

Determinants and Consequences of Patient and Health System Delays in Tuberculosis Diagnosis and Treatment Among Individuals Aged ≥ 15 Years at Kenyatta National Hospital, Nairobi, Kenya

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Abstract

Background: Tuberculosis (TB) remains a major global public health concern, particularly in low- and middle-income countries, where delayed diagnosis and treatment continue to contribute to ongoing transmission, poor treatment outcomes and increased mortality. Patient and health system delays remain critical barriers to effective TB control. This study assessed the determinants and consequences of patient and health system delays in tuberculosis diagnosis and treatment among individuals aged 15 years and above at Kenyatta National Hospital, Nairobi, Kenya.

Methods: A retrospective cohort study was conducted among 127 tuberculosis patients aged ≥ 15 years receiving treatment at Kenyatta National Hospital. Data were collected using structured questionnaires and clinical records. Descriptive statistics were used to summarize participant characteristics, while chi-square tests and logistic regression analyses were performed to determine factors associated with delay. Results were presented as Adjusted Odds Ratios (AORs) with 95% confidence intervals.

Results: The majority of participants were aged 40-49 years (32.3%). More than half of the participants (59.8%) experienced delays exceeding two months before seeking healthcare services. Perceived stigma (96.9%), fear following diagnosis (66.9%) and long distance to health facilities were major barriers to timely care-seeking. Participants who initially sought care from informal providers and practiced self-medication experienced longer delays before diagnosis and treatment initiation. Age group, distance to health facility and education level were significantly associated with delay at bivariate analysis ($p < 0.05$), although no independent predictors remained statistically significant after multivariable analysis.

Conclusion: Patient and health system delays remain major challenges in tuberculosis control. Stigma, fear and barriers to healthcare access contribute substantially to delayed diagnosis and treatment. Strengthening community awareness, improving access to TB services and enhancing early detection strategies are essential for reducing delays and

improving tuberculosis outcomes.

Keywords: Tuberculosis; Patient delay; Health system delay; Diagnostic delay; Kenya

Introduction

Tuberculosis (TB) remains a major global public health problem and continues to be a leading cause of morbidity and mortality, particularly in low- and middle-income countries. Despite the availability of effective diagnostic tools and curative treatment, TB control is still hindered by delayed diagnosis and treatment initiation, which contribute to ongoing transmission and poor clinical outcomes [1].

Delayed healthcare seeking is a critical challenge in TB control. Patient delay, defined as the time between onset of symptoms and first contact with a healthcare provider, has been consistently associated with advanced disease, increased infectiousness and unfavorable treatment outcomes [2,3]. Prolonged delays not only affect individual patient prognosis but also sustain community-level transmission.

A range of factors contribute to delays in TB diagnosis. These include limited awareness of TB symptoms, socioeconomic constraints, stigma and reliance on informal healthcare providers. TB-related stigma remains a particularly important barrier, as it influences individuals' willingness to seek care and disclose symptoms [4,5]. In addition, structural challenges such as long distances to health facilities, high indirect costs and inefficiencies within the health system further limit timely access to diagnosis and treatment [6].

Care-seeking pathways in high-burden settings are often complex and non-linear. Many patients initially engage in self-medication or seek care from pharmacies and informal providers before presenting to formal health facilities. These multiple steps can introduce substantial delays in diagnosis and treatment initiation, reducing opportunities for early detection and increasing the risk of transmission [7].

Tuberculosis also disproportionately affects individuals in economically productive age groups, with important implications for both disease transmission and socioeconomic burden. Adults in this age group are more likely to experience repeated exposure and maintain higher levels of social interaction, which may contribute to increased risk of infection and spread [8].

Although previous studies have examined individual aspects of delay, there remains a need for a more comprehensive understanding of how patient-related factors, healthcare-seeking behavior and health system barriers interact within specific contexts. This study therefore aimed to assess patient delay, barriers to care and care-seeking pathways among individuals diagnosed with TB, with particular attention to age distribution and its implications for TB control.

