

Analysis of Risk Factor of Pulmonary Tuberculosis Among Patients Receiving Treatment at the Pulmonary Clinic of Anutapura Regional General Hospital, Palu, In 2024

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ARTICLE INFO	ABSTRACT
Article History: Received : 9 May 2026 Accepted : 8 June 2026 Published online	Background: Tuberculosis (TB) is an infectious disease caused by <i>Mycobacterium tuberculosis</i> and is still one of the major health problems in the world. Transmission occurs through nuclear droplets that are inhaled until they reach the pulmonary alveoli. Globally, in 2024, there will be an estimated 10.6 million cases of TB with 1.2 million deaths. Indonesia ranks second with the highest number of cases after India, and in Central Sulawesi, there are 44,555 cases, including 294 cases found at RSUD Anutapura Palu. The high incidence rate shows the need to identify risk factors related to pulmonary TB as a basis for disease prevention and control planning. Objective: This study aims to find out and analyze factors related to the incidence of pulmonary TB in patients undergoing treatment at the Pulmonary Polyclinic of RSUD Anutapura Palu in 2024. Methods: This study used an analytical observational design with a case-control approach. The sample consisted of patients diagnosed and undiagnosed with pulmonary TB and undergoing outpatient treatment at the Pulmonary Polyclinic of RSUD Anutapura Palu in 2024, who met the research inclusion criteria, namely 122 patients. Data analysis was carried out univariate and bivariate using the chi-square test. Results: Based on the results of the univariate analysis, it was shown that the majority of respondents were male in the age group of late adulthood to elderly, with normal nutritional status and no history of comorbid disease. Bivariate analysis showed that sex had a meaningful relationship with the incidence of pulmonary TB ($p=0.039$), where males had a higher risk than females. Meanwhile, age ($p=0.494$), nutritional status ($p=0.209$), and history of comorbidities ($p=0.088$) did not show a statistically significant relationship. Conclusion: This study concludes that the risk factor related to the incidence of pulmonary TB in patients treated at RSUD Anutapura Palu in 2024 is gender. Meanwhile, age, nutritional status and history of comorbidities did not show a meaningful relationship. 03) were independent risk factors for mortality in people with sepsis
Keywords: Pulmonary Tuberculosis; Risk Factors; Gender; Case Control. This is an open access article under the  CC-BY-SA license.	

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*, which is transmitted through the air via respiratory droplets measuring 1–5 micrometers. Due to their extremely small size, these bacteria can penetrate the respiratory tract defenses and reach the bronchioles and alveoli, causing infection that primarily affects the lungs but may also spread to other organs, such as the bones, brain, and lymph nodes.¹

Globally, tuberculosis (TB) remains one of the ten leading causes of death, with an estimated 10.6 million cases and 1.2 million deaths reported in 2024 (Ministry of Health of the Republic of Indonesia, 2024). Indonesia ranks second worldwide in TB burden, with approximately 969,000 cases (World Health Organization, 2024). At the regional level, the prevalence of TB in Central Sulawesi reached 44,555 cases (Central Sulawesi Provincial Health Office, 2024). Meanwhile, in Palu City, a total of 1,844 TB cases were recorded in 2024, with the highest number reported at Anutapura Regional General Hospital, accounting for 294 cases.²

Tuberculosis (TB) remains a major public health concern due to the risk of severe complications and death when treatment is not completed. This challenge is further exacerbated by the prolonged duration of therapy and the limited public awareness regarding the risk of TB transmission (Ministry of Health of the Republic of Indonesia, 2024). Susceptibility to pulmonary TB is strongly influenced by individual factors, including age (immunological changes), sex (hormonal and behavioral factors), nutritional status (immune function), and a history of comorbid diseases, all of which can significantly compromise the immune system.¹

As the main referral hospital in Palu City, Anutapura Regional General Hospital recorded a substantial burden of pulmonary TB, with 294 reported cases. The high prevalence of pulmonary TB, coupled with the limited availability of local data on its specific risk factors, highlights the importance of this study in providing evidence-based information to support TB prevention and control policies. Therefore, this study was conducted under the title: "Risk Factor Analysis of Pulmonary Tuberculosis Among Patients Attending the

Pulmonary Clinic at Anutapura Regional General Hospital, Palu, in 2024."

MATERIAL AND METHOD

This study employed an analytic observational design using a case–control approach to analyze the risk factors associated with the occurrence of pulmonary tuberculosis (TB) among outpatients treated at Anutapura Regional General Hospital, Palu, in 2024.

