Original Article

Prevalence of tuberculosis in *Hadramout Al-Sahel*, Yemen: A 1-year cross-sectional study

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ABSTRACT

Background: There is a lack of adequate data about the prevalence and types of tuberculosis (TB) disease in Hadramout Al-Sahel, Yemen. Hence, this study aimed to investigate the prevalence, types, and outcomes of TB disease in Hadramout Al-Sahel, Yemen. **Materials and Methods:** This cross-sectional study was conducted at the National TB Program (NTP) center in the city of Al Mukalla, Hadramout, Yemen. The study enrolled TB patients from different districts of Hadramout Al-Sahel who had registered at the NTP center between January 1 and December 31, 2021. **Results:** A total of 127 new active TB cases were recruited, including 102 (80.3%) with pulmonary TB (PTB) and 25 (19.7%) with extra PTB (EPTB). The overall prevalence of TB disease in 2021 was 12.7 new TB cases per 100,000 population, while the median age of the study population was 38 years. The majority of cases (23.6%) belonged to the age group of 35–44 years. There were 85 (66.9%) males, and most patients (74; 58.3%) were identified in Al Mukalla City. EPTB was detected in 25 (19.7%) patients, with pleural effusion being the most frequent manifestation, found in 12 (48.0%) patients. All patients received 4-agent anti-TB therapies; 99 (77.9%) patients received anti-TB therapy for 6 months; 9 (7.1%) patients received anti-TB therapy for 9–12 months; 8 (6.3%) patients died during treatment; and 11 (8.7%) patients were lost during follow-up. The majority of patients (108; 85%) were cured on completion of treatment. **Conclusion:** The prevalence of TB in Hadramout Al -Sahel was 12.7 cases per 100,000 population. Males were affected more than females; the pleura was the most commonly affected extrapulmonary site; and 85% of cases were cured. The results indicated the need to support the Al Mukalla NTP center, by providing more resources for improved TB reporting and for conduct of surveillance to detect new TB cases among high-risk groups. Health authorities are also urged to provide state hospitals with the equipment needed for TB diagnosis.

Keywords: Acid-fast bacilli, Extrapulmonary tuberculosis, Prevalence, Pulmonary tuberculosis

Tuberculosis (TB) is a major global health concern that may emerge as a disease affecting several systems with myriad presentations. According to the 2020 World Health Organization (WHO) report, the number of TB cases decreased worldwide until 2019, although very slowly [1]. Thereafter, TB cases increased during the COVID-19 period, as efforts were redirected to the new pandemic at the expense of TB care. According to the 2022 WHO report [2], the COVID-19 pandemic is still negatively impacting TB diagnosis and care, and thus the disease burden, leading to slowing, halting, or reversing of the progress made through 2019 in the fight against TB. According to the report, an estimated 10.6 million people contracted TB in 2021, compared to 10.1 million in 2020. Further, 16 million people died of TB in 2021 (including people with HIV), compared to 15 million in 2020 (including people with HIV). In addition, the incidence rate of TB increased by 36% in 2021 as compared to 2020, suggesting a reversal of the trend of nearly 2% decline per year over the past 2 decades.

In Yemen, the COVID-19 pandemic, civil war, poverty, and social unrest were expected to have a significant negative impact on TB infection rates [3]. However, the WHO reports showed that the incidence of TB gradually decreased in 2021 compared to 2020. The incidence of TB decreased slightly from 49 cases per 100,000 population in 2020 [4] to 48 cases per 100,000 population in 2021 [5]. In Al Mukalla, the incidence of TB was 26.1/100,000 population between 2011 and 2018 [6]. This study aimed to highlight the prevalence, epidemiology, and outcomes of TB disease in Hadramout Al-Sahel, Yemen during the COVID-19 period, between January 1, 2021 and December 31, 2021.

