Barriers to effective tuberculosis patient management in Kitui Central Sub-County, Kitui County, Kenya: A cross-sectional analysis of treatment delay and default

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ABSTRACT

Tuberculosis (TB) remains a major global public health challenge, particularly in low- and middle-income settings where multiple, interacting barriers continue to undermine effective disease control. This study assessed the determinants of barriers to effective TB management in Kitui Central Sub-County, Kenya, focusing on treatment initiation delay, treatment default, and TB prevention and control strategies. The study was guided by the Health Belief Model, complemented by the Andersen Behavioral Model of Health Services Use. An analytical cross-sectional design was adopted, drawing a sample of 399 TB patients aged 15 years and above from eight purposively selected high-burden health facilities, using stratified systematic random sampling. Data were collected through structured, interviewer-administered questionnaires and analyzed in the Statistical Package for the Social Sciences (SPSS) version 29 and R using descriptive statistics, chi-square tests, and binary logistic regression, with crude and adjusted odds ratios (COR/AOR) reported at the 95% confidence level. The results showed that 42.9% of respondents delayed initiating TB treatment after diagnosis. Being diagnosed at the first health facility visited was the strongest predictor of delay (AOR = 6.924, 95% confidence interval (CI): 1.812–36.782, $p = 0.004$), while male sex increased the odds of delay (AOR/OR = 1.87, $p = 0.018$) and employment was protective (OR = 0.40, $p < 0.001$). For treatment default, 39.2% of respondents discontinued treatment; income level was the strongest predictor, with a marked "income paradox" in which middle- and higher-income respondents were more likely to default (OR = 6.99, $p < 0.001$) than the lowest-income group, while employment again conferred protection (OR = 0.40, $p < 0.001$) and single marital status increased default risk. Model diagnostics confirmed good fit (Hosmer–Lemeshow $p > 0.05$ for both models) and no problematic multicollinearity (VIF < 5), with Nagelkerke R^2 of 0.177 for the delay model and 0.122 for the default model. TB prevention and control assessment revealed strong facility-based interventions (Directly Observed Treatment, Short-course [DOTS] availability 91.3%; free drugs 97.4%) alongside markedly weaker community-based interventions (household contact tracing 37.0%; community outreach 28.6%). The study concludes that barriers to TB management in Kitui Central Sub-County are stage-specific: treatment initiation is shaped primarily by behavioral and health-system factors, while treatment continuation is shaped primarily by socio-economic and social-support factors. The study recommends strengthening intramural diagnosis-to-treatment linkages, reducing indirect financial barriers to care, adopting flexible and gender-responsive service delivery models, and integrating social protection and community health system strengthening into TB control programming.

Keywords: Barriers to Care, Kenya, Kitui County, Logistic Regression, TB Care Continuum, Treatment Default, Treatment Delay, Tuberculosis

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I. INTRODUCTION

Tuberculosis (TB) remains one of the most significant global public health challenges, with approximately 10 million new cases and over 1.5 million deaths reported annually, making it the leading cause of death from a single infectious agent worldwide (World Health Organization (WHO), 2023). Despite global efforts such as the End TB Strategy and Sustainable Development Goal 3.3, which target ending the TB epidemic by reducing infection and mortality rates, progress has been slower than expected, compounded by the growing spread of drug-resistant TB, which requires longer, more complex, and costlier treatment regimens (WHO, 2024).

Effective TB control depends on early diagnosis, consistent adherence to treatment, prevention of onward transmission, and continuous patient support (Goletti et al., 2025). Even where effective treatment exists, multiple interacting barriers continue to constrain successful outcomes in resource-limited settings. At the patient level, stigma remains a significant deterrent to care-seeking, particularly in communities where TB is associated with poverty, HIV/AIDS, or substance abuse (Siroka et al., 2019). The lengthy treatment course — typically six months or longer — and its associated side effects further undermine adherence and increase the risk of default and drug resistance (Tiberi et al., 2018), while limited awareness of TB symptoms compounds delays in care-seeking, especially in underserved communities (Abubakar et al., 2017).