RESULTS

Table 1. Frequency Distribution of Respondents by Age

Pulmonary TB Status	Usia	F	%
Cases	Young Adults: 18-30 years	14	23
	Middle Adults: 31-45 years	10	16,4
	Late Adults: 46-60 years	21	34,4
	Older Adults: >60 years	16	26,2
Total		61	100
Controls	Young Adults: 18-30 years	12	19,7
	Middle Adults: 31-45 years	8	13,1
	Late Adults: 46-60 years	17	27,9
	Older Adults: >60 years	24	39,3
Total		61	100

Based on Table 1, the age distribution of respondents in the case group was predominantly composed of late adults (46–60 years), accounting for 34.4% (21 respondents), followed by older adults (>60 years) at 26.2%. In contrast, the control group was dominated by older adults (>60 years), representing 39.3% (24 respondents). In both the case and control groups, the middle adult (31–45 years) category had the smallest proportion of respondents, accounting for 16.4% and 13.1%, respectively.

Table 2. Frequency Distribution of Respondents by Sex

Pulmonary TB Status	Gender	f	%
Cases	Male	44	72,1
	Female	17	27,9
	Total	61	100
Controls	Male	32	52,5
	Female	29	47,5
	Total	61	100

Based on Table 2, the majority of respondents in the case group were male, accounting for 72.1% (44 respondents), while female respondents comprised 27.9% (17 respondents). Similarly, in the control group, male respondents constituted the larger proportion at 52.5% (32 respondents), compared with 47.5% (29 respondents) who were female. These findings indicate that male respondents predominated in both the case and control groups, with a more pronounced male predominance observed in the case group.

Table 3. Frequency Distribution of Respondents by Nutritional Status

Pulmonary TB Status	Nutritional Status	f	%
Cases	Underweight (BMI $\leq$ 18,49 kg/m ²)	18	29,5
	Normal Weight (BMI 18,5-24,9 kg/m ²)	35	57,4
	Overweight (BMI > 25-27 kg/m ²)	3	4,9
	Obesity: (BMI > 27 kg/m ²)	5	8,2
	Total	61	100
Controls	Underweight (BMI $\leq$ 18,49 kg/m ²)	16	26,2
	Normal Weight (BMI 18,5-24,9 kg/m ²)	29	47,5
	Overweight (BMI > 25-27 kg/m ²)	10	16,4
	Obesity (BMI > 27 kg/m ²)	6	9,8
	Total	61	100

Based on Table 3, the majority of respondents in both groups had a normal nutritional status,

accounting for 57.4% (35 respondents) in the case group and 47.5% (29 respondents) in the control group. Underweight was the second most common nutritional status in both groups, representing 29.5% (18 respondents) among cases and 26.2% (16 respondents) among controls. In contrast, the overweight and obesity categories had the lowest proportions of respondents in both groups.

Table 4. Frequency Distribution of Respondents by Comorbidity Status

Pulmonary TB Status	Komorbid	f	%
Cases	Presence of Comorbidities (e.g., Diabetes Mellitus, HIV/AIDS, or COPD)	26	42,6
	No Comorbidities	35	57,4
Total		61	100
Controls	Presence of Comorbidities (e.g., Diabetes Mellitus, HIV/AIDS, or COPD)	17	27,9
	No Comorbidities	44	72,1
Total		61	100

Based on Table 4, the majority of respondents in both groups had no comorbidities. In the case group, 57.4% (35 respondents) had no comorbid conditions, whereas 42.6% (26 respondents) had at least one comorbidity. In the control group, the proportion of respondents without comorbidities was higher, accounting for 72.1% (44 respondents), while only 27.9% (17 respondents) had a history of comorbid conditions such as diabetes mellitus (DM), HIV/AIDS, or chronic obstructive pulmonary disease (COPD). These findings indicate that comorbidities were more prevalent among respondents in the case group than in the control group.

Table 5. Association Between Age and Pulmonary Tuberculosis

Pulmonary Tuberculosis						
Variable	Cases		Controls		Total	
	n	%	n	%	n	p-value
Age						
18-30 years	14	53,8	12	46,2	26	0,494
31-45 years	10	55,6	8	44,4	18	
46-60 years	21	55,3	17	44,7	38	
>60 years	16	40	24	60	40	

Based on Table 5, the distribution of pulmonary TB cases was relatively similar across the productive age groups, with the highest proportions of cases observed among respondents aged 31–45 years (55.6%) and 46–60 years (55.3%). In contrast, among respondents aged over 60 years, the majority (60.0%) were in the control group and did not have pulmonary TB.

