



Health system delay and its associated factors among tuberculosis patients in Gamo Zone public health facilities, Southern Ethiopia: An institution-based cross-sectional study

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ABSTRACT

Background: Delayed tuberculosis (TB) diagnosis and treatment increase morbidity, mortality, expenditure, and transmission in the community. Early diagnosis and initiation of treatment are essential for effective TB control. **Objective:** The main objective of this study was to assess the magnitude and factors associated with health system delay among tuberculosis patients in Gamo Zone, Southern Ethiopia.

Methods: A cross-sectional study was conducted in Gamo Zone, Southern Ethiopia from February to April 2019. Fifteen health facilities in the study area were selected randomly and 255 TB patients who were ≥ 18 years of age were included. Data were collected using a questionnaire through face-to-face interviews and analyzed using SPSS version 20.0. Health system delay was analyzed using the median as a cut-off. Logistic regression analysis was performed to investigate factors of delays. A p-value of ≤ 0.05 at multivariable analysis was considered statistically significant.

Results: The median (inter-quartile range) of health system delays was 14(6–30) days. About 54.5% of patients had prolonged health system delays. Patients who had multiple healthcare contacts (AOR: 5.74; 95% CI: 2.47, 13.34) and aged between 25 and 44 years old (AOR: 1.98; 95% CI: 1.02, 3.86) and aged ≥ 45 years (AOR: 3.54; 95% CI: 2.17, 14.27) were significantly associated with longer health system's delay. However, female gender (AOR: 0.46; 95% CI: 0.25, 0.87) and patients presenting symptoms [Hemoptysis (AOR: 0.27; 95%CI: 0.11, 0.65) and Chest pain (AOR: 0.28; 95%CI: 0.14, 0.56)] were significantly associated with reduced health system's delay.

Conclusion: In this study, it was observed that a significant proportion of patients experienced more than the acceptable level for health system delay. The number of health care contact, presenting symptoms, age and sex were factors associated with health system delay. Hence, increasing clinician awareness of TB clinical presentation, implementing systems enabling early case detection, and ensuring rapid diagnosis of TB are required to achieve further TB control. Finally, maintenance of a high index of suspicion for tuberculosis in the vulnerable population could reduce long health system delays in the management of TB.

1. Introduction

Tuberculosis remains a public health problem worldwide, claiming nearly 4000 lives every day and >10 million people fell ill in 2019 [1]. The main target of Tuberculosis (TB) control and prevention is to detect and treat new incident cases as early as possible. However, patients often arrive late at the health facility, and health care providers can miss tuberculosis diagnoses in populations with early classic symptoms, making the target difficult to achieve [2].

Tuberculosis infection spreads among the population by inhalation of bacterial droplets produced during coughing and sneezing by infected individuals [3]. Delays in diagnosis and treatment make patients more prone to developing severe disease, complications, and mortality, as well as increase community-wide person-to-person transmission [4,5]. It's also been estimated that an untreated smear-positive pulmonary TB patient infects >10 persons each year on average, and >20 during the natural course of the disease until death [6]. This means that rapid diagnosis and early treatment initiation are fundamental to reducing the

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transmission, morbidity, and mortality of tuberculosis patients [11].

In our case, health system delay was defined as the time between a patient's initial contact with a modern health facility and the start of anti-TB treatment. This includes time spent on referrals between facilities, diagnosis, and the time between diagnosis and treatment initiation, as well as time spent treating patients with drugs other than those used to treat tuberculosis [7]. In comparison to patient delay in seeking care, TB diagnosis and treatment are delayed because care providers take too long to diagnose and treat patients who sought care (health system delay) [8]. Health system delay has been recognized as a challenge for the effective diagnosis and treatment of TB patients in TB burdened countries. The Health system delay varies from region to region where; 27% in France, 50% in India, and 42% in Uganda [9–11]. In Ethiopia, the median health system delay ranged from 6 to 28 days [7,12–14].

Studies from multiple countries have identified various factors linked to the delay in TB diagnosis and treatments have been identified (Health system delay). The number and types of providers encountered before TB diagnosis, educational level, severity level, types of symptoms, and the first health facility visited were all taken into account. Socio-demographic factors, the clinical presentation of the patient, and characteristics of public health systems have been identified as health system delays [12,13,15,16].

TB remains a major public health problem with a significant number of undetected cases. Notably, WHO estimated that almost 32% of TB cases have not been detected in Ethiopia due to low TB diagnostic and treatment coverage [3]. TB control has been a focus of the Ethiopian Health Sector Transformation Plan (HSTP) to diagnose and treat it as early as possible. However, the achievement is unsatisfactory with not more than two-thirds of cases being diagnosed annually. Consequently, TB delay in diagnosis and treatment remains a major obstacle to ending the TB epidemic in 2030 [17,18].

