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Treatment and Incidence Rate of Tuberculosis in Diyala Province

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Abstract

Background: Tuberculosis (TB), a chronic granulomatous infection produced by the obligate aerobe, slow-growing, acid-fast bacillus (AFB) Mycobacterium tuberculosis, owns a lipid-rich cell wall (mycolic acids, lipoarabinomannan) that delivers resistance to antibiotics and phagocytosis.

Objectives: To evaluate the Incidence rate of tuberculosis in Diyala province

Patients and methods: The study is a cross-sectional analysis directed in Diyala province, Iraq, between November 2024, and February 2025, concerning 713 TB patients (69 males and 71 females). The study fixated on gender distribution, TB types (pulmonary and extrapulmonary), and treatment consequences, with 691 patients recovering, 17 deaths, and 5 treatment failures. Statistical analysis was accomplished using Microsoft Excel and SPSS, applying descriptive statistics to analyze patterns in the data.

Results: The study results designate a higher prevalence of tuberculosis (TB) amongst females (58%) associated to males (42%). The primary causes of TB cases were the general healthcare sector (381 cases), followed by the private sector (208 cases), direct reporting (111 cases), and prisons (13 cases). In relations of treatment regimens, most patients (657) usual Cut 1,

which comprised isoniazid, rifampin, pyrazinamide, and ethambutol, while only 56 patients usual Cut 2, which involved of the same drugs with the addition of streptomycin.

Conclusion: This study describes the trends of tuberculosis (TB) incidence, treatment distribution and patient outcome in the province of Diyala. The results show that TB is predominantly pulmonary; with the males having a higher prevalence of TB, and TAC is influenced by the male population.

Keywords: Tuberculosis, Incident rate, Mycobacterium tuberculosis, Treatment.

Introduction

Tuberculosis (TB), a chronic granulomatous infection caused by the slow-growing, obligate aerobe, acid-fast bacillus (AFB) *Mycobacterium tuberculosis*, possesses a lipid-rich cell wall (mycolic acids, lipoarabinomannan) that provides resistance to phagocytosis and antibiotics [1].

TB transmission occurs through air droplets when a tuberculous person coughs, sneezes, or talks; inhaled bacilli reach the alveoli and subsequently are phagocytized by alveolar macrophages. The pathogen commandeers this for intracellular survival and replication by inhibiting phagosome-lysosome fusion to avoid destruction. This immune response results in the formation of granulomas, consisting of epithelioid macrophages, Langhans giant cells, and caseous necrosis, which contain the infection at this stage, but can act as a latent reservoir for TB reactivation. If not, the disease can be classified as primary TB, secondary/reactivation TB, or miliary TB (disseminated form involving multiple organ systems due to hematogenous dissemination) [2].

TB is still one of the largest global public health threats, with millions of new cases occurring every year, and with the largest burden of the disease occurring in low- and middle-income countries. As per the World Health Organisation (WHO), in global TB cases, around 10.6 million new cases were reported in 2022, with the largest burden concentrated in South Asia, sub-Saharan Africa, and Southeast Asia [3]. Globally, TB incidence is estimated to be 132 cases for each 100,000 individuals in a given year, with more than 65 percent of cases occurring in India, China, Indonesia, the Philippines, Pakistan, Nigeria, and Bangladesh. Health officials say TB killers–related mortality is still high at about 1.6 million every year, making it the second leading cause of death after COVID-19 from an infectious disease. The emergence of drug-resistant strains of the pathogen has made it more difficult to control the disease, with approximately 500,000 new cases of drug-resistant TB occurring

in 2023, mostly in Eastern Europe, Russia, and parts of Asia [4]. TB is a major public health problem in Iraq, but the situation has improved in the last decade. The incidence rate of TB in Iraq dropped from 45 cases per 100,000 population to a little over 23 cases per 100,000 population with the provision of better diagnostic facilities, and by greater access to treatment and national TB control programmes. Despite progress, nearly 8,000 new TB cases are still reported every year, and Baghdad, Basra, and Mosul have the highest burden [5].

