Infection and Drug Resistance

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Assessment of Non-Adherence to Anti-TB Drugs and Associated Factors Among Patients Attending TB Treatment Centers During COVID-19 Pandemic in Mogadishu, Somalia: A Cross-Sectional Study

Abdullahi Abdirahman Omar[1], Jamal Hassan Mohamoud[2], Mohamed Hussein Adam[2], Bashiru Garba[2], Mariam Abdi Hassan[1], Ibrahim Abdullahi Mohamed[1], Zakaria Mohamed Adam[1]

[1]Dr.Sumait Hospitals, Faculty of Medicine and Health Sciences, SIMAD University, Mogadishu, Somalia; [2]Department Public Health, Faculty of Medicine and Health Sciences of SIMAD University, Mogadishu, Somalia

Correspondence: Abdullahi Abdirahman Omar, Tel +252615444315, Email dr.abdullahi.yare@simad.edu.so

Background: The COVID-19 pandemic's first wave and subsequent lockdowns disrupted global healthcare systems, significantly impacting essential services including tuberculosis (TB) care. Non-adherence to anti-TB drugs is a critical concern, leading to treatment failure, drug resistance, and increased morbidity and mortality. This study assessed the rate and determinants of non-adherence to TB treatment among patients at TB centers during the first wave of the pandemic.

Material and Methods: A cross-sectional study was conducted from June 15 to July 30, 2020, involving 255 TB patients at three centers in Mogadishu. Data were gathered using the Morisky Medication Adherence Scale-8 (MMAS-8) through structured interviews and analyzed using descriptive statistics and binary logistic regression.

Results: The study found a 34.5% non-adherence rate during the pandemic. Key reasons for non-adherence included forgetting to take medication (33%), feeling well (29%), experiencing side effects (18%), and fear of contracting COVID-19 (16%). Significant factors associated with non-adherence were age groups 25–34 years (OR = 2.96, p = 0.024) and 35–44 years (OR = 4.55, p = 0.005), unemployment (OR = 2.57, p = 0.037), smoking (OR = 3.49, p = 0.029), tobacco use (OR = 4.15, p = 0.034), proximity to a health facility (OR = 0.44, p = 0.033), perception of healthcare providers as very friendly (OR = 0.24, p = 0.031) or friendly (OR = 0.45, p = 0.023), being in the continuous treatment phase (OR = 3.2, p < 0.001), and experiencing adverse treatment effects (OR = 2.42, p = 0.003).

Conclusion: Non-adherence to anti-tuberculosis treatment was notably high in Mogadishu during the first wave of the pandemic, necessitating targeted interventions to improve adherence.

Keywords: non-adherence, anti-tuberculosis drugs, COVID-19, Tuberculosis

Introduction

Tuberculosis (TB) is a major global health concern and one of the leading causes of death worldwide, in 2019, approximately 10.0 million individuals worldwide were ill with tuberculosis and there were an estimated 1.2 million TB-related deaths among HIV-negative individuals, along with an additional 208,000 deaths among those who were HIV-positive.[1]

Africa bears a significantly higher burden of tuberculosis (TB), accounting for approximately 24% of the reported 10 million global incidence of TB in 2018, and revealing the slowest rate of TB decline worldwide.[2]

In 2020, Somalia was ranked as the second leading cause of death among communicable, maternal, neonatal, and nutritional diseases, affecting an estimated 41,000 individuals, including 8,500 children, within a population of just under 16 million people.[3]

Somalia, situated in East Africa and characterized by a low-income status, bears a significant tuberculosis (TB) burden, as evidenced by a 2011 nationwide survey revealing rates of multidrug-resistant TB (MDR-TB) at 5.2% among

Received: 21 March 2024
Accepted: 29 August 2024
Published: 6 September 2024

new TB patients and 40.8% among those previously treated.[4] According to a WHO report, Somalia is ranked seventh among the top 10 countries with a high burden of MDR-TB.[5]

The first wave of the COVID-19 outbreak, beginning in late 2019 and extending into 2020, caused unprecedented challenges to global healthcare systems, including significant disruptions to tuberculosis (TB) treatment and services, leading to reduced TB diagnoses and notifications due to supply side issues like healthcare capacity, and demand-side challenges such as movement restrictions, fear of visiting health facilities, and stigma associated with the similar symptoms of TB and COVID-19.[6–8]

In 2020, during the first wave of the COVID-19 pandemic, there were concerns about the non-adherence to anti-TB drugs in both developed and non-developed countries.[6] The overwhelming surge in COVID-19 cases strained healthcare resources, diverting attention and resources away from routine medical services, including TB diagnosis and treatment.[6]

Somalia confirmed the first case of COVID-19 on March 16, 2020, which posed a serious challenge to the already weak and fragile healthcare system of the whole country.[4,9] As a result, essential TB services suffered adverse effects, with resources being diverted from TB to address COVID-19, including the repurposing of Gene-Xpert machines for COVID-19 testing, redeployment of staff in national TB programs to COVID-19 tasks in 85 countries, including Somalia, and budget reallocations.[6,10]

The Somalia National Tuberculosis Control Program suggests direct observed therapy as the main strategy for disease control, but its utilization differs due to local health institutions' capacities to guarantee patient supervision.[11] In Somalia, there is no any published study on prevalence, barriers and determinants of non-adherence to anti-tuberculosis treatment. Therefore, this study aimed to assess the level of non- adherence to anti-TB therapy, barriers interrupting the uptake of anti-TB medications, and factors associated with non-adherence to anti-TB drugs among patients undergoing TB treatment during the first wave of the COVID-19 pandemic in Mogadishu, Somalia.

