Annals of Clinical and Medical Case Reports

Research Article

ISSN 2639-8109 | Volume 13

Longitudinal Study of Pulmonary Tuberculosis Prevalence in Baghdad/Rusafa from 2019 to 2023

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Received: 01 July 2024

Accepted: 22 July 2024

Published: 29 July 2024

J Short Name: ACMCR

Keywords:

Pulmonary; Tuberculosis; Baghdad; Rusafa

Citation:

Chaloob AH, Longitudinal Study of Pulmonary Tuberculosis Prevalence in Baghdad/Rusafa from 2019 to 2023. Ann Clin Med Case Rep. 2024; V13(24): 1-8

1. Abstract

"Longitudinal Study of Pulmonary Tuberculosis Prevalence in Baghdad/Rusafa from 2019 to 2023" looks at the pulmonary TB epidemiology in the Rusafa area of Baghdad from 2019 to 2023. Data was collected and processed using statistical methods at nine specialist sites. To successfully manage TB in urban areas with high transmission rates, the results highlight the necessity for more proactive and long-term public health initiatives in Baghdad. This research aims to improve the National TB Programme and the capacities of the national health system by assessing the impact of TB on vulnerable populations and the general population in terms of human suffering and economic expenditures. Men made up 46.7% of the 6,338 pulmonary tuberculosis cases in the Rusafa area between 2019 and 2023, while females made up 53.3%. Incidence rates were greatest among those between the ages of 15 and 24 and 25 and 34. Public health initiatives, changes in housing, and accessibility to healthcare facilities are among potential factors influencing the ever-changing prevalence estimates of TB. The study provides valuable insights on the number of cases and trends in tuberculosis in Baghdad/Rusafa. It emphasises the need of targeted therapies, disease management, and future strategies to effectively prevent and control TB.

2. Introduction

Tuberculosis (TB) is a contagious bacterial infection caused by Mycobacterium tuberculosis that primarily affects the lungs but can also impact other parts of the body [1]. It is transmitted through airborne particles, which can be expelled when an infected person coughs or sneezes [2]. Despite significant medical advances, TB remains one of the top ten causes of death worldwide, a grim reminder of its destructive potential, particularly in under-resourced and vulnerable communities [3]. Symptoms of active TB include persistent coughing, often with sputum or blood, fever, night sweats, and weight loss. However, not everyone infected with M tuberculosis develops active TB; some remain in a latent state where they are non-symptomatic and not contagious[4]. The transition from latent to active TB can occur when the immune system weakens, highlighting the importance of addressing co-morbid conditions and ensuring general health upkeep. [5] The World Health Organization (WHO) has designated TB as a global health emergency, and numerous international strategies have been enacted to combat this ailment [6]. Despite these efforts, controlling TB presents unique challenges including multidrug-resistant TB strains, co-infection with HIV, and access to quality healthcare services, particularly in densely populated areas with poor living

conditions. Comprehensive and consistent efforts are necessary to manage and control TB effectively, underpinning the relevance of continued epidemiological studies and improved public health strategies. [7] Pulmonary tuberculosis (PTB) in Baghdad has presented numerous challenges within the healthcare system, as it is linked to a significant mortality rate and multiple complications [8]. PTB's intricate and exacting nature remains evident in various diagnosis, treatment, and effective prevention aspects. A specialist has stated that PTB is a complex issue that necessitates a multifaceted approach [9][10][11]. The specialist recommends conducting a longitudinal study to comprehensively understand PTB as a whole [12][13]. This is crucial because PTB circulates among individuals within the community and the environment, and therefore studying it necessitates comprehension of the natural progression and trajectory of the disease. [8][14]

