

# Prevalence of Rifampicin Resistant *Mycobacterium tuberculosis* among Treatment Failures and Relapse Patients Attending Mogadishu Tuberculosis Centers

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## Abstract

**Background:** A resistance to rifampicin drugs has been a problem since the era of chemotherapy. After dramatic outbreaks of multidrug-resistant tuberculosis (MDR-TB), including rifampicin in the early 1990s, resistance became recognized as a global problem. A global total of 206,030 people with multidrug and/or rifampicin-resistant TB (MDR/RR-TB) were detected and notified in 2019, a 10% increase from 186,883 in 2018. Globally, in 2019, 3.3% of new TB cases and 17.7% of previously treated cases had MDR/RR-TB. MDR/RR-TB still threatens the inhabitants of high TB burden countries in Africa. Mogadishu, the capital of Somalia, represents one such affected area. The most important risk factor for the development of rifampicin resistance-TB is previous anti-TB therapy. **Methods:** This study was carried out to ascertain the prevalence of rifampicin resistance *Mycobacterium tuberculosis* (MTB) among TB treatment failures and relapse patients attending Mogadishu TB centers. This was a retrospective cross-sectional descriptive study of TB treatment failures and relapses that was based on secondary data collected from TB patients who attended Mogadishu TB clinics. The prevalence of rifampicin resistance in relation to age, gender, and geographic location was determined via the examination of this data. **Results:** A total of 52 patients from Mogadishu TB clinics were recruited, including 28 treatment failure patients and 24 relapse patients. The average age was 31.77 years, with a range of 14–68 years. There were 18 female patients (34.6%) and 34 male patients (65.4%). Rifampicin resistance MTB was found in 78.57 % of treatment failure patients. The prevalence of relapse patients was 54.17%. **Conclusion:** The prevalence of rifampicin resistance MTB in treatment failure and relapse patients was high. This study emphasizes the need to study the nation-wide prevalence of rifampicin resistance MTB in previously treated patients.

**Key words:** *Mycobacterium tuberculosis*, prevalence, relapse, resistance, rifampicin, treatment failures

## INTRODUCTION

Tuberculosis (TB) is a communicable disease that is a major cause of ill health, one of the top 10 causes of death worldwide, and the leading cause of death from a single infectious agent. TB remains one of the world's deadliest communicable diseases. In 2019, an estimated 10.0 million people developed TB and 1.4 million died from the

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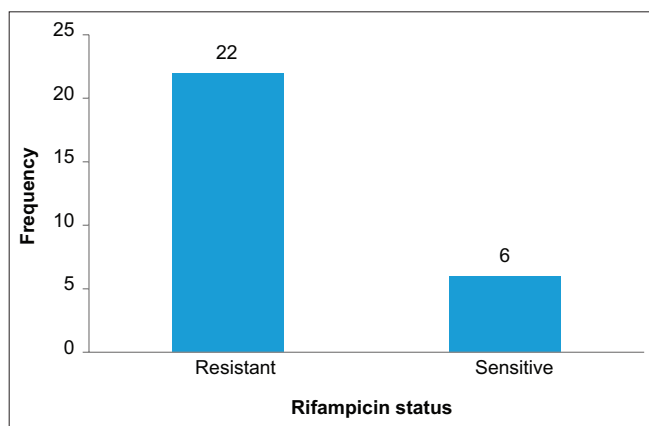
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**Received:** 02-02-2026

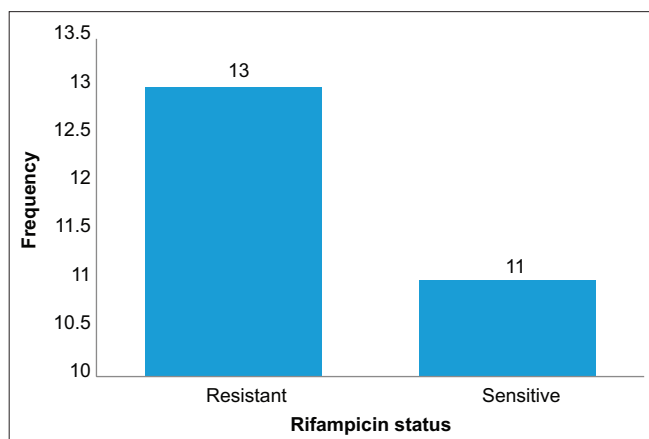
**Revised:** 07-03-2026

**Accepted:** 19-03-2026

disease, 208,000 of whom were Human Immunodeficiency Virus-positive.<sup>[1]</sup> Globally, the TB incidence rate is falling, but not fast enough to reach the first milestone of the End TB Strategy; that is, a 20% reduction between 2015 and 2020. However, given that most deaths from TB are preventable, the death toll from the disease is still unacceptably high, and efforts to combat it must be accelerated if global targets, set within the context of the millennium development goals, are to be met.<sup>[2]</sup>