Materials and Methods

Study Design, Population and Period

This study adopted an analytical cross-sectional design to investigate the level, reasons, and determinants of non-adherence to anti-TB treatment among patients attending tuberculosis centers in Mogadishu, Somalia, during the first wave of the COVID-19 pandemic. The study population consisted of 255 patients selected from three tuberculosis centers in Mogadishu: Gulled TB Center, Manhal TB Center, and Finsoma TB Center. The study period spanned from 15th June to 30th July 30, 2020.

Sample Size Determination and Sample Technique

The sample size was calculated based on the Kish Lies formula: n=Z^2 P (1-P)/e^2. The study used a comparative study sampling size from adjacent Ethiopia, where they used a single population proportion formula using the following assumptions: population of each tuberculosis center = 21%, with a 95% confidence level and 5% level of precision.[12] The final sample size was 255.

$$n = (1.96)^2 \times 0.21(1 - 0.21)/(0.05)^2 n = 3.8426 \times 0.1659/0.0025$$

Convenience sampling was the technique of selection in this study due to the COVID-19 pandemic and the limited number of regular patients visiting TB centers during the lockdown.

Data Collection Tool

This study was conducted by trained interviewers using a structured questionnaire that collected sociodemographic information, clinical characteristics of the patient with individual-related information, health facilities, treatment-related information, and reasons for non-adherence. The questionnaire was the Morisky Medication Adherence Scale-8 (MMSA-8), which measures adherence on a scale of 0–8. Scores of > 8 indicate high adherence, 6–8 indicates medium adherence, and scores below 6 indicate low adherence (non-adherence).[13,14]

The study was carried out on 255 patients through face-to-face interviews using a questionnaire in a quiet open room at the TB centers, while ensuring confidentiality and anonymity of the patients who came for follow-up and routine treatment. The interviewers received thorough training to ensure consistent data collection and to minimize bias, with a focus on maintaining patient confidentiality. During data collection, all precautionary measures for COVID-19 were observed. Data consistency in this study was ensured through the use of standardized tools, clear data collection protocols, thorough data cleaning, and statistical validation, all of which contributed to the reliability and accuracy of the findings. The questionnaire contained questions that explored barriers related to current TB control programs and possible reasons for treatment non-adherence during the COVID-19 pandemic.

Inclusion and Exclusion Criteria

All patients who attended TB centers for medication that were at least 15 years of age, regardless of the site or smear status of their TB, and had taken anti-TB medication for at least a month were included. On the other hand, all patients < 15 years of age were excluded from this study regardless of the site or smear status of their TB, and new TB patients who started taking medication for less than one month and ill TB patients were excluded.

Operation Definition

Non-adherence to anti-TB drugs was defined as an individual scoring less than 6 points on the Morisky Medication Adherence Scale-8 (MMAS-8), indicating low adherence. In this study, the tool was justified by its reliability, which was previously validated, and its simplicity in assessing medication adherence across a wide spectrum of chronic conditions. It is sensitive to varying levels of adherence and is, thus, a very effective and cost-efficient tool. The MMAS-8 comprises eight items of question, with the first seven being answered with "yes" = 0 or "no" = 1, except item question 5 is reversed answer with "no" = 0 or "yes" = 1 and the eighth item being a five-point Likert scale. The Likert scale assigns values that range from 0 to 1. Never/rarely = 1, once in a while = 0.75, sometimes = 0.5, usually = 0.25, all times = 0. The total score ranges from 0 to 8 and determines the degree of adherence. For the data analysis, the three original categories of adherence were re-categorized into two categories. Accordingly, high and medium adherence were reassigned as adherent with a score of less than or equal to 2, and low adherence was regarded as non-adherent with a score greater than 2.

Data Management and Analysis

After the data collection was completed, the raw data were curated, cleaned, and organized before being exported SPSS for analysis. We subdivided the variables into categories and rearranged them to obtain a sufficient number for analysis. Data were analyzed using SPSS version 26 (IBM. 2019). Descriptive analysis was performed to understand the socio-demographics, prevalence, and reasons for non-adherence to anti-TB treatment among the patients. Subsequently, binary logistic regression analysis was used to identify the determinants of non-adherence to anti-TB treatment.

Results

The sociodemographic characteristics of the patients, more than half of the patients were male (65.5%) with age range 15–24 years (35.7%) being the majority followed by 25–35 years (28.6%). The results also revealed that the majority of those surveyed were married (52.5%) and single (36.9%). In terms of education level, approximately (30.6%) were illiterate, and (22%) attended high school. The occupation of the patients was unemployed (28.2%) and (27.5%), followed by employment, housewives, and students. Additionally, a larger proportion of the patients' income level was between 100-299 per month (52.2%), and (29.4%) of the patients' income was less than 99$ each month, as shown in (Table 1).

The overall proportion of non-adherence to anti-TB treatment was found to be 34.5% as shown in (Figure 1). The main reasons claimed by the participants for non-adherence were forgetting to take the medication and collection time (33%). Others were feeling well (29%), missing treatment due to side effects experienced (18%), and (16%), missing treatment due to fear of contracting COVID 19 (Figure 2).

According to the results of the binary logistic regression analysis to understand the odds of non-adherence based on a 95% confidence interval and statistical significance ($p<0.05$), sociodemographic variables such as age group

Table 1 Sociodemographic Characteristics of the Patients Attending Tuberculosis Centers During Pandemic COVID 19 (N=255)

Variables	Category	Frequency	Percent (%)
Sex	Female	88	34.5
	Male	167	65.5
Age	≥15-24	91	35.7
	25–34	73	28.6
	35–44	44	17.3
	≥45	47	18.4
Marital Status	Single	94	36.9
	Married	134	52.5
	Divorced	19	7.5
	Windowed	8	3.1
Educational Level	Illiterate	78	30.6
	Islamic Studies	51	20
	Primary	31	12.2
	Secondary	56	22
	University	39	15.2
Occupation	House wife	60	23.5
	Student	53	20.8
	Non-employ	72	28.2
	Employ	70	27.5
Income Level	<99$	75	29.4
	100–299$	133	52.2
	300–499$	36	14.1
	>500$	11	4.3

and occupation were found to be statistically significant (Table 2). The age group 25–34 had an odds ratio of 2.96 (p = 0.024), indicating that individuals in this age group are almost three times more likely to be non-adherent than those aged 45 years and above. Similarly, for the age group 35–44, the odds ratio was 4.55 (p = 0.005), suggesting that individuals in this age group have a significantly higher likelihood of non-adherence. In contrast, the occupation variable presented as odds for the non-employed category compared to the employed category was 2.57 (p = 0.037), indicating that non-employed individuals were more likely to be non-adherent to anti-TB treatment.