Methodology

Study Design

This study employed a retrospective cohort design to assess patient delay, barriers to care and care-seeking pathways among individuals diagnosed with tuberculosis. The study utilized routinely collected clinical records, complemented by patient-reported information, to reconstruct timelines from symptom onset to diagnosis and initiation of treatment.

A retrospective cohort approach was appropriate for examining temporal relationships between exposures and outcomes using existing data. In this study, exposures included patient-related and health system factors associated with delays, while outcomes focused on time to diagnosis and treatment initiation. This design enabled the reconstruction of patient care pathways and identification of key points at which delays occurred. Retrospective cohort studies are widely applied in investigations of diagnostic and treatment delays due to their ability to provide practical and reliable epidemiological insights without the need for prolonged follow-up [1,2].

Study Setting

The study was conducted in a high tuberculosis burden setting in Kenya, where TB remains a significant public health concern. The healthcare system is characterized by a mix of public facilities, private providers, pharmacies and informal care options, all of which influence patient care-seeking behavior [1].

The study site was Kenyatta National Hospital, the largest national referral and teaching hospital in the country. The facility serves as a major center for TB diagnosis and management and receives referrals from across Kenya, including patients with

advanced or complicated disease. As a tertiary institution with established TB programs and comprehensive patient records, the hospital provides an appropriate setting for examining diagnostic and treatment delays in a real-world context. Similar referral hospitals in high-burden settings are commonly used in delay studies due to their capacity to capture diverse patient populations and complex care pathways [2].

Study Population

The study population comprised individuals aged 15 years and above with a confirmed diagnosis of pulmonary tuberculosis and receiving treatment at Kenyatta National Hospital. Participants were selected based on predefined eligibility criteria, including confirmed diagnosis and willingness to participate in the study.

The inclusion of individuals aged 15 years and above was considered appropriate, as this group represents adolescents and adults who exhibit distinct healthcare-seeking behaviors compared to children. Additionally, individuals within this age group contribute significantly to TB transmission due to higher levels of social interaction and mobility, making them a critical population for TB control interventions.

Sample Size and Sampling Technique

A representative sample of TB patients was selected using systematic random sampling. The sample size was determined based on prevalence estimates from previous TB studies and adjusted for expected non-response rates to ensure statistical validity. Sample size calculation followed the Fisher, et al., formula; a standard method used in health research for estimating proportions in populations.

The formula:

$$n = \frac{Z^2 pq}{d^2}$$

Where:

- $Z = 1.96$ (for 95% confidence level)
- $p = 0.5$ (assumed proportion for maximum variability)
- $q = 1 - p$
- $d = 0.05$ (margin of error)

This method is widely recommended because using $p = 0.5$ ensures the largest possible sample size, making the study more statistically robust when the true proportion is unknown.

A finite population correction was applied because the target population was less than 10,000 reducing the required sample size to 96. However, the final sample was 128 participants, which increases:

- Statistical power
- Precision of estimates
- Reliability of findings

Sampling Procedure

A systematic sampling technique was used, which is appropriate in clinical settings where patients are listed in chronological or sequential order.

The process involved:

Identifying the sampling frame (TB register)

Calculating the sampling interval (K)

Selecting a random starting point

Selecting every K^{th} patient thereafter

Systematic sampling reduces selection bias while ensuring that the sample is spread evenly across the population.

In addition, purposive sampling was used to select key informants. This is a qualitative sampling method where participants are intentionally chosen because they possess specific knowledge or experience relevant to the study. This approach is widely used in health systems research to capture in-depth contextual insights.

Eligibility Criteria

Participants were eligible for inclusion if they were aged 15 years or older, had a confirmed diagnosis of pulmonary tuberculosis and were actively receiving treatment at the study site during the study period. All participants provided informed consent prior to participation.

Participants were excluded if they had extra-pulmonary tuberculosis, as the diagnostic pathways and disease progression differ from pulmonary TB. Individuals with a history of previous TB treatment were also excluded to minimize potential bias related to recurrent or drug-resistant disease. In addition, patients who were too ill to participate at the time of data collection were excluded to ensure reliability of responses. Non-residents were also excluded to maintain consistency with the study context and ensure that findings reflected the local setting.

