

# Epidemiology and Rifampicin Resistance Patterns of Tuberculosis at a Tertiary Chest Hospital in Benghazi, Libya: A Retrospective Analysis (2018- 2023)

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## Epidemiology and Rifampicin Resistance Patterns of Tuberculosis at a Tertiary Chest Hospital in Benghazi, Libya: A Retrospective Analysis (2018-2023)



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**Abstract:** Tuberculosis (TB) remains a significant public health challenge in Libya. This retrospective study consolidates data from two periods (2018-2019 and 2021-2023) at Al-Kuwayfiya Teaching Hospital for Chest Diseases in Benghazi to analyze the local epidemiology and rifampicin resistance (RR-TB) trends. Among 833 total suspected cases, 380 (45.6%) were confirmed as pulmonary TB. A significant male predominance was observed, comprising 70.5% of all confirmed cases. Rifampicin-resistant TB was 877 identified in 43 patients, representing 11.3% of all culture-positive individuals. The GeneXpert MTB/RIF assay was instrumental in diagnosis, with semi-quantitative analysis revealing that most positive samples (41.8%) had a medium bacterial load. The incidence was higher during the dry season, and the 34-43 year age group showed the highest frequency of RR-TB. These findings confirm a high TB prevalence in the region with a concerning rate of rifampicin resistance, underscoring the need for sustained use of rapid molecular diagnostics and enhanced public health interventions.

**Keywords:** Tuberculosis, Rifampicin Resistance, Libya, GeneXpert, Epidemiology, Benghazi.

## INTRODUCTION

Tuberculosis (TB), a disease caused by the bacterium *Mycobacterium tuberculosis*, continues to be a major contributor to global morbidity and mortality from infectious diseases (World Health



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Organization [WHO], 2023). The growing challenge of drug-resistant TB, particularly multidrug-resistant TB (MDR-TB)—defined as resistance to at least the first-line drugs rifampicin (RIF) and isoniazid—severely undermines global TB control efforts (Koirala *et al.*, 2024). Rifampicin resistance serves as a reliable proxy for MDR-TB, making its rapid and accurate detection critical for initiating effective, second-line treatment regimens and curbing the chain of transmission (Baya *et al.*, 2021). In Libya, TB remains an endemic health concern, with case notifications showing considerable fluctuation over the past decade, partly due to socio-political instability impacting healthcare services (Zorgani *et al.*, 2020). Robust surveillance systems and contemporary, localized epidemiological data are fundamental for shaping and refining national TB control strategies. This retrospective study aims to consolidate and analyze the epidemiological characteristics and rifampicin resistance patterns among patients presenting at a major tertiary chest hospital in Benghazi, Libya, spanning two distinct timeframes (2018-2019 and 2021-2023), thereby providing an updated snapshot of the disease's profile in Eastern Libya.

## MATERIALS AND METHODS

### 2.1 Study Design and Setting

A retrospective, cross-sectional analysis was conducted utilizing the medical records of Al-Kuwayfiya Teaching Hospital for Chest Diseases in Benghazi, a primary referral center for respiratory ailments in the region. Data were amalgamated from two discrete periods: an initial phase from January 2018 to December 2019, and a subsequent phase from January 2021 to December 2023.

### 2.2 Sample Collection and Processing

Sputum specimens were collected from individuals exhibiting clinical symptoms suggestive of pulmonary TB into sterile, leak-proof containers. For the 2021-2023 cohort, laboratory confirmation was primarily achieved using the GeneXpert MTB/RIF assay (Cepheid, USA), performed in strict adherence to the manufacturer's guidelines. This automated molecular diagnostic tool allows for the simultaneous identification of *M. tuberculosis* complex and rifampicin resistance. The earlier cohort (2018-2019) was also analyzed using molecular techniques, including the GeneXpert system, ensuring methodological consistency across the study periods.

### 2.3 Data Analysis

Demographic and clinical information, including patient age, sex, nationality, and diagnostic outcomes, were systematically extracted from hospital registries. The compiled dataset was analyzed to compute prevalence rates and delineate rifampicin resistance patterns. Descriptive statistics were employed to summarize the findings.

## RESULTS

### 3.1 Overall Prevalence and Demographic Characteristics

The consolidated analysis encompassed 833 clinically suspected TB cases. From these, 380 were confirmed as positive for pulmonary TB, resulting in an overall prevalence of 45.6%. A pronounced male predominance was consistently noted across both study intervals, with male patients constituting 268 (70.5%) of the 380 confirmed cases.