**Figure 1:** Distribution of rifampicin status of treatment failure patients



**Figure 2:** Distribution of rifampicin status among the relapse patients

Globally, the burden of multidrug and/or rifampicin-resistant TB (MDR/RR-TB) as a share of the number of TB cases remains stable. In 2019, an estimated 3.3% of new TB cases and 18% of previously treated cases had MDR/RR-TB. In absolute numbers, there were an estimated 465,000 (range, 400,000–535,000) incident cases of rifampicin resistant TB; 78% had multidrug-resistant TB. India (27%), China (14%) and the Russian Federation (8%) had the largest share of the global burden.<sup>[1]</sup>

After more than 2 decades of civil war, Somalia remains one of the least developed and violent countries in the world. The conflict and violence, particularly in the south-central region, have caused massive population movements. This has been exacerbated recently by severe drought, floods, and famine.<sup>[3]</sup> In 2011, around 1.5 million internally displaced persons were reported among the country's 9 million inhabitants. Ratios of maternal mortality and deaths of children <5 years of age are among the highest in the world, and communicable diseases are the most common causes of illness and death.<sup>[3]</sup>

TB is a serious public health problem in Somalia with estimated incidence of 258 cases/100,000 persons in 2019. Fewer than half of the estimated cases are actually detected.<sup>[1]</sup> The levels of MDR-TB in Somalia are among the highest in the Eastern Mediterranean and African region.<sup>[4,5]</sup> Drug resistance arises due to improper use of anti-TB medicines, including the administration of improper treatment regimens and failure to ensure that patients complete the whole course of treatment.<sup>[6]</sup> Resistance to anti-TB drugs is considered an emerging problem, but the prevalence of MDR-TB (i.e., resistance to rifampicin and isoniazid, the 2 most potent anti-TB drugs) is unknown. To determine the magnitude of drug-resistant TB and better plan for treatment needs, this study aimed to quantify the prevalence of rifampicin-resistance *Mycobacterium tuberculosis* (MTB) among treatment failures and TB relapse patients attending Mogadishu TB center.

## MATERIALS AND METHODS

This study was conducted using data from Mogadishu TB centers of Banadir region of Somalia in the first 6 months of

**Table 1:** Contingency table on age and rifampicin status amongst the relapse and treatment failure patients

Age group	Relapse patients			Treatment failure patients			Gran total
	Resistant	Sensitive	Total	Resistant	Sensitive	Total	
5–14	1	0	1	0	0	0	1
15–24	3	3	6	9	1	10	16
25–34	6	5	11	5	1	6	17
35–44	0	1	1	5	3	8	9
45–54	3	2	5	2	0	2	7
54–64	0	0	0	0	1	1	1
65+	0	0	0	1	0	1	1
Total	13	11	24	22	6	28	52

**Table 2:** Distribution of patients by district

Name of the district	Number of the patient	Percentage
A.aziz	2	3.8
Dayniile	4	7.7
H.Wadag	4	7.7
H.jajab	2	3.8
Hodan	9	17.3
Kaaraan	5	9.6
Waaberi	3	5.8
Wadajir	2	3.8
Warta	1	1.9
Yaqshid	8	15.4
H.weyne	2	3.8
Shibis	2	3.8
Dharkenley	3	5.8
Huriwa	2	3.8
Shangani	1	3.8
Kahda	1	1.9
Grand Total	52	100.0

**Table 3:** Contingency table on gender and rifampicin status

Row labels	Resistant	Sensitive	Grand total
Female	13	5	18
Male	22	12	34
Grand total	35	17	52

2020 clinical records. Mogadishu is the largest city and capital of Somalia. Situated on the Indian Ocean coastline in the Benadir region of central Somalia, it consists of 17 districts and 2020 population estimate of 1,839,000 residents.<sup>[7]</sup> The National TB programs in Somalia are implementing directly observed treatment, short course in about 7 centers countrywide, with seven TB centers in Mogadishu, the TB patients attend daily in the centers for treatment, especially in the first phase of treatment, and some of them are admitted to the hospital where inpatient facilities are available.

The study design used was a retrospective cross-sectional secondary data analysis of rifampicin-susceptibility testing using Gene Xpert MTB/RIF system. The Gene Xpert is a fully automated nested real-time polymerase chain reaction system and was used on all sputum-positive treatment failures and relapse cases in Mogadishu first 6 months of 2020. Secondary data includes: Age, gender, facility (TB center), and rifampicin susceptibility test result. Consecutive sampling was used to enroll study participants. All relapse and failure TB patients diagnosed first 6 months of 2020 were eligible for enrollment. We project to obtain data from 28 Treatment failure TB patients and 24 Relapse TB patients.

A computer statistical package, the Statistical Package for the Social Scientists, was used to help the statistician, guided by the researcher to facilitate interpretation. Percentages and frequency tables were used to present the results.