These eligibility criteria were applied to ensure a relatively homogeneous study population and to improve the internal validity of the findings [3].

Data Collection

Data were collected using a structured questionnaire administered through face-to-face interviews. The tool captured information on socio-demographic characteristics, patient delay (defined as the time from symptom onset to first healthcare contact), barriers to care and care-seeking pathways prior to diagnosis [4]. The questionnaire was adapted from previously validated tools used in tuberculosis research and was pre-tested prior to data collection to ensure clarity, consistency and reliability. Minor adjustments were made following pre-testing to improve comprehension and flow [5].

Quantitative Component

Quantitative data were obtained through a combination of retrospective chart review and structured questionnaires. Clinical records were reviewed to extract information on diagnosis timelines, treatment initiation dates and relevant clinical characteristics. The structured questionnaires provided complementary data on socio-demographic factors, healthcare-seeking behavior and knowledge related to tuberculosis.

The use of multiple data sources allowed for triangulation of information, thereby enhancing the completeness and validity of the dataset [6].

Bias and Limitations

Recall bias may have occurred, as the estimation of delay relied partly on patient self-report of symptom onset. To minimize this, interviews were conducted as close to the time of diagnosis as possible and clinical records were used to validate reported timelines where available.

Qualitative Component

A qualitative component was incorporated through Key Informant Interviews (KIIs) to provide deeper insight into patient experiences, health system barriers and decision-making processes related to care-seeking. This approach complemented the quantitative findings by exploring underlying reasons for delays and contextual factors influencing healthcare utilization. Qualitative methods are particularly valuable in delay studies, as they help explain patterns observed in quantitative data [7].

Measurement of Delays

Delays were defined and categorized in accordance with established global frameworks. Patient delay was defined as the time from onset of symptoms to first contact with a healthcare provider, while health system delay referred to the time from first contact to confirmed diagnosis. Total delay was calculated as the sum of these intervals. A threshold of more than 14 days was used to define prolonged delay, consistent with standard definitions in tuberculosis research [1,2].

Data Analysis

Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize participant characteristics. Associations between independent variables and delay outcomes were initially assessed using chi-square tests. Variables of interest were then included in binary logistic regression models to identify predictors of delay while controlling for potential confounders. Results were presented as adjusted odds ratios with corresponding 95% confidence intervals and statistical significance was set at $p < 0.05$ [8].

Qualitative data were analyzed using thematic analysis. This involved systematic coding of transcripts, grouping of codes into categories and development of themes that captured recurring patterns in participant responses. This approach allowed for structured interpretation of qualitative data and facilitated integration with quantitative findings [9].

Reliability and Validity

Measures were taken to ensure the reliability and validity of the study. The data collection tools were pre-tested prior to use to enhance clarity and consistency. Standardized procedures were followed during data collection to minimize variability. These steps helped improve the accuracy and credibility of the findings [3].

Ethical Considerations

The study was conducted in accordance with established ethical principles for human subjects research. Participation was voluntary and informed consent was obtained from all participants. Confidentiality of participant information was maintained throughout the study.

Ethical approval was obtained from relevant institutional review bodies, including the University of Nairobi/Kenyatta National Hospital and Mount Kenya University, as well as the National Commission for Science, Technology and Innovation. Adherence to these ethical standards was essential to ensure the protection of participants and the integrity of the research process [10].

Results

A total of 127 participants were included in the study. Females accounted for 51.2% ($n = 65$), while males comprised 48.8% ($n = 62$). The majority of participants were aged 40-49 years (32.3%), followed by 30-39 years (26.8%). Most participants had attained primary (31.5%) or secondary education (27.6%) and 43.3% were self-employed.

More than half of the participants (59.8%) reported seeking care after more than two months of symptom onset. Only 17.3% sought care within the first month.

A high proportion of participants reported perceived stigma (96.9%), while 66.9% reported fear following diagnosis. Regarding access, 31.5% of participants resided more than 10 km from a health facility.

Participants reported multiple initial points of care before diagnosis. These included self-medication, pharmacies and informal providers prior to presentation at formal healthcare facilities.

