RESEARCH ARTICLE

The effect of COVID-19 on a sample of tuberculosis patients in Baghdad

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ABSTRACT

Introduction: Tuberculosis (TB) remains a major public health concern worldwide, including in Iraq, where the disease has historically posed significant challenges. The COVID-19 pandemic, a global health crisis, disrupted healthcare systems and potentially influenced TB diagnosis, management, and outcomes.

Objective: This study aimed to evaluate the effects of the COVID-19 pandemic on tuberculosis (TB) incidence, mortality, and treatment outcomes in Iraq, with a specific focus on the period from 2018 to 2021.

Methods: A retrospective analysis was conducted using data from 6,006 TB cases registered at a TB centre in Baghdad. The data were categorised into pre-pandemic (2018–2019) and pandemic (2020–2021) periods. Variables analysed included demographic characteristics, TB site (pulmonary and extrapulmonary), and treatment outcomes. Statistical tests (chi-square and t-tests) were applied to assess differences between the two periods.

Results: A significant decrease in reported TB cases occurred during the pandemic (38.1%) compared to pre-pandemic years (61.9%). Mortality rates from TB declined by 29.6% during the pandemic.

The incidence of TB was higher in males during the pandemic, while females had higher rates pre-pandemic. Geographical analysis revealed a sharper decline in TB cases in Kerkh than in Rasafa, though overall incidence remained higher in Rasafa. Pulmonary TB remained the dominant form across all periods, but both pulmonary and extrapulmonary TB showed decreasing trends. Treatment outcomes (cure rates, treatment failure, and loss to follow-up) showed a general decline, consistent with the overall reduction in TB cases.

Conclusion: The COVID-19 pandemic substantially impacted TB case detection and outcomes in Iraq, resulting in a marked decrease in reported cases and mortality rates.

Key words: COVID-19, Tuberculosis, Patient Impact, Baghdad.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a highly contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The incubation period for COVID-19 is shorter than that for TB, ranging from 1 to 14 days.[1] Unlike SARS-CoV-2, M. tuberculosis has been around as a human pathogen for thousands of years. The COVID-19 pandemic has significantly impacted the TB care system, leading to a reduction in TB testing and reporting. This impact can be attributed to the interruption of TB services and restrictions on patient movement, thus increasing TB-related deaths.[2]

Both diseases are transmitted primarily through respiratory droplets, so their spread is enhanced by close contact and crowding. Additionally, vulnerable populations—such as individuals with immunocompromised conditions, older adults, and those with underlying health conditions—may face a heightened risk of infection with COVID-19 and tuberculosis (TB). Lockdowns, travel

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restrictions, and reduced access to healthcare facilities have hampered TB case detection and timely diagnosis.[3]

The COVID-19 pandemic has profoundly disrupted tuberculosis (TB) diagnosis and screening programs, creating significant challenges for global TB control efforts. The diversion of healthcare resources, reduced access to medical facilities, and interruptions to diagnostic services have hindered the early detection of TB cases during this period. In many settings, the urgent focus on responding to COVID-19 redirected both human and financial resources away from TB programs. Funding previously supporting TB diagnosis and screening was reallocated to COVID-19 response initiatives, leaving gaps in TB control resources. Consequently, declining TB testing capacity and delaying implementation of TB control strategies.[4]

COVID-19 has disrupted laboratory services, including shortages of diagnostic supplies, staff shortages, and long turnaround times for test results. These disorders have greatly affected the availability of tuberculosis diagnostic services.[5]

The COVID-19 pandemic has had a profound impact on the epidemiology of tuberculosis, particularly its impact on unemployment, poverty, and malnutrition, which are among the most important known risk factors for TB transmission and disease progression.[6] The interaction between these two infectious diseases can have significant effects, even on treatment, with potential drug interactions, immune dysregulation, and increased morbidity and mortality.[7] COVID-19 and tuberculosis can cause dysregulation of the immune system, complicating clinical management. The immune response in individuals infected with COVID-19 and tuberculosis (TB) is complex and influenced by innate and adaptive immunity.[8]

Any healthcare system needs to measure the effects of one infectious disease on another to put plans in place to address any unwanted consequences. So, this study aimed to determine the rate of newly diagnosed tuberculosis cases at the National TB Institute during 2020 and 2021 (the COVID-19 period) and to compare these rates with those recorded in 2018 and 2019 (the pre-COVID-19 period). Additionally, the study assessed selected demographic and clinical characteristics of the patients, including treatment outcomes, and compared these variables between the two groups.