At the health system level, limited diagnostic capacity, shortages of trained health workers, and inconsistent drug supply continue to affect TB management, particularly in high-burden, resource-constrained settings (Chung et al., 2020). The rising burden of multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) adds further complexity, given the specialized medication and care these forms require (Zumla et al., 2013). Socio-economic conditions — poverty, malnutrition, and overcrowded housing — increase both the risk of infection and the practical difficulty of completing treatment, while the cost of accessing care, even when medication itself is free, can delay care-seeking and lead to incomplete treatment (Pérez et al., 2020). Cultural beliefs and reliance on traditional remedies can further delay presentation to formal health services (Baba et al., 2021).

Because these barriers are multiple and interacting rather than singular, effective TB control requires a comprehensive and context-specific understanding of how they operate locally. This study, therefore, sought to identify and analyze the key barriers to effective management of TB patients in Kitui Central Sub-County, Kenya, with the aim of generating evidence to support targeted, evidence-based interventions to reduce treatment delay, curb treatment default, and strengthen TB control.

1.1 Statement of the Problem

Tuberculosis remains a leading cause of morbidity and mortality in Kenya, with the HIV epidemic compounding TB control efforts by increasing case numbers and contributing to the rise of multidrug-resistant TB (MoH, 2016). Effective TB control rests on three pillars — early case detection, prompt treatment initiation, and treatment completion — yet TB case-finding in Kenya remains largely passive, requiring patients themselves to seek care, a pattern that produces persistent diagnostic and treatment delays (MoH, 2020). Untreated TB carries a case-fatality rate exceeding 50% (Rodriguez et al., 2023), and an estimated half of Kenya's TB cases remain undiagnosed (MoH, 2018), sustaining ongoing community transmission — a concern that is especially acute among patients co-infected with HIV, where late presentation remains common (Yimer et al., 2005).

Treatment default represents a second major challenge. Against WHO benchmarks of a 70% case detection rate and an 85% treatment success rate (WHO, 2022), Kenya's national loss-to-follow-up rate stands at 5.4% and death rate at 6%, with a 2021 treatment success rate of 77% — below the global target (Limo et al., 2025). Default drives poor outcomes, increased transmission, relapse, and the emergence of drug-resistant TB, and disproportionately increases mortality among patients also living with HIV (Mwende et al., 2019; MoH, 2018).

Despite the importance of early diagnosis and adherence, quantitative evidence on patient-level delay and default remains limited in rural, high-HIV-prevalence settings in Kenya — a gap that is especially pronounced in Kitui Central Sub-County. Although the sub-county records a relatively high treatment success rate of approximately 88%, mortality and loss to follow-up persista 15.64% MDR-TB prevalence was recorded in 2021 (TLTP, 2021), and Kitui Central has recorded the highest number of delays and defaults among Kitui County's eight sub-counties over the past four years [citation needed — source to be supplied by author]. Existing research gaps include limited evidence on how geographic, financial, and logistical barriers jointly affect access; unclear quantitative evidence on the direct effect of income on adherence; insufficiently examined links between health literacy and actual health-seeking behavior; underexplored gender differences in TB management; underexplored roles of stigma and cultural belief; and a lack of studies integrating socio-economic, behavioral, and health-system determinants within a single analytical framework. This study addressed these gaps by generating quantitative, stage-specific evidence on the determinants of TB treatment delay and default in Kitui Central Sub-County.

1.2 Research Objectives

i. To determine the factors associated with delay in initiation of TB treatment in Kitui Central Sub-County;
ii. To assess the factors associated with TB treatment default in Kitui Central Sub-County;
iii. To assess TB prevention and control measures in Kitui Central Sub-County.

