

Factors Contributing to Tuberculosis Relapse Among Patients Following Treatment Completion

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Abstract

Tuberculosis (TB) is a continuing major public health concern, and relapse is the most challenging determinant of treatment success and disease management. This study is descriptive research and determined the predictors of relapse of tuberculosis among patients once they have already undergone treatment. The respondent-population targets included TB DOTS enrollees who are covered exclusively for 2024 who are also facing recurrence of TB. Data were collected from 177 respondents, classified by age, sex, socio-economic status, comorbidities, treatment duration, and locality of residence. Findings suggest the greatest number of respondents lay within the 30-64 age bracket, with a largely male population. The largest percentage was in the lowest income category, highlighting economic vulnerability as a key determinant of TB recurrence. The most common comorbidities were hypertension and diabetes, conditions which are common to affect TB treatment outcomes. The majority of the respondents received the regular six-month TB treatment. The researcher used the adapted and modified questionnaire. Treatment adherence, lifestyle, and social support were rated as being most frequently experienced, followed by awareness of TB recurrence as the highest-rated factor. Statistical analysis also reflected important differences in treatment adherence according to comorbidities and residential area. Lifestyle was significantly affected by age, comorbidities, and residential area. Social support differed significantly with age, while knowledge of TB recurrence differed significantly according to residential areas. These results emphasize the influence of socio-economic and environmental determinants on TB recurrence and identify the potential importance of targeted interventions. This research suggested healthcare policies from the findings of the study to minimize the probability of tuberculosis recurrence.

Keywords: Tuberculosis (TB), TB Relapse, Treatment Adherence, Lifestyle, Social Support

Introduction

Tuberculosis (TB), caused by *Mycobacterium tuberculosis* (Mtb), is still a global health known issue that continues to impact millions. According to the World Health Organization (WHO, 2022), in the year 2022 alone, 1.3 million individuals lost their lives due to TB, with about 10.6 million being newly ill. The total includes 5.8 million men, 3.5 million women, and 1.3 million children. Though a preventable and curable illness, TB is still the global infectious killer, especially in low- and middle-income nations (Tarafdar, 2019). Appreciation of the subtleties of TB, particularly the determinants of relapse after treatment, is essential not just for patient outcomes at the individual level but also for global health strategies to stem this disease. By solving the issue of TB relapse, we can lend support to bigger discussions at a societal level concerning healthcare equity, prevention of diseases, and the importance of well-designed public health interventions.

Recurrent tuberculosis (TB) results when a patient develops multiple events either through re-infection or relapse by the same strain of *Mycobacterium tuberculosis* (Shao et al., 2021). Drug-resistant TB is also a leading reason for recurrence. In 2022, MDR/RR-TB led to an estimated 160,000 deaths worldwide (WHO, 2022), and in 2021, more than 350,000 relapse TB cases were reported, accounting for 5.5% of incident cases. In the Philippines, only 43% of the estimated 741,000 new and relapse TB cases were diagnosed and reported, with many going undiagnosed and untreated, putting more at risk of community transmission.

Among the primary problems to be addressed in this research is the fact that TB frequently recurs after successful completion of treatment. This factor becomes particularly essential among high prevalence sites, such as Negros Occidental, where socio-economic as well as health system issues further exacerbate the condition. Recurrent TB can be either relapse or reinfection, and it is very important to differentiate between the two mechanisms for proper control (Shao et al., 2021). The lack of understanding regarding the precise factors responsible for relapse in the patients of this local area presents a principal research challenge. In examining this question, this study is motivated to isolate and analyze the ultimate causes of relapse for TB, for guidance that will facilitate more appropriate

prevention and cure regimens.

The significance of exploring the factors leading to TB relapse cannot be overemphasized. Studies have demonstrated that recurrence after post-treatment plays a significant role in morbidity and mortality levels, making control of TB problematic and exerting pressure on the healthcare system (Anaam & Alrasheedy, 2023). Current evidence points to the impact of tackling the social determiner of health—including income status, education, and access to the healthcare system—on treatment completion and relapse rates (Florentino et al., 2022; Kaufmann, 2021; Shao et al., 2021). Further, real-life experience shows that there are usually impediments, which are financial difficulties and cultural belief systems that complicate their treatment adherence. The above considerations underpin the emergent need for investigating TB relapse in its entirety, thus making interventions salient and beneficial to the vulnerable groups.

Regardless of the prior literature on TB and its reappearance, it is evident that there are quite a number of gaps that continue to exist, which need further investigation. A lack of knowledge is one of the most significant weaknesses (Flores et al., 2021), especially with respect to socio-economic and cultural determinants for TB relapse in Negros Occidental. In Negros Occidental, a greater proportion of respondents indicated past TB treatment (38%), household contacts with TB (20%), and more intense symptoms like loss of appetite, weight loss, night sweats, and hemoptysis at the start of treatment compared to Cebu and Metro Manila (Cox et al., 2021). Whereas some research has analyzed overall relapse rates, few have considered how certain demographics influence treatment protocol adherence. In addition, there is a gap between research and practice, where the outcomes of research have not successfully translated to community-based interventions that solve local problems. The review of studies on adherence to tuberculosis (TB) treatment identifies several factors of non-adherence among different populations. Contributing factors common across populations are homelessness, incarceration, substance abuse (Jones et al., 2021), and socioeconomic determinants such as housing instability and employment (Ehnholt et al., 2022). Moreover, patient characteristics like forgetfulness, apprehension of side effects, and perception of good improvement during therapy also play roles in non-compliance (Ali & Prins, 2020; Zegeye et al., 2019).