## RESULTS

The study collected data from 52 participants. This consisted of 28 treatment failure patients (males were 57.1% [ $n = 16$ ], and females were 42.9% [ $n = 12$ ]). The mean age for these patients was 32.68 years with a standards deviation of 12.60 and ranging from 18 to 68 years) and 24 relapse patients (males were 75% [ $n = 18$ ] and females were 25% [ $n = 6$ ]). The mean age for these patients was 30.71 years with a standards deviation of 10.14 and ranging from 14 to 50 years attending Mogadishu TB centers. This sample was collected from 13 facilities in Mogadishu. TB centers. This sample was collected from 13 facilities in Mogadishu. Age-wise distribution of rifampicin resistance is presented in Table 1. District-wise distribution of patients is shown in Table 2, and gender-wise distribution is shown in Table 3. In this sample, the proportion of those who were resistant to rifampicin was 67.31% [ $n = 35$ ]. In the treatment failure patients group, the proportion of those who were resistant to rifampicin was 78.57% [ $n = 22$ ], as shown in Figure 1. In the relapse patients group, the proportion of those who were resistant to rifampicin was 54.17% [ $n = 13$ ], as shown in Figure 2.

## DISCUSSION

Rifampicin resistant MTB has become a major health problem and presents a challenge to the control of TB in Somalia. Several studies worldwide have found that previous anti-TB medication treatment is a significant risk factor for developing rifampicin-drug resistance.<sup>[8,9]</sup> Globally, it was projected that 3.3% of new TB infections and 18% of previously treated patients had MDR/RR-TB.<sup>[1]</sup> Most TB centers Somalia lack facilities for *Mycobacterium* culture and drug susceptibility testing, but with the help of donor agencies, some now have Gene Xpert MTB/RIF for quick and simple diagnosis of TB and rifampicin resistance.

The prevalence of rifampicin resistant MTB among treatment failure patients was 78.57%. This level of resistance was higher than the findings of other studies done in different cities of Nigeria, which reported 2–19%.<sup>[10-14]</sup> Higher prevalence rates can be due to poor TB control methods and non-compliance with preventative measures, which results in insufficient treatment. According to several sources, the link between TB treatment failure and MDR-TB or rifampicin resistant TB may be due to patient non-compliance, a lack of treatment monitoring, ineffective medication regimens, and insufficient or irregular drug supply, all of which may contribute to drug resistance.<sup>[15-17]</sup>

According to findings of this study, the prevalence of rifampicin resistant MTB detected by GeneXpert among relapse patients was 54.17%. This finding is higher than earlier studies from similar findings in Ethiopia and throughout the world (19.4–45.3%).<sup>[18,19]</sup> Furthermore, this prevalence is very high when compared to the study conducted in India, which was about Multidrug-resistant TB among Category II pulmonary TB patients, with the prevalence of 20.4%, 14.8% had relapse.<sup>[20]</sup>

This study also found that the age groups of 15–24 years for treatment failures and 25–34 years for relapse TB patients had the highest rifampicin resistance, due to the fact that youth make up the majority of the Somali population. The prevalence of rifampicin resistance in this sample is comparable to two earlier investigations in Nigeria, which found a greater prevalence of rifampicin resistance in the age groups 24–32 years and 31–40 years, respectively.<sup>[12,21]</sup>

Findings of the present study found that Over 65% of the participants were males comparing to females 34.6%. The study is in agreement with previous studies with a national anti-TB drug-resistant study in Tanzania.<sup>[22]</sup> The variance in gender can be attributed to the rate of exposure of males to the risk factors of TB infection such as smoking which could make them more susceptible.

## CONCLUSION

Our findings showed that the prevalence of rifampicin resistance MTB in treatment failures and relapse TB patients was high, and these patients are at high risk of amplified resistance, including extensive drug-resistant TB. This is considered as a threat to the TB control program in Somalia.

## AUTHOR'S CONTRIBUTIONS

A.M.S. and S.I.M.: Conceptualization, methodology, software, writing – original draft preparation and validation; K.H., A.M., W.M.C., E.M.: Formal analysis, investigation, resources, data curation, writing – review and editing; visualization, supervision, and project administration. All authors have read and agreed to the published version of the manuscript.

## INSTITUTIONAL REVIEW BOARD STATEMENT

The study was conducted according to the guidelines of NPHRL, and approved by the ethical committee of National public health reference laboratory of Somalia (reference number NPHRL-ERC/010821 and August 23, 2021).

## INFORMED CONSENT STATEMENT

Patient consent was waived due to using secondary data collected by TB centers.

## DATA AVAILABILITY STATEMENT

Data supporting reported results should be addressed to A.M.S.

## ACKNOWLEDGMENTS

First of all thank to Allah who made it possible for me to successfully finish this research. I would like to thank Dr. Khalid Mohamed Ali Haji, Dr. Enoch Omonge, and Dr. Winnie C. Mutai for their assistance and guidance throughout this entire research. My thanks extend to Dr. Abukar Hilowle and Sahra Isse Mohamed for their support and permission to carry out this research in Mogadishu TB centers.

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**Source of Support:** Nil. **Conflicts of Interest:** None declared.