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Research Article

Determinants of Prolonged Hospital Stay and In-Hospital Outcomes among Tuberculosis Patients in Sri Lanka

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Abstract

Background: Tuberculosis (TB) remains a major public health challenge in low- and middle-income countries. Although most patients are managed on an outpatient basis, some require hospitalisation due to disease severity, comorbidities, adverse drug reactions, or social factors limiting safe outpatient care. Understanding factors associated with prolonged hospital stay and adverse in-hospital outcomes is important for optimising patient management and healthcare resource utilisation.

Methods: A descriptive cross-sectional study was conducted among adult patients with tuberculosis admitted to the National Hospital for Respiratory Diseases in Sri Lanka from January to February 2026. Data were collected using interviewer-administered questionnaires and clinical records. Patients with pulmonary and extrapulmonary tuberculosis were included. Length of hospital stay was categorised, and prolonged hospitalisation was defined as a stay exceeding 14 days. Adverse outcomes were defined as death, leaving against medical advice (LAMA), or absconding during admission. Associations were assessed using Chi-square or Fisher's exact tests.

Results: A total of 141 patients were included (mean age 56.0 ± 14.9 years; 76.6% male). Pulmonary tuberculosis accounted for 123 (87.2%) cases, while others had extrapulmonary tuberculosis. Most patients were newly diagnosed cases (80.1%). Diabetes mellitus was present in 29.8% of patients, and 66.0% had a history of smoking. Prolonged hospitalisation (>14 days) occurred in 41.1% of patients. Adverse outcomes were observed in 13.5% of patients. Among the nine deaths recorded, respiratory failure was the leading cause of death, followed by myocardial infarction, sepsis/septic shock, and disseminated tuberculosis. No statistically significant associations were identified between socio-demographic, clinical, or behavioural factors and prolonged hospital stay or adverse outcomes.

Conclusion: Hospitalised tuberculosis patients commonly had multiple comorbidities, behavioural risk factors, and social vulnerabilities. Prolonged hospitalisation was frequent, likely reflecting disease severity and healthcare system factors rather than individual socio-demographic characteristics alone. Strengthening integrated inpatient and outpatient TB care pathways may help optimise patient outcomes and reduce prolonged hospital stays.

Keywords: Tuberculosis, hospitalisation, length of stay, adverse outcomes, comorbidities, Sri Lanka

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Introduction

Tuberculosis (TB) is an airborne infectious disease caused primarily by *Mycobacterium tuberculosis*, and less commonly by *Mycobacterium africanum* and *Mycobacterium bovis*. Tuberculosis primarily affects the lungs but may also involve extrapulmonary sites [1]. Despite being preventable and curable, TB remains one of the leading causes of death from a single infectious agent worldwide.

Globally, tuberculosis continues to pose a major public health challenge, particularly in low- and middle-income countries. According to the WHO, an estimated 10.8 million people developed TB in 2023, and the disease has re-emerged as the leading cause of death from a single infectious agent following the COVID-19 pandemic [2,3,4]. The burden of TB is closely associated with social determinants such as poverty, overcrowding, malnutrition, and limited access to healthcare [4].

Beyond its direct health effects, TB imposes substantial socioeconomic and psychological burdens on affected individuals and their families. Patients frequently experience loss of income, financial hardship, and social stigma, which may negatively influence healthcare-seeking behaviour and treatment adherence [4]. Although approximately 85% of patients can be successfully treated with current regimens, prolonged treatment duration and adverse drug effects may contribute to poor adherence and treatment interruption [2]. Inadequate adherence not only compromises individual outcomes but also increases the risk of transmission and development of drug-resistant tuberculosis.

In Sri Lanka, tuberculosis control is coordinated through the National Programme for Tuberculosis Control and Chest Diseases (NPTCCD), which operates in alignment with the WHO End TB Strategy. Specialised respiratory units have been established to provide inpatient care for patients requiring close monitoring, including those with severe disease, significant comorbidities, adverse drug reactions, or social circumstances that limit safe outpatient care [5]. The National Hospital for Respiratory Diseases (NHRD), Welisara, serves as the main tertiary referral centre for such patients.