This study will influence several important groups, particularly public health policymakers and local public health leaders. Policy makers can use the knowledge gained from the study to develop targeted interventions to reduce TB relapse rates in high-burden areas such as Negros Occidental. Knowing the respondents' profile when conducting research on tuberculosis (TB) relapse is important since several factors significantly affect the risk of recurrence. The difference of adulthood highlights age-dependent vulnerabilities, such as reduced immunity in the old and increased exposure risks in the young, each stage having distinct challenges and medical concerns (Halloran, 2024). Socioeconomic status is equally significant because the less privileged may struggle with healthcare access, sufficient nutrition, or adherence to treatment regimens. Moreover, co-morbidities such as diabetes, HIV/AIDS, and chronic illnesses may weaken the immune system, increasing vulnerability to tuberculosis (TB) and worsening the chances of relapse (Goletti et al., 2023). The place of residence also determines tuberculosis (TB) outcomes. Urbanization could potentially increase the risks of transmission, yet rural locations usually experience difficulties in accessing healthcare services. Urban settings tend to have poorer treatment outcomes than rural settings, likely due to crowding and higher rates of transmission (Singh & Ramamohan, 2020). Analysis of such profiles assists researchers in identifying key risk factors and designing targeted interventions, resulting in improved treatment outcomes and relapse reduction.

Literature Review

Epidemiology of Tuberculosis and Global Incidence Burden

Tuberculosis (TB) is still one of the most important worldwide health issues, even though it is a preventable and curable disease. The World Health Organization (WHO) estimates that about one-quarter of the global population is infected with *Mycobacterium tuberculosis*, the bacterium responsible for TB.

The Global Tuberculosis Report 2023 by the WHO reports that in 2021, an estimated 10.6 million new cases of TB occurred, with a global incidence of 132 cases per 100,000 population. Incidence is highest in low- and middle-income countries, especially in sub-Saharan Africa and certain regions of Asia (WHO, 2023). The rate of TB prevalence is high across regions with India, China, and Indonesia contributing a high percentage of the global burden (Dodd et al., 2021). The Philippines is ranked 8th among nations with the highest burden of TB with a calculated incidence rate of 554/100,000 population in 2021 (WHO, 2023).

The health burden of TB is heavy with high morbidity and mortality. TB contributed to an estimated 1.6 million deaths globally in 2021 (WHO, 2023) and was thus one of the leading infectious cause killers. However, disease burden goes beyond numbers killed and into years of life lost due to early death or disability (YLDs). An estimated 2.5 million YLDs were calculated to be from TB in the year 2019 by Global Burden of Disease Study (GBD 2019 Diseases and Injuries Collaborators, 2020).

The effect of TB relapse on public health in the Philippines is complex. The Department of Health (DOH) of the Philippines reported that TB caused about 25,000 deaths in 2021, thus it is one of the leading killers of infectious diseases (DOH, 2022). Relapses may result in increased healthcare expenses, longer morbidity, and greater risk of transmitting the disease to others. This cycle worsens the already burdened healthcare system, which is already under pressure due to high rates of incidence and scarce resources. Additionally, relapse cases frequently present in patients who might have been treated before but did not receive the full course of treatment or were treated with suboptimal regimens (Alcantara et al., 2022).

Public health programs should give due emphasis to not just the treatment of new cases but also follow-up and support for those who have already undergone TB treatment to avoid relapse. Proper follow-up care, education of patients, and addressing the social determinants of health are the most important elements of controlling relapse rates and overall TB control in the nation.

Methodology

Research Design

The descriptive research design was used in this study due to its suitability to present a clear and systematic description of the attributes related to a given phenomenon (Bouchrika, 2024). In-depth analysis of the causes of tuberculosis relapse after treatment of regimen 1 and 2 completion were involved in this study. Statistical tools and analysis were employed to achieve results that were objective, quantifiable, and testable or replicable and is essential in distinguishing patterns or associations between factors that are under scrutiny (Ahmad et al., 2019).

Respondents of the Study

The respondents of the study were those who are enrolled in the TBDOTS program for the inclusive year of 2024. These TB relapse respondents were enrolled in regimen 1 which lasted for 6 months and regimen 2 that is lasted for 12 months for continued treatment. All of the respondents of the study were from District 6 particularly from the Municipality of Candoni, Hinobaan, Ilog, Kabankalan City, and Sipalay City.

The research analyzed different independent variables associated with the respondents' profiles, such as their categorization of adulthood, gender, socioeconomic status, nature of comorbidities, duration of treatment, and place of residence. A total of 427 TB DOTS enrollees in CHICKS areas.

Sampling Method

This research employed proportionate stratified sampling. There were 427 patients (N) in the CHICKS area who were registered in 2024. With Modified Cochran tool at a 95 percent confidence level and 5 percent margin of error, the sample size (n) was 177.

