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Clinical and Epidemiological Characteristics of Tuberculosis at a Tertiary Care Center in Oman: A Retrospective Study (2015-2020)

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Abstract

Tuberculosis (TB) remains a significant global health concern. In Oman, despite progress towards TB elimination, data describing the clinical and epidemiological characteristics of patients managed in tertiary care settings remain limited. This study aimed to characterize the epidemiological and clinical profiles of patients with TB at the Royal Hospital in Muscat, Oman.

A retrospective cross-sectional study was conducted from January 2015 to December 2020, including all confirmed cases of pulmonary TB (PTB) and extrapulmonary TB (EPTB). Demographic, clinical, and microbiological data were retrospectively reviewed and analyzed using IBM SPSS Statistics for Windows, Version 23.0 (Released 2015; IBM Corp., Armonk, NY, USA).

Among the 158 patients included, 99 (62.7%) had PTB, 56 (35.4%) had EPTB, and 3 (1.9%) had disseminated TB. Males accounted for 63.9% of cases, and the mean patient age was 50 years. Cough (60.7%) and fever (58.2%) were the most frequently reported symptoms. Hypertension (26.6%) and diabetes mellitus (20.2%) were the most common comorbidities. Rifampicin resistance was detected in 2 of the 40 patients tested (5.0%), representing 1.3% of the overall cohort. Pleural effusion (23%) and death (10%) were the most frequently reported complications.

In this cohort, PTB was more common than EPTB, and males accounted for the majority of cases. The findings highlight the importance of integrating TB care with chronic disease management and maintaining surveillance as Oman advances towards TB elimination.

Categories: Public Health, Pulmonology, Infectious Disease
Keywords: epidemiology, extrapulmonary tb, oman, pulmonary tb, rifampicin resistance, tuberculosis

Introduction

Tuberculosis (TB) remains one of the most important bacterial infectious diseases worldwide and is caused by infection with *Mycobacterium tuberculosis*, a slow-growing, acid-fast bacillus. The organism primarily affects the lungs, causing pulmonary TB (PTB), but it can also involve other organs, a form known as extrapulmonary TB (EPTB) [1].

According to the World Health Organization (WHO) Global Tuberculosis Report 2024, an estimated 10.8 million people developed TB in 2023, with approximately 1.25 million deaths, including about 161,000 among people living with HIV [2]. These figures mark a resurgence of TB as the leading cause of death from a single infectious agent [3].

Several factors increase the risk of TB, including HIV infection, diabetes mellitus, smoking, chronic respiratory disease, advanced age, household crowding, and close contact with individuals with active TB. Recent studies continue to emphasize the contribution of metabolic and immunological comorbidities to disease development and treatment outcomes [4,5].

In Oman and other Gulf countries, TB epidemiology is influenced by population mobility and migration from high-burden countries. Recent molecular epidemiological studies from Oman have demonstrated substantial genetic diversity among circulating *Mycobacterium tuberculosis* strains and highlighted the importance of continued surveillance in supporting TB elimination efforts [6]. Expatriate workers constitute a substantial proportion of TB cases in Gulf Cooperation Council (GCC) countries [6].

In Oman, the National Tuberculosis Control Program, launched in 1981, aims to reduce morbidity, mortality, and transmission through early case detection and standardized treatment [5]. According to the WHO 2024 report, Oman reported an estimated incidence of 11 cases per 100,000 population in 2023,

reflecting an approximate 23% increase since 2015. Despite this increase, the treatment success rate remains around 90%, underscoring the effectiveness of the national control strategy [2].

Data describing the epidemiology of TB in Omani tertiary hospitals remain limited. Notably, Al Lawati et al. described the clinical profile of patients with PTB at a tertiary hospital, highlighting demographic trends, associated comorbidities, and complications [7].

PTB remains the most common and epidemiologically significant form of the disease because of its high transmissibility [8]. Accurate diagnosis is essential and typically involves a combination of clinical, radiological, and microbiological methods, including chest radiography, sputum smear microscopy, mycobacterial culture, and nucleic acid amplification tests [8,9].

PTB is suspected in patients with a positive tuberculin skin test or interferon-gamma release assay (IGRA), characteristic radiological features, such as a Ghon focus, or a history of close contact with an individual with TB. Confirmation is achieved through sputum examination using Ziehl-Neelsen (ZN) staining and/or polymerase chain reaction (PCR) testing. Mycobacterial culture remains the gold standard for definitive diagnosis and drug-susceptibility testing. In patients who are unable to produce sputum or in whom diagnostic uncertainty persists, bronchoscopy with bronchoalveolar lavage may be employed [8,9].