Identification of barriers to the different forms of delays to TB treatment has been set as a national priority research agenda [19]. Moreover, TB diagnosis and treatment delays, as well as contributing factors, differ across societies, types of health facilities visited, and geographic areas between population groups of the same local settings and disease category [18,20–23]. This evidence supports localized research aimed at identifying the geographical and population-specific factors that contribute to the prolonged delay in TB diagnosis and treatment (Health system delay). Furthermore, there is a paucity of available data about health system-related delays for TB diagnosis and treatment in the study area. Therefore, this study aimed to assess the magnitude and factors associated with health system delays among tuberculosis patients in Gamo Zone public health facilities.

2. Methods and materials

2.1. Study setting and design

An institution-based cross-sectional study was conducted from February 1 to April 1, 2019, in the Gamo zone of the Southern Nations Nationalities and Peoples Region. The zone is located 500 km from Addis Ababa and 275 km from Hawassa, the capital city of Southern Ethiopia. In this study area, there are 55 public health facilities (One general hospital, three primary hospitals, and fifty-one health centers), and forty-eight private clinics during the study period.

Diagnosis and treatment of all forms of TB across the country are based on the adopted national TB control guideline that specifies case definitions, diagnostic and treatment standards [24]. Public health institutions are the main sources of health care for most people: health services access, as defined by a residence within 10 km of any health institution, is about 80% in the study area. The TB control program operates as an integral part of the public health system with control program structures at national, regional, and district levels. Patients have free access to TB diagnostic services and treatment in public health facilities. Therefore, all the districts are providing tuberculosis diagnosis

and treatment service including DOTS at the nearest possible health facilities to the patient, which is mainly in health centers and health posts, and passive case finding and sputum microscopy is the primary strategies used in the country during the study period.

2.2. Sample size determination

The sample size was determined by using the formula required for the determination of sample size for estimating single population proportions considering the following assumptions: a proportion of health system delay (41.1%) taken from a previous study conducted in Northern Central Ethiopia [7], confidence interval of 95%, the margin of error of 5% and an expected non-response rate of 10%. Accordingly, the calculated sample size was 410. However, since the total number of all forms of TB cases in the study area is <10,000, we have considered a finite population correction for the sample size. This made the final sample size of the study 234. Considering a non-response of 10% a total of 258 cases of TB was required.

2.3. Sampling technique

To obtain a representative sample for this study, we selected six districts and two towns administrative randomly out of 13 districts and four towns administrative in the study areas. Then, a sample of two health centers was randomly taken from all health facilities found in each district, one health center and one general hospital from Arba Minch Town and one primary hospital from Chenchä Town. Therefore, the study was carried out in 15 randomly selected public health facilities that provide directly observed treatment shortcourse (DOTS) in the study area. The total sample size was proportionately allocated for the 15 randomly selected health facilities based on the expected size of TB patients who seek care at each health facility was undertaken after reviewing previous years' TB reports. The proportions of participant TB patients were included from each selected health facility as follows: 45 from Arba Minch General hospital, 18 from Chenchä primary hospital, and 195 from 13 health centers. Finally, the study participants were selected from the above-mentioned public health facilities by using a systematic sampling technique.

2.4. Data collection tool and data collection procedure

A structured questionnaire adapted from tools used in Tuberculosis prevalence surveillance, in Addis Ababa, Ethiopia, and an in-depth analysis of TB patient's pathways in the Eastern Mediterranean Region were used to gather the data [25,26]. Besides, a data abstraction checklist was prepared to draw clinical profiles of the patients from the TB register. The questionnaire was initially prepared in English and then translated to the local language Amharic, and translated back to English to check for any inconsistencies.

The questionnaire has consisted of Socio-demographic characteristics, clinical and health-seeking behavior, knowledge about TB, and related stigma. Data were collected after obtaining verbal informed consent from the study participants by interviewers. Also, TB registration books were reviewed for tuberculosis diagnostic information, such as date of diagnosis, type of PTB, type of diagnostic investigation used to diagnose TB, nutritional status, HIV serostatus, patient category, and date of treatment initiation.

Health system delay was defined as from the patient's first visit to a formal health care provider to start of anti-TB treatment [7,14,27–29]. The median value was used as a cut-off value to make a simple comparison with previous similar studies. If the time after initial reporting to a formal health care provider to initiation of treatment is more than the median value, it is considered as 'delayed'.

2.5. Data quality assurance

To assure the data quality, the data collection tool was prepared after a review of relevant literature and similar studies. The training was given for one day both for data collectors and supervisors on a briefing on the general objective of the study, and discussion of the contents of the questionnaire by the principal investigator. Pre-testing of the questionnaire was carried out on the 5% sample size outside my study area (Sodo Zuriya, Humbo Tabala Health Center) before starting the actual data collection. A necessary correction was made based on the pretested result to avoid any confusion and for better completeness of the questions.

2.6. Data management and analysis

The collected data were entered into Epi-data version 4.4.1 and exported to SPSS software version 20.0 for analysis. Data were described using frequency, proportions, mean, median, standard deviation, interquartile range, tables, and graphs for descriptive analysis.