II. LITERATURE REVIEW

2.1 Theoretical Review

This study was anchored on the Health Belief Model (HBM), which explains and predicts health-related behavior through individuals' beliefs and perceptions that shape their decisions to seek care and adhere to treatment (Rosenstock, 1974; Champion & Skinner, 2008). The model has been widely applied in TB control research because it helps explain behaviors such as delayed health-seeking and poor treatment adherence (Janz & Becker, 1984; Carpenter, 2010), and rests on six constructs. Perceived susceptibility — an individual's belief about their risk of contracting TB — motivates preventive action among higher-risk groups such as people living with HIV, healthcare workers, and those in overcrowded housing (Rosenstock, 1974; Glanz et al., 2015). Perceived severity — belief about how serious TB and its consequences are — encourages early treatment-seeking and adherence when patients recognize TB as life-threatening if untreated (Champion & Skinner, 2008). Perceived benefits — belief that a given action (early diagnosis, adherence, treatment completion) will reduce risk or severity — encourage uptake of recommended behaviors when the perceived benefits outweigh the burden of treatment (Janz & Becker, 1984). Perceived barriers — obstacles such as stigma, cost, distance, and side effects — are often the strongest predictors of non-adherence (Carpenter, 2010). Cues to action — external triggers such as health education, provider reminders, and outreach — help translate knowledge into behavior change (Glanz et al., 2015). Self-efficacy — confidence in one's ability to carry out a health behavior — sustains long-term adherence to lengthy treatment regimens (Bandura, 1997). Community-based interventions — health education, active case finding, and community health worker engagement — can address all six constructs simultaneously, strengthening perceived susceptibility, severity, and benefits while lowering perceived barriers and reinforcing self-efficacy through counseling and follow-up (WHO, 2020; Glanz et al., 2015).

Complementing the HBM, the discussion of findings in this study also draws on the Andersen Behavioral Model of Health Services Use, under which treatment continuation (as distinct from initial care-seeking) is understood to be shaped by enabling factors such as income, employment, and social support — a framework that helps explain why different determinants become salient once a patient has already entered TB care.

2.2 Empirical Review

2.2.1 Patient-Related Factors in Treatment Delay

Stigma remains one of the most consistently documented barriers to TB care. Because TB is commonly associated with poverty, poor hygiene, HIV/AIDS, or substance use in many communities, individuals often avoid seeking diagnosis or treatment for fear of social rejection, which delays presentation and increases transmission risk (Siroka et al., 2019; Bhagyalaxmi et al., 2019). In the Netherlands, despite an 88% treatment success rate exceeding the global average, homelessness and substance abuse — closely linked to stigma — remained key predictors of poor outcomes (Ivan et al., 2019). In Southeast England, mental health challenges were linked to delayed treatment initiation (Robert et al., 2020), while in Kenya, Mwarasi et al. (2022) and Maluki et al. (2020) both found that stigma — driven partly by the perceived TB–HIV link and by myths about TB transmission — contributed to delayed care-seeking. Limited awareness of TB symptoms compounds these delays: studies in Southeast England, Ethiopia, and Kenya (Robert et al., 2020; Rima et al., 2024; Mbuthia et al., 2021; Mwarandu et al., 2018) have variously linked poor TB knowledge, self-medication, reliance on religious healing, and beliefs that TB is hereditary to delayed formal care-seeking.

2.2.2 Health-System-Related Factors in Treatment Delay

Limited access to healthcare — inadequate infrastructure, shortages of diagnostic equipment, and insufficient trained staff — constrains timely TB diagnosis and treatment in many low- and middle-income settings (Chung et al., 2020). Long travel distances and poor road networks have been repeatedly identified as barriers: in South Africa, distance contributed to delay among 27% of participants (Chiposi et al., 2021), while in Ethiopia and Kenya, transport access and poor road networks similarly delayed care-seeking (Yirgu et al., 2017; Nzioki et al., 2020; Mbuthia et al., 2021). Diagnostic delay and misdiagnosis are further compounded by the limited sensitivity of sputum smear microscopy — particularly for extrapulmonary and drug-resistant TB — and by the cost and limited availability of more advanced tools such as GeneXpert and culture-based testing (Zhang et al., 2020; Gillespie et al., 2019). Self-medication prior to formal care-seeking has been linked to diagnostic delay in India and Ethiopia (Sahu et al., 2020; Awoke et al., 2020), while in Kenya, inadequate TB knowledge, stigma, and fear of diagnosis have similarly been identified as key determinants of delayed presentation (Limo et al., 2022; Linda et al., 2021, 2023).