Table 1. The sampling Distribution using proportionate stratified sampling using Modified Cochran

AREA	Population Distribution (N)	Sample Distribution (n)	%
Municipality of Candoni	30	12	7.03
Municipality of Hinobaan	95	39	22.25
Municipality of Ilog	50	21	11.71
Municipality of Cauayan	70	29	16.39
Kabankalan City	105	44	24.59
Sipalay City	77	32	18.03
Total	427	177	100

Research Instrument

The researcher made use of an adapted and adapted questionnaire for all of the following domains: Treatment Adherence (Al-Sayyad et al., 2020), Lifestyles (Alsharani et al., 2021), Social Support (Information Support, Emotional Support, Instrumental Support) (Fuady et al., 2022), and Awareness of TB Recurrence (Zhang et al., 2024). The first part of the instrument was the demographic profile of the respondents. The second part of the

instrument comprised of 20 questions regarding the tuberculosis relapse which the respondents rated using the 5 point Likert Scale and descriptions are as follows:

- 5 = Always
- 4 = Often
- 3 = Sometimes
- 2 = Rarely
- 1 = Never

Validity and Reliability of the Instrument

Since the researcher utilized an adapted and modified questionnaire, ensuring its validity via a rigorous validation process was paramount. The researcher utilized the Lawshe Content Validity Ratio (CVR) as a tool for validation, which was utilized by the panel of nine validators to examine the relevance and sufficiency of the instrument. Then, the Content Validity Index (CVI) was derived from their ratings and was computed as 0.93, reflecting a strong validity. All items in the test instrument were considered by the validators. The reliability of the instrument was administered at Himamaylan City. Himamaylan City is not part of District 6. There were 30 respondents who answered the survey questionnaire. The scores were tallied and was analyzed using Chronbach's alpha. The reliability test was 0.82 and was reliable and consistent.

Data Collection Procedure

This research undertaking involved an important step in the data gathering process. A systematic and ethical approach was performed. Through a formal letter of permission, permission was sought from the Municipal and City Health Office under the TB DOTS program. This was an important first step in securing official clearance and enlisting the cooperation of those responsible in accessing the data needed.

Upon receiving approval, the researcher distributed the questionnaires to the corresponding respondents. In order to retrieve the pertinent details regarding TB relapse and its sequela the questionnaires were well designed. The researcher also got data from the health office through massive contents on data relevant to the study to further make wide-ranging understanding of the topic. The instrument containing dealing questions for TB relapse were completed by the respondents. In case of respondents with reading difficulties, the researcher provided help and assistance to them in answering the questions. To collect the data, the researcher complied with the health protocols by using a mouth mask and social distance to avoid contact with the respondent. Confidentiality and privacy was practiced in the conduct of this study and orientation was conducted before the distribution of the questionnaire to be answered by the respondents of the study. This ensured transparency, informed consent, and affirmation of voluntary participation.

Statistical Treatment Analysis

Frequency count and percentage distribution were employed to determine the respondents demographic profile in terms of categorization of age, sex, socio-economic status, comorbidities, duration of treatment, and area of residence.

Mean and standard deviation were employed in determining the level of tuberculosis recurrence contributing factors regarding treatment compliance, lifestyles, social support, and TB recurrence awareness.

To ascertain the critical difference in the extent of tuberculosis recurrence, contributing factors were categorized based on respondents' profiles. A t-test and ANOVA were utilized.

At the level of frequency of tuberculosis recurrence among patients, the scale was employed for interpretation.

In interpreting gathered data, the following range and interpretations were followed:

Mean Numerical Rating	Descriptive Interpretation
4.50 – 5.00	Always
3.50 – 4.49	Often
2.50 – 3.49	Sometimes
1.50 – 2.49	Rarely
1.00 – 1.49	Never Observed

Ethical Considerations

Ethical concerns were at the forefront of this research project, and this study of tuberculosis (TB) recurrence was no different. The ethical framework that informed this research included a number of important aspect to protect the well-being, rights, and privacy of the respondents while preserving the integrity of the research process.

One of the principal ethical issues was the securing of informed consent from all research participants. Participants were fully informed on the goals of the study, procedures, potential harms, and benefits prior to their participation in the study. They were free to pose questions and gave voluntary, informed consent. A lot of care was taken to inform participants about their rights to back out or not participate in the study at any time without facing harmful repercussions.

Participants' privacy and confidentiality were of extreme significance. Every care was taken to ensure that the participants' identity was secured through the use of unique identifiers in responses and that no participant's information was revealed in publications or presentations stemming from the study. The data are kept on a password-protected laptop and document-protected laptop with a password, to which access is limited and controlled by the researcher. Respecting participants' autonomy entailed recognition of their right to decide regarding being involved in the research. This entailed the right to decline to participate, withdraw from participating at any time, or omit certain questions in the questionnaire without adverse repercussions. Vulnerable groups like persons suffering from TB were especially protected.

Before the start of the study, clearance was obtained from the appropriate department. This ensured that the research design, procedures, and protections were consistent with accepted ethical guidelines. The researchers strictly followed the guidelines during the study. The researcher also pledged to report the results openly, including any unanticipated results or difficulties encountered during the research process. Open and truthful reporting ensured the integrity of the research and helped in the development of scientific knowledge.

Access to the data was strictly restricted to the researcher. Policies regarding data retention were implemented to guarantee responsible management, with data retained for five years after the conclusion of the study to facilitate verification and follow-up analyses if needed. Beyond this time, all personally identifiable data would be completely erased or destroyed through secure data disposal techniques like digital wiping and physical paper shredding.