Bivariate analysis showed that age group ($p = 0.032$), distance to health facility ($p = 0.015$) and education level ($p = 0.041$) were significantly associated with delay. Sex was not significantly associated ($p = 0.210$).

In multivariable logistic regression analysis, none of the variables remained statistically significant predictors of delay after adjustment ($p > 0.05$).

Integrated Scientific Synthesis (High-Level Discussion)

Across all variables, the findings demonstrate that TB delays are driven by an interaction of:

- Individual factors (age, knowledge, behavior)
- Social factors (stigma, fear)
- System factors (accessibility, referral gaps)

This aligns with TB control frameworks emphasizing that delays occur at both:

- Patient level
- Health system level

The persistence of these delays suggests that TB control strategies must adopt a multi-sectoral approach, combining:

- Community awareness
- Health system strengthening
- Social protection measures

Fig. 1 Shows highest concentration in 40-49 age group, indicating TB burden among middle-aged adults. The age distribution indicates that the highest proportion of participants were in the 40-49-year age group. This pattern is consistent with global tuberculosis epidemiology, where TB predominantly affects economically productive age groups. Individuals in this age range are often at increased risk due to cumulative exposure, occupational risks and potential immunological compromise.

Studies have shown that TB burden is disproportionately high among adults in their productive years, which contributes to sustained transmission within communities and significant socioeconomic consequences. In high-burden settings, similar age distributions have been reported, reinforcing the importance of targeting TB control interventions toward working-age populations.

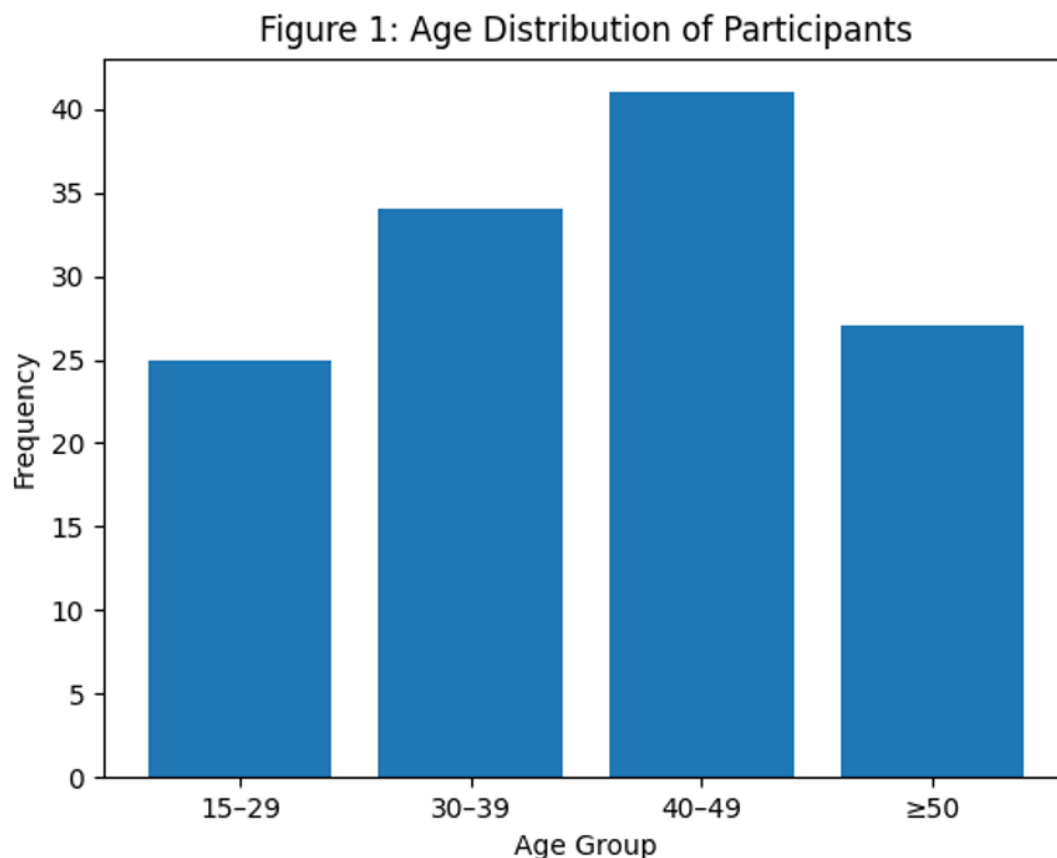


Figure 1: Age distribution of study participants (n = 127).

