

Tuberculosis Treatment Outcomes and Associated Factors in Benadir Somalia. A Multicenter Cohort Study

Mevlüt Karataş , Abdirahman Mohamed Hassan Dirie , Sedat Çolakoğlu, Abdirahman Osman Hussein , Amal Nor Ali

Pulmonology Department, Somalia Mogadishu Türkiye Recep Tayyip Erdoğan Training and Research Hospital, Mogadishu, Benadir, Somalia

Correspondence: Mevlüt Karataş; Abdirahman Mohamed Hassan Dirie, Email fmkaratas@yahoo.com; dirie515@gmail.com

Background: In low-resource countries like Somalia, tuberculosis (TB) is still a serious global health concern. Understanding the treatment outcomes of TB patients in specific regions is crucial for developing effective strategies to combat the disease. This study aimed to assess the treatment outcomes of TB patients in Benadir, Somalia.

Methods: A retrospective cohort study was conducted using data from TB treatment centers in Benadir, Somalia. The study included all TB patients who initiated treatment between July 1, 2019 and June 30, 2020. Treatment outcomes, including treatment success, treatment failure, lost, death, and transfer out, were analyzed. Factors associated with treatment outcomes were also examined using chi-square test.

Results: The study comprised 3165 TB patients in total. The mean age of the observations was 29.9 years, with males making up the majority (64.58%). The overall success rate of TB treatment was 80.6%, with 5.3% lost, 4.6% died, 0.5% failed, 4.6% transferred out, and 4.4% not evaluated. Factors associated with unfavorable treatment outcomes included older age and HIV co-infection.

Conclusion: The treatment success rate for TB patients in Benadir, Somalia, is below the global target of 90%. Enhancing access to quality TB diagnostic and treatment services, as well as addressing social and economic barriers to treatment adherence, are essential for improving TB control in Benadir, Somalia.

Keywords: TB, treatment failure, treatment success, outcomes

Introduction

Tuberculosis (TB) is an infectious disease, one of the world's most common causes of death, and significantly contributes to poor health. TB was the most common cause of death from a single infectious disease prior to the COVID-19 pandemic.^{1,2} No matter their age, gender, or race, TB can afflict anyone. Approximately 90% of all cases of tuberculosis (TB) occur in adults, with a higher incidence rate in males than in women.¹ Adult males account for 56% of all cases of TB, whereas adult females account for 33% and children for 11%.^{3,4} The World Health Organization (WHO) estimates that *Mycobacterium tuberculosis* (MTB), the TB causative organism, infects one-third of the world's population, or roughly two billion individuals.⁵

TB determinants like poverty, malnutrition, HIV infection, smoking, and diabetes can have an impact on the number of people who contract infection and treatment outcomes.¹ A number of studies have found that age, biological sex, comorbidity or underlying health issues, pretreatment weight, financial circumstances, and family support are all factors impacting TB treatment results in Sub-Saharan Africa.⁶

Between 2019 and 2021, the estimated number of TB deaths increased globally, reversing years of decline between 2005 and 2019.¹ According to estimates, 1.4 million HIV-negative people and 187000 HIV-positive people died in 2021 due to TB co-infection.¹ Due to the resurgence of TB, the Stop TB Strategy implemented the standardized directly observed treatment (DOTS) in 1993 in order to scale up TB prevention and control.⁷

The number of TB cases worldwide in 2019 was estimated to be 10.0 million (range, 8.9–11.0 million), a figure that has been steadily declining in recent years.^{3,8} China and India are responsible for more than half of the global TB burden.

The countries in Sub-Saharan Africa have the highest rates of TB infection worldwide.⁹ Drug-resistant TB (DR-TB) is still a threat to the public's health. Resistance to rifampicin, the most effective first-line treatment, is the main cause for concern. The prevalence of multi-drug-resistant TB was reported as being 10.56% in Somalia.⁴

Globally, eighty-six percent of those started on first-line TB treatment in 2020 had a successful treatment outcome, but rates remain lower among people living with HIV.¹ The prevalence of HIV among the Somali population is not known, but the prevalence of HIV among TB cases in Somalia was reported to be very low, reaching 1.5%.¹⁰ Usually, immunocompetent patients with tuberculosis (TB) exhibit typical symptoms, but in very rare situations, atypical TB symptoms could show up as active pulmonary tuberculosis with empyema necessitans in patients who are immune-competent.¹¹ In the civil war era, the health system of the Benadir region and other federal regions was very poor, but it started to improve in the last group, especially in TB treatments.¹²