Respecting participants' autonomy involved recognition of their right to have control over whether or not they participated in the study. This was the right to refuse to participate, withdraw from the study at any time, or to omit certain questions on the survey without repercussion. The autonomy of vulnerable groups, like people with TB, was especially protected through further consent processes and open communication about their rights.

The researcher also pledged to report their results openly, including any unforeseen results or difficulties that arose during the research process. Honest and open reporting in a clear manner ensured the validity of the research and helped in the development of scientific knowledge. These ethical promises ensured that the rights, privacy, and dignity of the participants were maintained throughout the research process.

Results and Discussion

Table 2: Profile of the respondents

Profile	Frequency	Percentage Distribution
Age		
12 to 18 Years Old (Adolescent)	30	16.9
19 to 29 Years Old (Early Adult)	58	32.8
30 to 64 Years Old (Middle Age)	65	36.7
65 Years Old and Onward (Old Age)	24	13.6
Sex		
Male	119	67.2
Female	58	32.8
Socio-economic Status		
less than 9, 520	115	65.0
between 9, 520 - 19, 040	52	29.4
between 19, 040 - 38, 080	8	4.5
between 38, 080 - 66, 640	2	1.1

Types of Comorbidities

Diabetes	48	27.1
CRD	5	2.8
Malnutrition	8	4.5
Substance use disorder	2	1.1
CKD	7	4.0
Cancer	2	1.1
Hypertension	44	24.9
Others	17	9.6
None	44	24.9

Duration of Treatment

Regimen 1 (6 Months)	175	98.9
Regimen 2 (12 Months)	2	1.1

Area of Residence

Cauayan	29	16.4
Hinobaan	39	22.0
Ilog	21	11.9
Candoni	12	6.8
Kabankalan	44	24.9
Sipalay	32	18.1

Total	177	100%
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Table 2 shows the respondents' demographic profile, such as age, sex, socio-economic status, comorbidity types, treatment duration of TB, and residential area. Most of the respondents were in the Middle Age group (30–64 years old), at 36.7% (n=65), followed by the Early Adult group (19–29 years old) at 32.8% (n=58). Adolescents aged 12–18 years constituted 16.9% (n=30), while the Old Age group aged 65 years and above accounted for 13.6% (n=24). These statistics indicate that TB recurrence occurs more often among middle-aged and older individuals, perhaps because of factors including age-related compromise in immune status and comorbidities.

The predominant majority of the respondents were male (67.2%, n=119), while 32.8% (n=58) were female. This concurs with previous findings that men are more prone to recurrent TB, possibly because they have greater exposure to risk factors like smoking, alcohol consumption, and workplace hazards.

The majority of the respondents (65.0%, n=115) reported earning less than PHP 9,520 per month, which puts them below the poverty line. Another 29.4% (n=52) earned PHP 9,520–19,040, and only 4.5% (n=8) earned between PHP 19,040–38,080. The fewest respondents (1.1%, n=2) earned between PHP 38,080–66,640. Such statistics highlight the economic susceptibility of TB patients, since lower incomes can hamper access to healthcare, adequate nutrition, and drug compliance—variables associated with disease relapse.

Among the participants, Diabetes (27.1%, n=48) and Hypertension (24.9%, n=44) were the most prevalent comorbidities. Moreover, 4.5% (n=8) of participants experienced Malnutrition, 4.0% (n=7) had Chronic Kidney Disease (CKD), and 2.8% (n=5) had Chronic Respiratory Disease (CRD). On the other hand, 1.1% (n=2) had Cancer or Substance Use Disorder. Interestingly, 24.9% (n=44) did not have any comorbidities, which suggests that although the contributing factor to recurrent TB is health conditions, other risk factors like lifestyle, environment, and access to healthcare might also be important.

Majority of the respondents (98.9%, n=175) received treatment under Regimen 1 (6-month treatment regimen), whereas a mere 1.1% (n=2) were treated under Regimen 2 (12-month treatment regimen). This suggests that the majority of the TB relapse cases occurred in spite of compliance with the standard 6-month treatment, underscoring the necessity for extensive research on treatment efficacy, compliance, and follow-up after treatment.

Based on the results, TB relapse is more frequent among older, male, and low-income population groups. Additional comorbid conditions, most notably diabetes mellitus and hypertension, also augment the risk for relapse. The prevalence of TB in selected municipalities also raises concerns regarding site-specific interventions enhancing adherence to treatments and post-cure care. The mitigation of these determinants by improved health care services, specific education programs, and social economic support will considerably decrease recurrence rates of TB among affected communities.

Table 3. Extent of tuberculosis recurrence contributing factors in terms of treatment adherence, lifestyles, social support, and awareness of TB recurrence

Table 3 shows the degree to which various determinants cause recurrence of tuberculosis (TB), with special emphasis on treatment compliance, lifestyle, social support, and level of awareness towards recurrence of TB. The findings reveal to what extent respondents experience or adopt these determinants as evidenced through their mean scores and standard deviations.

Factors	Mean	Standard Deviation	Interpretation
Treatment Adherence	3.97	0.31	Often
Lifestyle	3.77	0.48	Often
Social Support	3.49	0.41	Often
Awareness of TB Recurrence	4.48	0.42	Always

A mean score of 3.97 implies that respondents frequently comply with their TB drug regimen. The fairly low standard deviation of 0.31 suggests response consistency. Adherence is fairly high, though there may be occasional slips that could lead to recurrence of TB. Non-adherence to TB treatment is linked with unfavorable treatment outcomes such as death and failure of treatment (Chimeh et al., 2020). Such barriers as psychological distress associated with hospital-based treatment, unsupportive communication with healthcare providers, economic pressures, and increased pill burden can affect compliance with treatment, influencing overall success in treatment (Aibana et al., 2020).