2.2.3 Socio-Economic Factors in Treatment Default

Poverty increases both TB transmission risk (through overcrowded, poorly ventilated housing) and the practical burden of treatment, since indirect costs such as transport and accommodation persist even where medication is free (Pérez et al., 2020). In Bangladesh, poorer households experienced longer delays between initial care-seeking and diagnostic referral than wealthier households (Di Gennaro et al., 2025), while in Ethiopia, low monthly income was linked to delayed care-seeking despite free treatment (Gamtesa et al., 2020). Findings on income in the Kenyan context have been mixed: Maluki et al. (2020) found no significant income–delay association but did find that occupation type mattered, with farmers less likely to delay treatment than salaried workers or business owners. Malnutrition, which weakens immune function and worsens treatment outcomes, further compounds socio-economic vulnerability among TB patients (Simieneh et al., 2024).

2.2.4 Cultural and Behavioral Factors in Treatment Default

Cultural beliefs about TB causation and treatment continue to shape care-seeking behavior in parts of East Africa. Mkosa et al. (2021) found that belief in witchcraft as a cause of TB delayed treatment-seeking as patients sought traditional healers first, while Ondwela et al. (2019) linked reliance on faith-based healing to reduced adherence. However, findings from Kenya show some variation: Omenge et al. (2016) found that despite the presence of such beliefs in some communities, most respondents did not strongly believe TB could be effectively treated through traditional medicine, suggesting mixed perceptions of traditional treatment practices locally.

2.2.5 TB Prevention and Control: Policy Context and Recent Advances

Weak national policy frameworks — inadequate patient education, insufficient follow-up systems, and limited integration of TB services with programs such as HIV care — contribute to fragmented care pathways and poorer adherence (Chung et al., 2020; Zumla et al., 2013). Against this backdrop, notable advances have strengthened the global TB response: molecular diagnostics such as GeneXpert have shortened diagnostic turnaround from weeks to hours while enabling early detection of rifampicin resistance (Boehme et al., 2010); DOTS remains the backbone of treatment support (Lönnroth et al., 2020); shorter four-month regimens for drug-sensitive TB show promise for improving adherence (Diacon et al., 2014); and newer drugs such as bedaquiline and delamanid have improved outcomes for drug-resistant TB, though access remains constrained in low-resource settings (Tiberi et al., 2018). The WHO End TB Strategy, launched in 2015, provides the overarching global framework targeting a 95% reduction in TB deaths and 90% reduction in incidence by 2035, emphasizing integration of TB care with other health services and attention to social determinants such as poverty and overcrowding (WHO, 2020).

2.3 Comparative Analysis of Empirical Studies

Across settings as diverse as Ethiopia (Belay et al., 2012; Demissie et al., 2003), Kenya (Muture et al., 2011), Uganda (Kiwuwa et al., 2005), Zambia (Needham et al., 2001), South Africa (Claassens et al., 2013), and multi-country systematic reviews (Storla et al., 2008; Alipanah et al., 2018), the reviewed literature converges on a consistent set of determinants: financial hardship, inadequate social support, transport barriers, stigma, poor health-seeking behavior, and health-system weaknesses. Although the relative weight of these factors varies by context — reflecting differences in infrastructure, health-system capacity, and gender norms — the overall pattern supports the case for integrated, patient-centered TB interventions that combine adherence support with efforts to improve healthcare accessibility and reduce socio-economic barriers.

III. METHODOLOGY

3.1 Research Design

The study adopted an analytical cross-sectional design, allowing data to be collected at a single point in time to capture a snapshot of barriers to TB treatment initiation and adherence, and to examine associations between socio-demographic, socio-economic, behavioral, and health-system factors and TB treatment outcomes.

3.2 Study Area

The study was conducted in Kitui Central Sub-County, one of eight sub-counties in Kitui County, Kenya, encompassing Kitui town and five administrative units (Mulango, Kyangwithya East, Kyangwithya West, Miambani, and Township). The sub-county covers approximately 421.8 km², with an estimated population of 105,991 (KNBS, 2019) and 81 health facilities providing TB diagnostic and treatment services.

3.3 Target Population

The target population comprised TB patients aged 15 years and above, a threshold chosen for epidemiological relevance (this group accounts for the majority of the global TB burden and the most infectious pulmonary presentations), diagnostic standardization, alignment with WHO adult treatment protocols, and ethical/logistical considerations around independent informed consent. The study population consisted of all 791 TB patients on treatment aged ≥15 years across the sub-county's five administrative areas during the eight-week study period.