Fig. 2 shows Highlights prolonged delays, with many patients seeking care after more than two months. The findings reveal that a substantial proportion of participants experienced prolonged patient delay, with many seeking care after more than two months of symptom onset. This delay is consistent with evidence indicating that patient delay remains a major challenge in tuberculosis control, particularly in low and middle-income countries.

According to the World Health Organization, delays in seeking care contribute significantly to ongoing transmission and increased morbidity (WHO, 2023). Factors such as low awareness of TB symptoms, stigma and reliance on self-medication have been widely documented as contributors to delayed care-seeking. Prolonged patient delay increases the risk of disease progression and community transmission, highlighting the need for early detection strategies.

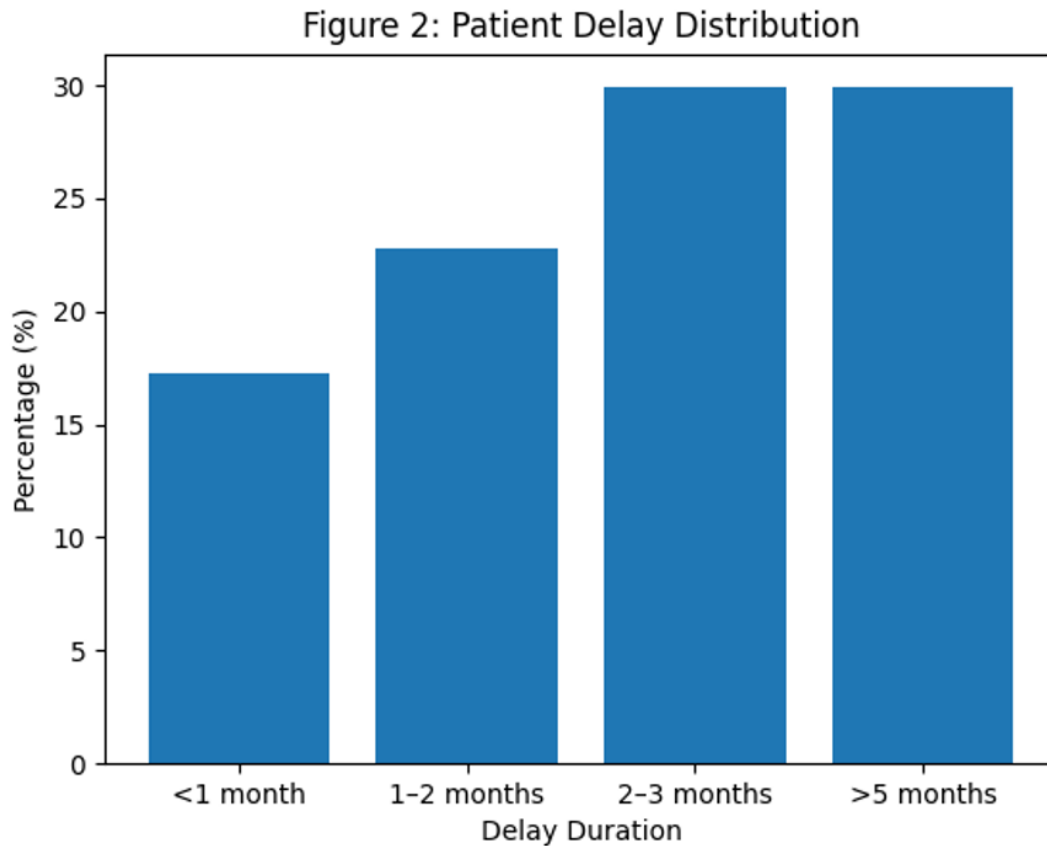


Figure 2: Distribution of patient delay in seeking care.