The respondents score an average of 3.77, frequently practicing behaviors that can impact recurrence of TB. The standard deviation (0.48) indicates some degree of variation in responding. Dietary, smoking, alcohol use, and exercise lifestyle factors may significantly influence TB disease progression and relapse. Smoking has a detrimental effect on the treatment of TB, decreasing the cure rate and raising the dropout rate (Vargas et al., 2021). Undernutrition is correlated with poor outcomes in drug-resistant TB, and severe undernutrition is correlated with treatment failure (Baluku et al., 2021). Unhealthy lifestyle habits can cause compromised immunity, making one more prone to recurrence even after treatment.

The average score of 3.49 shows that respondents receive social support from family, friends, or medical professionals, albeit less than that for treatment compliance and lifestyle.

The moderate standard deviation (0.41) indicates some difference in the amount of support obtained. Social support is essential to ensure treatment compliance, mental health, and access to medical care. Support from families is a key determinant in influencing TB treatment regimen adherence (Barik et al., 2020; Suparjo et al., 2020). Emotional, informational, and instrumental support facilitate TB patients to comply with their treatments, while peer group support and community program interventions also contribute positively towards adherence and recovery (Suaranti et al., 2021). Family support improves TB patients' quality of life by boosting motivation and confidence and enhancing medication adherence (Lutfian et al., 2024).

With the highest mean score (4.48) and a relatively low standard deviation (0.42), the respondents know the symptoms, risks, and preventative measures for tuberculosis recurrence.

Education programs improve treatment compliance and outcomes by increasing patients' knowledge of tuberculosis (Yousif et al., 2021). However, tangible measures must promote awareness to convert understanding into long-term preventive practices.

The study indicates that the level of awareness of TB relapse is high, but treatment adherence, daily habits, and social support are areas with gaps that can impact the risk of TB relapse. Low household income is found to

significantly enhance the risk of TB relapse, with the most significant risk recorded in the poorest income groups (Chung et al., 2023). Anxiety and depression are prevalent, and they impact the results of the treatment (Agbeko et al., 2020). Psychological interventions that improve compliance and reduce distress are necessary (Agarwal & Sarthi, 2020).

Table 4.a Significant difference in the extent of tuberculosis recurrence contributing factors when grouped according to the respondents' profiles.

Profile	Treatment Adherence			Lifestyle		
	t-test/ ANOVA	p-value	Int.	t-test/ ANOVA	p-value	Int.
Age	0.459	0.711	Not Sig	3.947	0.009	Sig
Sex	0.557	0.578	Not Sig	-0.842	0.401	Not Sig
Socio-economic Status	1.516	0.212	Not Sig	0.728	0.537	Not Sig
Types of Comorbidities	2.411	0.017	Sig	3.271	0.002	Sig
Duration of Treatment	-0.118	0.906	Not Sig	0.308	0.810	Not Sig
Area of Residence	10.733	0.000	Highly Sig	1.516	0.001	Sig

Table 4.a shows the statistical comparison of the contributing factors of tuberculosis (TB) recurrence—treatment adherence and lifestyle—when classified by respondents' demographic and health-related profiles. With the use of t-tests and ANOVA, the findings show that age, sex, socio-economic status, comorbidity types, treatment duration, and residential area may or may not significantly affect these factors.

In terms of treatment compliance, the results indicate that no significant variations exist based on age ($p = 0.711$), sex ($p = 0.578$), socio-economic status ($p = 0.212$), and treatment duration ($p = 0.906$), implying that these factors do not significantly determine whether or not patients adhere to their TB treatment protocol. But types of comorbidities ($p = 0.017$) had a significant effect, meaning that patients with several or severe illnesses can have extra difficulty in sustaining adherence, as supported by research demonstrating that comorbidities like diabetes and HIV/AIDS complicate TB treatment outcomes (Dauphinais et al., 2024). The residence location area ($p = 0.000$) demonstrated a significant difference, highlighting the fact that patients from other places—urban or rural—are having different levels of access to healthcare, medication supplies, and compliance with follow-ups, as reflected in research revealing that treatment outcome is largely determined by healthcare facilities (Mohammed Elmuttalut, 2024).

Of lifestyle determinants, age ($p = 0.009$) had a significant effect, indicating varying health behaviors, including smoking, alcohol intake, and diet, among different age groups that are responsible for TB relapse. This is evidenced by studies pointing to the fact that substance abuse and unhealthy dieting predispose individuals to TB relapse (Ragan et al., 2020; Carwile et al., 2022). In the same manner, comorbid types ($p = 0.002$) greatly affected lifestyle, in the sense that those who have certain health conditions take on activities that might increase TB risks. At the same time, sex ($p = 0.401$), socio-economic status ($p = 0.537$), and treatment duration ($p = 0.810$) did not reveal a difference, meaning that these factors do not significantly influence lifestyle-based TB recurrence risks.

Yet again, the residential area ($p = 0.001$) was significant, affirming the influence of environmental and community determinants on health behaviors. Unhygienic living conditions, crowding, and poor ventilation have been found to enhance TB transmission and recurrence rates (Yosua et al., 2022; Sriratih et al., 2021). Moreover, economic difficulties in TB-affected families have been found to lead to lifestyle difficulties, even with free treatment services (Muniyandi et al., 2020).