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MATERIALS AND METHODS

Design, Population, and Setting

This cross-sectional study was conducted at the National TB Program (NTP) Center in Al Mukalla City, Hadramout Al-Sahel, Yemen. For those suspected of having TB, this facility provides free chest X-rays and acid-fast bacilli (AFB) smear tests. It also notifies active TB cases across various Hadramout Al-Sahel districts and provides free anti-TB therapy. Hadramout Al-Sahel includes the districts of Ar Raydah Wa Qusayar, Ad Dis Wa Alhami, Ash Shihr, Ghayl Ba Wazir, Daw'an, Hajr, Brom Mayfa, and Al Mukalla. This study enrolled patients of various ages who had been diagnosed with active TB disease and were notified by the NTP center between January 1, 2021 and December 31, 2021.

Definition of Cases

This study classified active TB into two categories: Pulmonary TB (PTB) and extra PTB (EPTB) [3]. Patients with TB disease confined to the lung parenchyma were classified as having PTB. They were further subdivided into those with smear-positive PTB and those with smear-negative PTB (clinically diagnosed PTB), based on the detection of AFB upon microscopic examination of unconcentrated sputum. Criteria for smear-positive active PTB included patients with at least 2 sputum samples that had tested positively for AFB under direct smear microscopy. Patients with clinically diagnosed active PTB had smear-negative results but PTB -related clinical and/or radiological abnormalities; further, they had responded adequately to anti-TB treatment [3].

EPTB refers to TB that occurs in any tissue or organ in the body other than the lung parenchyma. EPTB was diagnosed through bacteriology/histology of aspirated/biopsied specimens. The bacteriology of the specimens included only an AFB smear due to limited facilities. Histopathological diagnosis involved the identification of caseating granuloma in the biopsy. EPTB cases unconfirmed by bacteriology/histology of an aspiration/biopsy specimen but with clinical, radiographic findings and/or fluid analysis suggestive of EPTB and showing adequate response to anti-TB treatment were considered as clinically diagnosed EPTB cases [3].

First-line anti-TB treatment has been defined as the use of 4 anti-TB drugs, including isoniazid, rifampicin, pyrazinamide, and ethambutol, for at least 6 months, divided into intensive and maintenance phases. A case was considered lost to follow-up if the course of treatment was discontinued for 2 consecutive months or longer following the final dose of medication. A TB patient was considered to be cured if they had completed their course of therapy and experienced at least 1 sputum smear-negative result or clinical improvement. A patient was considered dead if they had passed away while receiving TB treatment due to any reason whatsoever.

Data Analysis and Ethical Approval

This study used simple descriptive statistics. Data were presented as the median (interquartile range [IQR]) for quantitative variables, whereas qualitative variables were described as numbers and percentages. The prevalence of TB in this study was calculated as the number of reported TB cases (during the study period) divided by the total population during the same period multiplied by 100,000 [3].

Ethical approval to conduct this study was obtained from the administration of the NTP center in Al Mukalla City, as the Governorate had no research committee.

RESULTS

Demographic Characteristics of TB Patients

During the period from January 1, 2021, to December 31, 2021, a total of 127 new TB cases were reported at the NTP center in Al Mukalla city, including 102 (80.3%) with PTB and 25 (19.7%) with EPTB. The overall prevalence of TB disease in Hadramout Al-Sahel in 2021 was 12.7 new TB cases per 100,000 population, whereas the mean age of the study population was 38 years (IQR: 28–53 years). Most cases (22.1%) belonged to the age group of 35–44 years; there was a higher male preponderance of 66.9% (n=85) and most patients (74; 58.3%) were identified in Al Mukalla City. Table 1 describes the demographic characteristics of the study population. In addition, the distribution of TB patients across the different districts of Hadramout Al-Sahel is summarized in Table 2.

Clinical Characteristics and Anti-TB Treatment Outcome of the Patients Involved

Out of the 102 PTB cases, AFB microscopy was positive in 41 (40.2%) cases, whereas 61 (59.8%) cases were clinically diagnosed. EPTB was detected in 25 (19.7%) patients, with pleural effusion being the most frequent manifestation, found in 12 (48.0%) patients, followed by lymph node TB in 8 (32.0%) patients, abdominal TB in 4 (16.0%) patients, and spinal TB in 1 (4.0%) patient (Fig. 1). All patients received 4-agent anti-TB therapies; 99 (77.9%) patients received anti-TB therapy for 6 months; 9 (7.1%) patients received anti-TB therapy for 9–12 months; 8 (6.3%) patients died during treatment; and 11 (8.7%) patients were lost during follow-up (Table 1). Majority of patients (108; 85%) were cured upon treatment completion; the course of treatment was closely monitored by NTP staff from beginning to end (Table 1).