While the majority of TB patients are managed on an outpatient basis using directly observed treatment (DOT), a subset requires hospital admission due to clinical, social, or behavioural factors. Hospitalisation has important implications for patient outcomes, healthcare resource utilisation, and infection control [6]. Previous studies have shown that demographic characteristics, comorbidities, behavioural factors such as smoking and alcohol use, and social determinants may influence hospitalisation and treatment outcomes among TB patients [7,8,9,10].

Previous studies have demonstrated that demographic characteristics, comorbidities, behavioural risk factors, and social determinants may influence hospitalisation patterns and treatment outcomes among TB patients. However, there is limited published data from Sri Lanka, particularly from specialised respiratory centres such as the National Hospital for Respiratory Diseases (NHRD), Welisara, examining factors associated with prolonged hospitalisation and adverse outcomes among admitted tuberculosis patients. Therefore, this study aimed to describe the socio-demographic, clinical, behavioural, and social characteristics of adult tuberculosis patients admitted to NHRD and assess their association with length of hospital stay and in-hospital outcomes.

Methods

Study design and setting

This descriptive and analytical cross-sectional study was conducted at the NHRD, Welisara, Sri Lanka, the national tertiary referral centre for respiratory diseases and tuberculosis. Data were collected from all dedicated tuberculosis wards (Wards 07, 09, 11, 12, and 15) and the tuberculosis High Dependency Unit (Ward 08). The study was carried out over two months from 1 January to 28 February 2026.

Study population and sampling

The study population comprised adult patients diagnosed with pulmonary or extrapulmonary tuberculosis who were admitted to TB wards or the TB High Dependency Unit during the study period. Patients were eligible for inclusion if they were aged 18 years or more and had a confirmed or clinically established diagnosis of tuberculosis.

Patients were excluded if they were unable to provide informed consent and no proxy respondent was available, or if essential clinical data required for analysis were missing from medical records. A consecutive sampling method was used, whereby all eligible patients admitted during the study period were included.

The sample size was calculated using the formula for estimating a single population proportion:

$n = Z^2P(1-P) / d^2$. Assuming a 95% confidence level, an expected proportion of 50% in the absence of recent local data, and a precision of 5%, the calculated minimum sample size was 384 participants. Since the estimated number of eligible TB admissions during the study period was approximately 120, finite population correction was applied using the standard formula, resulting in a minimum required sample size of 92 participants. Because approximately 120 patients were expected to be admitted during the study period, all eligible patients admitted consecutively were included in the final analysis. A total of 141 patients were ultimately included.

Patients included in the study comprised both individuals admitted with an established diagnosis of tuberculosis and patients diagnosed during hospitalisation following clinical, radiological, microbiological, or histopathological evaluation.

Data collection

Data were collected using an interviewer-administered structured questionnaire and a clinical data extraction form. Socio-demographic information collected included age, sex, ethnicity, marital status, education level, employment status, household income, living conditions, and housing ownership. Clinical data were extracted from bedhead tickets, laboratory reports, and ward records, including the type of tuberculosis, smear status, GeneXpert results, and comorbidities such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), bronchial asthma, hypertension, and ischaemic heart disease.

Behavioural factors assessed included smoking history, alcohol use, and illicit drug use. Hospital-related variables included the source of admission, the requirement for high-dependency unit care, the length of hospital stay, and in-hospital outcomes.

Patients were admitted or transferred to the TB wards for specialised inpatient management due to severe respiratory symptoms, hypoxaemia, haemoptysis, significant comorbidities, adverse drug reactions, suspected or confirmed drug-resistant tuberculosis, need for specialised respiratory care, or social circumstances limiting safe outpatient management.

Outcome measures

The primary outcomes of interest were length of hospital stay and in-hospital outcomes.

Length of hospital stay was categorised into five groups: 1-5 days, 6-10 days, 11-14 days, 15-30 days, and >30 days. Prolonged hospital stay was defined as a duration exceeding 14 days.

In-hospital adverse outcomes were defined as a composite of death, leaving against medical advice, or absconding during admission.

Statistical analysis

Data were entered and analysed using SPSS version 27 (IBM Corp., Armonk, NY, USA).

Continuous variables were summarised using the mean and standard deviation or the median with the interquartile range (IQR), depending on the data distribution. Categorical variables were presented as frequencies and percentages. Associations between socio-demographic, clinical, and behavioural factors and the outcomes of interest (prolonged hospital stay and adverse outcomes) were assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant.