The results of individual-related factors showed that being a smoker/shish user was associated with a higher likelihood of non-adherence (OR = 3.49, p = 0.029), and tobacco use was also associated with a higher likelihood of non-adherence (OR = 4.15, p = 0.034) (Table 3).

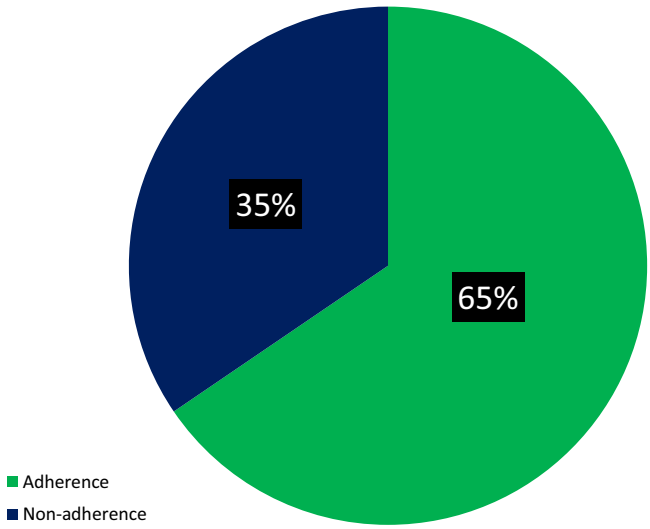

Figure 1 Adherence Status of anti-tuberculosis treatment among tuberculosis patient attending TB centers during pandemic COVID 19 lock down in Somalia.

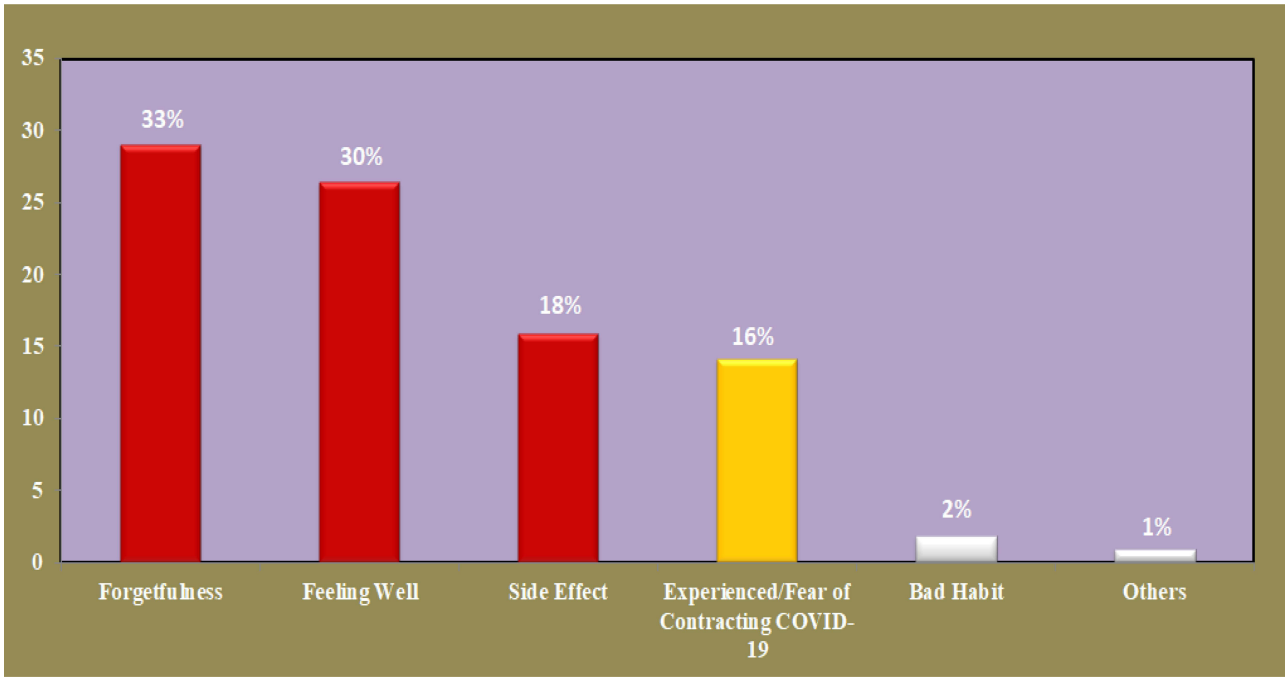

Figure 2 Reasons of missing anti-tuberculosis medication among patients attending at TB centers during COVID 19 pandemic in Somalia.