Statistical analysis yielded a p-value of 0.494 ($p > 0.05$), indicating no statistically significant association between age and the occurrence of pulmonary tuberculosis among respondents at the study site.

Table 6. Association Between Sex and Pulmonary Tuberculosis

Pulmonary Tuberculosis						
Variable	Cases		Control		Total N	p-value
	n	%	n	%		
Sex						
Male	44	57,9	32	42,1	76	0,039
Female	17	37	29	63	46	

Based on Table 6, there was a marked difference in the proportion of pulmonary TB cases between males and females. Among male

respondents, 44 of 76 (57.9%) were diagnosed with pulmonary TB, whereas among female respondents, only 17 of 46 (37.0%) had pulmonary TB.

The statistical analysis yielded a p-value of 0.039 ($p < 0.05$), indicating a statistically significant association between sex and the occurrence of pulmonary tuberculosis. These findings suggest that male respondents had a significantly higher proportion of pulmonary TB than female respondents.

Table 7. Association Between Nutritional Status and Pulmonary Tuberculosis

Variable	Pulmonary Tuberculosis					
	Cases		Controls		Total	
	n	%	n	%	N	p-value
Nutritional Status						
Underweight	18	52,9	16	47,1	34	0,209
Normal Weight	35	54,7	29	45,3	64	
Overweight	3	23,1	10	76,9	13	
Obesity	5	45,5	6	54,5	11	

Based on Table 7, pulmonary TB was observed across all nutritional status categories, with the highest proportions of cases found among respondents with normal weight (54.7%) and those who were underweight (52.9%). In contrast, the majority of respondents who were overweight belonged to the control group and did not have pulmonary TB (76.9%).

The statistical analysis yielded a p-value of 0.209 ($p > 0.05$), indicating no statistically significant association between nutritional status and the occurrence of pulmonary tuberculosis among the respondents in this study.

Table 8. Association Between Comorbidities and Pulmonary Tuberculosis

Variable	Pulmonary Tuberculosis					
	Cases		Controls		Total	p-value
	n	%	n	%	N	
Comorbidity Status						
Presence of Comorbidities (DM,HIV/AIDS, Asthma, PPOK)	26	60,5	17	39,5	43	0,088
No Comorbidities	35	44,3	44	55,7	79	

Based on Table 8, the majority of respondents with comorbid conditions—including diabetes mellitus (DM), HIV/AIDS, asthma, and chronic obstructive pulmonary disease (COPD)—were diagnosed with pulmonary TB, accounting for 26 respondents (60.5%). In contrast, among respondents without comorbidities, a greater proportion belonged to the control group and did not have pulmonary TB (55.7%).

Although differences in the distribution of pulmonary TB were observed between respondents with and without comorbidities, the statistical analysis yielded a p-value of 0.088 ($p > 0.05$), indicating no statistically significant association between the presence of comorbidities and the occurrence of pulmonary tuberculosis in this study.

DISCUSSION

This study aimed to analyze the risk factors associated with the occurrence of pulmonary tuberculosis (TB) among patients attending the Pulmonary Clinic at Anutapura Regional General Hospital, Palu, in 2024 using a case-control design. The study compared an equal number of patients diagnosed with pulmonary TB (cases) and patients without pulmonary TB (controls). The descriptive analysis showed that the majority of respondents were late adults and older adults, indicating that these age groups

constitute the population most frequently utilizing pulmonary outpatient services for diagnosis and routine disease management. This finding is consistent with the study by Khairun Nisak et al. (2024).³

With regard to sex, male respondents predominated in both the case and control groups, reflecting differences in environmental exposure and risk-related behaviors between men and women. This finding supports the theory proposed by Sri Andayani (2020) that men are more susceptible to exposure to *Mycobacterium tuberculosis* and consequently have a higher risk of developing pulmonary TB.⁴

In terms of physical characteristics, the majority of respondents had a normal nutritional status (54.7%), consistent with the findings of Rosmawati et al. (2023) in Makassar. Furthermore, the prevalence of comorbid conditions, including diabetes mellitus, HIV/AIDS, asthma, and chronic obstructive pulmonary disease (COPD), was relatively low, in agreement with the findings reported by Manda R. Hapyanto et al. (2024).^{5,6}

Overall, these univariate findings provide a comprehensive overview of the demographic and clinical characteristics of respondents at Anutapura Regional General Hospital and serve as a foundation for subsequent statistical analyses to determine the significance of the associations between the investigated risk factors and the occurrence of pulmonary tuberculosis.