The treatment outcomes of TB cases in Somalia were reported to be as low as 79% in 2012 and 81.8% in 2016, but these studies covered a small population, which cannot interpret the whole TB-affected population.^{13,14} Bacterial investigations include molecular WHO-recommended rapid diagnostics (mWRDs) e.g Xpert MTB/RIF, Ultra, and Truenat assays for diagnosing TB, along with culture, Line Probe Assay (LPA), and Lateral flow urine lipoarabinomannan assay (LF-LAM) assay. Radiological investigations include X-rays, CT scans, and MRIs.¹⁵ The exorbitant expense of phenotypic diagnostic testing (DST) is prompting a reevaluation, especially in low-income nations. An integrated national plan is required to guarantee the implementation, expansion, and implementation of these tests.¹⁶

The COVID-19 pandemic and its related public health initiatives potentially affected the prevention and management of tuberculosis.¹⁷

In general, national-level studies in Somalia have not been well published in the academic literature due to the civil war, a lack of funding for such country-wide research, and a lack of a strong, and centralized health system. The aim of this study was to determine the treatment outcomes of TB treatment in Benadir, Somalia.

Methodology

This study conducted a retrospective cohort analysis of tuberculosis treatment outcomes registered in Benadir, Somalia, covering the period from July 1, 2019 to June 30, 2020.

Study Design

This study was a retrospective cohort analysis. It was aimed at investigating the treatment outcomes of TB and the associated factors in Benadir, Somalia, a region of about three million people, including the capital city of the country. We retrieved this data from all 12 TB treatment centers in Benadir, Somalia. We applied a retrospective methodology to examine the pre-existing data and patient records, yielding valuable insights into the tuberculosis treatment practices and outcomes in the area. A total of 3165 treated TB cases, which were collected from all TB centers, were analyzed.

Data Collection

Data was collected from multiple TB centers involved in TB control in Benadir. The study covered a one-year period, from July 1, 2019 to June 30, 2020, to ensure a representative sample of TB cases. Inclusion Criteria: The study included all Benadir resident TB patients who received treatment in the Benadir region during the specified data period. Exclusion Criteria: The analysis excluded patients who did not reside in the Benadir region.

Data Variables

The data included the patients' age, gender, address, HIV status, affected site (pulmonary or extra-pulmonary), smear status (smear-positive and smear-negative), and treatment outcomes (Cured, ie, a pulmonary TB patient with bacteriologically confirmed TB at the beginning of treatment who completed treatment as recommended by the national policy with evidence of bacteriological response§ and no evidence of failure, completed, ie, A patient who completed treatment as recommended by the national policy whose outcome does not meet the definition for cure or treatment failure, died, ie, a patient who died before starting treatment or during the course of treatment, Lost to follow-up, ie, A patient who did not start treatment or whose treatment was interrupted for 2 consecutive months or more, Not evaluated, ie, A patient for

whom no treatment outcome was assigned, Transferred, ie, transferred to another region with unknown outcome, or Treatment failed, ie, a patient whose treatment regimen needed to be terminated or permanently changed to a new regimen or treatment strategy).¹⁸ Treatment success means the sum of cured and treatment completed. An unsuccessful outcome means the patient died, defaulted, or failed to respond to the treatment.

Definition of groups: Group 1 (0 to 9 years old), Group 2 (10 to 19 years old), Group 3 (20 to 29 years old), Group 4 (30 to 39 years old), Group 5 (40 to 49 years old), Group 6 (50 to 59 years old), Group 7 (60 to 69 years old), Group 8 (70 to 79 years old), Group 9 (80 to 89 years old), and Group 10 (90 to 100 years old).

Data Analysis

The data was entered into the Statistical Package for Social Sciences (SPSS) software (IBM SPSS Statistics version 26) for analysis. Descriptive Analysis: Initial analysis involved the description of patient demographics and characteristics, as well as the overall distribution of treatment outcomes in the study population. The association between different factors and treatment outcomes was examined using statistical tests such as chi-square test.