3.4 Sampling Technique and Sample Size

A combination of non-probability and probability sampling was used. Eight health facilities were purposively selected based on high TB patient load and service availability, yielding an accessible sampling frame of 493 TB patients. Participants were then stratified by age group (15–25, 26–35, 36–50, and 50+ years) and gender, and systematic random sampling was applied within each stratum (sampling interval $K = N/n = 791/399 \approx 2$), with every second eligible patient selected from a random starting point. The sample size was initially calculated using Yamane's (1967) formula, $n = N/(1 + N \cdot e^2)$, with $N = 791$ and a 5% margin of error, yielding $n \approx 266$; this was subsequently increased to 399 to improve statistical power, strengthen representativeness across strata, and reduce sampling error in subgroup analysis. The final sample was proportionately allocated across the eight facilities based on each facility's registered TB caseload.

3.5 Data Collection Instruments and Procedures

Data were collected via a structured, interviewer-administered questionnaire covering socio-demographic, socio-economic, health-system, knowledge, and behavioral domains. A pilot study involving 40 TB patients was conducted at Mwingi Level V Hospital, selected for its demographic and healthcare similarity to the study area, to pre-test and refine the instrument, assess sampling and field logistics, and identify ambiguities prior to main data collection; pilot data were not included in the final analysis. Content validity was established through review of WHO TB guidelines, national TB program documents, and peer-reviewed literature, supplemented by expert review from supervisors in public health and epidemiology, while construct validity was ensured by aligning items with the study objectives and conceptual framework. Internal consistency was assessed using Cronbach's alpha, with a threshold of 0.70 considered acceptable; items with weak item-total correlation were revised before the main survey. Quantitative data were subsequently collected through face-to-face interviews conducted by the researcher and a trained research assistant, using an English-language questionnaire to maintain standardization.

3.6 Data Analysis

Data were coded, entered, cleaned, and analyzed in the Statistical Package for the Social Sciences (SPSS) version 29, with additional validation and cross-checking performed in R. Descriptive statistics (frequencies, percentages, means, standard errors, and 95% confidence intervals) summarized respondent characteristics. Cross-tabulation examined the distribution of categorical predictors against treatment delay and treatment default. Pearson's chi-square tests assessed bivariate associations at a 95% confidence level ($p < 0.05$), and bivariate binary logistic regression produced crude odds ratios (COR). Variables significant at the bivariate level, together with theoretically important variables, were entered into multivariate binary logistic regression models to obtain adjusted odds ratios (AOR), with Model 1 assessing predictors of treatment-initiation delay and Model 2 assessing predictors of treatment default. Model adequacy was evaluated using the Hosmer–Lemeshow goodness-of-fit test ($p > 0.05$ indicating acceptable fit) and Nagelkerke pseudo-R^2, multicollinearity was assessed via Variance Inflation Factors (VIF < 5 indicating no serious concern), and interaction effects (e.g., gender × employment) were tested. TB prevention and control measures (Objective 3) were assessed descriptively using frequencies, percentages, means, and standard deviations.

3.7 Ethical Considerations

The study was conducted in accordance with standard research ethics protocols for human-subjects research involving a sensitive health condition. Participation was voluntary, and respondents were informed of their right to withdraw at any stage without consequence. Written informed consent was obtained from all participants prior to data collection, confidentiality of patient information was maintained throughout data handling and reporting, and the study proceeded only after the requisite institutional and ethical review approvals were secured.

IV. FINDINGS & DISCUSSIONS

4.1 Socio-Demographic and Socio-Economic Characteristics

A total of 392–399 respondents (varying slightly by item non-response) were surveyed. The sample was predominantly male (74.5%; 95% CI: 70.2–78.8%) and young — half (50.3%) were aged 18–30 years — with 82.7% having attained secondary education and 62.1% currently employed (Table 1). Regarding monthly income (in Kenya Shillings, Ksh), 44.2% fell into the low-income category (<Ksh 5,000), 49.6% into the middle-income category (Ksh 5,001–10,000), and only 6.2% into the high-income category (>Ksh 10,000).