DISCUSSION

Yemen is considered to have a moderate TB burden with an incidence rate of 48 cases per 100,000 people in 2021 [4]. However, based on observations from daily clinical practice, we disagree with these numbers and believe that TB cases are

Table 1: The demographic and clinical characteristics of the study population

Variable	Number (%)
Sex	
Male patients	85 (66.9)
Female patients	42 (33.1)
Median of age	38 (IQR: 28–53)
Age groups	
5–14	5 (3.90)
15–24	19 (15.0)
25–34	24 (18.9)
35–44	28 (22.1)
45–54	21 (16.5)
55–64	11 (8.6)
≥65	19 (15.0)
Types of tuberculosis	
Pulmonary TB	102 (80.3)
Extrapulmonary TB	25 (19.7)
Treatment and outcomes	
Number of patients received four-drug anti-TB therapy	127 (100)
Number of patients received anti-TB therapy for 6 months	99 (77.9)
Number of patients received anti-TB therapy for>6 months	9 (7.1)
Number of patients died	8 (6.3)
Number of patients lost during follow up	11 (8.7)
Number of patients cured	108 (85.0)

TB: Tuberculosis

Table 2: Distribution of cases in different districts of Hadramout Al-Sahel

District	Number (%)	District	Number (%)
Al Mukalla	74 (58.3)	Ghayl Ba Wazir	8 (6.2)
Ar Raydah Wa Qusayar	14 (11.0)	Daw'an	9 (7.1)
Ad Dis Wa Alhami	3 (2.4)	Hajr	3 (2.4)
Ash Shihr	13 (10.2)	Brom Mayfa	3 (2.4)

under-reported in Yemen. Between April 2020 and August 2021, there were 3 COVID-19 pandemic waves in Yemen [7], which added further pressure on the already languishing healthcare system, leaving little room for TB care. Government-mandated lockdowns, disruption of routine out-patient services, lack of resources for the NTP to run surveillance for detection of new TB cases across various regions of the country, and fear of visiting hospitals — all contributed to impaired TB case-detection, leaving several undiagnosed cases with an ongoing transmission risk. Therefore, we believe that Yemen has one of the lowest TB detection rates in the world.

TB infection in humans is mainly caused by *Mycobacterium tuberculosis* complex (MTBC), which includes *M. tuberculosis*, *Mycobacterium bovis*, *Mycobacterium africanum*, *Mycobacterium caprae*, *Mycobacterium microti*, *Mycobacterium canettii*, and

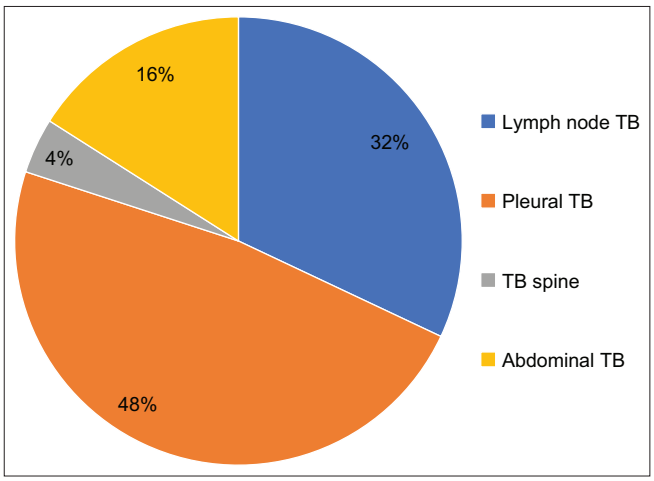

Figure 1: Frequency of extrapulmonary tuberculosis

Mycobacterium pinnipedii [8]. A definitive diagnosis of TB can be made only by culturing mycobacterial species from patient samples. Further detection of mycobacterial species can be carried out in culture media using special biochemical tests. Polymerase chain reaction (PCR) or gene probe tests can also distinguish MTB from other mycobacteria [9]. However, this study could not access information on the pathogens responsible for TB, because neither TB culture facilities nor PCR tests for MTB DNA were available in the Governorate.