The maintenance of TB in Iraq is related to socioeconomic factors, internal displacement, conflict-related health system disruptions, and poor living conditions. MDR-TB cases are also developing, becoming a hindrance to regular TB management plans. In Iraq, the National Tuberculosis Programme in conjunction with WHO has conducted active case finding, contact tracing, and DOTS (Directly Observed Treatment, Short-course) therapy complementing TB control activities [6]. Chronic productive cough (lasting longer than 3 weeks), hemoptysis, pleuritic chest pain, night sweats, unintentional weight loss, and malaise may be manifestations of pulmonary TB whereas extrapulmonary infection may involve the lymph nodes (scrofula), vertebrae (Pott's disease leading to vertebral collapse and kyphosis), meninges (TB meningitis involving basal exudates and hydrocephalus as well as cranial nerve palsies), kidneys (sterile pyuria), and adrenal glands (Addison's disease due to adrenal destruction). Diagnosis is based on clinical suspicion, microbiological confirmation, and imaging. While the Mantoux Tuberculin Skin Test (TST) and Interferon-Gamma Release Assays (IGRA) point to latent infection, they are not able todistinguish an active TB [7]. Sputum acid-fast bacilli (AFB) staining (Ziehl-Neelsen stain), mycobacterial culture on Lowenstein-Jensen medium (gold standard, but slow-growing, ~6 weeks), and nucleic acid amplification tests (GeneXpert MTB/RIF PCR, detects rifampin resistance, especially by rpoB gene mutations) provide a confirmatory test for the diagnosis. Chest X-ray (CXR) features include cavitary disease of the upper lobes of the lung, hilar lymphadenopathy, and/or pleural effusion; CT scans may demonstrate more specific cavitary lesions and nodal involvement [8].

Management is as per WHO's Directly Observed Therapy, Short-course (DOTS) strategy; RIPE regimen (Rifampin, Isoniazid, Pyrazinamide, Ethambutol) for 2 months (intensive phase) followed by RI for 4 months (continuation phase) [9].

MDR-TB (multidrug-resistant tuberculosis -- resistant to isoniazid and rifampin) necessitates a longer regimen (18–24 months) and second-line drugs including fluoroquinolones, linezolid, and bedaquiline, during which time outcomes are worse

still; XDR-TB (extensively drug-resistant tuberculosis resistant to fluoroquinolones and second-line injectables) leads to even worse consequences. Corticosteroids (TB meningitis, pericarditis), nutritional support, and oxygen therapy (in more severe cases) are adjunctive therapies [10]. Vaccination with BCG (live-attenuated Mycobacterium bovis) is one of the preventive measures, along with Isoniazid. Preventive Therapy (IPT) for high-risk groups and strict infection-control measures (N95 masks, negative-pressure rooms in hospitals). Novel antimycobacterial agents, rapid molecular diagnostics, and global public health interventions are urgently needed to stop transmission and improve patient outcomes as drug-resistant TB emerges [11]. This study aimed to assess the Incidence rate of tuberculosis in Diyala province.

Patients and Methods

Study Design: This study is cross-sectional study that included 713 participants diagnosed with tuberculosis (TB) from various regions of Diyala province, Iraq. Data was collected between November 1, 2024, and February 26, 2025. Participants were TB patients who sought treatment at healthcare facilities across the province. Of the 713 patients, 69 were male and 71 were female.

Data Collection: Data was gathered using structured paper questionnaires, which included multiple-choice and open-ended questions about TB sources, treatment regimens, and patient outcomes. The questionnaires were dispersed to patients undergoing TB treatment, with a focus on gender, TB type (pulmonary or extrapulmonary), treatment consequences (recovery, death, failure), and the cause of TB infection (general sector, private sector, etc.).

Explanation of Cut Types treatment:

- **Cut 1:** A regimen comprises isoniazid, rifampin, pyrazinamide, and ethambutol, which is the most common treatment for TB patients.
- **Cut 2:** This regimen involves the same drugs as Cut 1, with the adding of streptomycin for patients with resistant TB or those not responding to Cut 1 therapy.

Statistical Analysis: The composed data were planned and investigated using Microsoft Excel 2013 and SPSS Statistics V21. Descriptive statistics, counting cross-tabulations and chi-square tests, were used to assess patterns in gender distribution, TB types, treatment consequences, and the effectiveness of different TB regimens (Cut 1 and Cut 2).

Results

The results of this study displayed that the incident rate of tuberculosis was 42% in males, while 58% are stated in females in Diyala Province (Figure 1).
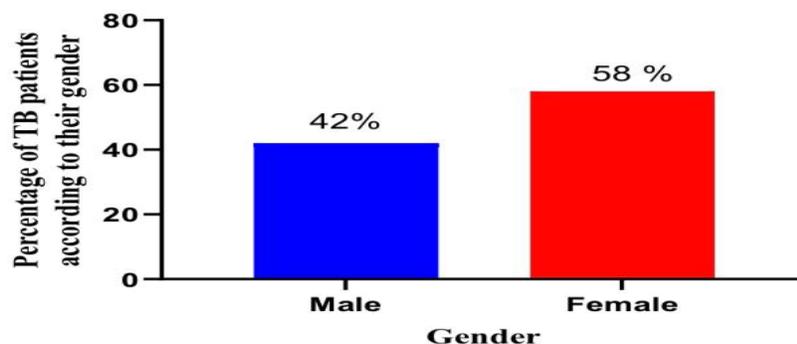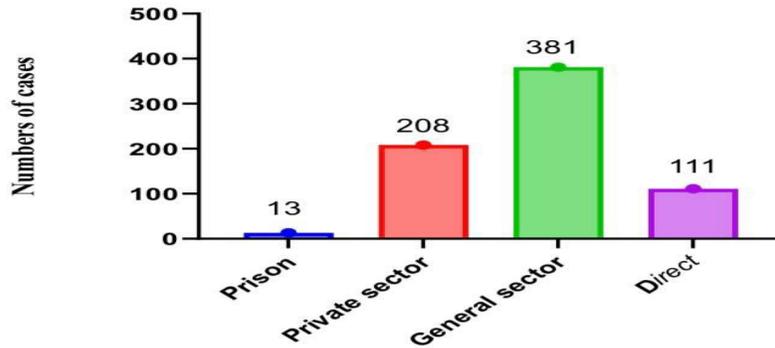