Table 1

Socio-Demographic Characteristics of the Study Participants

Variable	Category	n	%	95% CI
Gender	Male	295	74.5	70.2–78.8%
	Female	101	25.5	21.2–29.8%
Age Group	18–30 yrs	199	50.3	45.4–55.2%
	31–45 yrs	107	27.0	22.6–31.4%
Education	Secondary	326	82.7	79.0–86.4%
Employment	Employed	241	62.1	57.3–66.9%
Income	Low (<5,000)	165	44.2	—
	Middle (5,001–10,000)	185	49.6	—
	High (>10,000)	23	6.2	—

Knowledge of TB was generally high: 91.7% correctly identified bacterial causation and 94.2% correctly identified airborne transmission, though 15.6% still believed witchcraft could cause TB. Health-system access indicators revealed a paradox: while 77.1% of respondents lived within 5 km of a health facility, 72.5% reported poor (murram) road conditions and 69.8% reported waiting more than 30 minutes for service — indicating that geographic proximity did not translate into functional accessibility.

4.2 Chi-Square Associations and Reliability of Study Constructs

Bivariate chi-square analysis found statistically significant associations between gender and treatment delay ($\chi^2 = 12.84$, $p = 0.0003$), employment status and treatment delay ($\chi^2 = 18.67$, $p < 0.001$), road network and treatment delay ($\chi^2 = 16.31$, $p < 0.001$), stigma and treatment delay ($\chi^2 = 9.76$, $p = 0.002$), income level and treatment default ($\chi^2 = 21.55$, $p < 0.001$), and marital status and treatment default ($\chi^2 = 4.92$, $p = 0.027$). Distance to facility ($p = 0.065$) and education level ($p = 0.140$) were not significant. All measurement scales showed acceptable-to-high internal consistency (Cronbach's alpha 0.79–0.88), with health-system barriers the most reliable construct ($\alpha = 0.88$), supporting the robustness of subsequent multivariate analysis.

4.2.1 Factors Associated with Delay in TB Treatment Initiation

Overall, 168 of 392 respondents (42.9%; 95% CI: 38.0–47.8%) experienced delayed treatment initiation — a level comparable to Montenegro (49%; Bojovic et al., 2018) and consistent with patterns reported in South Africa, Ethiopia, and Uganda (Claassens et al., 2013; Belay et al., 2012; Demissie et al., 2003; Kiwuwa et al., 2005). Cross-tabulation showed marked gender disparity: 48.1% of male respondents delayed treatment versus 25.7% of female respondents.

Table 2

Independent Predictors of Delayed Tuberculosis Treatment Initiation

Variable	AOR / OR	95% CI	p-value
Diagnosed at first health facility (Yes)	6.924	1.812–36.782	0.004*
Gender (Male)	1.87	1.12–3.17	0.018*
Employment (Yes)	0.40	0.25–0.65	<0.001*
Road network (Tarmacked)	0.296	0.074–1.054	0.060
TB cause belief (Witchcraft)	0.068	0.003–1.476	0.084

The most striking finding was that patients diagnosed at their first point of contact were roughly seven times more likely to experience delayed treatment initiation than those referred through other pathways (AOR = 6.924, $p = 0.004$) — a counterintuitive result pointing to intramural bottlenecks (batched sputum processing, internal pharmacy clearance, weak internal tracking) rather than external referral pathways, which paradoxically appear better coordinated. This is consistent with health-system delay findings from Tanzania and Ethiopia (Mfinanga et al., 2008; Demissie et al., 2003). Gender remained significant after adjustment, with men more likely to delay (AOR/OR = 1.87, $p = 0.018$), consistent with patterns reported in Zambia and Nepal linked to occupational demands, masculine norms, and lower perceived susceptibility (Needham et al., 2001; Yamasaki-Nakagawa et al., 2001). Employment was protective (OR = 0.40, $p < 0.001$), reflecting employed patients' greater capacity to absorb indirect costs such as transport and lost work time, consistent with findings from Zambia and Zimbabwe (Simieneh et al., 2024; Takarinda et al., 2015). Road network and cultural beliefs about causation showed associations at the bivariate level but did not retain significance after adjustment. Model 1 showed good fit (Hosmer–Lemeshow $p = 0.492$) and modest explanatory power (Nagelkerke $R^2 = 0.177$), with VIFs all below 1.2, indicating no multicollinearity concern. Predicted-probability analysis identified unemployed males as the highest-risk group for delay (68.4% predicted probability), against 21.2% for employed females.