Therefore, the significant implications of these findings highlight the importance of the place of residence as the most overwhelming factor in compliance with treatment and lifestyle, meaning that interventions should be directed towards optimizing healthcare accessibility across different settings. The type of comorbidities is also an essential problem, necessitating specially targeted interventions among individuals with pre-existing health conditions. Even though age significantly affects lifestyle, treatment adherence is not influenced by it, meaning that TB treatment strategies must be less health-state and environmental determinant-driven than total demographic factors. Mental illness, including addiction, depression, and anxiety, also leads to poor results of TB treatment (Thungana et al., 2022; Lee et al., 2020). According to the existing evidence that scaling up mental health care in TB programs improves adherence and outcomes (Pradipta et al., 2020), policymakers must implement holistic interventions to meet TB care's medical and psychosocial needs.

Such outcomes suggest that intervention through the public must emphasize ensuring enhanced localized provision of healthcare as well as comorbid person-specific assistance to promote greater compliance and healthier alternatives, reducing recurrent TB. It can also lead to improved patient compliance through utilization of directly observed treatment (DOT), short messaging alerts, as well as neighborhood-based education modules (Dave & Rupani, 2022; Pradipta et al., 2020). Breaking financial constraints by direct benefit transfer (DBT) schemes can also help patients with proper nutrition during treatment (Muniyandi et al., 2020). With a combination of medical, environmental, and socio-economic interventions, TB control programs can be more effective in preventing relapse and improving patient outcomes.

Table 4.b. Significant difference in the extent of tuberculosis recurrence contributing factors when grouped according to the respondents' profiles

Profile	Social Support			Awareness of TB Recurrence		
	t-test/ ANOVA	p-value	Int.	t-test/ ANOVA	p-value	Int.
Age	4.135	0.007	Sig	0.765	0.515	Not Sig
Sex	1.088	0.278	Not Sig	-0.259	0.796	Not Sig
Socio-economic Status	0.547	0.651	Not Sig	2.487	0.062	Not Sig
Types of Comorbidities	0.762	0.636	Not Sig	1.325	0.234	Not Sig
Duration of Treatment	1.371	0.172	Not Sig	-0.075	0.940	Not Sig
Area of Residence	9.511	0.000	Highly Sig	4.221	0.001	Sig

Table 4.b shows the statistical comparison of the significant social support and awareness of TB recurrence when grouped based on respondents' demographic and health-related profiles. Through t-tests and ANOVA, the table determines which factors significantly affect social support and TB recurrence awareness.

The findings indicate that age ($p = 0.007$, Sig) is significant in determining social support, implying that there are differences in levels of support from family, peers, and healthcare professionals for different age groups. Older patients can depend on family support more, whereas young people might respond to peer-based interventions (Kerkhoff et al., 2022). Support from families is important in enhancing medication compliance and quality of life in TB patients since emotional and supportive help boosts confidence, motivation, and treatment outcomes (Barik et al., 2020; Lutfian et al., 2024). Social support from family, peers, and healthcare workers is a principal stimulator of medication adherence (Suparjo et al., 2020). Sex ($p = 0.278$), socioeconomic status ($p = 0.651$), comorbidities ($p = 0.636$), and length of treatment ($p = 0.172$) do not significantly differ from one another, suggesting that these factors have little effect on how much social support people receive. Residence area ($p = 0.000$) is significant at a very high level, indicating that respondents from various geographical areas—urban and rural—have different levels of social support, possibly as a result of differences in healthcare access, networks in the community, and government assistance availability (Singh et al., 2023). Rural patients usually encounter problems such as limited access to healthcare, reduced education, and increased distances to medical facilities, leading to TB diagnosis and treatment adherence delays (Singh & Ramamohan, 2020).

Regarding awareness of TB recurrence, age ($p = 0.515$), sex ($p = 0.796$), socio-economic status ($p = 0.062$), types of comorbidities ($p = 0.234$), and duration of treatment ($p = 0.940$) all show no significant impact, meaning that these variables do not influence how well respondents understand TB recurrence risks. This indicates that awareness levels are similar among various demographic groups, perhaps because there are standardized health education programs (Craciun et al., 2023). Area of residence ($p = 0.001$), however, is significant, and it implies that location is very important for TB awareness. Research indicates that people living in urban areas tend to have superior TB knowledge, whereas rural dwellers could have more favorable attitudes toward TB (Oladele et al., 2020). Patients in rural areas tend to have lower literacy and poorer access to healthcare, resulting in delayed treatment and non-adherence (Singh et al., 2023). Stigma is also a both rural and urban obstacle, deterring early detection and compliance (Oladele et al., 2020).

Depression and anxiety are prevalent among TB patients and can adversely affect treatment compliance and outcomes (Agbeko et al., 2022; Farooq et al., 2021). Psychological distress is also exacerbated by socioeconomic disadvantage, social disapproval, and stigma (Farooq et al., 2021).

It has been shown that integration of mental health services within TB treatment programs increases treatment completion, as well as decreases symptoms of depression and anxiety (Pasha et al., 2021). Peer support and family can alleviate these complications, thus enhancing success and adherence rates (Suarnianti et al., 2021).