Patients with PTB commonly present with constitutional symptoms, such as fever, weight loss, and night sweats, together with respiratory manifestations, including chronic cough and hemoptysis [8].

For EPTB, histopathological and microbiological evaluation of biopsy specimens is critical, particularly in cases of tuberculous pleuritis. Diagnosis is based on the identification of acid-fast bacilli or the presence of caseating granulomas in biopsy tissue [10,11]. Although tissue biopsy is considered the gold standard, it may be invasive or technically challenging. Therefore, analysis of pleural, peritoneal, or pericardial fluids can provide valuable diagnostic information in suspected cases of EPTB [10,11].

Therefore, this retrospective descriptive study aimed to characterize the demographic, clinical, and microbiological features of patients diagnosed with tuberculosis at the Royal Hospital, a tertiary referral center in Oman, between 2015 and 2020.

Materials And Methods

A retrospective, cross-sectional study was conducted at the Royal Hospital, a tertiary care center in Muscat, Sultanate of Oman, between January 2015 and December 2020. The study included all patients diagnosed with PTB or EPTB during this period. The study aimed to descriptively evaluate the demographic, clinical, and microbiological characteristics of patients diagnosed with TB at a tertiary referral center.

All confirmed TB cases were identified through the hospital's electronic medical record system and microbiology database. Patients were identified through electronic searches of the hospital's electronic medical record system using the diagnostic terms "TB", "tuberculosis", and "Mycobacterium tuberculosis". Only the first episode of TB for each patient was included in the analysis; duplicate records and recurrent episodes were excluded. The inclusion criteria comprised a confirmed diagnosis based on positive sputum smear microscopy, mycobacterial culture, or PCR for *Mycobacterium tuberculosis*. For EPTB, the diagnosis was established on the basis of microbiological confirmation and/or histopathological findings consistent with TB. Cases with incomplete records or uncertain diagnoses were excluded.

Demographic variables, including age, gender, and nationality, were collected to assess distribution patterns. Clinical parameters included presenting symptoms, comorbidities, and risk factors, such as previous TB exposure, smoking, diabetes mellitus, and HIV infection. Smoking history was defined as current or former tobacco use. Immunosuppression included HIV infection, immunosuppressive therapy, organ transplantation, or malignancy. Travel history referred to travel to a TB-endemic region within the preceding 3-6 months.

The study also documented the diagnostic methods used, including sputum acid-fast bacilli (AFB) smear microscopy, culture, nucleic acid amplification tests (specifically, the GeneXpert MTB/RIF assay; Cepheid, Sunnyvale, CA, USA, which uses cartridge-based automated real-time PCR) [12], and biopsy results for EPTB cases. Drug susceptibility data were retrieved from the microbiology laboratory to evaluate the prevalence of drug-resistant TB (DR-TB). Documented complications and treatment outcomes were reviewed where available.

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 23.0 (Released 2015; IBM Corp., Armonk, NY, USA). Continuous variables are presented as means, whereas categorical variables are presented as frequencies and percentages. As this was a descriptive study, no inferential statistical analyses were performed. Variables with missing data were excluded from the relevant analyses, and no data imputation was undertaken.

The study was approved by the Royal Hospital Research and Ethical Review Committee, Ministry of Health, Sultanate of Oman (Approval No. SRC#75/2022). Patient identifiers were removed before data analysis to maintain confidentiality. The requirement for informed consent was waived by the ethics committee because of the retrospective nature of the study and the use of de-identified patient data.

Results

The study included 158 patients diagnosed with TB: 99 (62.7%) with PTB, 56 (35.4%) with EPTB, and 3 (1.9%) with disseminated TB. Male patients predominated, accounting for 63.9% of the study population, while females accounted for 36.1%. Among female patients, 30 had PTB, and 27 had EPTB, indicating a nearly equal distribution between the two forms of the disease. The mean age was 50 years, with most patients aged 51 years or older. Baseline demographic characteristics stratified by TB type are presented in Table *1*.