Ethical considerations

Ethical approval for this study was obtained from the Ethics Review Committee of the Postgraduate Institute of Medicine, University of Colombo, Sri Lanka (ERC/PGIM/2025/269). Administrative approval was obtained from the NHRD, Welisara. Written informed consent was obtained from all participants before enrolment. Confidentiality was maintained by anonymising all data before analysis.

Results

Study population

A total of 141 adult patients admitted to the tuberculosis wards at the NHRD in Welisara were included in the study. The mean age was 56.0 ± 14.9 years, with a median of 56 years (interquartile range [IQR]: 43–70 years). Of the total study population, 123 (87.2%) patients had pulmonary tuberculosis, including 102 bacteriologically confirmed and 21 clinically diagnosed cases, while 18 (12.8%) patients had extrapulmonary tuberculosis.

Most patients were newly diagnosed tuberculosis cases (n=113, 80.1%). Previously treated categories included treatment after loss to follow-up (n=12, 8.5%), treatment after default (n=10, 7.1%), relapse (n=3, 2.1%), treatment after failure (n=2, 1.4%), and other previously treated cases (n=1, 0.7%).

Socio-demographic characteristics

The socio-demographic characteristics of the study population are summarised in Table 1.

Clinical and behavioural characteristics

Diabetes mellitus was the most common comorbidity, and behavioural risk factors were common among the study population. A history of smoking was reported by 66.0% of patients, while alcohol use was also prevalent. Illicit drug use was reported by 13.5% of participants.

Prolonged hospitalisation (>14 days) was seen in 41.1% of patients.

Table 1: Socio-demographic and clinical characteristics (n = 141)

Variable	Category	n (%)
Sex	Male	108 (76.6)
Ethnicity	Sinhala	105 (74.5)
	Tamil	20 (14.2)
	Muslim	16 (11.3)
Marital status	Married	115 (81.6)
	Single	24 (17.0)
	Divorced	2 (1.4)
District of residence	Gampaha	72 (51.1)
	Colombo	51 (36.2)
	Other districts	18 (12.7)
Educational level	No formal schooling	21 (14.9)
	Grade 1–5	53 (37.6)
	Grade 6–11	49 (34.8)
	GCE O level completed	11 (7.8)
	GCE A level completed	7 (5.0)
Monthly household income	< Rs. 30,000	16 (11.3)
	Rs. 30,000–60,000	67 (47.5)
	Rs. 60,000–100,000	49 (34.8)
	> Rs. 100,000	9 (6.4)
Living conditions	Living alone	19 (13.5)
	Living with family members	121 (85.8)
	Living with non-family members	1 (0.7)
BMI category	Underweight (<18.5 kg/m²)	76 (53.9)
	Normal (18.5–24.9 kg/m²)	59 (41.8)
	Overweight (25–29.9 kg/m²)	4 (2.8)
	Obese (≥30 kg/m²)	2 (1.4)
Diabetes mellitus		42 (29.8)
COPD		13 (9.2)
Hypertension		21 (14.9)
Smoking history		93 (66.0)
Source of admission	Transfer from another institution	53 (37.6)
	Self-presentation	48 (34.0)
	Admitted as requested	20 (14.2)
	Inward transfer	20 (14.2)

In-hospital outcomes

Most patients were discharged after clinical improvement (66.0%), while 14.2% were still admitted at the time of data collection. Transfers to other institutions occurred in 6.4% of patients. Deaths occurred in 6.4% of patients, while 5.7% absconded from the ward and 1.4% left against medical advice. Overall, adverse outcomes were observed in 13.5% of patients.

Among the nine in-hospital deaths observed, respiratory failure was the most common cause of death (n=4), followed by myocardial infarction (n=2), sepsis/septic shock (n=2), and disseminated tuberculosis (n=1). No post-mortem examination findings were available for analysis. All deaths occurred among patients with pulmonary tuberculosis, including seven bacteriologically confirmed pulmonary TB cases and two clinically diagnosed pulmonary TB cases. No deaths were recorded among patients with extrapulmonary tuberculosis.