Ethical Considerations

The study complied with ethical standards, and we obtained the necessary approvals from relevant ethics committees, ie, Mogadishu Somali Turkey Recep Tayyip Erdogan Training and Research Hospital (Ref No. MSTH/15781) and the Somali Ministry of Health, National TB Program, which had given permission to conduct the study (Ref No. FMOH/NP/009/2022). Patient privacy and confidentiality were strictly maintained, and the data was anonymized. The ethics committee waived patient consent for our study because this data was the result of a retrospective record analysis. This study complies with the Declaration of Helsinki.¹⁹

Results

In this retrospective record-analysis study, we collected a total of 3412 TB cases. After excluding 247 cases who were collected from Benadir TB centers but whose residence area was outside of the Benadir region, the eligible cases for our study were 3165. According to the age distribution of our study population, the mean, mode, and median were 29.9, 26, and 30, respectively. The ages of our cases ranged from 3 months to 95 years old. By the grouping of patients' ages, more than 70% of our study cases were young adults, teenagers, and children, less than 40 years old. About 60% of our subjects were aged between 10 and 39 years old. Group 3 (ie, 20 to 29 years old) was the most prominently affected age group, comprising 26.8% of the subjects (Figure 1).

Regarding the sex of the TB cases that we analyzed, 64.6% (2044/3165) were male, while 35.4% (1121/3165) of them were female (Table 1). In the context of HIV status, 1.5% (46/3165) were HIV positive, 95.3% (3015/3165) of our cases were HIV negative, 0.4% (14/3165) were transferred from another TB center and HIV status was not documented in Benadir TB centers, and 0.3% (11/3165) had not undergone HIV testing.

In our study, we found that 82.5% (1662/2014) of subjects with pulmonary tuberculosis were smear-positive, while the other 17.5% (352/2014) were smear-negative pulmonary tuberculosis. We identified 28.7% (907/3165) as extra-pulmonary cases, 5.6% (177/3165) as not available (N/A), 0.4% (13/3165) as transfers from other centers, and 1.7% (54/3165) as missing from the records (Table 1).

Within our investigation, a significant proportion of people (42.8%; 1354 out of 3165; specifically those who tested positive for bacteria in their smears) successfully underwent therapy and had a complete cure. Out of a total of 3165 patients, 37.8% (1196) successfully completed the therapy, 5.3% (168) were lost, 4.6% (145) died during the treatment period, and 0.5%¹⁵ failed to respond to the treatment and considered as drug resistant cases. These subjects were then transferred to multi-drug resistant tuberculosis centers for further assessment and treatment. In addition, 4.6% (146 out of 3165) were transferred out.

In subgrouping of treatment outcome according to the HIV test result, the HIV positive subjects: 45.5% of them cured, 15.9% completed, 18.2% died, 11.4% lost, 2.3% transferred out, 6.8% were not evaluated, and there were no failure cases. While the HIV-negative subjects were evaluated, 45.4% of them were cured, 38.6% completed, 0.4% failed, 4.5% died, 5.5% lost, 4.7% transferred out, and 0.8% were not evaluated.

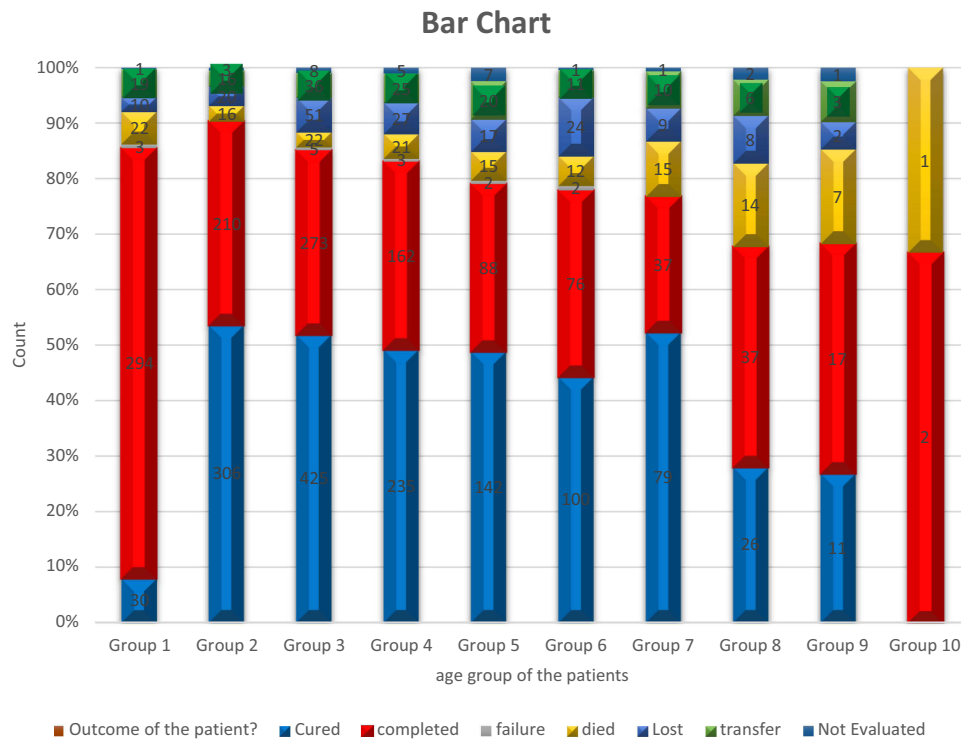


Figure 1 Treatment outcomes distributed in age groups.