Characteristic	Pulmonary TB (n = 99)	Extrapulmonary TB (n = 56)	Disseminated TB (n = 3)	Total (N = 158)
Sex, n (%)				
Male	69 (69.7)	29 (51.8)	3 (100)	101 (63.9)
Female	30 (30.3)	27 (48.2)	0 (0)	57 (36.1)
Age group, n (%)				
18-25 years	11 (11.1)	3 (5.4)	0 (0)	14 (8.9)
26-50 years	42 (42.4)	27 (48.2)	0 (0)	69 (43.7)
≥51 years	46 (46.5)	26 (46.4)	3 (100)	75 (47.5)

TABLE 1: Baseline demographic and clinical characteristics of tuberculosis (TB) patients

Cough (60.7%) and fever (58.2%) were the most frequently reported symptoms, followed by weight loss (39.8%), loss of appetite (29.1%), shortness of breath (23.4%), and night sweats (22.8%). The most common complication observed at diagnosis was pleural effusion, which affected 37 patients (23.4%). Two patients were asymptomatic and received incidental diagnoses of PTB. The first case was detected by MTB-PCR using a sputum sample, whereas the second was identified through sputum culture (Table *2*).

Clinical feature	n (%)
Cough	96 (60.7)
Fever	92 (58.2)
Weight loss	63 (39.8)
Loss of appetite	46 (29.1)
Shortness of breath	37 (23.4)
Night sweats	36 (22.8)

TABLE 2: Clinical presentation of tuberculosis patients

Hypertension (26.6%) was the most prevalent comorbidity, followed by diabetes mellitus (20.2%), immunosuppression (13.3%), lung disease (7.6%), autoimmune disease (5.7%), and HIV infection (5.0%). Risk factors included smoking in 31 patients (19.6%), prior travel in 49 patients (31.0%), and known contact with patients with TB in 11 patients (7.0%) (Table *3*).

Variable	n (%)
Hypertension	42 (26.6)
Diabetes mellitus	32 (20.2)
Immunosuppression	21 (13.3)
Lung disease	12 (7.6)
Autoimmune disease	9 (5.7)
HIV infection	8 (5.0)
Smoking	31 (19.6)
Prior travel	49 (31.0)
TB contact	11 (7.0)

TABLE 3: Comorbidities and risk factors

Diagnostic methods included AFB smear microscopy, which identified 57 patients with PTB. MTB-PCR was used to diagnose 78 cases of PTB using either sputum or bronchoalveolar lavage specimens. Diagnostic confirmation often involved multiple modalities per patient. Among the 56 patients with EPTB, diagnoses were supported by tissue biopsy in 29 cases, TB culture in 23 cases, MTB-PCR in 16 cases, and AFB smear microscopy in 11 cases (Table *4*).

Although 23 EPTB cases were culture-positive and 16 were evaluated using MTB-PCR, complete drug susceptibility profiles were not routinely documented in the electronic medical records for all non-pulmonary specimens during the earlier years of the study. Consequently, definitive rifampicin susceptibility results were available for only eight patients with EPTB (Table *4* and Figure *1*), while the remaining patients were classified as not tested or as having no retrievable susceptibility data.

	Rifampicin				Total
	Sensitive	Resistant	Indeterminate	Not tested	
Pulmonary	25	2	4	68	99
Extrapulmonary	8	0	0	48	56
Both	1	0	0	2	3
Total	34	2	4	118	158

TABLE 4: Presentation of the type of tuberculosis according to rifampicin sensitivity

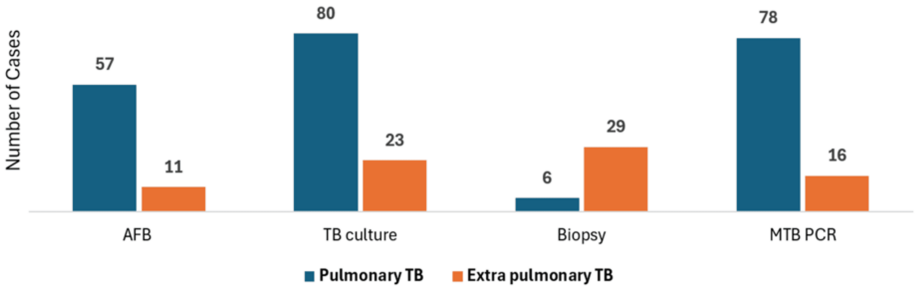


FIGURE 1: Diagnostic modalities yielding positive results

The graph illustrates the distribution of positive diagnostic tests among pulmonary (n = 99) and extrapulmonary (n = 56) tuberculosis (TB) cases.

Note: The diagnostic methods are not mutually exclusive; individual patients frequently underwent and tested positive via multiple modalities.

Mortality occurred in 16 patients (10%), highlighting the significant burden of severe disease among patients managed at this tertiary referral center.