Association Between Age and Pulmonary Tuberculosis

Based on the bivariate analysis, age was not significantly associated with the occurrence of pulmonary tuberculosis (TB), as indicated by a p-value of 0.494 ($p > 0.05$). Although age has theoretically been linked to declining immune function and changes in mobility, as reported by Desi Maya and Hafiza Ilmi (2024), the findings of this study demonstrated that the differences in the proportion of TB cases across the age groups (18–30 years to >60 years) were not statistically significant.

This lack of association suggests that the occurrence of pulmonary TB is more strongly influenced by the intensity of exposure to infectious sources, individual immune status, and environmental factors than by chronological

age alone. Individuals of productive age may experience greater exposure to *Mycobacterium tuberculosis* because of their broader social interactions and occupational activities.⁷

These findings are consistent with previous studies. Ika Septiana Sari and Munaya Fauziah (2012), in a study conducted in Central Jakarta, reported no significant association between age and pulmonary TB ($p = 0.334$). Similarly, Annisa et al. (2022), in a study conducted in the coastal region of West Sumatra, found no statistically significant relationship between age and pulmonary TB ($p = 0.221$).^{8,9}

Overall, these findings indicate that age is not a major predictor of pulmonary tuberculosis among patients attending the Pulmonary Clinic at Anutapura Regional General Hospital. Therefore, TB prevention and control strategies should place greater emphasis on modifiable risk factors, including strengthening early case detection, reducing community transmission, improving environmental conditions, and enhancing the overall health and immune status of the population.

Association Between Sex and Pulmonary Tuberculosis

The findings of this study demonstrated a statistically significant association between sex and the occurrence of pulmonary tuberculosis (TB), as indicated by a p-value of 0.039 ($p < 0.05$). Anatomically, males generally have larger lung volumes and wider airway diameters, which may increase the deposition of *Mycobacterium tuberculosis* within the respiratory tract. In addition, behavioral factors such as higher rates of smoking and alcohol consumption among men may impair pulmonary immune function and increase susceptibility to TB.^{4,10}

Beyond environmental exposure and broader social interactions, hormonal differences also contribute to TB susceptibility. According to Rubin and Rahman (2021), estrogen enhances cellular immune responses in females, whereas testosterone exerts immunosuppressive effects in males, collectively increasing the vulnerability of men to tuberculosis infection.¹¹

These findings are consistent with previous studies. Charles et al. (2025), in a study conducted at RI Sidomulyo Primary Health Center, reported a significant association

between sex and pulmonary TB ($p = 0.041$). Likewise, Sunarmi and Kurniawaty (2022) found a statistically significant relationship between sex and TB risk ($p = 0.030$).^{12,13}

Overall, the findings of this study indicate that sex is a significant risk factor for pulmonary tuberculosis, reflecting the complex interaction between biological and hormonal characteristics, high-risk health behaviors, and greater occupational and social exposure among males, all of which contribute to an increased susceptibility to *Mycobacterium tuberculosis* infection.

Association Between Nutritional Status and Pulmonary Tuberculosis

With regard to nutritional status, the findings of this study demonstrated no statistically significant association between nutritional status and the occurrence of pulmonary tuberculosis (TB), as indicated by a p-value of 0.209 ($p > 0.05$). Although nutritional status and infection are clinically interrelated—where TB infection often leads to reduced appetite, decreased nutrient intake, and subsequent weight loss (Rosmawati et al., 2023)—the results of this study suggest that the occurrence of pulmonary TB is more strongly influenced by exposure to *Mycobacterium tuberculosis*, environmental conditions, and behavioral factors than by nutritional status alone. The absence of a significant association may also be explained by the case-control study design, in which nutritional status was measured at the time of diagnosis and therefore may reflect the consequences of the disease, such as weight loss due to active TB, rather than representing a pre-existing causal risk factor.⁵

According to Mariyanti Rasyid et al. (2024), although poor nutritional status is frequently considered a risk factor for tuberculosis, findings from field studies may differ, suggesting that nutritional assessment is more important for managing disease progression and complications than for predicting the initial occurrence of TB.¹⁴

The present findings are consistent with those reported by Charles et al. (2025), who found no significant association between nutritional status and pulmonary TB ($p = 0.429$), and by Abriansyah (2022) in Lahat Regency ($p = 0.08$), who likewise concluded that nutritional

status was not significantly associated with pulmonary tuberculosis.^{12,15}

Overall, these findings indicate that, within the context of this study, nutritional status was not a major predictor of pulmonary tuberculosis, suggesting that other factors, such as exposure to infectious sources, environmental conditions, and host-related factors, may play a more important role in the development of the disease.