PATIENTS AND METHODS

Study setting and design: This retrospective, cross-sectional analytical study was conducted at the National Tuberculosis Institute in Baghdad from January to April 2024. The study involved reviewing the records of patients diagnosed with tuberculosis in 2020 and 2021 and comparing them with those of patients diagnosed in 2018 and 2019.

Ethical considerations: Ethical approval was obtained from Al-Imamain Al-Kadhimain Medical City and the Scientific Committee of the Arab Board of Medical Specialisations. An agreement was obtained from the administration of the National Tuberculosis Institute in Baghdad to use its data for this research.

Case definition; inclusion, and exclusion criteria: We included patients aged 17 years or older who were diagnosed with tuberculosis according to national guidelines, based on clinical and laboratory criteria. We excluded the records of patients with incomplete or missing data.

Sampling technique and sampling: We included all records that fulfilled our enrolment criteria. A total of 6006 patient records were included in this study.

Data collection and instruments: Data from patients' records were classified into pre-COVID (2018 and 2019) and during the COVID pandemic (2020 and 2021).

The institution diagnoses TB based on whether it is pulmonary or extrapulmonary: pulmonary TB, either smear–positive or smear–negative. Smear-positive patients had sputum tests showing acid-fast bacilli in at least one of the three successive tests; some

underwent bronchoscopic examination and bronchial washings sent for acid-fast bacilli or gene expert testing. Smear-negative patients who are diagnosed to have pulmonary TB despite at least two successive sputum tests give negative results to the acid-fast bacilli test. The criteria used to diagnose smear-negative TB relied on the WHO guidelines, which stated that if the patient has a clinical picture suggestive of pulmonary tuberculosis with highly suggestive imaging findings and negative smear results on sputum AFB test and did not respond to a two-week trial of antibiotics that do not include levofloxacin or antituberculosis medications, these patients can be considered to have pulmonary tuberculosis and given treatment course of antituberculosis. [9,10] For extrapulmonary TB diagnosis by tissue biopsy, send for histopathology and gene expert testing.

For each enrolled case, we extracted the age, sex, residence, the site of TB infection to pulmonary or extrapulmonary, and the HIV status to positive and negative. Also, we extracted the treatment outcome from the records: cured, treatment completed, failed, lost to follow-up, and death. The definitions of each depend on the Iraqi National Guidelines for the Programmatic Management of Drug-Sensitive and Drug-Resistant Tuberculosis, Revised 8th edition, 2023.[11]

Cured: Bacteriologically confirmed PTB who is smear/culture negative at the last month of treatment and at least at one previous occasion.

Treatment Completed: patients who completed the full anti-TB treatment course without bacteriological confirmation of cure

Died: A patient who dies for any reason before or during the course of treatment.

Treatment Failed: A TB patient whose sputum smear/culture is positive at months 5 or later during treatment.

Lost to follow-up: A TB patient who did not start treatment or whose treatment was interrupted for 2 consecutive months.

The cases were grouped into two: the first included those diagnosed with TB in 2018 and 2019 (pre-COVID-19 group), and the second included those diagnosed in 2020 and 2021 (COVID-19 Group). Note: The Iraqi health authority announced the first case of COVID-19 in Iraq in February 2020. We assess statistical significance between the two groups and examine the trend in diagnoses from 2018 to 2021.

Statistical analysis: Data were entered and analysed using SPSS (Statistical Packages for Social Sciences), version 28. Continuous variables were presented as mean ± standard deviation (SD), and an independent two-sample t-test was used to compare the difference in means between the two groups (pre-COVID and COVID). Categorical variables were reported as counts and frequencies, and the chi-square test was used to assess associations between the two TB groups across parameters. A p-value equal to or less than 0.05 is considered statistically significant.