The binary logistic regression analysis of health facilities and treatment-related factors, including distance to health facilities, attitude of healthcare providers, treatment phase, and adverse effects of treatment, were found to be significantly associated with adherence to anti-TB treatment. The odds ratio for a distance greater than 10 km compared to 2–9 km was 1.13, indicating no significant difference in adherence. However, the odds ratio for distance within 1 km compared to 2–9 km was 0.44 ($p = 0.033$), suggesting that individuals living within 1 km of a health facility are likely to be non-adherent. The odds ratios for very friendly and friendly attitudes compared to indifferent attitudes are 0.24 ($p = 0.031$) and 0.45 ($p = 0.023$), respectively. This indicates that individuals who perceive their healthcare providers as very friendly or friendly are less likely to be nonadherent. Similarly, the odds ratio for the continuous treatment phase compared to the intensive phase was 3.2 ($p < 0.001$), indicating that individuals in the continuous treatment phase were more likely to be nonadherent. Finally, the odds

Table 2 Binary Logistic Regression Estimates the Sociodemographic Factors Associated of Non -Adherence Anti-Tuberculosis Treatment During COVID-19 Pandemic in Somalia (N=255)

Variables	Category	Anti-TB Treatment Adherence		Odds Ratio (95% CI)	P-value
		Non- adherence (n=88)	Adherence (n=167)		
		N (%)	N (%)		
Sex	Female	22 (25)	101 (60.8)	1	
	Male	66 (39.2)	68 (74.7)	1.87 (0.72–4.85	0.2
Age	≥15-24	23 (25.3)	42 (57.5)	1.36 (0.39–4.66)	0.63
	25–34	31 (42.5)	24 (54.5)	2.96 (1.15–7.59)	0.024*
	35–44	20 (45.5)	33 (70.2)	4.55 (1.59–13.02)	0.005*
	≥45	14 (29.8)	67 (71.3)	1	
Marital Status	Single	27 (28.7)	87 (59.2)	0.38 (0.07–2.08)	0.266
	Married	47 (40.8)	9 (47.4)	0.42 (0.09–2.02)	0.279
	Divorced	10 (52.6)	4 (50)	1.05 (0.18–6.29)	0.957
	Windowed	4 (50)	44 (73.3)	1	
Occupation	House wife	16 (26.7)	39 (73.6)	1.21 (0.37–3.92)	0.751
	Student	14 (26.4)	40 (55.6)	1.99 (0.59–6.74)	0.27
	Non-employ	32 (44.4)	44 (62.9)	2.57 (1.06–6.25)	0.037*
	Employ	26 (37.1)	51 (64.4)	1	
Educational Level	Illiterate	27 (34.6)	34 (66.7)	1.01 (0.33–3.05)	0.988
	Islamic Studies	17 (33.3)	21 (67.7)	0.97 (0.33–2.78)	0.947
	Primary	10 (32.3)	36 (64.3)	1.06 (0.33–3.36)	0.927
	Secondary	20 (35.7)	25 (64.1)	1.31 (0.5–3.47)	0.584
	University	14 (35.9)	52 (69.3)	1	
Income Level	<99$	23 (30.7)	92 (69.2)	0.35 (0.08–1.61)	0.177
	100–299$	41 (30.8)	18 (50)	0.37 (0.1–1.4)	0.143
	300–499$	18 (50)	5 (45.5)	0.63 (0.15–2.64)	0.528
	>500$	6 (54.5)	101 (60.8)	1	

Note: *Statistically Significant.

ratio for those patients experiencing adverse effects of the treatment compared to those who did not experience any adverse effects of the treatment was 2.42 (p = 0.003) indicated that patients who experienced any side effects of the anti-tuberculosis treatment were associated with a higher likelihood of non-adherence, as presented in (Table 4).

Discussion

These findings indicate that the first wave of the COVID-19 pandemic significantly affected adherence to anti-TB medication among patients in Mogadishu, Somalia. The identified reasons for non-adherence reflect the challenges posed by the pandemic, such as disruptions to daily routines, perceptions of wellness, and concerns about COVID-19. Binary

Table 3 Binary Logistic Regression Estimates the Clinical Characteristics and Individual Related Factors Associated of Non-Adherence Anti-Tuberculosis Treatment During COVID-19 Pandemic in Somalia (N=255)

Variables	Category	Anti-TB Treatment Adherence		Odds Ratio (95% CI)	P-value
		Non-adherence (n=88)	Adherence (n=167)		
		N (%)	N (%)		
Types of TB	PTB (+)	41 (32.3)	86 (67.7)	0.79 (0.34–1.83)	0.584
	EPTB	31 (35.6)	56 (64.4)	1.01 (0.42–2.43)	0.983
	PTB (-)	16 (39)	25 (61)	1	
Patient Category	New	70 (32.3)	147 (67.7)	0.58 (0.27–1.28)	0.179
	Relapse	18 (47.4)	20 (52.6)	1	
Chronic Illness	Yes	20 (37)	34 (63)	1.04 (0.51–2.14)	0.913
	No	68 (33.8)	133 (66.2)	1	
Smoker/Shisha	Yes	30 (77)	9 (23)	3.49 (1.13–10.74)	0.029*
	No	58 (26.9)	158 (73.1)	1	
Tobacco	Yes	22 (84.6)	4 (15.4)	4.15 (1.11–15.52)	0.034*
	No	66 (28.8)	163 (71.2)	1	
Chad	Yes	14 (87.5)	2 (12.5)	2.13 (0.34–13.33)	0.42
	No	74 (31)	165 (69)	1	
Knowledge	Poor	38 (51.4)	36 (48.6)	1.77 (0.9–3.48)	0.1
	Good	12 (27.3)	32 (72.7)	1.28 (0.58–2.81)	0.541
	Fair	38 (27.7)	99 (72.3)	1	

Note: *Statistically Significant.

Table 4 Binary Logistic Regression Estimates the Health Facility and Treatment Related Factors Associated of Non-Adherence Anti-Tuberculosis Treatment During COVID-19 Pandemic in Somalia (N=255)

Variables	Category	Anti-TB Treatment Adherence		Odds Ratio (95% CI)	P-value
		Non-adherence (n=88)	Adherence (n=167)		
		N (%)	N (%)		
Collector	Self	55 (32.2)	116 (67.8)	0.68 (0.38–1.24)	0.214
	Treatment Supporter	33 (39.3)	51 (60.7)	1	
Time of collecting Treatment	Once a week	25 (38.1)	39 (60.9)	0	0.998
	Twice a week	10 (28.6)	25 (71.4)	0	0.998
	Once every 2 weeks	50 (32.7)	103 (67.3)	0	0.998
	Once a month	3 (100)	0 (0)	1	

(*Continued*)

Table 4 (Continued).