In this study, the prevalence of TB was recorded at 12.7 new cases per 100,000 people in 2021. This figure is low, compared to 3 other studies conducted in the Kashmir Valley, India, in 2020 [10], in Sousse, Tunisia, during 2009 and 2019 [11], as well as a previous study conducted in Shabwa governorate, Yemen, during the same period [3]. A male preponderance was seen among the patients in this study, which is consistent with other studies conducted in Yemen and around the world [3,6,11-14]. This may be partially explained by the fact that men in Yemeni society are more likely than women to participate in social and professional activities, making them more frequently exposed to infections. Cultural considerations can also be another factor, such as the stigmatizing fear that keeps women from seeking medical care and reporting to NTP centers.

EPTB is generally less common and contagious than PTB, but it still contributes to the overall disease burden in terms of morbidity, complications, and long-term consequences. The prevalence of EPTB varies significantly from country to country and may even vary from area to area within a country. In this study, EPTB accounted for 19.7% of all cases registered during the study period, which is lower than the prevalence of EPTB in other studies from Tunisia [11], Qatar [12], Turkey [13], Nepal [14], Bangladesh [15], India [16], and Pakistan [17]. In Yemen, data on TB types are lacking in most governorates. In the city of Sana'a [18], EPTB accounted for 50% of all TB cases, while in the Shabwah Governorate [3], EPTB accounted for 30.1% of all TB cases registered in the TNP. Uncertainty exists regarding the causes of the variations in EPTB prevalence across various nations and regions. Some of the proposed explanations attributed this variation to a difference in the terminology used [19], while

others attributed this variation to the accessibility of diagnostic resources, that is, hospitals are more likely to diagnose EPTB if they have more sophisticated clinical, radiological, and laboratory capabilities [20].

Recent studies have shown that EPTB location can vary by geography and population, with lymph nodes being the most common locations for EPTB in many studies worldwide [3,12-15,21,22]. This study revealed pleura as a common site for EPTB, consistent with results from India [16], Pakistan [17], and Sri Lanka [23]. In Yemen, a few reports have described the types/locations of EPTB, especially during the outbreak of COVID-19. While this study showed pleural TB as the main EPTB site, Hezam and Humaidah reported lymph nodes as the main location of EPTB in the Shabwah Governorate [3].

All patients received 4-drug anti-TB therapy, with 85.0% of them having completed the treatment successfully. Some patients (8.7%) were lost during follow-up, and 8 patients (6.3%) died during treatment. This raises queries about drug resistance to TB in Yemen. The health care system in Yemen lacks information about the drug susceptibility of MTBC due to a lack of facilities, such as TB culture.

This study had several limitations that need to be recognized. First, the study was retrospective and therefore relied on secondary data, which is limited to pre-existing variables captured in the NTP center reports. There was also a lack of data about risk factors, such as smoking, alcohol consumption, and DM. Second, data about mycobacterial species were not available due to a lack of facilities. Third, the study was limited to only 1 governorate of the country; hence, findings could not be generalized. Finally, the present study did not examine HIV serology due to resource limitations. Despite these drawbacks, the data gathered by this study offer the first description of TB prevalence and types in Hadramout Al-Sahel during the COVID-19 period.

CONCLUSION

According to this study, Hadramout Al-Sahel had 12.7 cases of TB per 100,000 population. Males were affected more frequently than females; the pleura was the most commonly affected extrapulmonary site; and 85% of cases were cured. The results of this study indicated the need to support the Al Mukalla NTP center, by providing more resources to improve TB reporting and to conduct surveillance for detection of new TB cases among high-risk groups. Health authorities are also urged to provide state hospitals with the equipment needed for TB diagnosis.

AUTHORS' CONTRIBUTION

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; and gave final approval of the version to be published.

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