Discussion

The present study provides a contemporary overview of patients with TB managed at a tertiary referral hospital in Oman over a six-year period. The findings demonstrate that PTB remains the predominant disease presentation, while EPTB accounts for a substantial proportion of cases.

The predominance of PTB observed in this cohort is consistent with findings from previous studies conducted in Oman and neighboring Gulf countries. Similar patterns have been reported among tertiary care populations, in which pulmonary involvement remains the major contributor to disease burden and transmission. The proportion of EPTB observed in our study also aligns with regional reports suggesting that extrapulmonary disease accounts for approximately one-third of all diagnosed TB cases [7,13].

The higher proportion of males in our cohort is consistent with findings from several international studies, in which behavioral and biological factors, including smoking, occupational exposure, and healthcare-seeking behavior, have been associated with higher TB incidence among males [14].

The mean age of 50 years observed in our cohort is comparable to that reported in several middle-income countries and reflects the age distribution of patients treated at our institution during the study period [5].

Smoking was reported in approximately one-fifth of patients in our cohort. Previous studies have identified smoking as a recognized risk factor for TB, although our study design does not permit an assessment of this association. Diabetes mellitus was present in approximately 20% of patients and was one of the most frequently observed comorbidities in this cohort, alongside hypertension [7,15,16]. Diabetes mellitus has been associated with delayed treatment response, unfavorable outcomes, and an increased risk of drug-resistant disease in recent systematic reviews [15,17]. The association between diabetes and TB has become increasingly important worldwide owing to the rising prevalence of diabetes in low- and middle-income countries. Hyperglycemia impairs cellular immunity and has been associated with delayed sputum conversion, treatment failure, and disease recurrence [17].

HIV co-infection was identified in 5% of patients in our study. Although this proportion is lower than that reported in many high-burden countries, co-infection continues to present important diagnostic and therapeutic challenges. Current WHO guidance emphasizes integrated TB-HIV screening and care to improve patient outcomes [18,19]. Given the diagnostic and therapeutic implications of co-infection, integrated TB-HIV screening remains important even when HIV co-infection is identified in only a small proportion of patients.

Regarding clinical manifestations, cough, fever, and weight loss were the most common symptoms, consistent with classical TB presentations globally [8,16]. Two patients were asymptomatic at diagnosis, highlighting that TB may occasionally be detected in the absence of symptoms, particularly among individuals undergoing targeted screening.

Pleural effusion was the most frequent complication, reported in 23% of patients. This finding is consistent with previous reports identifying TB pleuritis as a common form of EPTB in adults [10,11]. Rifampicin resistance was identified in 2 of the 40 patients who underwent susceptibility testing (5%). Because

susceptibility results were available for only a subset of patients, these findings should be interpreted cautiously and may not fully represent resistance patterns across the entire cohort [6].

Our findings are consistent with those of Gaifer [11], who reported that EPTB accounted for one-third of cases in Oman, predominantly affecting the lymph nodes and pleura. This similarity suggests comparable disease patterns among patients presenting to tertiary care centers in Oman, although broader national trends cannot be inferred from the present study.

This study has several limitations. First, its retrospective design may have resulted in incomplete documentation and missing clinical information. Second, the study was conducted at a single tertiary referral center, introducing the possibility of referral bias. As a tertiary referral hospital may manage patients with more complex disease, these findings may not be representative of the broader TB population in Oman. Third, because case identification relied on microbiological confirmation and/or histopathological findings, some clinically suspected cases, particularly among patients with extrapulmonary disease, may not have been captured. Fourth, drug susceptibility testing was available for only a subset of patients, limiting the interpretation of drug resistance estimates. Finally, treatment outcomes could not be comprehensively evaluated because of incomplete follow-up data. Information regarding the timing and causes of death was also not consistently available, limiting the interpretation of mortality outcomes.

Conclusions

This study demonstrates that PTB was the predominant form of the disease among patients managed at a tertiary referral center in Oman, while EPTB accounted for a substantial proportion of cases. Diabetes mellitus and hypertension were among the most commonly observed comorbidities in this cohort. The occurrence of extrapulmonary disease and rifampicin-resistant TB highlights the continued importance of accurate diagnosis, surveillance, and monitoring of drug resistance patterns. These findings provide clinical data from a tertiary referral center in Oman and may help inform future TB care and research in the country.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Redha Al Lawati, Nasser Al Busaidi, Asmahan R. Alyaaqoubi

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Supervision: Nasser Al Busaidi, Abdul Hakeem Al Rawahi