Besides, health system delay was further explored for skewness, kurtosis, normality plots (Q-Q plots and/or histograms), or the Kolmogorov-Smirnov test to check for normality. Therefore, the distribution of the number of days elapsed across different time points was not normal and median days were used as a cutoff point to define delays. Thus, health system delay was defined based on the median days elapsed between the patient's first visit to a formal health care provider to start of anti-TB treatment. As the data were skewed, non-parametric tests (Mann-Whitney/Kruskal-Wallis) were employed to compare group differences in health system delays. Mann-Whitney test was used to compare two groups and the Kruskal-Wallis test was used for comparing three or more groups.

Associations between the dependent variables (health system delay) and the independent variables were analyzed by calculating the Odds Ratios and 95 % confidence interval. Independent variables with marginal associations ($P \leq 0.25$) in the bivariable analysis were entered into a multivariable logistic regression analysis to detect independent factors of health system delay (>14 days). The significant association of independent variables with the outcome variable was declared by using a 95% confidence interval and a respective adjusted odds ratio (AOR). The models' fitness was checked using Hosmer-Lemeshow GOF-test at a p -value > 0.05 . A two-tailed-sided p -value of ≤ 0.05 was taken as statistically significant.

3. Results

3.1. Socio-demographic characteristics of the study participants

Two hundred fifty-eight TB patients were enrolled from randomly selected 15 DOTS providing public health facilities, three patients were excluded from analysis due to incomplete information on TB registration books and questionnaires making the response rate 99%. Thus, data of 255 TB patients were analyzed. Accordingly, 161(63.1%) of the respondents were registered at health centers and 106(41.6%) were females. The median (IQR) age of the study participant was 25(21–28) years and the majority of the 112(43%) were in the age range of 18–24 years. One hundred forty (54.9%) of the cases were followers of protestant Christianity and 149(58.4%) of the enrolled participant resided in rural. Concerning occupation and income, around 69 (27.1%) participants were students and 159(62.4%) belonged to the income level of ≤ 550 ETB respectively. The median one-way time required by patients from their residence to initially visit the health facility was 30 min (IQR 20–60) (Table 1).

3.2. Health-care seeking behavior of tuberculosis patients

After the symptoms, 115 (44.7%) took action including self-

Table 1

Socio-demographic characteristics of TB patients in Gamo Zone public health facilities, Southern Ethiopia, 2019 (n = 255).

Variables		Frequency	Percent (%)
Treatment center	Hospital	94	36.9
	Health center	161	63.1
Sex	Male	149	58.4
	Female	106	41.6
Age	18–24	112	43.9
	25–44	97	38.0
	≥ 45	46	18.1
Residence	Urban	106	41.6
	Rural	149	58.4
Educational status	Illiterate	68	26.7
	Primary school	89	34.9
	Secondary and above	98	38.4
Marital status	Single	98	38.4
	Married	145	56.9
	Widowed/Divorced	12	4.7
Family size	1 to 3	63	24.7
	> 3	192	75.3
Income status(ETH Birr)	≤ 550	159	62.4
	551–1000	47	18.4
	> 1000	49	19.2
Occupational status	Employed	58	22.7
	Farmer	60	23.5
	Student	69	27.1
	Unskilled worker ^a	16	6.3
	Unemployed/Housewife	52	20.4
Religion	Orthodox	106	41.6
	Protestant	140	54.9
	Others ^b	9	3.5
One way walking time	≤ 30 min	144	56.5
	30–60 min	59	23.1
	≥ 60 min	52	20.4

^a Housemaid and daily labourer

^b Muslim, Catholic, traditional.

treatment and use of traditional medicine before the Health Care Facility (HCF) visit. Regarding the severity of the diseases at presentation, 144(56.5%) of the patients were ambulatory in functional status before contacting a formal health facility. Of all the respondents, 193(75.7%) perceived their first visit was delayed for which 170(66.7%) and 50 (19.6%) reasoned expecting the illness to limit itself and lack of money respectively (Fig. 1).

In general, 171 (67%) of patients first contacted public health facility and 214 (83.9 %) were encountered more than one health care contact before a diagnosis of TB made, and 17 (6.7%) patients were diagnosed at private facilities. Related to community-based health insurance (CBHI) status 44 (17.3%) were a member before seeking care among respondents (Table 2).

3.3. Knowledge and perceived stigma related to tuberculosis

Regarding knowledge about TB, 124 (48.6%) had relatively good knowledge about TB illness and its treatment. The majority of the TB patients knew that TB is curable 232(91%) and the duration of anti-TB treatment was 155 (60.8%). Nearly 225(88.2%) of the patients knew that TB was a contagious disease. Regarding the level of stigma associated with TB, 213(83.5%) of the respondents practiced High stigma on tuberculosis (Table 2).