RESULTS

The mean age of all patients was (40.9± 16.7) years, with 3038 (50.6%) being females, and 2968 (49.4%) being males. The highest age group was 24-34 years (1320, 22.0%); 4077 (67.9%) patients resided in Baghdad/ Rasafa, and 1929 (32.1%) in Baghdad/Karkh. In the pre-COVID period, 3717 patients were diagnosed with tuberculosis (61.9%), and 2289 patients (38.1%) were diagnosed in the COVID period. Pulmonary TB were reported in 3217 (53.5%) and extrapulmonary TB in 2789 (46.4%), only (0.1%) were HIV positive (table 1). The incidence of TB cases was 61.9% during the pre-COVID period and 38.1% during the COVID period, as shown in **Table 1 and Figure 1**.

Figure 2 shows the trends of Pulmonary TB (PTB) and extrapulmonary TB (EP) in the years 2018-2021. There was a decreasing trend in both pulmonary and extrapulmonary TB during the COVID period compared with the pre-COVID period.

Table 2 shows the association between demographic and clinical features of patients with tuberculosis before and during the

Table 1 | Demographic characteristics of the TB patients.

Variable	No.	%
Sex		
Female	3038	50.6
Male	2968	49.4
Age (years)		
17-24	1171	19.5
25-34	1320	22.0
35- 44	1156	19.2
45-54	974	16.2
55-64	712	11.9
> 65	673	11.2
Residence		
Rasafa	4077	67.9
Karkh	1929	32.1
Year		
Pre-COVID-19 (2018 -2019)	3717	61.9
COVID-19 (2020 -2021)	2289	38.1
Site of TB total 6005		
Pulmonary	3217	53.6
Extra pulmonary	2789	46.4
HIV Results		
Negative	5609	93.4
Positive	4	0.1
NA *	393	6.5
TOTAL	6006	100

*NA: no available data about HIV results

COVID-19 period. There was no statistically significant association between sex in both TB groups (Pre-COVID and COVID period) (P value 0.102). However, there was a slight increase in the percentage of males during the COVID period (51.7%) from 47.9% in the pre-COVID period. Across age groups, no statistically significant association was found in either group (P=0.31). However, there were higher incidences in the younger age groups. Regarding residence, there was a statistically significant association: residence in both TB groups (pre-COVID and COVID) was higher in Rasafa than in Kerkh (P<0.001).

A statistically significant association was observed between the site of tuberculosis (pulmonary versus extrapulmonary) and the study period (pre-COVID-19 versus COVID-19). Pulmonary TB represented 52.3% (1,944 cases) of all TB cases in the pre-COVID-19 period, compared with 55.6% (1,272 cases) during the COVID-19 period (P = 0.01). Regarding the association between treatment outcomes and the period of diagnosis (pre-COVID-19 versus COVID-19; cured, failed, lost to follow-up, and death), there was a non-significant association (p=0.17).

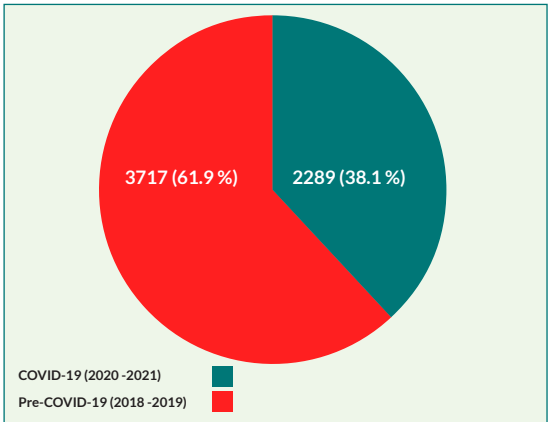

Figure 1 | The distribution of total TB cases.