Variables	Category	Anti-TB Treatment Adherence		Odds Ratio (95% CI)	P-value
		Non-adherence (n=88)	Adherence (n=167)		
		N (%)	N (%)		
Waiting of the service	<30 Minutes	72 (33.3)	144 (66.7)	1	
	≤30 Minutes	16 (41)	23 (59)	0.99 (0.45–2.18)	0.975
Distance of Health Facility	Within 1km	14 (24.6)	43 (75.4)	0.44 (0.21–0.94)	0.033*
	>10km	7 (35)	13 (65)	1.13 (0.39–3.24)	0.819
	2–9km	67 (37.6)	111 (62.4)	1	
Attitude of Health care provider	Very Friendly	4 (21.1)	15 (78.9)	0.24 (0.06–0.88)	0.031*
	Friendly	59 (32.6)	122 (67.4)	0.45 (0.22–0.9)	0.023*
	Unfriendly	1 (33.3)	2 (66.7)	0.37 (0.03–5.16)	0.457
	Indifferent	24 (46.2)	28 (53.8)	1	
Treatment Phase	Continuous	64 (43.5)	83 (56.5)	3.2 (1.75–5.84)	<0.001*
	Intensive	24 (22.2)	84 (77.8)	1	
Other Treatment	Yes	18 (38.3)	29 (61.7)	1.23 (0.59–2.56)	0.58
	No	70 (33.6)	138 (66.4)	1	
Adverse effect of Treatment	Yes	49 (40.8)	71 (59.2)	2.42 (1.34–4.37)	0.003*
	No	39 (28.9)	96 (71.1)	1	

Note: *Statistically Significant.

logistic regression analysis revealed several statistically significant associations with non-adherence, including age, employment status, smoking or shisha use, tobacco use, distance to the health facility, attitude of healthcare providers, treatment phase, and adverse effects of treatment.

The COVID-19 pandemic has caused significant disruption to healthcare systems worldwide, leading to the cancellation of routine services and emphasizing the importance of physical distancing measures, which have profound effects on tuberculosis (TB) service provision.[15] This situation is similar to the Ebola outbreak in Liberia, where a decrease in case notifications and a decline in the tuberculosis (TB) treatment success rate from 80% to 69%, with a subsequent increase to 77% post-Ebola, underscoring the significant impact on TB treatment outcomes.[16]

The prevalence of non-adherence to anti-TB drugs was approximately 34.5% among patients attending a tuberculosis treatment center in Mogadishu, Somalia. Prior to this report, no other published study was found, to the best of our knowledge, that reported on the impact of the COVD-19 pandemic on anti-TB treatment, especially in resource-constrained countries, and there were only predictions and concerns. However, other studies carried out in neighboring countries before the pandemic, including studies from Ethiopia, reported 24.5% non-adherence to anti-tuberculosis medications, which is lower than the 34.5% recorded in this study.[17] Other studies in Kenya and China were slightly similar, with 35% and 33.6% non- adherence to anti-tuberculosis medication, respectively.[18,19] The variation in the prevalence of non-adherence in these studies may be attributed to different study periods, designs, and settings.

Forgetting medication and collection time, feeling well, experiencing side effects, and fear of contracting COVID-19 were the primary reasons for non-adherence to anti-TB drugs among patients with TB in the current study. Different studies in northwest Ethiopia and Baringo Kenya revealed that forgetting medication was the major reason for TB

treatment resulting in interruption/ non-adherence.[20,21] Studies from Indonesia and Uganda reported that feeling better with accompanying poor knowledge about the duration of treatment was associated with non-adherence to anti-TB treatment.[22,23] Several studies have reported that drug side effects are the primary reason for patients not taking TB medication as prescribed, which is related to therapy.[18,24,25]

Many socioeconomic and behavioral factors that could increase the spread of coronavirus in Africa are also known to facilitate the transmission of Mycobacterium tuberculosis, leading to potential delays in seeking care for chronic cough amid COVID-19 infection.[26]

One of the identifiable independent determinants of non-adherence was the age group of 25–34 and 35–45 years old which was similar to other studies.[27–30] In contrast, many other studies have shown that older age is significantly associated with non-adherence to anti-tuberculosis treatment.[31,32] A study conducted in Bandung, Indonesia, and Sub-Saharan Africa observed no variation across different age groups.[33,34] The decreased adherence to anti-tuberculosis medication among younger individuals during the COVID-19 pandemic may be attributed to experiencing COVID-19 themselves or being busy with caregiving responsibilities for sick parents at home who became ill with COVID-19. Consequently, they may have missed their scheduled medication intake or neglected to ingest prescribed drugs. Therefore, this requires consideration from the tuberculosis (TB) program during the pandemic in developing countries, particularly Africa.

Our analysis showed that unemployment was associated with non-adherence to TB treatment among TB patients, similar to studies in Uzbekistan and Russia.[35,36] Conversely, another study in Sri Lanka showed that patients who were unemployed or home bound had a greater level of adherence to anti-TB treatment than skilled or unskilled laborers.[37]

Furthermore, smoking (shisha and/or tobacco) has been identified as a factor associated with non-adherence to tuberculosis treatment. The results of this study indicate that smoking is an individual behavioral factor linked to non-adherence to TB treatment. This finding aligns with studies conducted in other developing countries.[38–40] This could be attributed to the different types of smokers believing that persistent coughing is solely a result of their smoking habits and could also be mistaken for COVID-19 illness that may worsen, subsequently leading to non-adherence to anti-TB medications.