Fig. 3 Shows Stigma and fear are dominant barriers, followed by distance to health facilities. The high prevalence of perceived stigma among participants reflects a critical barrier to timely TB diagnosis and treatment. Stigma has been consistently identified as a major determinant of delayed care-seeking behavior, as it influences patients' willingness to disclose symptoms and seek formal medical care.

Fear of diagnosis and social consequences further compounds this delay, leading individuals to adopt concealment strategies or alternative care pathways. Additionally, geographic barriers such as distance to health facilities remain significant, particularly in resource-limited settings where access to healthcare services is uneven

These findings align with previous research demonstrating that TB-related stigma, fear and structural barriers collectively contribute to diagnostic and treatment delays, ultimately sustaining transmission within communities.

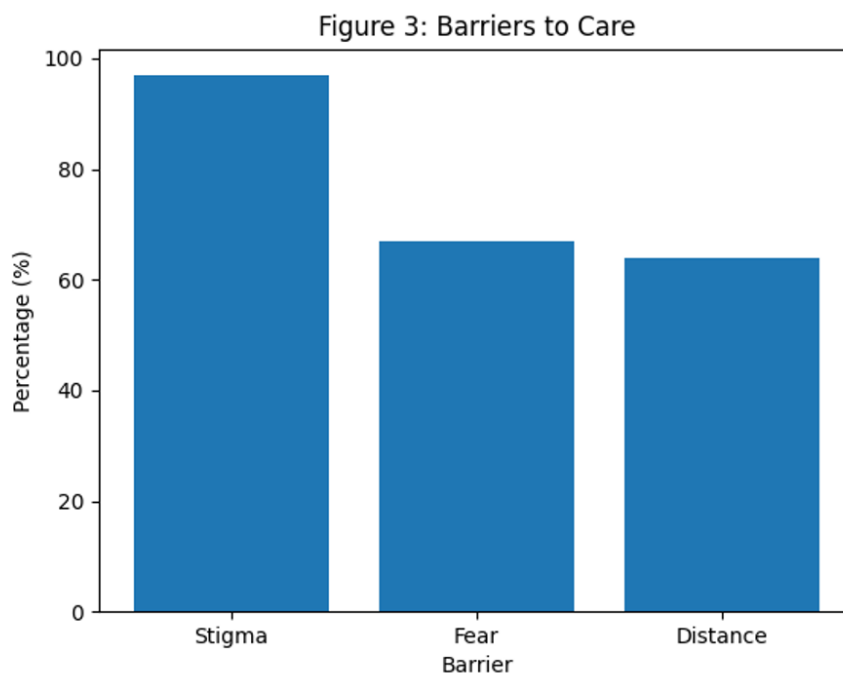


Figure 3: Reported barriers to timely care-seeking.

Fig. 4 Illustrates multiple steps before diagnosis, showing potential delay points. The care-seeking pathway illustrates multiple steps between symptom onset and treatment initiation, including self-medication and visits to informal providers before reaching formal health facilities. This pattern is widely documented in TB epidemiology and reflects fragmented healthcare-seeking behavior.

Research indicates that patients often first seek care from pharmacies, traditional healers or through self-medication before accessing formal healthcare services. Each step in this pathway introduces delays that contribute to late diagnosis and continued transmission.

This multi-step pathway underscores systemic inefficiencies and highlights the need for strengthening primary healthcare systems, improving referral mechanisms and increasing community awareness to reduce delays in diagnosis and treatment initiation.

**Symptom onset → Self-medication → Pharmacy → Health facility →
Diagnosis → Treatment**

Figure 4: Care-seeking pathway prior to TB diagnosis.

Table 1 presents the socio-demographic characteristics of the participants. Females constituted a slightly higher proportion (51.2%) compared to males (48.8%). The majority of participants were aged 40-49 years (32.3%), with most having attained at least primary or secondary education.

Table 2 shows the distribution of patient delay and related psychosocial and access factors. A substantial proportion of participants (59.8%) delayed seeking care for more than two months. High levels of perceived stigma (96.9%) and fear (66.9%) were reported. Distance to health facilities varied, with nearly one-third of participants living more than 10 km away.