There are also gender differences in TB care trajectories, with men prioritizing work ahead of health-seeking actions, while women experience more prolonged delays in diagnosis but are helped by greater social networks (Daniels et al., 2021; Kerkhoff et al., 2022).

Economic factors such as job loss and medical expenses may impact both social support systems and the level of awareness about TB (Rui & Du, 2023; Craciun et al., 2023). Studies have shown that higher socioeconomic status and education levels are related to improved TB knowledge and access to support groups (Rui & Du, 2023). Nevertheless, government TB control programs tend not to have particular social support programs but rather address general social vulnerability (Zeitoune et al., 2022). Policies supporting digital health interventions (DHIs), including SMS reminders, medicine taking apps, and online counseling, have been successful in enhancing treatment outcomes (Lee et al., 2023). These interventions are especially beneficial where patients have limited physical access to healthcare and peer support groups (Musiimenta et al., 2020).

The results highlight that the area of residence and age are the most significant determinants of social support and awareness regarding TB. Older adults have more social support, while geographic variation impacts support systems as well as TB awareness levels. The lack of significance in findings for sex, socio-economic status, comorbidities, and treatment length shows that these factors do not directly influence social support or awareness, affirming the need for targeted interventions in under-served groups rather than general demographic-based policies.

Conclusion

The results of the study revealed that TB relapse is found to occur more frequently in older people, men, and those from poorer socioeconomically stratified backgrounds. Comorbidities in patients like diabetes and hypertension increases the risk of TB relapse. The study finds persistent gaps in lifestyle practices and social support networks that are significant causes of relapse, even though patients have high rates of treatment compliance. The recurrence of TB is surprisingly well known. However, this knowledge is rarely applied to routine preventive actions, indicating a disconnect between behaviour modification and information sharing. These findings emphasize that not only is TB recurrence a clinical issue but also a complex socio-economic and psychological issue. This study contributes greatly to public health by identifying key demographic, social, and health-related predictors of TB relapse. Through a better understanding of these risk factors, the study enables more effective and targeted interventions. Policymakers, practitioners, and community leaders can use the findings to build holistic TB control strategies that move beyond the mere treatment of medical conditions—melding mental health care, financial assistance, and health education drives. In addition, the results emphasize the need to reinforce rural and underserved region healthcare systems and patient support networks. Community-based programs, augmenting the accessibility of mental health resources, and fostering healthy behaviors for sustainability towards curbing TB recurrence rates is imperative.

Appendix A**POLICY BRIEF****ADDRESSING TUBERCULOSIS RECURRENCE: KEY FINDINGS AND POLICY IMPLICATIONS****ERNALYN E. JAMON, RN**

Researcher

EXECUTIVE SUMMARY/OVERVIEW

Tuberculosis (TB) recurrence remains a significant public health challenge, jeopardizing treatment success and increasing disease transmission. Although TB treatment programs already exist, relapse continues owing to socioeconomic factors, comorbidities, and behaviors. This study investigated TB relapse among the patients registered with the TB DOTS program at District 6 in 2024, considering the major contributing factors like adherence to treatment, lifestyle habits, social support, and knowledge of the recurrence of TB. Findings revealed that relapse was more common among males and economically disadvantaged individuals, with diabetes and hypertension as the most prevalent comorbidities. Treatment adherence varied by comorbidities and residence, while age, comorbidities, and location influenced lifestyle factors. Social support differed by age, and awareness of TB recurrence varied by residence. These findings suggest the need for interventions according to the specific requirements, like better treatment observance, stronger social support systems, and economic support to vulnerable groups. Providing universal healthcare accessibility, promoting healthier lifestyles, and integrating mental care into TB program management can reduce recurrence rates. Public health policies should focus on community-based interventions, awareness campaigns, and financial support for at-risk populations to strengthen TB control efforts and prevent relapse.

To address the TB recurrence, the following options are made:

- Strengthening Treatment Adherence Programs
- Addressing Socioeconomic Barriers
- Enhancing Public Awareness and Education
- Expanding Social and Community Support
- Improving Healthcare Infrastructure and Accessibility

BACKGROUND AND SIGNIFICANCE

Tuberculosis is a global health threat to mankind. If, quality healthcare is absent, rising of TB infections will rise and TB relapse will surge too. This issue must be addressed to protect vulnerable populations and improve public health outcomes.

The Philippines ranks fourth worldwide in TB incidence, with about 1 million active cases and 70 daily deaths (Flores et al., 2022). Despite the effectiveness of the Directly Observed Treatment, Short-course (DOTS) program, TB relapse continues to pose challenges due to incomplete treatment adherence, socioeconomic barriers, and comorbid conditions like diabetes mellitus, which complicate treatment outcomes (Khattak et al., 2024). Psychological distress, lack of social support, and financial burdens hinder adherence (Aibana et al., 2020; Appiah et al., 2023).

In District 6—comprising the municipalities of Candoni, Hinoba-an, Ilog, Kabankalan, and Sipalay City—TB recurrence among patients who have completed initial treatment raises concerns about existing healthcare interventions.

Economic weaknesses and restricted access to healthcare centers increase the likelihood of relapse, especially in rural areas where patients experience transport challenges (Dlangalala et al., 2024; Marahatta et al., 2020). Moreover, shortages in TB diagnostic equipment, laboratory reagents, and trained personnel hinder effective TB control (Mohammed et al., 2020; Lisboa et al., 2020).