This study found that living within a short distance from the health facility (within 1 kilometer) was associated with non-adherence to tuberculosis treatment. A similar study conducted in an urban Ugandan population revealed that while the distance between a patient's home and the TB treatment facility lacked a significant correlation with overall unfavorable treatment outcomes, it was associated with an increased likelihood of mortality and a decreased likelihood of loss to follow-up.[41] On the contrary, another study showed that patients living more than 10 kilometers away from a primary healthcare center are at an increased risk of discontinuing treatment, which can lead to the development of treatment failure.[42] Moreover, this study found that a friendly attitude of healthcare providers contributes to patient non-adherence to treatment. According to a study conducted in Addis Ababa among patients who missed follow-up, healthcare providers were perceived as showing disrespect towards their patients and displaying reduced commitment to their profession.[43] A significant contributor to non-adherence to TB medication was the poor relationship between healthcare providers and patients, characterized by communication gaps.[44] These findings suggest that patients living within 1 kilometer a tuberculosis center facility and receiving very friendly care are more likely to result in non-adherence. No previous studies have reported these findings; in contrast, other studies reported that poor communication between healthcare provider-patient and distance from health center were associated frequently with non-adherence to anti-tuberculosis treatment.[22–24,31,35,38,39] The unexpected finding that friendly services and proximity to the clinic contributed to non-adherence may stem from patients underestimating the importance of strict medication adherence due to a false sense of security, compounded by pandemic-related behavior changes where patients, despite easy access, might have avoided the clinic or reduced adherence. This highlights the importance of TB control programs in improving treatment adherence among those receiving friendly care and living closer to facilities during the pandemic.

This study observed that the continuation phase of anti-tuberculosis therapy was associated with non-adherence during the COVID-19 pandemic, which is in agreement with studies conducted in the North Gondar Zone, Northwest Ethiopia, and Kassala State, Sudan.[20,45] A possible explanation could be that patients in the continuation phase may experience improved signs and symptoms of the disease and, as a result, may become reluctant to take their medications in addition to fear of contracting COVID-19. In this study, side effects were also found to be a significant factor

contributing to non-adherence to anti-TB treatment. This finding is similar to that of other studies that have established an association between side effects following TB treatment and non-adherence to TB treatment.[12,25,46]

The results indicate that the proportion of non-adherence posed a significant obstacle to achieving the targets set out in the Sustainable Development Goals (SDGs) and the End TB strategy, with deadlines of 2030 and 2035, respectively.[47] This study underscores the need for tailored interventions to address non- adherence to anti-TB medication during pandemic situations. Strategies to mitigate the impact of forgetting medication, address patient perceptions of wellness, manage side effects, alleviate COVID-19-related fears, and improve all determinants are essential for enhancing adherence among TB patients during similar crises.

One of the limitations of this study is its relatively short time frame (June 15 to July 30, 2020). While this period was sufficient to produce a snapshot of medication adherence and some of the factors associated with it during the first wave of the COVID-19 pandemic, adherence behaviors themselves may vary over longer time periods. This could have been better understood if the study period had been more extensive and might have modified the findings. The sampling in this study was convenience-based, and data collection was challenging during the pandemic, which could create selection bias and impact generalizability.

Further research is necessary to explore the long-term implications of non-adherence to anti-TB medication, and to develop and evaluate targeted interventions to improve adherence in similar crisis situations. Collaboration between public health authorities, healthcare providers, and community organizations is essential for implementing and evaluating the effectiveness of such interventions.

Conclusion

This study highlights the substantial rate of non-adherence to anti-TB medications during the first wave of the COVID-19 pandemic in Mogadishu, Somalia. The first wave of the COVID-19 lockdown presented numerous challenges for patients receiving TB treatment, leading to non-adherence to anti-TB drugs. Forgetting medication, feeling well, experiencing side effects, and the implications of the COVID-19 pandemic were among the primary reasons for non-adherence. The associations revealed by the logistic regression analysis provide valuable insights for targeting interventions to improve adherence. To address these challenges, patient-centered interventions, such as enhanced education on adherence, management of side effects, digital reminders, and strengthened healthcare responses during crises, are recommended to ensure continuous TB treatment and prevent drug resistance.

Abbreviations

TB, tuberculosis; COVID-19, coronavirus disease of 2019; MMAS-8, morisky medication adherence scale-8; MDR-TB, multidrug resistant tuberculosis.

Ethics Considerations

The study was approved by the SIMAD University IRB (Ref: 2020/SU IRB/FMHS/P0013) and adhered to the Declaration of Helsinki. Verbal informed consent was obtained directly from participants aged 18 years and older, whereas for those under 18, consent was obtained from their parents. This study process was approved by the ethics committee.

Acknowledgments

We would like to express our sincere gratitude to the Center of Research and Development, SIMAD University, for their encouragement and support. We would also like to thank Jamal Hassan Mohamoud, Mohamed Hussein Adam, and Bashiru Garba for their supervision and guidance. We acknowledge the use of the Morisky Medication Adherence Scale 8-Item (MMAS-8) in this study. We extend our sincere gratitude to Philip Morisky, MBA, Chief Optimus of Adherence, and Dr. Donald E. Morisky, Sc.D., M.S.P.H., Sc.M., President, for their permission and support in using this scale. The use of MMAS-8 in this manuscript was under license ©MMAS www.adherence.cc. Additionally, we deeply appreciate the participants, interviewers, and staff at the tuberculosis centers in Mogadishu for their dedication during the data collection process, especially under the challenging circumstances of the COVID-19 pandemic.

Disclosure

The authors report no conflicts of interest in this work.