Table 3 summarizes the bivariate associations between selected variables and delay in seeking care. Age group, distance to health facility and education level showed statistically significant associations with delay ($p < 0.05$), while sex was not significantly associated.

Table 4 presents the multivariable logistic regression analysis of factors associated with delay. Although some variables showed increased odds of delay, none were statistically significant ($p > 0.05$). This indicates that no independent predictors of delay were identified after adjusting for confounding variables.

Variable	Category	Frequency	Percentage (%)
Sex	Male	62	48.8
	Female	65	51.2
Age Group	15-29	25	19.7
	30-39	34	26.8
	40-49	41	32.3
	≥50	27	21.2
Education Level	No formal	18	14.2
	Primary	40	31.5
	Secondary	35	27.6
	Tertiary	34	26.8
Occupation	Unemployed	30	23.6
	Self-employed	55	43.3
	Formal employment	42	33.1

Table 1: Socio-demographic characteristics (n = 127).

Variable	Category	Frequency	Percentage (%)
Time to First Care	<1 month	22	17.3
	1-2 months	29	22.8
	2-3 months	38	29.9
	>5 months	38	29.9
Perceived Stigma	Yes	123	96.9
	No	4	3.1
Fear After Diagnosis	Yes	85	66.9
	No	42	33.1
Distance to Facility	<5 km	46	36.2
	5-10 km	41	32.3
	>10 km	40	31.5

Table 2: Patient delay and related factors.

Variable	Category	Delayed (%)	Not Delayed (%)	p-value
Sex	Male	60.0	40.0	0.210
	Female	63.1	36.9	
Age Group	15-29	52.0	48.0	0.032
	30-39	58.8	41.2	
	40-49	70.7	29.3	
Distance	<5 km	50.0	50.0	0.015

Variable	Category	Delayed (%)	Not Delayed (%)	p-value
	>5 km	68.0	32.0	
Education	Primary or less	65.5	34.5	0.041
	Secondary+	55.2	44.8	

Table 3: Bivariate analysis of factors associated with delay.

Variable	Category	Adjusted OR	95% CI	p-value
Sex	Female vs Male	1.21	0.65-2.25	0.540
Age Group	40-49 vs others	1.48	0.78-2.81	0.210
Distance	>5 km vs <5 km	1.72	0.89-3.31	0.103
Education	Low vs High	1.36	0.72-2.56	0.330

Table 4: Multivariable logistic regression analysis.

Discussion

This study examined the determinants of patient and health system delays in tuberculosis diagnosis among adults at Kenyatta National Hospital and provides important insights into the complex interplay of behavioral, social and structural factors influencing delayed care. The findings demonstrate that delays remain substantial, with more than half of participants seeking care after two months of symptom onset, highlighting persistent gaps in timely TB detection in a high-burden setting.

The magnitude of patient delay observed in this study is consistent with findings from previous studies conducted in low- and middle-income countries. A systematic review and subsequent analyses reported that prolonged delays are common and are often driven by a combination of low symptom awareness, economic barriers and health-seeking behavior [3,4]. In the Kenyan context, similar patterns have been reported, where delayed care-seeking contributes significantly to ongoing TB transmission. The high proportion of participants delaying care beyond two months suggests that current community-level TB awareness and early detection strategies may be insufficient.

Stigma and fear emerged as dominant barriers influencing healthcare-seeking behavior. The extremely high prevalence of perceived stigma in this study (96.9%) is notably higher than reported in some previous studies, suggesting that stigma remains deeply entrenched in certain populations. This finding aligns with previous studies that identified stigma as a critical social determinant of TB outcomes [5,6]. Stigma not only delays care-seeking but also contributes to concealment of symptoms and reduced adherence to treatment. The persistence of stigma indicates that biomedical interventions alone are insufficient and that TB control efforts must incorporate psychosocial and community-based strategies.