Factors associated with prolonged hospital stay

The association between patient characteristics and prolonged hospital stay (>14 days) is presented in Table 2. No statistically significant associations were identified between socio-demographic, clinical, behavioural, or nutritional variables and prolonged hospitalisation (all $p > 0.05$).

Additional socio-demographic variables, including educational level, household income, living conditions, and BMI category, were also not significantly associated with prolonged hospitalisation.

Table 2: Factors associated with prolonged hospital stay (>14 days)

Variable	p-value
Sex	0.214
Age group	0.809
Educational level	0.620
Household income	0.480
Living conditions	0.710
BMI category	0.190
Diabetes mellitus	0.158
COPD	0.203
Bronchial asthma	1.000
Hypertension	0.947
Ischaemic heart disease	0.685
Smoking history	0.418
Alcohol history	0.468
Illicit drug use	0.732

Factors associated with adverse outcomes

Similarly, no statistically significant associations were observed between the examined variables and adverse outcomes, as shown in Table 3. All analysed variables had p-values greater than 0.05.

Table 3: Factors associated with adverse outcomes

Variable	p-value
Sex	0.426
Age group	0.981
Educational level	0.540
Household income	0.610
Living conditions	0.884
BMI category	0.272
Diabetes mellitus	0.594
COPD	1.000
Bronchial asthma	1.000
Hypertension	0.315
Ischaemic heart disease	0.958
Smoking history	0.410
Alcohol history	0.056
Illicit drug use	0.349

Discussion

This study evaluated the socio-demographic, clinical, behavioural, and nutritional characteristics of adult tuberculosis patients admitted to the NHRD, Welisara, and assessed factors associated with prolonged hospital stay and adverse in-hospital outcomes. The study population was predominantly composed of older male patients with pulmonary tuberculosis, a finding consistent with both national and global TB epidemiology, where males account for a greater proportion of tuberculosis cases and hospital admissions [2,4,13]. This disparity has been attributed to factors such as occupational exposure, delayed healthcare-seeking behaviour, smoking, alcohol use, and increased social exposure among men [6,7,8,13].

Most patients in this cohort were residents of the Western Province, particularly the Gampaha and Colombo districts, which continue to report high tuberculosis notification rates in Sri Lanka [4,9,14]. This likely reflects higher population density, urbanisation, and concentration of vulnerable populations within these districts. The socioeconomic profile of the study population further highlights the close association between tuberculosis and social determinants of health. A considerable proportion of patients had low educational attainment and belonged to lower- or middle-income households. Similar findings have been reported in previous studies demonstrating the relationship between tuberculosis, poverty, overcrowding, unemployment, and limited

access to healthcare services in low- and middle-income countries [6,20].

Pulmonary tuberculosis accounted for the majority of admissions in this study. This is expected in a tertiary respiratory referral centre where patients with severe pulmonary involvement, respiratory compromise, or suspected complications are frequently admitted for specialised inpatient care. However, a smaller proportion of patients had extrapulmonary tuberculosis, reflecting the diverse spectrum of disease presentations encountered in routine clinical practice.

Comorbidities were common among hospitalised patients, with diabetes mellitus being the most frequently identified medical condition. The growing overlap between tuberculosis and diabetes has become increasingly important in South Asian countries, including Sri Lanka [10,11,12,15,17]. Diabetes is known to impair host immunity, increase susceptibility to tuberculosis infection, delay sputum conversion, and worsen treatment outcomes [10,11,12]. Other chronic conditions including hypertension, ischaemic heart disease, and chronic obstructive pulmonary disease were also observed in a notable proportion of patients, reflecting the increasing burden of non-communicable diseases among ageing tuberculosis populations.

Behavioural risk factors were also highly prevalent. Nearly two-thirds of the study population reported a smoking history, while alcohol use and illicit drug use were also observed. Smoking has been consistently associated with increased susceptibility to tuberculosis infection, impaired pulmonary immune defence, and more severe pulmonary disease [7,18]. Similarly, alcohol misuse may contribute to delayed healthcare seeking, poor treatment adherence, nutritional deficiency, and increased risk of adverse outcomes [8]. These findings are consistent with previous Sri Lankan studies that have highlighted the impact of behavioural and social factors on tuberculosis outcomes [16,19].