**Table:(1).** Distribution of Cases by Study Period and Gender

Study Period	Total Cases	Male n (%)	Female n (%)
2018–2019	58	39 (67.2%)	19 (32.8%)
2021–2023	322	229 (71.1%)	93 (28.9%)
<b>Total</b>	<b>380</b>	<b>268 (70.5%)</b>	<b>112 (29.5%)</b>

### 3.2 Rifampicin Resistance Patterns

Rifampicin-resistant TB (RR-TB) was identified in 43 of the 380 confirmed cases, yielding a resistance rate of 11.3%. Resistance was more frequently observed in male patients and was most prevalent within the 34–43 years age bracket.

**Table:(2).** Rifampicin Resistance by Gender and Age Group

Category	RR-TB Cases	Total TB Cases	Resistance Rate
<b>Gender</b>			
Male	32	268	11.9%
Female	11	112	9.8%
<b>Age Group</b>			
24–33 years	10	104	9.6%
34–43 years	18	75	24.0%
44–53 years	8	30	26.7%

### 3.3 Bacterial Load Distribution

Semi-quantitative analysis of bacterial load via the GeneXpert CT values revealed the following distribution among the positive cases from the 2021-2023 cohort.

**Table:(3).** Bacterial Load Distribution Among TB-Positive Cases (2021-2023)

Bacterial Load	Number of Cases	Percentage
Very Low	36	11.1%
Low	73	22.7%
Medium	138	42.8%
High	75	23.3%
Total	322	100%

## DISCUSSION

This consolidated analysis underscores a persistently high burden of pulmonary tuberculosis in eastern Libya, with nearly half (45.6%) of all suspected cases at a specialized center being confirmed. The significant male predominance (70.5%) is congruent with national epidemiological trends (Ghenghesh *et al.*, 2018) and reflects broader patterns observed across the Eastern Mediterranean Region (Asgedom *et al.*, 2024), potentially linked to gender-based differences in healthcare-seeking behavior and social exposure. The rifampicin resistance rate of 11.3% is a pivotal and concerning finding. This figure aligns with recent reports from neighboring nations, such as Iraq (Aljanaby *et al.*, 2022), and underscores the escalating challenge of drug-resistant TB for the Libyan healthcare infrastructure, a concern previously highlighted by Zorgani *et al.* (2020). The high RR-TB burden necessitates an urgent scale-up of routine drug susceptibility testing (DST) and access to shorter, more tolerable MDR-TB regimens (Borisov *et al.*, 2022).

The concentration of RR-TB cases within the 34-43-year age group, which represents the core of the economically productive population, highlights the substantial socioeconomic repercussions of the disease. The observed seasonal peak during the dry summer months may be associated with environmental factors and increased indoor crowding, which facilitate aerosol transmission of the bacillus (Kuddus *et al.*, 2021).

Furthermore, the bacterial load profile, with 42.8% of cases presenting a medium load and 23.3% a high load, points to a substantial reservoir of individuals with high transmission potential within the community. This finding calls for intensified case-finding and prompt isolation strategies to interrupt transmission cycles (Tirfessa *et al.*, 2023).

## CONCLUSION

The merged data from 2018 to 2023 confirm a high prevalence of tuberculosis and a significant rate of rifampicin resistance in the Benghazi region. These results stress the imperative for continuous epidemiological surveillance and the unwavering integration of rapid molecular diagnostics like GeneXpert into the national TB program. Public health initiatives should be strategically directed towards targeted interventions for high-risk demographics and geographic clusters identified in this study, alongside a sustained commitment to strengthening laboratory capacity for comprehensive drug susceptibility testing.

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**Author’s Contribution Form**

S.N	Author’s Name*	Conceived& design of the study	Collected the data	Contributed data or analysis tools	Performed the analysis/ interpretation of data	Drafting the manuscript/ revising for important intellectual context
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6	Leena mehdaow	/	/	/	/	/

Author’s number	Specify contribution in more detail ( no more than one sentence)
1	Designed the study, Collected data supervised the research work and prepared the manuscript
2	performed analysis
3	prepared the manuscript
4	Contributed to data collection and manuscript revision
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