3.4. Clinical characteristics of the participants at the presentation

At the onset of illness, the majority of patients came with a combination of symptoms. The most frequently reported symptom was cough in 209(82%) patients; followed by night sweating in 12(4.8%)patients, fatigue/weakness in 108(42.4%) patients, weight loss in 73 (28.6), chest pain in 74 (29.0) and loss of appetite in 70 (27.5) patients respectively (Fig. 2).

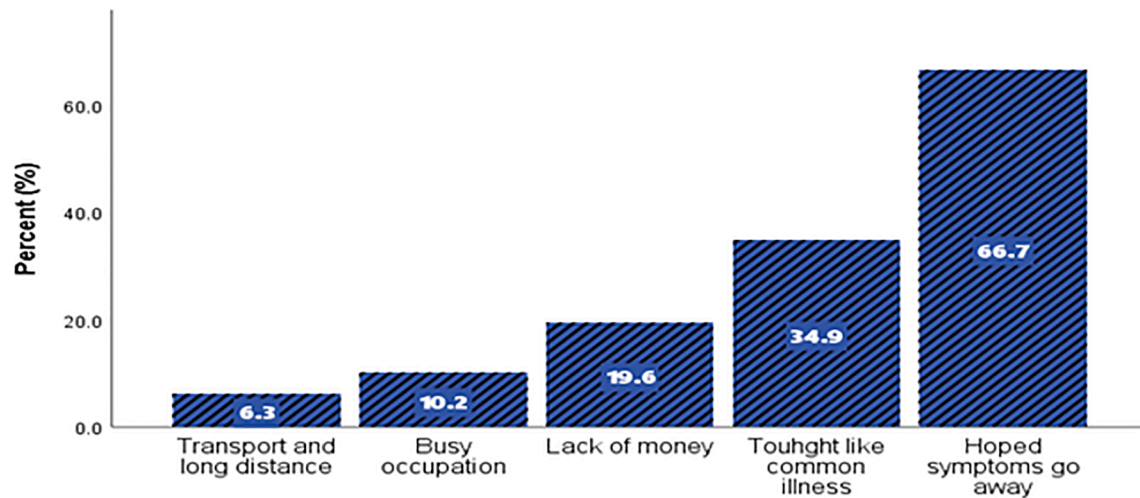


Fig. 1. Perceived reasons for the delay in health care seeking among TB patients in Gamo Zone public health facilities, Southern Ethiopia, 2019.

Table 2

Healthcare seeking behavior and clinical characteristics among TB patients in Gamo Zone public health facilities, Southern Ethiopia, 2019 (n = 255).

Variables		Frequency	Percent (%)
First action to illness	Visit HCF ^a	126	49.4
	Self-treatment	92	36.1
	Use traditional medicine	22	8.6
Severity of disease at the 1st contact	Consult HEW ^b	15	5.9
	Working	88	34.5
	Ambulatory	144	56.5
Facility first visited	Bedridden	23	9.0
	Private facilities	64	25.1
	Public hospital	59	23.1
	Health center	112	43.9
Health care contacts	Health post	20	7.9
	Single	41	16.1
Place of TB diagnosis	Multiple	214	83.9
	Public	238	93.3
CBHI status ^c	Private	17	6.7
	Yes	44	17.3
Knowledge towards TB	No	211	82.7
	Poor	131	51.4
TB associated Stigma	Good	124	48.6
	Low stigma	42	16.5
TB category	High stigma	213	83.5
	SPPTB ^a	173	67.8
	SNPTB ^b	35	13.7
HIV ^d status	EPTB ^c	47	18.5
	Positive	21	8.2
Contact history in the last 1 year	Negative	234	91.8
	Yes	65	25.5
BMI ^e	No	190	22.5
	Normal	132	51.8
	Underweight	123	48.2

^a health care facility, ^bHealth Extension worker(trained females those provide a household package of health care to household), ^c Community-based health insurance, ^a smear-positive pulmonary tuberculosis, ^b smear-negative pulmonary tuberculosis, ^c extrapulmonary tuberculosis, ^d human immunodeficiency virus ^e Body Mass Index.

More than half of the respondents 173 (67.8%) were smear-positive in classification and before the start of treatment, all of the cases were offered HIV screening tests of whom 21(8.2%) tested positive. Regarding contact history, in the last year with TB patients only 65(25.5%) had contact with TB patients.

Among the total respondents who were measured to check their nutritional status during diagnosis, 132(51.8 %) had normal BMI

between 18.5 and 24.99 kg/m², while the remaining was underweight. (Table 2).

3.5. Health system delay period and associated factors

3.5.1. Health system delay

The median (IQR) days elapsed between the first HCF visit to initiation of anti-TB treatment (health system delay) was 14(6–30) days. Of all recruited study participants, 139 (54.5%) were encountered health system delays ≥ 14 days. The median health system delay is significantly different with sex ($p = 0.039$), residence ($p = 0.003$), age groups ($p = 0.008$), educational status ($p = 0.007$), family size ($p < 0.001$), occupational status ($p = 0.015$), income status ($p = 0.026$), one way walking time to HF ($p = 0.007$), types of TB ($p = 0.013$), type of first visited HCF ($p < 0.013$), severity of the diseases at first contact ($p = 0.090$), types of symptoms($p < 0.018$) and number of health care contacts($p < 0.001$). However, the median provider delay is not significantly different with marital status, contact history in the last year, HIV status, the first action taken to the illness, and knowledge of TB (Table 3).