Regarding the smear status and treatment outcome, we found that 82.4% of smear-positives were cured, 0.6% failed, 3.8% died, 6.8% lost, 3.9% transferred out, and 2.5% were not evaluated. In smear-negative cases, 81.9% completed, 0.6% failed, 8.6% died, 5.3% lost, 2.4% transferred out, and 0.9% were not evaluated.

Table 1 Factors That Contribute Poor Treatment Outcome

Variables	Divisions	Successful	Unsuccessful	Unknown	Total	P-value
Sex	Male	80.7%	10.8%	8.6%	2044	0.2820
	Female	80.4%	9.6%	10.0%	1121	
Age groups	0 to 19	84.8%	7.2%	8.0%	990	*0.0000
	20 to 39	81.8%	9.6%	8.6%	1339	
	40 to 59	76.6%	13.6%	9.8%	530	
	60 and above	68.3%	18.3%	13.4%	306	
HIV-Status	Positive	58.7%	28.3%	13.0%	46	*0.0010
	Negative	81.0%	10.1%	8.9%	3015	
Smear	Positive	80.7%	10.7%	8.5%	1662	0.1940
	Negative	78.7%	13.9%	7.4%	352	
TB site	Pulmonary	80.4%	11.3%	8.3%	2014	0.0630
	Ex/pulmonary	81.8%	8.7%	9.5%	907	
	Not available	86.4%	5.6%	7.9%	177	
	Transfer In	61.5%	15.4%	23.1%	13	

Note: *p-value less than 0.05 which is statistically significant.

As a general success rate of TB treatment, 80.6% (2550/3165) were successfully treated, 10.7% (328/3165) were unsuccessful, and 9% (287/3165) had unknown results.

The success rate was higher in children and young adult groups under 50 years, and their treatment success rate was 82.5% (2152/2610), while in adult groups above 50 years, their successful treatment was 71.7% (398/555) with a statistically significant value ($p = 0.0001$).

In regards to HIV co-infection and successful treatment, we found that 58.7% of HIV positives had successful treatment, the unsuccessful rate was 28.3%, and 13% of them were of unknown fate. In HIV-negative subjects, 81.0% of them were successfully treated, 10.1% were unsuccessful, and the fate of the remaining 8.9% was not known ($p = 0.0010$). All newly diagnosed HIV subjects were transferred into the ART center at Benadir Hospital, and some of the subjects were previously known HIV-positive cases.

According to the success and sex of the subjects, the male success rate was 80.7%, the unsuccessful rate was 10.8%, and for the other 8.6%, their fate was not known. In the female subjects, treatment success was 80.4%, the unsuccessful rate was 9.6%, and the unknown rate was 10.0% ($p = 0.2820$).

We found that 80.7% (1342/1662) of smear-positive pulmonary TB cases were treated successfully, 10.7% were unsuccessful, and 8.5% were unknown. While 78.7% (277/352) of smear-negative cases were treated successfully, 13.9% were unsuccessful, and 7.4% of them were unknown ($p = 0.1940$). When we compared the success rate of subjects according to the TB-affected site, we found that 86.4% of extra-pulmonary cases were treated successfully, while the success rate in pulmonary TB subjects was 80.4% without statistical significance ($p = 0.0630$).

Discussion

The outcome of TB treatment in Benadir, Somalia, is a matter of significant concern due to various factors that may influence treatment success rates. In this study, we aimed to assess the treatment outcomes of TB patients in the Benadir region (the capital city of the country and the most populated region in the whole country) and to identify the potential factors associated with treatment success or failure.

Our findings revealed that the overall treatment success rate for TB patients in Benadir, Somalia, was 80.6% (2550/3165). This success rate is relatively low compared to the global target of (at least > 90% treatment success rate and 6.5% TB-related mortality rate) set by the World Health Organization (WHO).³ This might be due to the fact that the study period was coincident with the COVID-19 pandemic era, when many of the TB patients could not reach TB centers, which may contribute to increased default rates.