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Scientific Research Committee of Royal Hospital issued approval SRC#75/2022. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Centers for Disease Control and Prevention (CDC). Tuberculosis (TB) . (2020). Accessed: 08/10/2026: https://www.cdc.gov/tb/.
2. World Health Organization. Global Tuberculosis Report 2024. (2024). Accessed: 08/10/2026: https://www.who.int/teams/global-programme-on-tuberculosis-and-lung-health/tb-reports/global-tuberculosis-report-2024.
3. Hashim RA, Al Zubaidi A, Al Ghafri F, et al.: Temporal and regional dynamics of Mycobacterium tuberculosis in Oman. Sci Rep. 2025, 16:2506. 10.1038/s41598-025-32355-6
4. Jawed A, Tharwani ZH, Siddiqui A, et al.: Better understanding extrapulmonary tuberculosis: a scoping review of public health impact in Pakistan, Afghanistan, India, and Bangladesh. Health Sci Rep. 2023,

6:e1357. 10.1002/hsr2.1357
5. Ministry of Health Oman: Manual of the Tuberculosis Control Programme. Ministry of Health, Muscat; 2007.
6. Babiker H, Al-Jardani A, Al-Azri S, et al.: Mycobacterium tuberculosis epidemiology in Oman: whole-genome sequencing uncovers transmission pathways. Microbiol Spectr. 2023, 11:e0242023. 10.1128/spectrum.02420-23
7. Al Lawati R, Saad A, Salama M, Al Rawahi AH, Al Busaidi N: Clinical profile of pulmonary tuberculosis patients in Sultanate of Oman from 2010 to 2014: a tertiary care hospital perspective. Indian J Tuberc. 2025, 72:198-203. 10.1016/j.ijtb.2023.12.012
8. Loddenkemper R, Lipman M, Zumla A: Clinical aspects of adult tuberculosis. Cold Spring Harb Perspect Med. 2015, 6:a017848. 10.1101/cshperspect.a017848
9. Al-Jardani A, Al Yaquobi F, Adikaram C, et al.: Genomic and geospatial epidemiology of Mycobacterium tuberculosis in Oman: first national insight using whole genome sequencing. Int J Infect Dis. 2023, 130 Suppl 1:S4-S11. 10.1016/j.ijid.2023.04.001
10. Lee JY: Diagnosis and treatment of extrapulmonary tuberculosis. Tuberc Respir Dis (Seoul). 2015, 78:47-55. 10.4046/trd.2015.78.2.47
11. Gaifer Z: Epidemiology of extrapulmonary and disseminated tuberculosis in a tertiary care center in Oman. Int J Mycobacteriol. 2017, 6:162-6. 10.4103/ijmy.ijmy_31_17
12. Boehme CC, Nabeta P, Hillemann D, et al.: Rapid molecular detection of tuberculosis and rifampin resistance. N Engl J Med. 2010, 363:1005-15. 10.1056/NEJMoa0907847
13. Zhang CY, Zhao F, Xia YY, et al.: Prevalence and risk factors of active pulmonary tuberculosis among elderly people in China: a population based cross-sectional study. Infect Dis Poverty. 2019, 8:7. 10.1186/s40249-019-0515-y
14. Peer V, Schwartz N, Green MS: Gender differences in tuberculosis incidence rates-a pooled analysis of data from seven high-income countries by age group and time period. Front Public Health. 2022, 10:997025. 10.3389/fpubh.2022.997025
15. Xu G, Hu X, Lian Y, Li X: Diabetes mellitus affects the treatment outcomes of drug-resistant tuberculosis: a systematic review and meta-analysis. BMC Infect Dis. 2023, 23:813. 10.1186/s12879-023-08765-0
16. Rewari BB, Kumar A, Mandal PP, Puri AK: HIV TB coinfection - perspectives from India. Expert Rev Respir Med. 2021, 15:911-30. 10.1080/17476348.2021.1921577
17. Navasardyan I, Miwalian R, Petrosyan A, Yeganyan S, Venketaraman V: HIV-TB coinfection: current therapeutic approaches and drug interactions. Viruses. 2024, 16:321. 10.3390/v16030321
18. World Health Organization (WHO). WHO launches updated guidance on HIV-associated TB. (2024). Accessed: 08/10/2026: https://www.who.int/news/item/16-05-2024-who-launches-updated-guidance-on-hiv-associated-tb.
19. Barman TK, Roy S, Hossain MA, Bhuiyan GR, Abedin S: Clinical presentation of adult pulmonary tuberculosis (PTB): a study of 103 cases from a tertiary care hospital. Mymensingh Med J. 2017, 26:235-40.