DISCUSSION

Since COVID-19 was declared a global pandemic, it has placed a great burden on the healthcare services, which caused disruptions to programs for other diseases, such as tuberculosis (TB). In this study, 50.6% of patients with TB were female, and 49.4% were male. In a previous study in Baghdad, Iraq.[12] 50.5% of TB patients were females, and 49.5% were males. In our study, TB cases were predominantly concentrated in younger age groups. This finding is consistent with previous studies conducted in Iraq. In a study

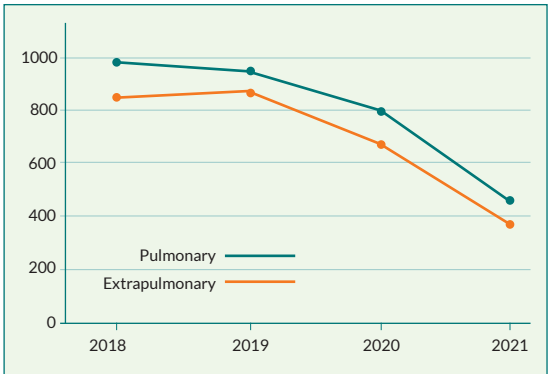

Figure 2 | Trends in pulmonary and extrapulmonary TB (2018-2022)

Table 2 | association between some demographic and clinical features and with time of diagnosis, pre- and during covid 19

Features	Total	Pre-COVID-19		COVID-19		X^2	d.f	p-value
		No.	%	No.	%			
Sex						3.7	1	0.102
Male	2968	1783	47.97	1185	51.7			
Female	3038	1934	52.03	1104	48.3			
Age group						5.9	5	0.31
17-24	1171	746	20.07	425	18.5			
25-34	1320	796	21.42	524	22.8			
35- 44	1156	721	19.40	435	19			
45-54	974	594	15.98	380	16.6			
55-64	712	428	11.51	284	12.4			
> 65	673	432	11.62	241	10.5			
Residence						67.5	1	0.001
Kerkh	1929	1205	32.42	724	18.2			
Rasafa	4077	2512	67.58	1565	81.7			
Site						6.9	1	0.01
EP	3217	1773	47.70	1017	44.4			
PTB	2789	1944	52.30	1272	55.6			
Outcomes					8.68	4	0.07	
Cured	2154	1288	59.80	866	40.20			
Treatment Completed †	3500	2201	62.90	1299	37.10			
Failed	61	35	57.40	26	42.60			
Lost to Follow-up	146	99	67.80	47	32.20			
Death	145	94	64.80	51	35.20			
Total	**6006**	**3717**	**100**	**2289**	**100**			

† Treatment Completed: patients who completed the full anti-TB treatment course without bacteriological confirmation of cure, per WHO standard TB outcome definitions (WHO, 2022).

from Najaf, pulmonary TB accounted for 53.5% of cases, while extrapulmonary TB represented 46.4%.[13] Similarly, Taif et al.[14] reported that pulmonary tuberculosis constituted 56% of cases, compared with 44% for extrapulmonary tuberculosis.

Our results showed a significant decrease in the number of TB cases during the COVID-19 pandemic compared to pre-pandemic levels (61.9% versus 38.1%). This result is multifactorial. The most important impact observed globally of the pandemic on tuberculosis is related to health systems, as these systems were overwhelmed by the large number of COVID-19 patients, and all health efforts in Iraq were shifted towards diagnosing, discovering, and treating COVID-19 patients, mainly as a natural and necessary response to the new pandemic that attacked the world. Thus, the first factor that may have caused a decline in TB cases was primarily the decrease in detection rate and the shift of efforts away from tuberculosis case finding.[15] The decline in TB incidence may also be attributed to a real decrease in disease transmission due to the lockdown and quarantine. The significant reduction in gatherings and socialisation implemented in response to the COVID-19 pandemic, as a means of controlling infection spread, since M. tuberculosis is transmitted in the same manner as SARS-CoV-2 via respiratory droplets. On the other hand, road closures make it difficult for those developing TB symptoms or those infected with the disease to reach health centres, thereby reducing TB case detection. A study in China also showed results that support our study, showing a clear decline in the number of TB cases during COVID, and indicating that it remains unclear whether the decline in reported cases is due to beneficial

prevention or under-reporting.[16] Avoidance of attending health centres or seeking health care is a phenomenon documented in a 2020 study of American adults, which is considered one possible explanation for the decrease in the number of individuals infected with tuberculosis.[17] Coinfection with COVID-19 and TB was common during the pandemic, along with possible reactivation of a latent TB in covid patients, along with the overlapping clinical presentation and subsequent possibility of missing TB cases when differentiation between those diseases is considered a diagnostic difficulty.[18]

The prevalence of TB patients is higher in Al-Rasafa than in Al-Kerkh in Baghdad, with a statistically significant difference (p-value 0.001). Another study from Iraq[19] similarly showed that TB is higher in Al-Rasafa (64.6%) than in Al-Kerkh (35.4%). This finding may be attributed to a combination of socioeconomic and cultural factors, together with rapid population growth and the high proportion of individuals living in rural and densely populated areas.