On bivariate logistic regression, multiple healthcare contacts, being in the old age group, living in rural, having an illiterate and primary education status, having an occupational status of farmer and education, one-way waking time of more than one hour, being in the EPTB category, and the severity of disease at first contact was bedridden were all significantly associated with a prolonged health system's delay. However, TB patients of the female gender, presenting with symptoms of hemoptysis and chest pain were less likely to have prolonged health system delay (Table 4).

In multivariable logistic regression, those TB cases whose gender female were 54% less likely to have delayed diagnosis and treatment compared to males (AOR: 0.46; 95% CI: 0.25, 0.87). Likewise, patients with presenting symptoms of hemoptysis and chest pain were 73%(AOR: 0.27; 95% CI: 0.11,0.65) and 72%(AOR: 0.28; 95% CI: 0.14,0.56) less likely to experience health system delay of >14 days once they contacted a health facility for their presenting symptom respectively. Patients whose ages were between 25 and 44 years old were 98% more likely to have health system delay beyond the median of 14 days (AOR: 1.98; 95% CI: 1.02, 3.86). Similarly, patients whose age is above 44 years old were 3.54 times more likely to have health system delays compared to the youngest age group (AOR: 3.54; 95% CI: 2.17,14.27). Furthermore, cases that visited more than one HCF until diagnosis was 5.74 times more likely to have health system delay beyond 14 days(AOR: 5.74; 95% CI: 2.47,13.34). (Table 4).

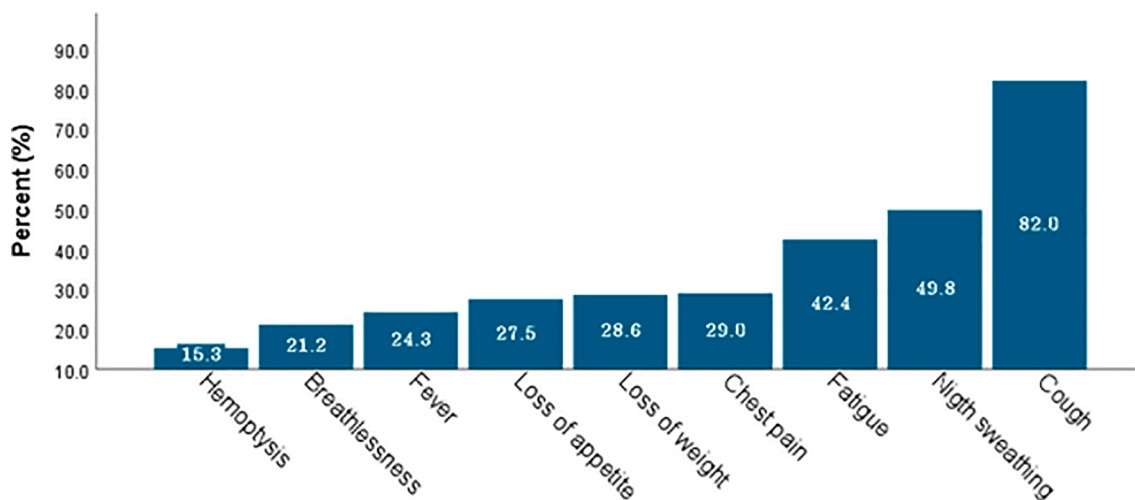


Fig. 2. Complaints, which made patients seek medical care in Gamo Zone public health facilities, Southern Ethiopia, 2019.

4. Discussion

This study set out with the aim of assessing the magnitude and factors associated with health system delay among tuberculosis patients in Gamo Zone, Southern Ethiopia. The finding of this study revealed that the median (IQR) health system delay was 14(6–30) days. About 54.5% of patients experienced long delays in the health system. Multiple health care contacts, presenting with symptoms of chest pain, and hemoptysis, being female, and higher age group were significantly associated with health system delay.

In the current study, from the first presentation to the health facility to the initiation of TB treatment, the median health system required was 14 days. This was consistent with reports from India (median, 13 days) [15] and Tunisia (median, 14 days) [16], but lower than previous results in Ethiopia, 21 to 33 days [13,27,30,31], and much lower than the findings from Africa, 45 to 68 days [32–34]. The differences may be due to differences between countries, study periods, and setup variations. The other reason for the observed low health system delay was currently that the patient was suspect to be according to WHO cutoff point and diagnosed in lab spot-spot sputum examination, which is very rapid and finished within 30–45 min. Nevertheless, the former one was spot-morning-spot, which takes 2–3 days during lab diagnosis even though some patients did not return.