Figure 1. Percentage of tuberculosis patients conferring to gender.

Figure 2 demonstrates the distribution of tuberculosis (TB) cases founded on their causes. The general sector accounts for the highest number of cases (381), followed by the private sector with 208 cases. Directly stated cases establish 111, whereas the prison category has the fewest cases, with only 13. Each category is signified by a distinct color, and numerical values are exhibited above the bars for clarity. In addition, Figure 3 represents the distribution of tuberculosis (TB) cases by classification as pulmonary or extrapulmonary. Pulmonary TB accounts for the majority of cases, with 713 reported cases, whereas extrapulmonary TB cases total 252.

Figure 2. Distribution of tuberculosis cases conferring to their sources.
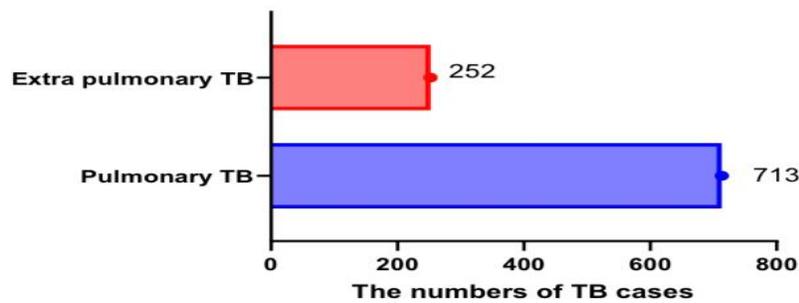

Figure 3. Distribution of pulmonary and extrapulmonary tuberculosis cases.

The results of the existing study demonstrate the treatment consequences of tuberculosis (TB) cases, categorized into recovery, death, and treatment failure. The majority of TB patients (691 cases) attained recovery, represented by the largest blue bar. A smaller proportion of cases (17) resulted in death (shown in red), whereas treatment failure was verified in 5 cases (shown in green) (Figure 4).
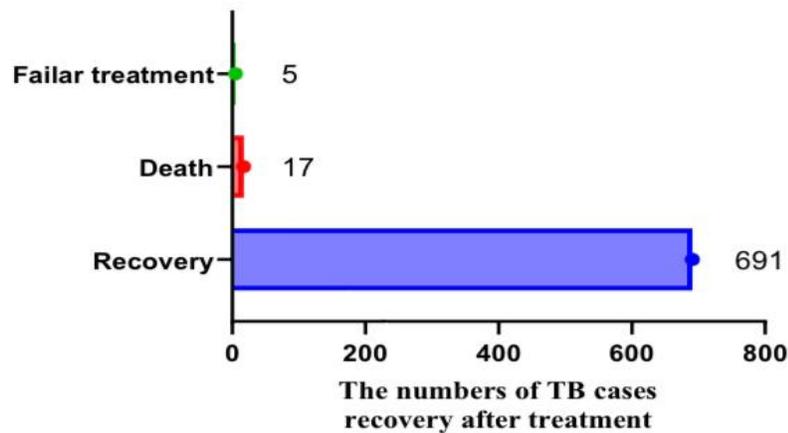

Figure 4. Treatment consequences of tuberculosis cases.

The results displayed that the number of tuberculosis (TB) cases described in different regions of Diyala province. First Baqubah has the highest number of stated cases (200), followed by Bald Ruz (112), Second Baqubah (107), Al-Kalis (102), and Miqdadiyah (88).

