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Correlation Between Demographic Factors (Age, Gender, and Living Area) and Tuberculosis Notification Rates in Private Healthcare: a Cross-sectional Study

Suryanti[1*], Idris Adewale Ahmed[2], Hamzah[3]

[1]Faculty of Medicine, Universitas Dian Nuswantoro
[2]Faculty of Applied Science, Lincoln University College
[3]Faculty of Medicine, University Airlangga

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Abstract

Tuberculosis (TB) remains a critical global health challenge, causing approximately 1.3 million deaths in 2022. Indonesia, ranking second globally in TB burden, faces substantial issues with under-reported TB cases, with nearly 30% unnotified due to barriers such as limited healthcare access, inadequate diagnostics, and inconsistent reporting systems. This study investigates the relationship between patient demographic factors—age, gender, and living area—and the under-reporting of TB cases in Indonesia's private healthcare sector. Using Spearman correlation analysis, the study identified a significant association between living area and TB under-reporting ($p < 0.05$), highlighting disparities between urban and rural regions. In contrast, no significant correlations were observed for age or gender ($p > 0.05$). The findings emphasize the urgent need for strengthening healthcare infrastructure and implementing standardized digital reporting systems to address regional disparities and improve case notification rates. These insights provide critical guidance for policymakers and healthcare professionals in designing targeted interventions to reduce TB under-reporting and enhance public health outcomes.

Correspondence Address:
University Dian Nuswantoro.
Jl. Imam Bonjol No.207,
Pendrikan Kidul, Kec.
Semarang Tengah, Kota
Semarang, Jawa Tengah
50131, Indonesia.
Email:
suryanti@dsn.dinus.ac.id

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Introduction

Tuberculosis (TB) remains one of the world's most pressing public health challenges and continues to be a leading cause of death among infectious diseases, surpassing even HIV prior to the COVID-19 pandemic. In 2022, TB claimed approximately 1.3 million lives, highlighting the severity of this disease. Indonesia ranks second globally for pulmonary TB cases, following India and ahead of China. The World Health Organization estimates that in 2022, around 10.6 million individuals developed TB, marking an increase of 0.3 million from the previous year. Without proper treatment, the mortality rate for TB can reach

50% within the first year of infection, underscoring the urgency of effective intervention. (Glaziou et al., 2021; Lestari et al., 2022; World Health Organization, 2023).

The rising burden of TB reflects significant failures in prevention and control efforts, often attributed to deficiencies in healthcare service delivery, lack of access to diagnostic and treatment services, inadequate case detection, and non-standardized treatment and reporting protocols. In 2022, nearly 3.1 million TB cases, accounting for about 30% of the global total, went unrecorded in official health statistics. These "missing cases" reveal substantial gaps in TB surveillance and reporting systems, hindering effective public health interventions. (World Health Organization, 2023).

The issue of missing cases encompasses two primary dimensions: the invisibility of active TB cases due to individuals avoiding medical consultation and the underreporting of diagnosed cases within national healthcare systems due to various systemic inadequacies. Indonesia, alongside India and Nigeria, accounts for 38% of these undetected cases, posing a major challenge for public health. The underreporting of TB cases not only hampers disease control and prevention efforts but also facilitates the wider spread of TB within communities, elevates the risk of drug resistance, and increases mortality rates. Addressing the underreporting of TB, particularly within the private healthcare sector, is crucial for mitigating this public health crisis. (Rusnoto, Murti B, Reviono, 2022; Suryanti & Ahmed, 2024).

Tuberculosis (TB) notification rates are influenced by various factors, including patient demographics, healthcare provider characteristics, and notification system effectiveness. Demographic elements such as age, gender, and geographic location significantly impact TB notification. A 2016 study in Kenya revealed that certain groups, particularly those aged 65 and older, males and rural residents, experience lower notification rates. Challenges in healthcare access for the elderly, compounded by mobility issues and age-related health problems, contribute to delayed diagnosis and underreporting.