References

1. World Health Organization. Global tuberculosis report 2020. World Health Organization; 2020. Available from: https://www.who.int/publications/i/item/9789240013131. Accessed October 18, 2020.
2. World Health Organization. Global tuberculosis report 2019. World Health Organization; 2019. Available from: https://www.who.int/publications/i/item/9789241565714. Accessed June 12, 2020.
3. SOMALIA TB Dashboard. Stop TB partnership. tuberculosis situation in 2020. Available from: https://www.stoptb.org/static_pages/SOM_Dashboard.html. Accessed November 16, 2020.
4. Mohamed H. Experts say coronavirus pandemic Somalia risk greater than China. Al Jazeera; 2020. Available from: https://www.aljazeera.com/news/2020/3/19/coronavirus-pandemic-experts-say-somalia-risk-greater-than-china. Accessed June 20, 2020.
5. Global tuberculosis report 2016. World Health Organization; 2016. Available from: https://www.who.int/publications-detail-redirect/9789241565394. Accessed October 21, 2020.
6. Migliori GB, Thong PM, Akkerman O, et al. Worldwide effects of coronavirus disease pandemic on tuberculosis services, January-April 2020. *Emerg Infect Dis J*. 2020;26(11):2709–2712. doi:10.3201/eid2611.203163
7. Global tuberculosis report 2022. COVID-19 and TB. World Health Organization; 2022. Available from: https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2022/covid-19-and-tb#:~:text=Other%20impacts%20associated%20with%20the. Accessed August 10, 2024.
8. Kyu HH, Ledesma JR. What is the impact of the COVID-19 pandemic on tuberculosis? *Lancet Glob Health*. 2023;11(9):e1323–e1324. doi:10.1016/s2214-109x(23)00360-1
9. Somalia Confirms First Case of Coronavirus. Voice of America; 2020. Available from: https://www.voanews.com/a/science-health_coronavirus-outbreak-somalia-confirms-first-case-coronavirus/6185895.html. Accessed September 12, 2024.
10. WHO's work in Somalia for COVID-19 response. World Health Organization; 2020. Available from: https://www.emro.who.int/somalia/information-resources/whos-work-in-somalia-for-covid-19-response.html. Accessed January 10, 2021.
11. Somali national strategic plan for tuberculosis control. Available from: https://moh.gov.so/en/wp-content/uploads/2020/07/Somali-national-strategic-plan-for-tuberculosis-control-2015-2019.pdf. Accessed October 10, 2020.
12. Gube AA, Debalkie M, Seid K, et al. Assessment of anti-TB drug nonadherence and associated factors among TB patients attending TB clinics in Arba Minch governmental health institutions, Southern Ethiopia. *J Tuberc Res Treat*. 2018;2018:1–7. doi:10.1155/2018/3705812
13. Berlowitz DR, Foy CG, Kazis LE, et al. Effect of intensive blood-pressure treatment on patient-reported outcomes. *N Engl J Med*. 2017;377(8):733–744. doi:10.1056/NEJMoa1611179
14. Bress AP, Bellows BK, King JB, et al. Cost-effectiveness of intensive versus standard blood-pressure control. *N Engl J Med*. 2017;377(8):745–755. doi:10.1056/NEJMsa1616035
15. Malik AA, Safdar N, Chandir S, et al. Tuberculosis control and care in the era of COVID-19. *Health Policy Plann*. 2020;35(8):1130–1132. doi:10.1093/heapol/czaa109
16. Desta KT, Kessely DB, Daboi JG. Evaluation of the performance of the national tuberculosis program of Liberia during the 2014-2015 Ebola outbreak. *BMC Public Health*. 2019;19:1221. doi:10.1186/s12889-019-7574-7
17. Woimo TT, Yimer WK, Bati T, Gesesew HA. The prevalence and factors associated for anti-tuberculosis treatment non-adherence among pulmonary tuberculosis patient in public health care facilities in South Ethiopia: a cross-sectional study. *BMC Public Health*. 2017;17(1):1–10. doi:10.1186/s12889-017-4188-9
18. Factors associated with non-adherence to tuberculosis treatment in Kenya; 2018. Available from: https://nltp.co.ke/wp-content/uploads/2020/10/TB-Adherence-Report-Final.pdf. Accessed November 22, 2020.
19. Fang XH, Shen HH, Hu WQ, et al. Prevalence of and factors influencing anti-tuberculosis treatment non-adherence among patients with pulmonary tuberculosis: a cross-sectional study in Anhui Province, Eastern China. *Med Sci Monit*. 2019;25:1928–1935. doi:10.12659/msm.913510
20. Mekonnen HS, Azagew AW. Non-adherence to anti-tuberculosis treatment, reasons and associated factors among TB patients attending at Gondar town health centers, Northwest Ethiopia. *BMC Res Notes*. 2018;11(1). doi:10.1186/s13104-018-3789-4
21. Obwoge RO, Sang RA, Wakube A. Factors associated to non-adherence in tuberculosis treatment, Baringo County, Kenya. *Int J Sci Res Innov Technol*. 2016;3(2):85.
22. Van der Werf MJ, Widjanarko B, Gompelman M, Dijkers M. Factors that influence treatment adherence of tuberculosis patients living in Java, Indonesia. *Patient Prefer Adherence*. 2009;1:231. doi:10.2147/ppa.s6020
23. Elbireer S, Guwatudde D, Mudiope P, Nabbuye-Sekandi J, Manabe YC. Tuberculosis treatment default among HIV-TB co-infected patients in urban Uganda. *Trop Med Int Health*. 2011;16(8):981–987. doi:10.1111/j.1365-3156.2011.02800.x
24. Gebremariam MK, Bjune GA, Frich JC. Barriers and facilitators of adherence to TB treatment in patients on concomitant TB and HIV treatment: a qualitative study. *BMC Public Health*. 2010;10(1). doi:10.1186/1471-2458-10-651
25. Tesfahuneygn G, Medhin G, Legesse M. Adherence to anti-tuberculosis treatment and treatment outcomes among tuberculosis patients in Alamata District, northeast Ethiopia. *BMC Res Notes*. 2015;8(1). doi:10.1186/s13104-015-1452-x
26. Togun T, Kampmann B, Stoker NG, Lipman M. Anticipating the impact of the COVID-19 pandemic on TB patients and TB control programmes. *Ann Clinic Microbiol Antimicrob*. 2020;19(1). doi:10.1186/s12941-020-00363-1
27. Ruru Y, Matasik M, Oktavian A, et al. Factors associated with non-adherence during tuberculosis treatment among patients treated with DOTS strategy in Jayapura, Papua Province, Indonesia. *Global Health Action*. 2018;11(1):1510592. doi:10.1080/16549716.2018.1510592
28. Shargie EB, Lindtjørn B. Determinants of treatment adherence among smear-positive pulmonary tuberculosis patients in Southern Ethiopia. *PLoS Med*. 2007;4(2):e37. doi:10.1371/journal.pmed.0040037
29. Cherkaoui I, Sabouni R, Ghali I, et al. Treatment default amongst patients with tuberculosis in urban Morocco: predicting and explaining default and post-default sputum smear and drug susceptibility results. *PLoS One*. 2014;9(4):e93574. doi:10.1371/journal.pone.0093574