More than half of the study population was underweight at admission, highlighting the significant burden of malnutrition among hospitalised tuberculosis patients. Malnutrition is both a risk factor for active tuberculosis and a consequence of chronic infection, contributing to impaired immunity, delayed recovery, and increased disease severity [6,20,21]. The high prevalence of undernutrition observed in this study reflects the close interaction between tuberculosis, socioeconomic vulnerability, and chronic illness in low- and middle-income settings.

Prolonged hospitalisation was common in this cohort, with more than 40% of patients remaining admitted for longer than 14 days. Several factors may have contributed to prolonged inpatient care, including severe pulmonary disease, respiratory failure, requirement for oxygen therapy, management of comorbidities, adverse drug reactions, social circumstances limiting safe discharge, and evaluation for suspected drug-resistant tuberculosis. A considerable proportion of patients also remained admitted for more than 30 days, reflecting the complexity of inpatient TB management within tertiary care settings.

Despite the high prevalence of comorbidities, behavioural risk factors, malnutrition, and socioeconomic vulnerabilities, no statistically significant associations were identified between these variables and prolonged hospital stay or adverse outcomes. This suggests that factors not assessed in the present study, such as disease severity, extent of radiological involvement, oxygen requirement, treatment-related complications, delayed diagnosis, and healthcare system factors, may play a greater role in determining inpatient outcomes among hospitalised TB patients. In addition, several variables related to disease severity and indications for admission were assessed descriptively but could not be fully quantified for analytical evaluation.

Adverse outcomes, defined as death, absconding, or leaving against medical advice (LAMA), were observed in a minority of patients. Respiratory failure was the leading cause of death in this cohort, reflecting the severity of pulmonary involvement among hospitalised patients. Other causes of mortality included myocardial infarction, sepsis/septic shock, and disseminated tuberculosis, highlighting the complex interaction between tuberculosis, systemic illness, and underlying comorbidities among severely ill inpatients. Importantly, all deaths occurred among patients with pulmonary tuberculosis, while no deaths were recorded among patients with extrapulmonary tuberculosis during the study period.

A proportion of patients in this study had extrapulmonary tuberculosis, which may present unique diagnostic and management challenges compared to pulmonary disease [22]. Patients with extrapulmonary TB often require prolonged hospitalisation for invasive investigations, multidisciplinary management, and monitoring of complications involving organ systems such as the pleura, central nervous system, or lymphatic system. Delayed diagnosis due to non-specific clinical manifestations may also contribute to increased healthcare utilisation and prolonged inpatient care.

This study has several strengths. It provides real-world data from Sri Lanka's national tertiary referral centre for respiratory diseases and assesses socio-demographic, behavioural, nutritional, and clinical factors among hospitalised tuberculosis patients. However, several limitations should be acknowledged. The study was conducted at a single centre, which may limit generalisability. The relatively short study period and limited number of adverse outcomes may have reduced statistical power. Additionally, important indicators of disease severity, including radiological extent of disease, oxygen requirement, bacillary load, nutritional progression during admission, and drug resistance patterns, were not included in the analytical evaluation.

Overall, the findings of this study highlight the complex interaction between tuberculosis, comorbidities, behavioural risk factors, malnutrition, and social vulnerability among hospitalised patients. Strengthening integrated inpatient and outpatient TB care services, improving nutritional and social support systems, and addressing barriers in the healthcare system may help reduce prolonged hospitalisation and improve patient outcomes.

Conclusion

Hospitalised tuberculosis patients in this study were predominantly older males with a high burden of comorbidities, behavioural risk factors, malnutrition, and socioeconomic vulnerability. Pulmonary tuberculosis accounted for the majority of admissions, and prolonged hospitalisation was common among admitted patients. Despite the high prevalence of these risk factors, no statistically significant associations were identified between socio-demographic, clinical, behavioural, or nutritional variables and prolonged hospital stay or adverse outcomes, suggesting a greater influence of disease severity and healthcare system factors. Strengthening integrated tuberculosis care services, nutritional support, discharge planning, and social support systems may help improve inpatient outcomes and reduce prolonged hospitalisation. Larger multicentre studies incorporating detailed disease severity indicators are recommended to evaluate further determinants of hospital stay and outcomes among hospitalised tuberculosis patients.

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