These demographic disparities highlight the multifaceted challenges in TB surveillance and underscore the need for targeted interventions to improve healthcare access, increase awareness, and enhance reporting mechanisms. Addressing these factors is crucial for effective TB control in Kenya and similar contexts globally. (Enos et al., 2018; Law et al., 2020).

Moreover, research by Fatima et al. (2019), Malik et al. (2018), and Oliwa et al. (2018) has illuminated the difficulties in diagnosing and reporting TB among pediatric patients. Children often display atypical symptoms, complicating timely diagnosis and leading to underreporting. Limited healthcare access in underserved areas and a lack of awareness among caregivers and healthcare providers further exacerbate these issues. (Fatima et al., 2019; Linn et al., 2023; Malik et al., 2018; Oliwa et al., 2018).

Age plays a crucial role in TB notification patterns, with young adults (ages 25-34) often showing higher TB burdens. This demographic trend necessitates age-specific strategies for TB control, addressing healthcare access and diagnostic accuracy. Pediatric TB presents unique challenges, highlighting gaps in healthcare infrastructure that impact reporting accuracy. (Dirjen P2P, 2023; Fatima et al., 2019; Mishra AK, Verma V, Dhasmana DJ, 2019).

Gender disparities in TB notification are also significant, influenced by biological, social, and systemic factors. Despite higher TB incidence among men, notification rates often lag due to cultural norms and stigma affecting healthcare-seeking behavior. In Kenya, male patients tend to have lower notification rates than females, attributed to differences in healthcare access and awareness. (Fatima et al., 2019; Martins et al., 2020; Mishra AK, Verma V, Dhasmana DJ, 2019).

Geographical location, classified into urban and rural areas, further influences TB notification. Urban areas, with better healthcare infrastructure, typically report higher TB rates, while rural areas face barriers such as limited healthcare access and lower health literacy, leading to lower notification rates. Socioeconomic disparities exacerbate these differences, emphasizing the need for geographically tailored interventions to enhance TB detection and reporting in rural communities. (Biswas A, Rahman A, Islam MS, Rahman MM, Ahmed S, 2020; Biswas et al., 2020; Enos et al., 2018).

Despite the extensive research on TB notification, limited studies explore demographic disparities in under-reporting within private healthcare settings in Indonesia. This study addresses this gap by evaluating the influence of demographic factors on TB under-reporting. Our findings contribute to understanding the systemic barriers in TB notification and offer targeted solutions to address these challenges.

Methods

This study employed a cross-sectional design to investigate factors influencing tuberculosis (TB) notification in Indonesia's private healthcare sector. Data were collected from medical records at clinics and private practice physicians to provide a comprehensive overview of patient demographics and clinical characteristics.

Study Population and Sampling

A total of 93 TB patient records were analyzed and selected to ensure adequate statistical power (80%) for detecting significant correlations. The sample size was determined based on the prevalence of TB under-reporting observed in similar studies. Clinics and private practices were chosen based on geographic distribution (urban and rural settings), patient volume, and facility type to capture a representative sample and minimize selection bias. Factors such as facility accessibility and service availability were also considered to enhance the reliability and reproducibility of the findings.

Data Collection

Data were meticulously extracted from patient medical records, focusing on demographic factors (age, gender, and living area) and TB notification status. Records were obtained from both urban and rural healthcare settings to ensure diverse representation. All data collection adhered to ethical guidelines, including maintaining patient confidentiality and obtaining appropriate permissions from healthcare facilities.

Data Analysis

Univariate and bivariate analyses were conducted to explore the relationships between variables. The Spearman rank correlation test was employed to assess the correlation between patient demographic factors (age, gender, living area) and TB under-reporting. This statistical method was chosen for its robustness in analyzing non-parametric data.

Ethical Considerations

An institutional ethics review board reviewed and approved the study protocol. Participating healthcare facilities provided consent for data use, and strict measures were implemented to ensure the confidentiality and anonymity of patient records.

This methodology ensures the reliability and generalizability of the study's findings by combining a robust sampling strategy, meticulous data collection, and rigorous statistical analysis.

Results

Univariate analysis

Univariate analysis was conducted to examine the frequency distribution of variables such as age, gender, and patient's living area (table 1).