According to age groups, no statistically significant association was found in both TB groups (Pre-COVID and COVID) (P= 0.31). The lowest rate was in those 65 years and older; this result aligns with another study [20] reporting lower TB cases among elderly (+65) age groups. This can be attributed to the higher COVID-19 mortality among older people and the substantial regional differences in TB prevalence.

Pulmonary TB remained more incident than extrapulmonary TB at all times, which in turn is consistent with global statistics where pulmonary TB is the most common presentation. [21] In 2022, the CDC Report showed that 33,148 tuberculosis cases were reported in 2020. Of these cases, 73.1% were pulmonary, and 21.5% were extrapulmonary. The remaining cases were reported as concurrent pulmonary-extrapulmonary tuberculosis or had no tuberculosis site reported.[22] In recent decades, an increase in extrapulmonary TB rates in developed countries has been reported, with a decrease in pulmonary TB rates. Despite this, extrapulmonary TB is not usually incorporated into TB control programs, possibly because of its lower transmissibility.[23]

Our study demonstrated a slight, non-significant reduction in the TB-related mortality rate during the COVID-19 period compared with the pre-COVID-19 period, amounting to a 0.3% decrease. This finding is consistent with a study conducted in China, which reported reductions in both TB incidence and TB-related mortality during the early stages of the COVID-19 pandemic.[24] Other studies reported an increase in hospitalisation and death related to TB in the pandemic compared to pre-COVID-19 rates, after an initial decrease in reported TB cases.[25,26] There are many possible explanations for the decrease in the death rate; the most important explanations are related to the decrease in the infection rate in general, as shown by the results. The second possible reason is related to the deaths that were recorded due to complications caused by COVID-19 and not due to tuberculosis itself. Studies that showed an increase in the death rate also attributed it to various factors, including acquiring a COVID-19 infection by a TB patient and developing complications that may lead to death. Other reasons include the difficulty of reaching TB centres due to closures, fear of contracting COVID-19, and non-adherence to antitubercular therapy. Poverty and the decline in the economic level, which was also due to the pandemic and the decline in employment, may be an important factor in the increase in the number of people infected with TB and the increase in the number of deaths due to tuberculosis, as poverty is a factor mainly linked to tuberculosis, as well as the inability to afford therapy.[27] Our study on TB treatment and follow up showed a statistical increase but not significant in some elements of therapy (cured from the disease, treatment failure) in comparison to pre-COVID-19 period and slight decrease in death rate and loss to follow up, this may be due to the Iraqi healthcare systems have been strengthened to prevent the spread of COVID-19, which can be utilised as a future step to combat and end tuberculosis in Iraq.

Limitation of the study: it was conducted in one governorate (Baghdad), so it does not reflect the tuberculosis status across Iraq.

CONCLUSION

In conclusion, there was a drop in the number of TB case reports during the coronavirus pandemic (2020, 2021) compared to the years (2018, 2019) before the pandemic. The decline in reported TB cases is larger in Kerkh than in Rasafa residence, with a persistently higher incidence of pulmonary TB for both periods. A slight decline in the number of TB deaths during the coronavirus pandemic in comparison to the pre-pandemic period.

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Abbreviations list: Acid Fast Bacillus (AFB), Centres for Disease Control and Prevention (CDC), Coronavirus disease 2019 (COVID-19), Extrapulmonary TB (EP), Human Immune Deficiency Virus (HIV), Pulmonary TB (PTB), Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), SPSS (Statistical Packages for Social Sciences), Standard deviation (SD), Tuberculosis (TB), World Health Organisation (WHO)

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