This research is critical to informing healthcare practitioners, policymakers, and community health programs regarding the root causes of TB relapse. Through risk factors like low treatment adherence, lifestyle factors, and lack of social support, the research provides evidence-based findings for more efficient interventions. Better TB management through enhanced healthcare facilities, socioeconomic support, and targeted awareness programs can help lower relapse rates and improve long-term health outcomes for affected populations.

POLICY STATEMENT

Tuberculosis (TB) remains a critical global health concern, particularly in high-burden countries such as the Philippines, Indonesia, and Bangladesh. Despite the availability of the Directly Observed Treatment, Short-course (DOTS) program, TB relapse continues to pose a threat to public health, increasing transmission rates, healthcare costs, and mortality (Flores et al., 2022). Recurrence is particularly prevalent among economically disadvantaged individuals and those with comorbid conditions like diabetes and hypertension (Hossain et al., 2020; Khattak et al., 2024).

Obstacles like food insecurity, transportation costs, and the absence of social support further contribute to low treatment adherence and relapse (Appiah et al., 2023). To manage the recurrence of TB, the following options are created: Strengthening Treatment Adherence Programs, Overcoming Socioeconomic Barriers, Raising Public Awareness and Education, Increasing Social and Community Support, and Enhancing Healthcare Infrastructure and Accessibility.

To mitigate TB recurrence, this policy calls for a multi-sectoral approach that prioritizes strengthening treatment adherence programs, addressing socioeconomic status, enhancing public awareness and education, expanding social and community support, improving healthcare infrastructure and accessibility through patient-centered care, expanding financial assistance, and reinforcing health education. Overcoming resource constraints—shortages of TB diagnosis equipment and patient volumes—is key to enhancing treatment accessibility within rural and underserved communities (Hussen Mohammed et al., 2020; Miguelhete Lisboa et al., 2020). Finally, enhancing community-based awareness programs and coordination among healthcare providers, local authorities, and NGOs will enhance post-treatment follow-up and long-term patient outcomes (Marahatta et al., 2020).

POLICY OPTIONS

The following are the proposed policy options tailored to the results of the study:

1. Enhancing Treatment Adherence

The barangay health workers should conduct regular home visits. A reward-based program may help improve patients' adherence and reduce TB relapse or reinfection.

2. Addressing Socioeconomic Barriers

To limit the number of patients and the recurrence of TB, assistance, livelihood training, improved PhilHealth benefits, and easily accessible centers should be offered by the government and other agencies. These interventions may lead to tackling socioeconomic barriers, one reason why treatment adherence and recurrence occur.

3. Boosting Public Awareness

Public education campaigns are the key to decreasing TB recurrence and relapse. It is easy to control and minimize TB relapse in the community as long as everyone is well-sensitized to the risk and potential harm of relapse and tuberculosis. Teachers and pupils from different schools and employees from different workplaces should attend seminars organized by health experts.

4. Strengthening Social and Community Support

Social and community support is essential in preventing TB relapse since it provides hope rendering patients to feel a sense of belongingness. Patient support groups, local government and NGO partnerships, and community health volunteer mobilization can enhance treatment success rates and eliminate the stigma surrounding TB.

5. Improving Healthcare Infrastructure

Expanding TB treatment centers, implementing mandatory post-treatment monitoring, and developing a national TB patient registry can facilitate early detection and provide better long-term patient care.

CRITERIA FOR POLICY BRIEF

CRITERIA	DEFINITIONS	POLICY OPTIONS				
		Strengthening Treatment Adherence	Addressing Socioeconomic Barriers	Enhancing Public Awareness	Expanding Social and Community Support	Improving Healthcare Infrastructure
Effectiveness	The ability of the policy to achieve their intended objectives in improving TB management and community health outcomes.	3	3	3	3	3
Feasibility	The practicality and viability of implementing policy within the local context, considering available resources and stakeholder capacity.	3	3	3	3	3
Equity	Ensuring fairness in resource distribution and access to TB management services across the community.	3	3	3	3	3
Sustainability	The capacity of policy options to be maintained over the long term, with continued support and funding.	3	3	3	3	3
Compliance	Ensuring adherence to existing TB management guidelines and regulations.	3	3	3	3	3
Cost-effectiveness	Maximizing the impact of resources to achieve desired outcomes in TB management.	3	3	3	3	3
Accessibility	Ensuring easy access to TB management services for all individuals in the community.	3	3	3	3	3

RECOMMENDATION

To address TB relapse and improve patient outcomes, the following measures are proposed:

1. Strengthen Treatment Adherence – Implement digital adherence tools (e.g., SMS reminders and mobile apps), enhance community-based support through home visits, and provide financial and nutritional assistance for low-income TB patients.

2. Improve Socioeconomic Support – Create livelihood initiatives for TB survivors, promote safety measures at work, and provide free or heavily discounted medical care to those who are most in need.
3. Expand Public Awareness and Education – Conduct community education on TB relapse prevention, develop culturally appropriate IEC materials, and integrate TB awareness into schools and workplaces.
4. Enhance Healthcare Infrastructure –Increase funding for state of the art facilities for TB treatment, integrate TB treatment into primary care so that TB patients will be given priority, and train medical personnel in recurrence management.
5. Develop Localized TB Policies – Create TB action plans at the local level, fortify public-private partnerships, and set up monitoring systems to assess the success of interventions.

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