Table 1. Univariate analysis

Variables	f	(%)
Age group		
Less than 15 years old	0	(0.0)
16-64 years old	90	(96.8)
More than 65 years old	3	(3.2)
Gender		
Male	54	(58.1)
Female	39	(41.9)
Patient's living area		
Urban	61	(65.6)
Rural	32	(34.4)

Bivariate analysis

In this study, the Spearman rank correlation test was applied to examine how patient age, gender, and living area correlate with the underreporting of tuberculosis (TB) cases in private healthcare settings. This statistical approach was used to explore the relationships between these demographic factors and the degree of TB underreporting, offering insights into the factors influencing notification rates within private healthcare facilities (table 2).

Table 2. Bivariate analysis

Variables	The Significance Value Of The Correlation Test	RR
Patient's age group	Sig 0.342; Sig >0.05	0.115
Patient's gender	Sig 0.628; Sig >0.05	0.628
Patient's living area	Sig 0.000; Sig <0.05	0.414

The results from the correlation test indicate that there is a notable correlation between patient living areas and the underreporting of tuberculosis cases among private healthcare providers. However, Age and gender did not show significant correlations ($p>0.05$), possibly due to overlapping systemic factors overshadowing demographic influences. Conversely, urban residency was significantly associated with under-reporting ($p<0.05$), highlighting geographical disparities in healthcare access and reporting mechanisms.

Discussion

This study provides critical insights into the factors influencing tuberculosis (TB) under-reporting in the private healthcare sector, focusing on patient demographic factors such as age, gender, and living area. The findings shed light on systemic and socioeconomic barriers that shape TB reporting dynamics, underscoring the need for targeted interventions to enhance notification practices.

Gender and TB Under-Reporting

Despite the biological vulnerabilities associated with TB among men, such as increased susceptibility due to smoking and chronic respiratory conditions, this study did not find a significant correlation between gender and TB under-reporting. While previous research suggests that men are more prone to TB due to occupational exposures in high-risk industries like mining and construction, gender-specific influences on reporting appear mitigated by broader systemic factors, such as occupational health policies and workplace healthcare accessibility. Additionally, men's potentially less proactive healthcare-seeking behaviors did not statistically influence reporting rates in this context. These findings align with studies by Daniels et al. (2019, 2022), which emphasize that healthcare infrastructure and reporting protocols outweigh gender-specific vulnerabilities in determining TB notification outcomes.

Age and TB Under-Reporting

The study also found no significant relationship between age and TB under-reporting. The wide age range of the sample (18–67 years) may dilute age-specific influences, as variations in healthcare access and health-seeking behaviors across age groups are less pronounced in private healthcare settings. While young adults often exhibit higher TB prevalence due to increased social interactions and mobility, age alone appears insufficient to explain disparities in reporting practices. These findings suggest that systemic healthcare barriers, rather than age-related differences, are the primary drivers of TB under-reporting.

Living Area and TB Under-Reporting

The most significant finding was the moderate positive correlation between patients' living areas and TB under-reporting. Urban areas showed higher rates of under-reporting despite better access to advanced diagnostic technologies and specialized TB clinics. This paradox reflects systemic inefficiencies in urban healthcare, including fragmented services, high patient-to-provider ratios, and overcrowding. In contrast, rural areas face distinct challenges such as limited infrastructure, diagnostic capabilities, and healthcare personnel shortages, further exacerbating TB reporting gaps. These disparities highlight the critical role of socioeconomic factors, including income levels, education, and healthcare accessibility, in influencing TB notification patterns.

Urban areas, particularly those with marginalized populations, demonstrate unique challenges in healthcare delivery. Overcrowding, high mobility, and fragmented healthcare services contribute to delays in diagnosis and under-reporting. These findings emphasize the need for tailored approaches to address the systemic inefficiencies in urban healthcare delivery while strengthening healthcare infrastructure in rural regions.