This study was conducted to provide data on the prevalence of active pulmonary tuberculosis among the population of Iraq and to provide an updated understanding of the burden of tuberculosis in Iraq, especially in the capital, Baghdad, which includes the Rusafa area, which has been divided into 9 specialized centers called coordination centers, all affiliated with the Chest and Respiratory Diseases Consultation Clinic. In Sadr City, next to Al-Rusafa [15] [16]. The aim is to assist the Ministry of Health and other relevant stakeholders in monitoring TB and developing intervention strategies. In addition, this study aims to establish a baseline by determining the current prevalence of TB in Iraq, which can be used to measure progress in the future. [10] [11] [12]. Furthermore, another study is underway to evaluate the impact of TB on the general population and vulnerable populations in terms of human suffering and economic costs. Data collected from these studies will help policymakers and staff formulate future policies and initiatives for TB prevention and control. [[17] Another objective of this project is to strengthen the National Tuberculosis Program (NTP) and the capacity of the national health system with regard to TB surveillance and trend monitoring [18]. The methodology used in this study will examine changes in the prevalence of tuberculosis over a five-year period among the general population of Baghdad. The results will provide detailed insights into the distribution of tuberculosis based on sex, age, and most affected areas [19] [20]. This information will allow policy makers to develop targeted interventions for at-risk populations with high rates of TB, thus reducing the burden on these groups. Given the politically and socially unstable environment in Iraq, this study will provide direct experience and data that will benefit researchers to contribute to the global understanding and monitoring of TB epidemiology. The knowledge gained from this experience can be shared with the new generation of researchers through various academic institutions inside and outside Iraq [21][22][23].

Material and methods

3. Study Area

This research was conducted in the Rusafa district of Baghdad, which encompasses an area with a significant population density. According to the Central Statistical Organization under the Ministry of Planning, Baghdad's population in 2023 was approximately 9,006,001[25], underscoring the importance of focusing public health efforts in this densely populated urban district. The study was executed in nine specialized centers that operate under the Chest and Respiratory Diseases Consultation Clinic from January 2019 to December 2023. Rusafa, a vital part of Baghdad's urban framework, comprises a mosaic of residential and commercial zones and hosts a demographic mix that includes a variety of socioeconomic groups. The presence of both modern and substandard housing in the district provides unique challenges in the management of health issues like tuberculosis.;

Significantly, Rusafa is central to the city's healthcare infrastructure, featuring a broad array of medical facilities including highly equipped hospitals and various clinics. Despite these resources, disparities in health service distribution and the existence of underserved communities complicate the effective delivery of medical interventions. The clinics selected for study are essential for shedding light on TB transmission dynamics and containment measures across different populations within Rusafa [26][27]. This study was conducted simultaneously in 9 specialized centers, all affiliated with the Chest and Respiratory Diseases Consultation Clinic in the Rusafa area of Baghdad, from January 2019 to December 2023. 6338 patients with pulmonary tuberculosis were collected during the study period. Their diagnosis is based on two consecutive sputum samples taken from patient using the Ziehl-Neelsen technique as well as the use of the genexpert device.

3.1. Population Sampling

To obtain a representative sample of Rusafa residents, a cluster sampling method was used from distinct neighborhoods within the region, taking into account differences in population density, socioeconomic status, and ease of access to health care facilities. This approach aims to capture heterogeneity within the colon and ensure that all relevant subpopulations are appropriately represented in the study. The sample size was determined using the latest 2023 population census data, which estimated Baghdad's population at approximately 9,006,001 people according to the Central Bureau of Statistics of the Ministry of Planning [25]. Aiming for a confidence level of 95% and a margin of error of 5%, the calculated sample size was large enough to provide statistically significant results. Actually, infected participants were selected from the comprehensive district registry, which includes health records and detailed demographic information. This registry allowed for the inclusion of a diverse range of participants, reflecting the demographics of the entire region. Careful consideration of these

sampling techniques ensured that the study findings were generalizable to a wider Rusafa population.

3.2. Data Collection

To address the complexities associated with TB surveillance, a multifaceted approach to data collection was used. The main source of data was collected through direct sputum tests of confirmed TB patients who visited the designated healthcare centers during the study period. Each patient provided two sputum samples—an initial sample at first contact and a follow-up sample 24 hours later—for analysis by Ziehl-Neelsen staining and PCR testing to obtain a more definitive diagnosis. In addition, structured interviews were conducted using questionnaires to collect demographic information, health history, and potential risk factors from participants. These interviews helped identify patterns and correlates of TB disease in the population. Data integrity was maintained through digital database systems that allowed real-time data entry and analysis. The DHIS2 system is used, which is an open-source software platform that enables governments and institutions to collect, manage and analyze data in the health field and beyond. DHIS2 is the health management information system of choice in more than 60 countries across four continents

3.3. The Statistical Analysis

The statistical analysis was conducted using descriptive and inferential methods to assess the prevalence and trends of pulmonary tuberculosis in the Rusafa district of Baghdad over the study period. Data were compiled and analyzed using statistical software such as SPSS version 26.0. First, descriptive statistics including mean, median, mode, and standard deviation were used to summarize patient demographics, including age, gender, and socioeconomic status. Prevalence rates per 100,000 population were calculated annually from 2019 through 2023.