Khanqin accounts for 74 cases, whereas Mansourieh has the lowest number, with only 30 cases. Each region is signified by a distinct color, and numerical values are interpreted at the end of each bar for clarity (Figure 5). Furthermore, it was found in this study that the number of tuberculosis (TB) patients varied according to the type of treatment they received. The vertical axis represents the number of patients, and the horizontal axis classifies patients into two treatment types: Cut 1 and Cut 2. Cut 1, received by the majority of patients (657), consists of isoniazid, rifampin, pyrazinamide, and ethambutol, and is represented by the blue bar. Cut 2, administered to 56 patients, includes the same drugs as Cut 1 with the addition of streptomycin and is shown in red. Numerical values are displayed above each bar for clarity (Figure 6).
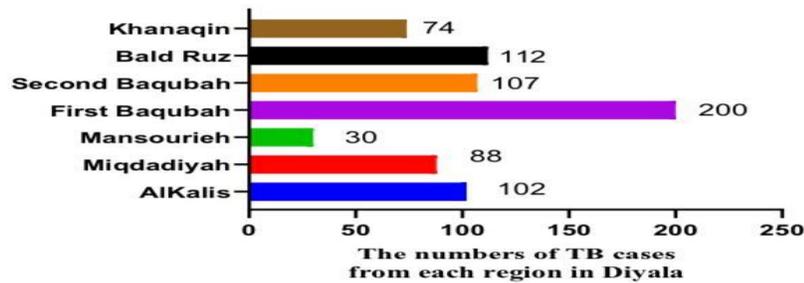

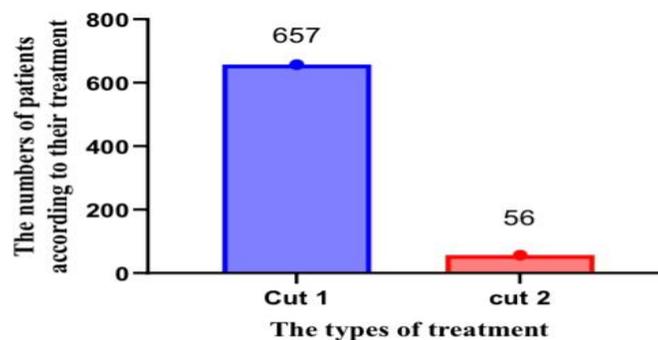**Figure 5.** Distribution of tuberculosis cases by region in Diyala.

Figure 6. Distribution of tuberculosis patients by treatment type

Discussion

The gender distribution percentage in terms of tuberculosis is composed of 69 (34%) males and 71 (36%) females, making it the predominant gender among humans. However, other authors like Yousif Ghassan Mohammed et al. (2024) [12], who indicated that the number of males with TB infections was higher than females at 65% in Thi-Qar province. The result may differ due to factors such as gender, accessibility to healthcare, risk, and social determinants of health which affect the rate at which people are diagnosed. The difference between the studies may show that there is a need to be more in-depth with the analysis to trends in gender-related tuberculosis.

Source of TB Cases shows a growing trend in general healthcare with 381 TB cases reported, 208 TB reported from the private sector, 111 direct reporting, and 13 from prisons. A statement supports this claim from the previous study conducted by Raad (2016) [13], which suggested that most cases are reported from the general healthcare sector with a decrease in the number of cases occurring in a controlled environment. The result is a clear indication that more effort should be channeled in research for general healthcare and private to have a containment approach to reduce the number of cases. Pulmonary vs Extrapulmonary TB illustrates that pulmonary TB is on the rise to 713 cases as Extrapulmonary TB stand at 252. A similar statement from Asmaa A. Al-Kaisse et al. (2023) [14] suggests that pulmonary TB has the potential to be more popular due to the large difference in the number of occurrences with their Extrapulmonary counterparts. The increasing trend indicates that focus measures need to be put in place in the prevention and control of pulmonary TB. The result supports the claims from Oraas Khalid Khudhair et al. (2022) [15] that there is a high return

to positive outcome experienced by TB patients in Diyala. However, it calls for constant monitoring and support from a treatment failure rate to be decreased.

Conclusion

The results show that TB is predominantly pulmonary; with the males having a higher prevalence of TB, and TAC is influenced by the male population. Most of the cases were confirmed from the general health sector and prisons had the least number of confirmed cases. The TB burden was heterogeneous within the region, with First Baqubah demonstrating the highest incidence. In terms of treatment outcomes, we observed a high rate of recovery, with few cases suffering from treatment failure or dying. Most of the patients received Cut 1 (25 mg isoniazid, 10 mg rifampin, 10 mg pyrazinamide, and 15 mg ethambutol), while a fewer received Cut 2 (1 g streptomycin added).

Recommendation

The following recommendations are made based on the results of this study, firstly, enhance TB surveillance and early detection programs, especially in high-incidence areas, such as First Baqubah. Secondly, adopt targeted public health measures that consider the higher prevalence of TB in women and possible barriers in health care, awareness and prevention. Finally, increase TB screening and health services available to prisoners and in underserved areas to decrease the undiagnosed and untreated.

Ethical Considerations

Approval for conducting the study was obtained from the Committee of College of Medicine, University of Diyala, code no. (2025 ASM 905). All personal data were anonymized to protect patient confidentiality, and ethical guidelines for handling clinical data were strictly followed.

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