	55,8
	Completed	30	44,2	30	44,2
Lighting	Not fulfilling	38	55,8	19	28,0
	Completed	30	44,2	49	72,0
Amount		68	100	68	100

In Table 2, it was obtained from 68 respondents in the case group that indoor environmental health with the category of not meeting the requirements was 42 respondents (61.8%), in the control group with the category of meeting the requirements was 50 respondents (73.5%). Residential density had the highest frequency in the case group that did not meet the requirements, namely 40 respondents 64 (58.9%) and the control group, the majority of respondents with ventilation met the requirements, namely 53 (78.0%).

Jurnal Kesehatan dr. Soebandi
ISSN : 2302-7932 (Print)
ISSN : 2527-7529 (OnLine)

Table 3 Frequency Distribution of Indoor Health Environment with Tuberculosis Incidences in Jember District

Variabel		Tuberculosis		Non Tuberculosis	
		f	%	f	%
Indoor Environmental Health	Not fulfilling	42	61,8	18	26,5
	Completed	26	38,2	50	73,5
Amount		68	100	68	100
OR (95% CI)		4,487 (2,168-9,289)			
P Value		0,000			

In table 3 The results of the chi square test obtained a value of ρ = 0.000 <0.05, which means that there is a relationship between indoor environmental health and the incidence of childhood tuberculosis in Jember Regency. The OR value = 4.487, which means that indoor environmental health that does not meet the requirements will experience a 4.487 times greater risk of tuberculosis compared to indoor environmental health that meets the requirements.

Discussion :

The temperature in the group of cases that did not meet the requirements was greater than the 38 respondents who met the requirements (55.8%), which means that temperature is one of the factors related to tuberculosis. The temperature is said to meet the requirements if the temperature ranges from 18°C-30°C, and the temperature is influenced by the outside air temperature, air movement and air humidity. Tuberculosis bacteria living in the house will affect health in the house, hot temperatures certainly affect activities in the house (Depkes RI, 2019). This study is in contrast to the study conducted by (Butiop et al., 2015) which stated that the temperature of the respondents' houses had no relationship (p = 0.677) with the incidence of pulmonary tuberculosis in Wori village, Wori health center work area. Temperature conditions play a major role in the growth of Mycobacterium tuberculosis bacilli, where the growth rate of the bacilli is determined based on the air temperature around it. Therefore, if a person has a suitable residential temperature, then that person can slow down or even prevent the growth of the bacillus (Apriliasari et al., 2018). The ventilation category in the case group is more dominant in those who do not meet the requirements, as many as 36 respondents (53.0%). In the average case group, ventilation is not given much attention because respondents assume that there are already windows and doors as a place for air exchange. Ventilation that is less than 10% does not meet the requirements can cause the growth of microorganisms that can cause human health problems. Bacteria will survive for a long time in the house if the ventilation in the house is very minimal. Lack of ventilation will also cause indoor air humidity, because the evaporation process occurs. The results of this study are in line with research conducted by (Sahadewa et al., 2019), namely the results of the study with an odds ratio test = 7.800 (> 1) meaning that H0 is rejected or poor home ventilation has a 7.800 times greater risk of experiencing pulmonary TB than respondents who live in houses with good home ventilation levels. According to (Sahadewa et al., 2019) poor ventilation will increase the development of TB germs 67 because the supply of fresh air entering the house is not sufficient and the release of dirty air outside the house is also not optimal, thus causing the quality of indoor air to be poor. The humidity category in this study predominantly does not meet the requirements as much as 51.4%. Humidity occurs because respondents rarely open the windows of the house so that the light and air entering are not optimal. High humidity will cause very easy transmission with the support of unhealthy environmental factors. According to the Indonesian Minister of Health Regulation No. 1077 of 2011 concerning Guidelines for Indoor Air Health, the humidity that meets the requirements is 40% - 70% (Ministry of Health of the Republic of Indonesia, 2011). In most of the respondents' houses, the humidity in the bedroom is still high >70% so that sunlight cannot enter optimally due to being blocked by buildings around the house, rarely opening windows and inadequate ventilation. According to Bawole (2014), humidity plays a role in the growth of microorganisms including pulmonary tuberculosis (TB) bacteria. High home humidity can increase the life of tuberculosis bacteria. The

density of housing in the group of cases that did not meet the requirements was 40 respondents (58.9%). The denser the occupants of the house, the faster the air in the house becomes polluted. This study is in line with the study conducted by Hamidah (2015) that statistically the results of the chi square test analysis obtained p = 0.001 which means that there is a relationship between housing density and the incidence of pulmonary tuberculosis. The results of this study indicate that respondents who live in houses with a housing density of <8m (do not meet the requirements) have a higher risk of suffering from pulmonary tuberculosis compared to respondents who live with a housing density that meets the requirements (8m). The density of housing in one house will have an impact on its occupants, with increasing levels of CO2 in the air in the house, it will provide more opportunities for bacteria to grow and reproduce (Konde et al., 2020). The results of the lighting category in this study in the majority of case groups did not meet the requirements (38 respondents). Lighting conditions are 68 a significant risk factor, this can be seen from the research above, with insufficient lighting, TB bacteria in the environment do not die because sunlight is one of the factors that can kill TB bacteria, so if the lighting is good, transmission and reproduction of bacteria can be prevented. Natural light is very important to enter the house because it can kill bacteria

Conclusions:

There is a relationship between indoor environmental health and the incidence of tuberculosis in children in Jember Regency, obtained ρ = 0.000 (ρ < 0.05). The category of residential density in the case group has the highest frequency value of not meeting the requirements, namely 40 respondents and the most meeting the requirements, namely humidity, 33 respondents.