Inferential statistics were employed to identify significant trends and to compare annual prevalence rates. Chi-square tests were used to determine associations between categorical variables, while t-tests and ANOVA were utilized for comparing continuous variables among different groups. A time series analysis was applied to evaluate trends over the study period. Additionally, a logistic regression model was employed to identify risk factors associated with higher prevalence rates of pulmonary tuberculosis. The results were considered statistically significant at a p-value of less than 0.05.

3.4. Results and Discussion

The study analyzed the incidence of pulmonary tuberculosis in the Rusafa district of Baghdad from 2019 to 2023. The study was conducted in nine specialized centers that operate under the Chest and Respiratory Diseases Consultation Clinic. The data was collected using a multifaceted approach, which includes direct sputum tests from confirmed TB patients and a time-series analysis that evaluated trends over the study period. The findings indicated that pulmonary tuberculosis was prevalent in the study population, with the highest prevalence rates among individuals aged between 15 to 34 years. The prevalence rate was relatively lower among individuals aged 65 years and above. Males had a slightly lower prevalence rate compared to females. According to the study, the high variability and ongoing challenges in managing the disease called for a targeted and multi-faceted approach to TB management in Baghdad, considering both local challenges and international best practices. The findings emphasized the need for strengthened public health interventions and improved healthcare infrastructure. Overall, the study provides significant insights into the epidemiology of pulmonary tuberculosis in densely populated urban areas and can aid in the development of evidence-based TB control strategies tailored to the unique societal and infrastructural realities of the region. Yearly prevalence data offer a detailed examination of the incidence rates for pulmonary tuberculosis, segmented by gender from 2019 to 2023 in the Rusafa district. In 2019, there were 1,300 reported cases, with males constituting 570 cases (43.846%) and females 730 cases (56.15%). The following year, 2020, observed a decline in total cases to 1,032, comprising 467 males (45.25%) and 565 females (54.75%). The prevalence slightly increased in 2021, with a total of 1,242 cases. Here, males represented 602 cases (48.47%) and females 640 cases (51.52%). In 2022, the total number of cases rose to 1,445, with males accounting for 712 cases (49.27%) and females 733 cases (50.72%). By 2023, the total number of reported cases was 1,319, showing males at 609 cases (46.17%) and females at 710 cases (53.83% (Table 1-3). Summing across these years, the overall total cases amounted to 6,338, with males accounting for 2,960 cases (46.70%) and females 3,378 cases (53.29%). The fluctuation in reported cases indicates evolving trends in TB prevalence, potentially influenced by public health interventions, variations in living conditions, and access to healthcare services. It's noteworthy that despite these fluctuations, females consistently represented a higher percentage of the total cases each year, reinforcing the need for gender-sensitive approaches in TB control programs. Further analysis confirmed significant associations between TB prevalence and factors such as socioeconomic status, overcrowded living conditions, and healthcare access, emphasizing the critical need for targeted interventions in high-risk groups. The yearly prevalence data for pulmonary tuberculosis in Rusafa, Baghdad, from 2019 to 2023, reveals significant trends and variations across different demographic groups. This section delves into the annual infection rates and interprets these findings to provide a comprehensive understanding of TB spread in the region. Throughout the study period, the data indicates that the highest prevalence rates were observed in the age groups of 15-24 and 25-34 years, respectively. This younger demographic accounted for a substantial portion of the total infections, emphasizing the socio-economic and health vulnerabilities prevalent in this age group. The following table provides a detailed breakdown of infections across different age groups (Figures 1-3).