Our findings in Somalia are consistent with previous research in Mogadishu, which reported a success rate of 81.8%. However, it is worth noting that the previous study had a smaller sample size of 385 patients,¹⁴ while our study included 10 times more cases, totaling 3165. Our study was slightly better than the one conducted in Galka'yo and Marere, which resulted in an overall success rate of 79.1%.¹³ This discrepancy might be due to the fact that our study was conducted in the capital city, the most urbanized region in the country, while Galka'yo is less urbanized, and part of their patients were rural residents who had less compliance than rural residents.

This cohort was similar to many studies conducted in Adama City, Ethiopia, with a success rate of 80.8%,¹⁶ Woldia Town, the capital city of North Wollo, Ethiopia, with an 80.7% successful treatment outcome,²⁰ and Kampala, which revealed an 80.0% success rate.

Our work yielded lower results when compared to the studies conducted in Bale, southern Ethiopia, with a successful treatment outcome reaching 87.7%,²¹ a Machakos Kenyan sub-county with an overall treatment success rate of 88.1%,²² the Addis Ababa study, which showed a 94.6% success rate,²³ and a large geospatial study conducted in Ethiopia with a success rate of 91%,²⁴ Madda Walabu University Goba Referral Hospital in Ethiopia, which reported a 91.2% success rate,⁹ and Gharbia and Menoufia governorates in Egypt, which showed success rates of 90.1% and 92.7%, respectively.²⁵ The differences might be due to sociodemographic, cultural, socio-economical, or COVID-19 effects. This study showed better results when compared to a 68.46% treatment success rate in Ashanti Region Ghana,⁶ a 75% success rate in Kampala Uganda²⁶ and a 75.8% success rate in Anambra, Nigeria.²⁷

In this study, we found that older age (over 40 years old) was one of the independent indicators of poor TB treatment outcome ($p = 0.0000$). This corroborates the results of other research in Eritrea that found a link between TB treatment failure and getting older.²⁸

This may be attributed to the higher prevalence of comorbidities, reduced adherence to medical recommendations, compromised immune system function, and increased susceptibility to the influence of societal attitudes in older individuals.

In our work, we found that TB/HIV co-infection had a poor TB treatment outcome with a three-fold higher mortality rate when compared to the other HIV-negative subjects. This is in line with many other studies, including one conducted in Eritrea that showed the same results.²⁹ This finding relates to the higher mortality rate in HIV patients, which is a result of their lower immune function, and the higher lost-to-follow-up rate, which is a result of the higher stigma associated with HIV.

One possible reason for the relatively low treatment success rate is the high prevalence of drug-resistant TB strains in Benadir, Somalia.⁴ Drug resistance is a major challenge in TB treatment, as it requires more complex and challenging treatment regimens.

This study's findings showed no sex-based differences in TB treatment outcomes, which is consistent with one study in Bale, Ethiopia, and many other studies that showed no sex-based variations in TB treatment outcomes.²¹

Generally, poverty, limited education, nomadic lifestyles, and social stigma related to TB can impede patients' access to timely and suitable healthcare, leading to inadequate adherence to treatment plans. Consequently, this can contribute to unfavorable outcomes in TB treatment and a high prevalence of multi-drug resistant strains of TB.¹⁵

To improve the outcome of TB treatment in Benadir, Somalia, several strategies should be implemented. Strengthening the healthcare system, improving diagnostic facilities, increasing awareness about TB, decreasing social stigma, and implementing community-based operations, including mobile outreach teams, all of these can help improve treatment adherence and TB treatment outcomes.²⁷

Limitations

The study relies on retrospective data, which may have limitations in terms of completeness and accuracy. It was challenging to account for all confounding factors that could influence treatment outcomes, including comorbidities like diabetes, hypertension, COPD, and asthma, as well as social factors like smoking and an illegal drug history.

Conclusion

In conclusion, the effectiveness of TB treatment in Benadir, Somalia, is currently lower than the WHO's global target and lower than that of the nations around it. The elderly and HIV patients have significantly poor outcomes. This study highlights the need for comprehensive efforts to improve TB treatment outcomes. Direct observed treatment (DOT) can become a tool to increase the success rate of TB treatment outcomes in Benadir, Somalia.

Declaration of Generative AI

The author used Copilot IA to improve the text's clarity and accuracy, carefully reviewing and editing the information as necessary while taking full responsibility for its publication.

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Disclosure

The authors have declared no conflict of interest.

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