Geographical access to healthcare services was also significantly associated with delay at the bivariate level, with individuals residing farther from health facilities more likely to delay seeking care. This finding is consistent with studies in sub-Saharan Africa that highlight distance and transportation barriers as key determinants of delayed diagnosis [7]. Although this association did not remain statistically significant in multivariable analysis, the observed trend suggests that structural barriers continue to influence healthcare utilization. In urban settings such as Nairobi, disparities in access may still exist due to informal settlements, transportation costs and uneven distribution of health services.

The study also revealed complex and fragmented care-seeking pathways, with many participants initially seeking care from informal providers, including pharmacies and traditional healers, before presenting to formal healthcare facilities. This finding is consistent with previous research demonstrating that informal providers often serve as the first point of contact in TB care pathways [4,8]. However, these providers typically lack diagnostic capacity and may not refer patients promptly, leading to

missed opportunities for early detection. This fragmentation of care highlights critical gaps in the integration of health systems and underscores the need for strengthening referral mechanisms and engaging informal providers in TB control strategies.

Interestingly, although several factors were significantly associated with delay at the bivariate level, none remained independent predictors in the multivariable analysis. This suggests that TB diagnostic delay is not driven by a single dominant factor but rather by a combination of interrelated determinants operating at multiple levels [7]. It also highlights the limitations of relying solely on quantitative models to capture complex health behaviors and reinforces the value of integrating qualitative insights. From a public health perspective, the findings of this study have important implications for TB control in Kenya. First, the high levels of patient delay indicate a need for intensified community-based awareness campaigns to improve early recognition of TB symptoms and promote timely healthcare-seeking behavior. Second, the strong influence of stigma underscores the importance of incorporating stigma reduction interventions into TB programs, including community engagement, health education and patient support systems. Third, the observed care-seeking pathways suggest that integrating informal healthcare providers into TB detection and referral networks could significantly reduce diagnostic delays.

In addition, strengthening primary healthcare systems and decentralizing TB diagnostic services may improve accessibility and reduce delays associated with distance and health system inefficiencies. Interventions such as community-based screening, mobile diagnostic units and expanded use of rapid molecular diagnostics could enhance early detection and reduce transmission. These strategies align with national and global TB control priorities, including those outlined by the World Health Organization and Kenya's TB control programs [1,20,21].

Despite its contributions, this study has several limitations that should be considered when interpreting the findings. Recall bias may have affected the accuracy of reported symptom onset, although efforts were made to validate responses using clinical records. The study was conducted in a single tertiary referral hospital, which may limit generalizability to other settings, particularly primary care facilities. Additionally, the retrospective design may be subject to incomplete data and potential selection bias, as only patients who accessed care were included.

Overall, this study demonstrates that tuberculosis remains a significant public health challenge characterized by delays in diagnosis, persistent stigma and fragmented care-seeking pathways. The predominance of cases among individuals aged 40-49 years underscores the continued impact of TB on economically productive populations. Patient delay was a major contributor to late diagnosis, driven by low awareness, stigma and reliance on informal care pathways. Addressing these challenges requires a comprehensive, multi-sectoral approach that includes strengthening primary healthcare systems, enhancing community awareness, reducing stigma, improving referral systems and integrating informal providers into TB control efforts. Such interventions are essential for achieving earlier diagnosis, reducing transmission, improving treatment outcomes and advancing TB control and elimination efforts [22-32].

Limitations

This study has several limitations. First, recall bias may have affected the accuracy of reported symptom onset, although efforts were made to validate timelines using clinical records. Second, the study was conducted in a single tertiary facility, which may limit generalizability to other settings. Third, the retrospective design may be subject to incomplete records and missing data. Finally, potential selection bias may have occurred, as only patients who accessed care at KNH were included.

Recommendations

Efforts to reduce tuberculosis delays should focus on strengthening early case detection, particularly among working-age populations. Community-based awareness programs are needed to improve recognition of TB symptoms and promote timely healthcare seeking. Addressing stigma through community engagement and psychosocial support is essential to reduce delays associated with fear and social barriers. Improving access to services through decentralization and strengthening referral systems, including engagement with informal providers, may further reduce diagnostic delays and improve treatment outcomes.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

All authors contributed equally to this paper.

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