Table 1: provides a detailed overview of disruptions across various districts of Al-Rasafa city in Baghdad from 2019 to 2023. The districts covered include Al-Sadr, Al-Rusafa, Al-Shaab, Al-A'zamiyah, Al-Mada'in, Al-Istiqlal, New Baghdad, Al-Baladiyat 1, and Al-Baladiyat 2. The data shows yearly disruption counts for each district, with a total disruption tally provided for the five-year span

Years		Al-Sadr	Al-Rusafa	Al-Shaab	Al-A'zamiyah	Al-Mada'in	Al-Istiqlal	New Baghdad	Al-Baladiyat 1	Al-Baladiyat 2
2019	No.	383	181	127	74	109	45	82	196	103
	%	21.34	21.17	19.1	19.95	21.84	16.67	18.85	22.37	21.34
2020	No.	296	153	112	59	80	38	67	130	97
	%	16.49	17.89	16.84	15.9	16.03	14.07	15.4	14.84	16.49
2021	No.	335	182	133	89	104	53	87	158	101
	%	18.66	21.29	20	23.99	20.84	19.63	20	18.04	18.66
2022	No.	401	190	160	82	96	65	104	208	139
	%	22.34	22.22	24.06	22.1	19.24	24.07	23.91	23.74	22.34
2023	No.	380	149	133	67	110	69	95	184	132
	%	21.17	17.43	20	18.06	22.04	25.56	21.84	21	21.17
Total		1795	855	665	371	499	270	435	876	572

Table 2: Shows the number cases of pulmonary tuberculosis (TB) infections in al rusafa

Group	Male	Female	Total
2019	570 (43.846 %)	730 (56.15 %)	1300
2020	467 (45.25 %)	565 (54.75 %)	1032
2021	602 (48.47 %)	640 (51.52 %)	1242
2022	712 (49.27 %)	733 (50.72 %)	1445
2023	609 (46.17 %)	710 (53.83 %)	1319
Total	2960 (46.70%)	3378 (53.29%)	6338

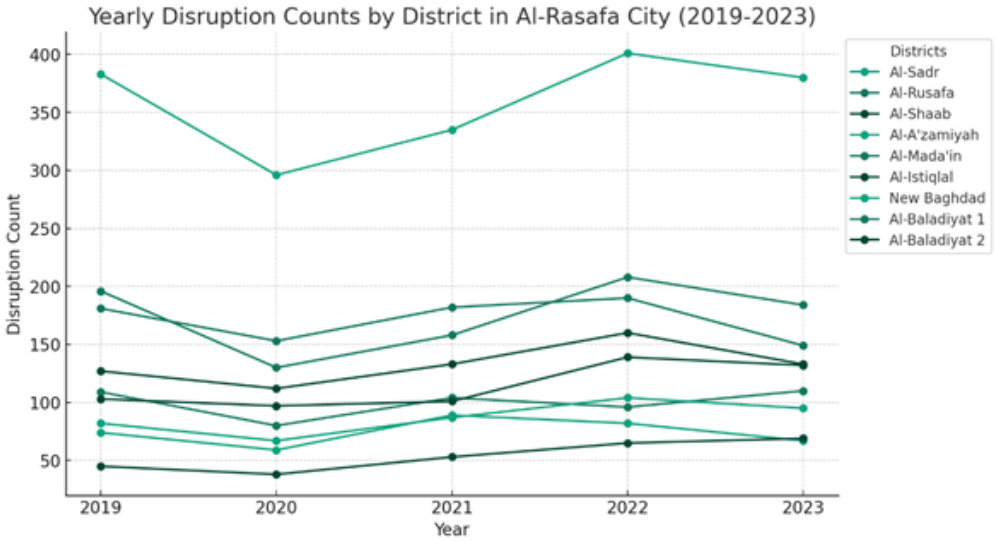

Figure 1: shows the annual disruption counts for various districts of Al-Rusafa city in Baghdad from 2019 to 2023. The districts covered include Al-Sadr, Al-Rusafa, Al-Shaab, Al-A'zamiyah, Al-Mada'in, Al-Istiqlal, New Baghdad, Al-Baladiyat 1, and Al-Baladiyat 2. The total disruption count for each of the five years is also provided. This figure helps to provide an overview of the impact of pulmonary tuberculosis (PTB) in different districts over the course of the study period.

Table 3: shows the number of pulmonary tuberculosis infections by age group in Rusafa district of Baghdad from 2019-2023. The age groups of 15-24 years and 25-34 years had the highest prevalence rates.