30. Finlay A, Lancaster J, Holtz TH, Weyer K, Miranda A, van der Walt M. Patient- and provider-level risk factors associated with default from tuberculosis treatment, South Africa, 2002: a case-control study. *BMC Public Health*. 2012;12(1). doi:10.1186/1471-2458-12-56
31. Muture BN, Keraka MN, Kimuu PK, Kabiru EW, Ombeka VO, Oguya F. Factors associated with default from treatment among tuberculosis patients in Nairobi province, Kenya: a case control study. *BMC Public Health*. 2011;11:696. doi:10.1186/1471-2458-11-696
32. Bam TS, Gunneberg C, Chamroonsawasdi K, et al. Factors affecting patient adherence to DOTS in urban Kathmandu, Nepal. *Int J Tuberc Lung Dis*. 2006;10(3):270–276.
33. Rutherford ME, Hill PC, Maharani W, Sampurno H, Ruslami R. Risk factors for treatment default among adult tuberculosis patients in Indonesia. *Int J Tuberc Lung Dis*. 2013;17(10):1304–1309. doi:10.5588/ijtld.13.0084
34. Castelnuovo B. A review of compliance to anti tuberculosis treatment and risk factors for defaulting treatment in Sub Saharan Africa. *Afr Health Sci*. 2010;10(4):320–324.
35. Hasker E, Khodjikhanov M, Usarova S, et al. Default from tuberculosis treatment in Tashkent, Uzbekistan; Who are these defaulters and why do they default? *BMC Infect Dis*. 2008;8(1). doi:10.1186/1471-2334-8-97
36. Jakubowiak WM, Bogorodskaya EM, Borisov ES, Danilova DI, Kourbatova EK. Risk factors associated with default among new pulmonary TB patients and social support in six Russian regions. *Int J Tuberc Lung Dis*. 2007;11(1):46–53.
37. Pinidiyapathirage J, Senaratne W, Wickremasinghe R. Prevalence and predictors of default with tuberculosis treatment in Sri Lanka. *Southeast Asian J Trop Med Public Health*. 2008;39(6):1076–1082.
38. Tachfouti N, Slama K, Berraho M, et al. Determinants of Tuberculosis treatment default in Morocco: results from a national cohort study. *Pan Afr Med J*. 2013;14:121. doi:10.11604/pamj.2013.14.121.2335
39. Bagchi S, Ambe G, Sathiakumar N. Determinants of poor adherence to anti-tuberculosis treatment in Mumbai, India. *Int J Prev Med*. 2010;1 (4):223–232.
40. Gegia M, Magee MJ, Kempker RR, et al. Tobacco smoking and tuberculosis treatment outcomes: a prospective cohort study in Georgia. *Bull World Health Organ*. 2015;93(6):390–399. doi:10.2471/BLT.14.147439
41. Robsky KO, Hughes S, Kityamuwesi A, et al. Is distance associated with tuberculosis treatment outcomes? A retrospective cohort study in Kampala, Uganda. *BMC Infect Dis*. 2020;20(1). doi:10.1186/s12879-020-05099-z
42. Amoran OE. Determinants of treatment failure among tuberculosis patients on directly observed therapy in rural primary health care centres in Ogun State, Nigeria. *Prim Health Care Res Dev*. 2011;1(1). doi:10.4172/2167-1079.1000104
43. Getahun B, Nkosi ZZ. Is directly observed tuberculosis treatment strategy patient-centered? A mixed method study in Addis Ababa, Ethiopia. *PLoS One*. 2017;12(8):e0181205. doi:10.1371/journal.pone.0181205
44. Nezenega ZS, Perimal-Lewis L, Maeder AJ. Factors influencing patient adherence tuberculosis treatment in Ethiopia: a literature review. *Int J Environ Res Public Health*. 2020;17(15):5626. doi:10.3390/ijerph17155626
45. Mohammed El-Muttalut MK. Factors contributing to non-compliance with treatment among tuberculosis patients-Kassala State-Sudan-2016. *Int J Public Health Epidemiol*. 2017;6(3):332–338.
46. Deshmukh RD, Dhande DJ, Sachdeva KS, et al. Patient and provider reported reasons for missing follow-up in MDRTB treatment: a qualitative study from a drug-resistant TB centre in India. *PLoS One*. 2015;10(8):e0135802. doi:10.1371/journal.pone.0135802
47. Uplekar M, Weil D, Lonnroth K, et al. WHO's new end TB strategy. *Lancet*. 2015;385(9979):1799–1801. doi:10.1016/S0140-6736(15)60570-0