In this study, about 54.5% of patients encountered health system delay which is much lower than a report from Bale Zone [13], with 99.8% of patients experiencing health systems delay and higher than studies conducted in another part of Ethiopia [7,26,31] and Africa [35,36]. The observed proportion of the health system's delay was relative to other mentioned studies [12,14,27,28,37]. The lower delay seen in this study compared with studies done in the Bale zone might be that the majority of the participants of this study were from an agrarian community who had access to better health care facilities compared to pastoralists in the case of Bale Zone.

However, the longer health system delay in this study might be due to the turnover of experienced staff and the efficiency of health care professionals in identifying the suspect. Furthermore, the shortage of resources in the TB control programs that were faced in most health facilities might be the reason for longer health system delays in TB diagnosis and treatment. Most 179 (70.2%) of TB diagnoses in this study were confirmed at the hospital level than in health centers or clinics that were closer to the community, while only 59 (23.1 %) of the patients visited the hospital on their first visits. Although all of the health facilities included in this study were entitled to provide diagnostic and treatment services, the participation of health centers was very limited in contributing to the case detection. This is unacceptable when we look

that most of the patients 161 (63.2%) were following the current treatment in health centers after they were referred back from hospitals. Another study from Ethiopia [30], which found that district hospitals made the majority of TB diagnoses, reported a similar situation.

This study demonstrates that “multiple healthcare contacts”, especially with different healthcare workers in different health facilities, have been retrieved as the overriding factors in healthcare system delay. A similar finding was reported in Ethiopia [7,13,14], Africa [32,34,35], and Asia [15,28], we're making more than one visit to health care providers is strongly associated with increased health system delay. This relation may be explained by healthcare providers' poor clinical suspicions of signs and symptoms, particularly in healthcare settings, and their inability to request proper investigations or refer patients to TB centers for further investigation, resulting in patients having multiple contacts due to recurring symptoms. Furthermore, a study conducted in Afghanistan speculates that multiple health care provider visits influence health system delay when patients receive an inappropriate antibiotic that can modify the clinical picture which may cause patients in believing that they will be cured; and in the long run, may choose alternative treatment [38].

Patients with the symptom hemoptysis were less likely to experience health system delay more than the median of 14 days. This may be clarified by the fact that hemoptysis, as a more severe symptom, could quickly remind health professionals of a TB diagnosis. Similar results were obtained in studies conducted in Addis Ababa, Ethiopia, and the Eastern Mediterranean region [12,39]. In line with this finding, our result demonstrates that patients with chest pain had less likely to experience health system delay when compared to those having none. Supporting the above finding, studies conducted in China, authors demonstrate that the presence of non-specific symptoms of cough was a risk factor associated with longer delays, but if other pulmonary symptoms like chest pain, for example, were considered together these delays could be shortened. Furthermore, the majority of the patients let more time pass before seeking medical care from any HCP and present to the HCPs with more severe forms (multiple symptoms) of the disease. In severe cases of the disease, patients might visit healthcare facilities sooner and take immediate action to restore their health, and health professionals easily diagnose TB with the help of the symptoms. However, we did not get any similar reports from other studies.

We observed that persons who were older than 45 years of age were more likely to experience health system delays. Our result is in line with a study from Zimbabwe, Montenegro, England, and others reporting that compared to younger people, persons older than 45 years were more likely to be diagnosed with tuberculosis at later stages [35,37,40–42]. This study also suggests that, compared to the younger population, older

Table 3

Distribution of health system delay by socio-demographic, clinical variables and health-seeking trajectories, non-parametric (Mann–Whitney and Kruskal–Wallis) test.