Policy suggestion

Addressing the systemic and socioeconomic factors that contribute to TB under-reporting requires a comprehensive and targeted approach. One key intervention is the implementation of mandatory digital reporting systems. Standardized digital platforms can streamline TB notification processes, ensuring real-time data collection and reducing reporting gaps. By leveraging technology, healthcare providers can enhance surveillance accuracy and facilitate more effective monitoring of TB cases.

Another crucial strategy is incentivizing private healthcare providers to comply with TB notification guidelines. Financial incentives, such as performance-based funding or tax benefits, and non-financial rewards, such as professional recognition, can motivate private practitioners to report cases consistently. These measures not only encourage adherence to reporting protocols but also highlight the critical role of private providers in TB surveillance efforts.

Training and capacity building represent additional priorities. By integrating TB notification training into healthcare education programs, particularly in urban settings, providers can develop a stronger understanding of reporting protocols and the importance of accurate case notification. This investment in education fosters a culture of accountability and enhances the overall effectiveness of TB reporting systems.

Finally, fostering public-private partnerships is essential for addressing TB under-reporting. Collaboration between public health authorities and private healthcare providers can improve resource allocation, enhance reporting compliance, and ultimately lead to better patient outcomes. Joint efforts can address gaps in infrastructure, diagnostic capabilities, and personnel distribution, especially in rural areas where healthcare resources are limited. Through these combined interventions, systemic inefficiencies can be mitigated, and TB notification practices can be significantly improved.

Conclusion

Tuberculosis continues to be a significant global health challenge, marked by high mortality rates and persistent issues of under-reporting. This study highlights critical gaps in TB surveillance and reporting systems, particularly in Indonesia's private healthcare sector. Systemic inadequacies, such as limited healthcare infrastructure, insufficient access to diagnostic and treatment services, and inconsistent reporting protocols, contribute to the substantial number of unrecorded TB cases globally, hindering effective public health responses.

Key findings from this study reveal that while biological vulnerabilities and behaviors may predispose certain populations, such as men, to higher TB prevalence, gender alone does not significantly influence reporting rates. Similarly, age was not a decisive factor due to the broad age range observed, suggesting that reporting disparities are shaped more by systemic issues than by individual demographic factors. However, a significant correlation was observed between urban residency and TB under-reporting, highlighting inequalities in healthcare access, diagnostic capabilities, and socioeconomic factors such as income levels and educational attainment.

Targeted interventions are necessary to address these challenges. Enhancing healthcare infrastructure, improving diagnostic capacities, and standardizing reporting protocols across healthcare sectors are essential steps. Bridging the urban-rural healthcare gap and mitigating socioeconomic disparities are also crucial to achieving equitable access to TB diagnosis and treatment. Digital tools, such as mandatory reporting systems, could streamline the notification process and improve surveillance accuracy. Furthermore, fostering public-private partnerships and incentivizing private healthcare providers can enhance compliance with TB notification guidelines.

Conclusion and Future Directions

Efforts to address TB under-reporting must focus on systemic improvements in healthcare delivery and reporting practices. Policymakers and healthcare stakeholders should prioritize digital reporting solutions, infrastructure enhancement, and equitable access to diagnostic and treatment services. Future research should explore the effectiveness of gender-specific interventions, assess the scalability of digital reporting systems in low-resource settings, and investigate the broader socioeconomic influences on TB notification. By tackling these challenges, stakeholders can strengthen TB surveillance systems, reduce reporting gaps, and advance global efforts to decrease TB incidence and mortality rates.

Author Contributions

Suryanti, MD, MPH, MMed, FIHFAA: Conceptualization, study design, data collection, data analysis, manuscript drafting, and final approval of the manuscript.
Dr.Idris Adewale Ahmed: Provided expertise in methodology, reviewed manuscript draft, and contributed to manuscript editing.
Dr. Hamzah, Sp.A KNA, KIC (K): Assisted in data collection and data analysis.
All authors have read and approved the final manuscript.

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Institutional Review Board Statement

This study has received ethical approval from the Research Ethics Committee of Universitas Dian Nuswantoro, with approval number 000464/Universitas Dian Nuswantoro/2023.

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Conflicts of Interest:

The authors declare no conflict of interest.

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