4.2.2 Factors Associated with Treatment Default

A total of 146 of 373 respondents (39.2%) defaulted on treatment after initiation. Unlike treatment delay, default was driven predominantly by socio-economic and social-support factors rather than health-system access, which was not a significant predictor once treatment had begun.

Table 3
Multivariable Logistic Regression Analysis

Variable	OR	95% CI	p-value
Income Ksh 5,001–10,000 (vs. lowest)	6.99	3.08–17.43	<0.001*
Income Ksh 10,001–20,000 (vs. lowest)	3.80	1.34–11.03	0.012*
Employment (Yes)	0.40	0.25–0.65	<0.001*
Gender (Male)	0.37	0.17–0.80	0.011*
Marital status (Single)	3.39	0.87–12.51	0.070

A notable "income paradox" emerged: rather than protecting against default, middle- and higher-income status was associated with markedly increased odds of default relative to the lowest-income group (OR = 6.99 and 3.80 respectively). This suggests that among economically active respondents, occupational demands, mobility, and competing time commitments — rather than an inability to pay — interfered with sustained clinic attendance. Similar patterns of work-related mobility undermining adherence among economically active patients have been reported in Brazil and Eritrea (Ali et al., 2017; Silva et al., 2018). Employment nonetheless remained protective overall (OR = 0.40, $p < 0.001$), and male sex was associated with lower odds of default once treatment had begun (OR = 0.37, $p = 0.011$) — the reverse of its effect on initiation delay, suggesting men who overcome the initial barrier to starting treatment adhere comparatively well. Marital status showed a borderline association ($p = 0.070$), with single individuals at elevated risk of default, consistent with the protective role of spousal or household support documented in Kenya and Ethiopia (Muture et al., 2011; Tola et al., 2015). Model 2 also showed good fit (Hosmer–Lemeshow $p = 0.553$; Nagelkerke $R^2 = 0.122$), with the highest VIF (marital status, 2.03) well within acceptable limits. Marginal effects analysis showed income ≥ Ksh 20,000 raised the probability of default by 20.8 percentage points and single status by 13.3 points, while male sex lowered it by 10.7 points; predicted-probability analysis identified single, higher-income respondents as the highest-risk default group (59.2%), against 28.4% for married, lower-income respondents.

4.2.3 TB Prevention and Control Measures

Facility-based TB interventions were strongly implemented: 91.3% of respondents reported DOTS availability, 97.4% reported access to free TB drugs, and 79.3% reported receiving health education during clinic visits. In contrast, community-based interventions were markedly weaker — only 37.0% reported household contact tracing and 28.6% reported awareness of community outreach programs. This structural imbalance — strong facility-based service delivery paired with weak community-level engagement — helps explain why, despite high TB knowledge and free, well-supplied facility services, delay and default remain substantial: without active community case-finding and post-initiation follow-up, symptomatic individuals (particularly unemployed men) may remain undiagnosed longer, and patients facing socio-economic strain after initiation lack the structured community support shown elsewhere to sustain adherence (Troop et al., 2016; WHO, 2023).

4.3 Synthesis: A Stage-Specific Model of TB Care Barriers

Taken together, the findings demonstrate that barriers to TB management are not uniform across the care continuum but operate differently at each stage. Treatment initiation is shaped primarily by behavioral factors (gender) and health-system inefficiencies (intramural diagnosis-to-treatment linkage), consistent with the Health Belief Model's emphasis on perceived susceptibility, severity, and barriers as drivers of initial care-seeking. Treatment continuation, once initiated, is shaped primarily by socio-economic conditions (income, employment) and social support (marital status), consistent with the Andersen Behavioral Model's emphasis on enabling factors in sustaining service use. Employment is the only factor that is consistently protective across both stages, while gender's effect reverses direction between initiation (where men are more vulnerable) and continuation (where men default less).