Characteristics		Health system delay Median(IQR)	P-value
Total		14(6,30)	
Delayed, n (%)		139(54.5)	
Sex	Male	16(7,30)	0.039
	Female	14(5.75,30)	
Residence	Urban	9(4.75,30)	0.003
	Rural	15(8,30)	
Age	18–24	14(7,30)	0.008
	25–44	15(7,22)	
	≥45	21(14.75,30)	
Education status	Illiterate	18(10,30)	0.007
	Primary school	15(6,30)	
	Secondary and above	9(4,30)	
Marital status	Single	15(7,30)	0.587
	Married	15(8,30)	
	Widowed/Divorced	4(3,60)	
Family size	1 to 3	8(4,15)	0.00
	>3	16(8,30)	
Occupational status	Employed	8(3.75,21)	0.015
	Farmer	18(10.5,30)	
	Student	15(7,33)	
	Unskilled worker	15(7,15)	
	Unemployed	15(7,30)	
Income status	<550	15(7,30)	0.026
	550–1000	15(8,22)	
	>1000	9(6,21)	
CBHI ^b status	Members	15(10,30)	0.357
	Not member	15(7,30)	
One way walking time	<30 min	15(5,30)	0.007
	30–60 min	14(7,321)	
	>60 min	19.5(12.5,30.75)	
Characteristics		Health system delay Median(IQR)	p- value
TB category	SPPTB ^b	15(7,30)	0.013
	SNPTB ^c	15(7,22)	
	EPTB ^d	22(8,60)	
Types of symptom	Cough	15(7,30)	0.001
	Fever	10(6,23.25)	
	Loss weight	10(7,30)	
	Hemoptysis	8(6,16)	
	Chest pain	10(6.21)	
	Breathlessness	14.5(7,30)	
	Night sweating	15(7,30)	
	Fatigue	15(7,30)	
	Loss of appetite	14.5(7,30)	
	Severity of disease at the 1st contact	Working	
Ambulatory	15(7,30)		
Contact history in the last 1 year	Bedridden	16(9,22)	0.529
	Yes	15(7,30)	
HIV ^e status	No	15(7,30)	0.586
	Positive	15(5,26)	
First action	Negative	15(7,30)	0.946
	Informal provider	15(7,30)	
Facility first visited	Formal provider	15(7,30)	0.013
	Government	15(7,30)	
Health care contacts	Private	15(8,53.75)	< 0.001
	Single	4(2.50,19.50)	
BMI ^f	Multiple	15(8,30)	0.718
	Normal	15(7,30)	
FIES ^g	Underweight	15(7,30)	0.416
	Food secure	14(15.5,30)	
	Moderate food insecurity	15(7,21.75)	
Knowledge towards TB	Sever food insecurity	15(7,30)	0.006
	Poor	16(8,30)	
TB associated stigma	Good	13(5.25,30)	0.190
	Low stigma	12.5(3,30.25)	
	High stigma	15(7,30)	

^a Housemaid, daily laborer, ^b Community-based health insurance.

Note: using non-parametric Kruskal–Wallis test to compare three or more groups and Mann–Whitney test to compare two groups. Statistically significant values are in bold. ^a interquartile range; ^b smear-positive pulmonary tuberculosis; ^c smear-negative pulmonary tuberculosis, ^d extrapulmonary tuberculosis, ^e human immunodeficiency virus, ^f Body Mass Index, ^g food insecurity experience scale.

persons whose ages were between 26 and 44 years old had an increased risk of prolonged health system delay [35]. Taken together, these findings imply that, as the age of the patient increases the chance of being late for the health system delay also increased. This result may be attributed to the fact that in older patients TB disease may not show typical symptoms indicative of TB rather the clinical presentation are nonspecific [43,44], which leads to a low index of TB suspicion by health care providers. Furthermore, diagnosis of tuberculosis in the elderly can be postponed due to the presence of various underlying conditions such as aspiration pneumonia and chronic obstructive pulmonary disease, which may hinder the overall clinical approach to tuberculosis in the elderly.

As reported in some other studies female patients experienced more often long health system delays than male patients [35,42,45–47]. These results imply that female patients are reported to encounter greater barriers (financial, physical, and health literacy) to appropriate medical care and treatment. Contrary to the above findings, our study did find a significant association between being female and having short health system delays. This observation was backed up by an Italian study which revealed that females were less likely to have health system delays compared to males [45]. Furthermore, our result supported by studies conducted in India has indicated that men will delay seeking care due to a variety of reasons including opportunity cost and fear of losing employment, which may affect their role and status as primary breadwinner as well as potentially influence their family's welfare [48]. Another possible explanation for this is that, the expansion of health extension programs that enables more advantageous to females due to their close relation to HEWs and helps them to recognize TB symptoms and get appropriate care from nearby health care facilities early.

5. Conclusions

In this research, the median time it has taken for the health system delay was 14 days. More than half of patients experienced prolonged delays in the health system, which implies a significant public health challenge. Multiple health care visits and older age are significantly associated with prolonged health system delay. However, being female and presenting symptoms of weight loss, hemoptysis, and chest pain were protective factors for not experiencing longer health system delay.

Based on this finding, since several patients sought healthcare treatment several times before being diagnosed with tuberculosis, our research highlights the need for better diagnostic capabilities. Consistent TB screening at all levels of treatment in HCFs will help to cut down on the time it takes to diagnose TB and stop it from spreading in the population. Furthermore, to improve access to TB services and early diagnosis, specific vulnerabilities such as sex disparities in care-seeking and being older should be recognized and addressed through tailored approaches. Further nationwide and extensive surveillance on the duration of health system delay and the unexplored factors of the delay should be done to design & develop effective programs for the diagnosis and treatment of TB.

6. Author's contribution:

Asrat Arja: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration; Biruk Bogale: Methodology, Validation, Writing - Review & Editing,

Table 4

Factors associated with health system delay among TB patients in Gamo Zone public health facilities, Southern Ethiopia, bivariate and multivariable analysis, 2019.