Acknowledgements:

Thank you to the Health Office for allowing research at the puskesmas 10 sub-districts in the district of Jember, namely mayang, sukorambi, kaliwates, rambipuji, ajung, jenggawah, bangsalsari, balung, jelbuk and sumbersari. which has allowed me to conduct research at the agency. And apologies if during my research I made mistakes or inconvenience to the institution.

References:

Agustian dan Mahesa. (2014). *Diskusi terbuka online UKMPPD batch 1*.

Apriliasari, R., Hestiningsih, R., & Udiyono Peminatan Epidemiologi dan Penyakit Tropik Fakultas Kesehatan, A. (2018). Faktor Yang Berhubungan Dengan kejadian Tuberkulosis Pada Anak (Studi Di Seluruh puskesmas Di Kabupaten Magelang)) (Vol. 6). http://ejournal3.undip.ac.id/index.php/jkm

Butarbutar, M. H. (2018). Hubungan Perilaku Dan Sanitasi Lingkungan Dengan Pasien Tb Paru. *Journal of Borneo Holistic Health*, *1*(1), 51–61. https://doi.org/10.35334/borticalth.v1i1.375

Ciuzas, D., P. T. (2016). Indoor Air Quality Management by Combined Ventilation and Air Cleaning: An Experimental Study. *Aerosol and Air Quality Research*, *16*, 2550–2559. https://doi.org/doi: 10.4209/aaqr.2015.10.0577

Dinas Kesehatan Jawa Timur. (2021). *Profil Kesehatan 2021 Jawa Timur*.

Dr. Khambali, Rachmaniyah, N. P. S. (2021). Terapan Teknologi Guna *Cyclone Ventilator Modification Untuk Meningkatkan Kualitas Udara Rumah Penderita Tb dan Ispa Paru* (Vol. 4003036200).

Fahimah, A.D.W., Wardiani, S., dan Musbah, M. . (2014). Pengaruh Perbandingan Masa Ca:P terhadap Sintesis Hidroksiapatit Tulang Sapi dengan Metode Kering. *Jurnal Mahasiswa Kimia*, *1*(2), 196–202.

Fitri, N. K., Handayani, P., & Vionalita, G. (2016). Faktor-faktor yang berhubungan dengan jumlah mikroorganisme udara dalam ruang kelas lantai 8 universitas esa unggul. *Foodborne Pathogens and Disease*, *14*, 472–477. https://doi.org/https://doi.org/10.1089/fpd.2017.2279

Indri Yosua, M., Ningsih, F., Ovany, R., Eka Harap Palangka Raya, Stik., Raya, P., &

Tengah, K. (2022). Relationship With House Environmental Conditions Event Of Tuberculosis (TB) Lungs. *Jurnal Surya Medika*, *8*(1).

Kemenkes RI. (2016). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 67 Tahun 2016 tentang Penanggulangan Tuberkulosis*.

Kemenkes RI. (2019). *Pedoman Nasional Pelayanan Kedokteran Tata Laksana Tuberkulosis*.

Kemenkes RI. (2021). *Laporan Kinerja Kementerian Kesehatan 2021*.

Kemenkes RI. (2022). *Profil Kesehatan Indonesia*.

Nur'aini, Suhartono, & Raharjo, M. (2022). Hubungan Faktor Lingkungan Fisik Dalam Rumah dan Perilaku Kesehatan Dengan Kejadian TB Paru di Purwokerto Selatan Banyumas. *Jurnal Kesehatan Lingkungan Indonesia*, 210–218.

Sahadewa, S., & Luh, N. (2019). Hubungan Tingkat Pencahayaan , Kelembaban Udara , dan Ventilasi udara dengan Faktor Risiko Kejadian TB Paru BTA Positif di Desa Jatikalang Kecamatan Krian Kabupaten Sidoarjo. *Jurnal Ilmiah Kedokteran Wijaya Kusuma*, *8*(2), 118–130. https://doi.org/http://dx.doi.org/10.30742/jikw.v8i2.617

Saragih, W. (2011). *Degradasi Polutan Udara Ruangan Menggunakan Lampu Hias dengan Penutup Berlapis Katalis TiO2 Termodifikasi*.

Setyaningsih, N., & Setyobroto, I. (n.d.). *Kajian Status Gizi , Imunisasi Bacillus calmette guerin (BCG), dan Kondisi Lingkungan Rumah dengan Kejadian Tuberkolosis pada Bakita di Kecamatan Mlati Sleman*. 125–130.