Table 4
Comparative Summary of Significant Determinants

Determinant	Stage 1: Initiation Delay	Stage 2: Treatment Default
Gender (Male)	Increases risk (p<0.05)	Reduces risk (p<0.05)
Employment (Yes)	Reduces risk (p<0.05)	Reduces risk (p<0.05)
Income (higher categories)	Not significant	Increases risk (p<0.05)
Marital status (Single)	Not significant	Increases risk (borderline)

This pattern diverges from findings in high-income, urban settings such as the Netherlands, where homelessness, mental illness, and substance abuse dominate as predictors of default (Ivan et al., 2019); in Kitui Central, transport barriers, occupational responsibilities, and income instability were more salient, underscoring that TB interventions calibrated for urban, high-income contexts may not transfer directly to rural, resource-limited settings. The study also helps resolve prior inconsistency in Kenyan literature regarding income and delay (e.g., Maluki et al., 2020, who found no significant association): the present findings suggest income effects become clearer only once occupation type and employment stability are considered jointly, since subsistence farmers appeared to face fewer interruptions than casual labourers with unstable daily income and lower schedule flexibility.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

Delay in TB treatment initiation remains a major challenge in Kitui Central Sub-County, driven by a combination of behavioral, health-system, and infrastructural factors. Male patients were significantly more likely to delay care-seeking, reflecting gender-related differences in health-seeking behavior, occupational responsibility, and risk perception, while health-system inefficiencies — particularly weak linkage between diagnosis and immediate treatment commencement at the first point of care — emerged as the single strongest predictor of delay. Employment, despite improving financial access to care, can simultaneously constrain physical availability for clinic attendance during working hours.

Treatment default, in contrast, is driven predominantly by socio-economic and psychosocial factors rather than physical access to care. Employment consistently protects against default, but the study's "income paradox" — in which middle- and higher-income patients showed elevated default risk — demonstrates that financial capacity alone does not guarantee adherence; occupational demands, mobility, and competing responsibilities can undermine continuity even among economically stable patients. Marital status further underscores the role of social support, with single patients at greater risk of default than married patients. TB prevention and control in the sub-county is characterized by strong facility-based service delivery (DOTS, free medication, routine health education) but markedly weaker community-based systems (contact tracing, outreach, and structured follow-up). This imbalance limits early case detection and weakens continuity of care once patients leave the clinical setting, and represents perhaps the most actionable structural gap identified by the study.

5.2 Recommendations

Based on these findings, the study makes the following recommendations. Intramural facility linkages should be optimized by mandating same-day diagnosis-to-treatment enrolment protocols, including automated electronic alerts that trigger immediate clinical enrolment upon a positive laboratory result, in order to close the gap responsible for the strongest predictor of delay. Economic support for patients should also be strengthened through transport vouchers, conditional cash transfers, nutritional support, and decentralized services such as community sputum collection points and mobile diagnostic clinics, so as to reduce the indirect costs of care, with particular prioritisation of patients earning below Ksh 5,000 per month. In addition, flexible, workplace-compatible care models — including extended clinic hours, employer engagement on TB-friendly leave policies, and workplace health education — should be adopted to accommodate economically active patients who are at risk of both delay and default.

Beyond these measures, gender-responsive interventions should be implemented, using workplaces, churches, social groups, and community leadership structures to promote earlier care-seeking among men. Community health systems should likewise be strengthened, including better-resourced and supervised Community Health Volunteers (CHVs), expanded household contact tracing, digital follow-up tools, and improved integration between facilities and community structures. Finally, social protection — nutritional support, income assistance, and psychosocial counseling — should be integrated into routine TB care through multi-sectoral collaboration between health authorities, social services, and development partners.

Further qualitative research is needed to explore patient experiences, provider perspectives, and institutional workflow inefficiencies underlying delayed diagnosis-to-treatment linkage. Longitudinal studies tracking patients across the full treatment course would help identify the precise points at which interruption occurs, while further evaluation of community-based interventions (contact tracing, decentralized care, digital adherence tools, CHV programming) would clarify their effectiveness in this setting. Additional research on psychological and behavioral determinants — stigma, mental health, treatment fatigue, and motivation — and on the interaction between occupation type, income stability, and treatment behavior would further illuminate the "income paradox" identified in this study.

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