Variables	Health system (days)		Crude and adjusted OR		P-value	
	≥14 n(%)	<14 n(%)	COR(95%CI) CI	AOR(95%CI)		
Sex	Male	87(58.4)	62(41.6)	1	1	
	Female	52(49.1)	54(50.9)	0.69(0.42,1.13)	0.46(0.25,0.87)	0.016*
Age	18–24	53(47.3)	59(52.7)	1	1	
	25–44	51(52.6)	46(47.4)	1.23(0.72,2.13)	1.98(1.02,3.86)	0.045*
	≥45	35(76.1)	11(23.9)	3.54(1.64,7.67)	5.56(2.17,14.3)	<0.001**
Residence	Urban	45(42.5)	61(57.5)	1	1	
	Rural	94(63.1)	55(36.9)	2.32(1.39,3.85)	1.85(0.93,3.70)	0.079
Educational status	Illiterate	45(66.2)	23(33.8)	2.50(1.32,4.75)	0.82(0.27,2.51)	0.729
	Primary school	51(57.3)	38(42.7)	1.72(0.96,3.06)	1.38(0.63,3.02)	0.419
	Secondary and above	43(43.9)	55(56.1)	1	1	
Occupation	Employed	22(37.9)	36(62.1)	1	1	
	Farmer	39(65.0)	21(35.0)	3.04(1.43,6.43)	1.13(0.38,3.39)	0.824
	Student	40(58.0)	29(42.0)	2.26(1.10,4.61)	2.73(0.87,8.58)	0.085
	Unskilled worker	10(62.5)	6(37.5)	2.73(0.87,8.55)	2.35(0.54,10.27)	0.255
	Unemployed	28(53.8)	24(46.2)	1.91(0.89,4.08)	1.62(0.49,5.39)	0.429
One way walking time	≤30 min	77(53.5)	67(46.5)	1	1	
	30–60 min	25(42.2)	34(57.6)	0.64(0.35,1.18)	0.75(0.30,1.86)	0.530
	≥60 min	37(71.2)	15(28.8)	2.15(1.08,4.27)	0.46(0.17,1.27)	0.135
TB category	SPPTB ^a	90(52.0)	83(48.0)	1	1	
	SNPTB ^b	18(51.4)	17(48.6)	0.97(0.47,2.02)	0.37(0.14,0.94)	0.036
	EPTB ^c	31(66.0)	16(34.0)	1.79(0.91,3.50)	1.32(0.57,3.05)	0.514
Severity of disease at the 1st contact	Working	42(47.7)	46(52.3)	1	1	
	Ambulatory	83(57.6)	61(42.2)	1.49(0.87,2.54)	1.11(0.54,2.32)	0.770
	Bedridden	14(60.9)	9(39.1)	1.79(0.91,3.50)	0.78(0.20,3.06)	0.722
Types of symptoms						
Cough	Yes	108(51.7)	101(48.3)	0.52(0.26,1.01)	0.43(0.14,1.34)	0.146
	No	31(67.4)	15(32.6)	1	1	
Fever	Yes	24(38.7)	38(61.3)	0.43(0.24,0.77)	0.93(0.42,2.03)	0.854
	No	115(59.6)	78(40.4)	1	1	
Hemoptysis	Yes	13(33.3)	26(66.7)	0.36(0.17,0.73)	0.27(0.11,0.65)	0.003*
	No	126(58.3)	90(41.7)	1	1	
Chest pain	Yes	29(39.2)	45(60.8)	0.42(0.24,0.72)	0.28(0.14,0.56)	<0.001**
	No	110(60.8)	71(39.2)	1	1	
Health care contacts	Single	14(34.1)	27(65.9)	1	1	
	Multiple	125(58.4)	89(41.6)	2.71(1.34,5.46)	5.74(2.47,13.34)	<0.001**

^a smear positive pulmonary tuberculosis, ^b smear negative pulmonary tuberculosis, ^c extrapulmonary tuberculosis; COR: crude odds ratio; AOR: adjusted odds ratio; CI: Confidence Interval; *P value < 0.05; ** P value < 0.001; 1:Reference category.

Supervision; Mesfin Gebremedhin: Methodology, Writing - Review & Editing, Supervision. All authors critically revised and approved the final manuscript.

7. Data sharing statement:

For those who are interested; the datasets of this study could be accessed from the corresponding author upon reasonable request.

8. Consent to publish

Not applicable. We didn't take images, voices, and videos at all. By considering the benefit of the study the findings are submitted for publication.

9. Participant consent:

Obtained.

Ethical approval

Ethical clearance was obtained from the Ethical review committee of Arba Minch University, College of Medicine and Health Science. Following the approval, an official letter of co-operation was written to concerned bodies by the Department of Public Health of Arba Minch University. Permission was also obtained from the Gamo Zone health department, district health office, and the respective health facilities. Informed verbal consent was obtained from each participant, after the

necessary explanation about the purpose, procedures of the study, and their right decision to participate and withdraw at any time. Confidentiality of the information was maintained throughout the study by maintaining anonymity, keeping their privacy by interviewing them in a separate room during the interview and locking records.

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CRediT authorship contribution statement

Asrat Arja: Conceptualization, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Biruk Bogale:** Methodology, Validation, Writing – review & editing, Supervision. **Mesfin Gebremedhin:** Methodology, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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