Association Between Comorbidities and Pulmonary Tuberculosis

The final variable examined in this study was the presence of comorbid conditions, including diabetes mellitus (DM), HIV/AIDS, asthma, and chronic obstructive pulmonary disease (COPD), which are theoretically known to increase susceptibility to tuberculosis, delay recovery, and worsen clinical outcomes (Khairun Nisak et al., 2024). However, the results of the bivariate analysis demonstrated no statistically significant association between comorbidities and the occurrence of pulmonary tuberculosis, with a p-value of 0.088 ($p > 0.05$). The absence of a significant association may be explained by the fact that the impact of comorbid diseases depends largely on their type, severity, and level of clinical control. Respondents with well-managed comorbid conditions may have had a reduced risk of TB activation despite the presence of underlying diseases. Furthermore, the occurrence of pulmonary TB in this study appears to have been more strongly influenced by direct exposure to infectious sources, such as close contact with individuals with active TB and unfavorable residential environmental conditions (Sintia Oktavia et al., 2023).^{3,16}

These findings are consistent with the study conducted by Fitranti Syahrani et al. (2025) at Poasia Primary Health Center, which reported a p-value of 0.503 ($p > 0.05$), indicating no statistically significant association between a history of comorbid disease and the occurrence of pulmonary tuberculosis.¹⁰

Overall, the findings of this study, together with evidence from previous research, suggest that the presence of comorbidities was not significantly associated with the occurrence of pulmonary tuberculosis among respondents at the study site. This indicates that, within this population, environmental exposure and

transmission-related factors may have played a more prominent role in the development of pulmonary TB than the presence of underlying comorbid conditions.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the findings of this study on the risk factors associated with pulmonary tuberculosis (TB) among patients attending the Pulmonary Clinic at Anutapura Regional General Hospital, Palu, in 2024, the following conclusions can be drawn:

1. Respondent characteristics indicated that patients attending the Pulmonary Clinic were predominantly late adults and older adults, male, had normal nutritional status, and most had no history of comorbid conditions.
2. Age was not significantly associated with the occurrence of pulmonary tuberculosis.
3. Sex was significantly associated with the occurrence of pulmonary tuberculosis, with a higher proportion of TB cases observed among male respondents than among female respondents.
4. Nutritional status was not significantly associated with the occurrence of pulmonary tuberculosis.
5. A history of comorbid conditions was not significantly associated with the occurrence of pulmonary tuberculosis.
6. Overall, sex was the only factor significantly associated with the occurrence of pulmonary tuberculosis, whereas age, nutritional status, and a history of comorbidities showed no statistically significant associations in this study.

Recommendation

Based on the findings, discussion, and objectives of this study, the following recommendations are proposed:

1. For Anutapura Regional General Hospital, Palu, particularly the Pulmonary Clinic, efforts to prevent and control pulmonary tuberculosis should be further strengthened through enhanced screening and early case detection, especially among high-risk groups such as male patients. In addition, continuous health education should be provided to promote healthy lifestyle practices, increase awareness of TB transmission prevention, and improve treatment adherence. The hospital is also encouraged to strengthen its TB surveillance, recording, and reporting systems to support more effective evidence-based TB control programs.
2. For the community, greater awareness of pulmonary TB prevention should be promoted by adopting healthy lifestyle practices, including maintaining environmental hygiene, ensuring adequate household ventilation, and avoiding smoking. Community members should also seek prompt medical evaluation when experiencing symptoms suggestive of pulmonary TB and adhere to the prescribed treatment regimen to prevent disease transmission, treatment failure, and further complications.
3. For future researchers, it is recommended to expand this study by including additional variables that may be associated with the occurrence of pulmonary

tuberculosis, such as history of contact with TB patients, residential environmental conditions, household crowding, housing ventilation, and behavioral risk factors. Incorporating these variables may provide a more comprehensive understanding of the determinants of pulmonary TB and contribute to the development of more effective prevention and control strategies.

AUTHOR CONTRIBUTIONS

Conceptualization, M.D.R, S.S., S.A.; Methodology, M.D.R.; Validation, S.S., S.A.; Formal Analysis, M.D.R.; Investigation, M.D.R., Resources, M.D.R.; Data Curation, M.D.R.; Writing-Original Draft Preparation, M.D.R., S.S. and S.A.; Visualization, M.D.R All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The Author declares no Conflicts of Interest

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