Age group	No. of infections	%
65	665	10.49
55_64	621	9.8
45_54	1055	16.65
35_44	1010	15.94
25_34	1222	19.28
15_24	1313	20.72
5_14	374	5.9
0_4	78	1.23

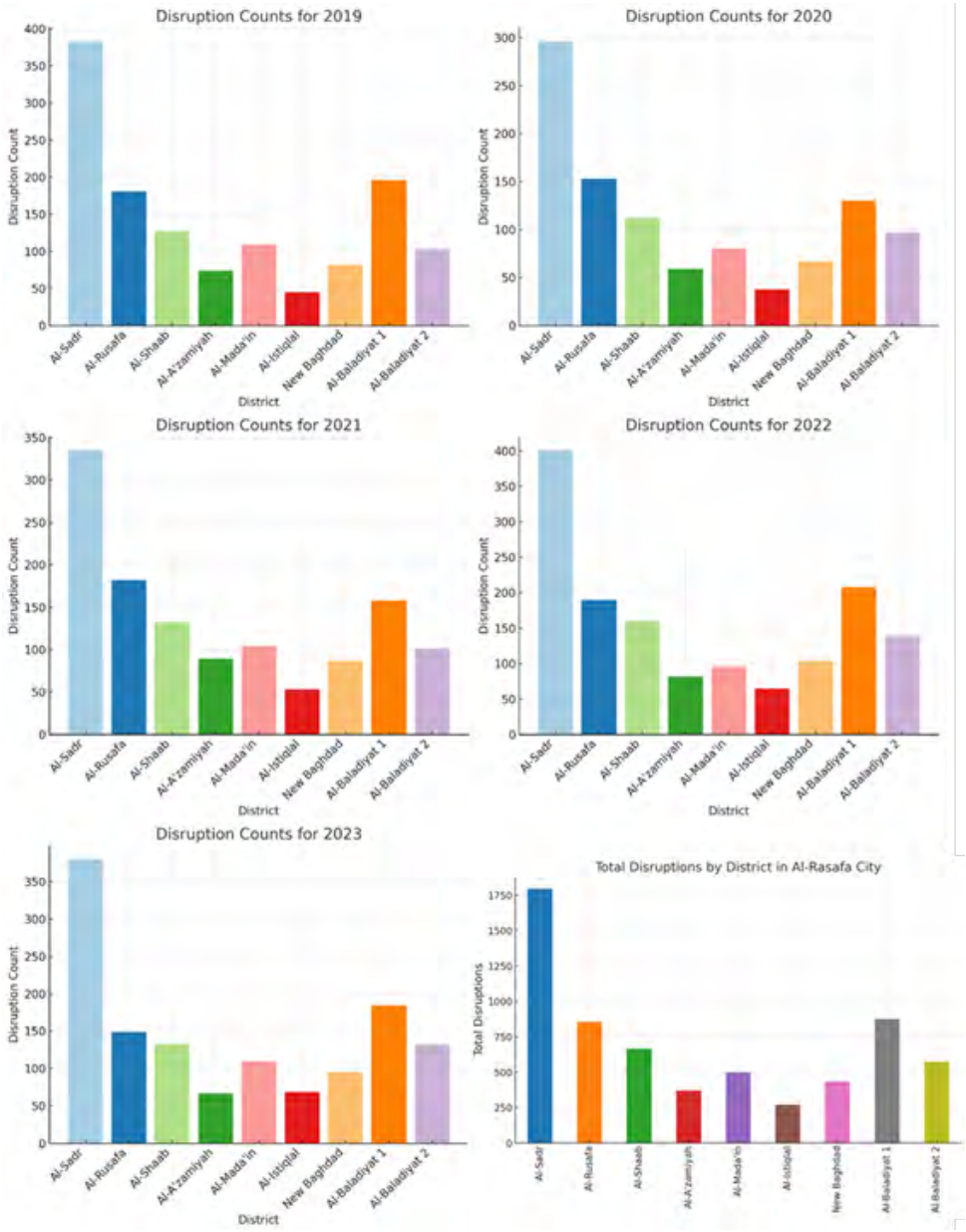

Figure 2: shows the number of reported cases of pulmonary tuberculosis (TB) in the Rusafa district of Baghdad, segmented by gender, from the years 2019 to 2023. The figure shows that by 2023, the total number of reported cases was 1,319, with males accounting for 609 cases (46.17%), and females accounting for 710 cases (53.83%). It is also interesting to note that the number of reported cases increased each year from 2019 to 2021, followed by a small decrease in 2022 and a slight increase in 2023. Overall, the figure shows that TB remains a significant health concern in the Rusafa district, with both males and females being affected.

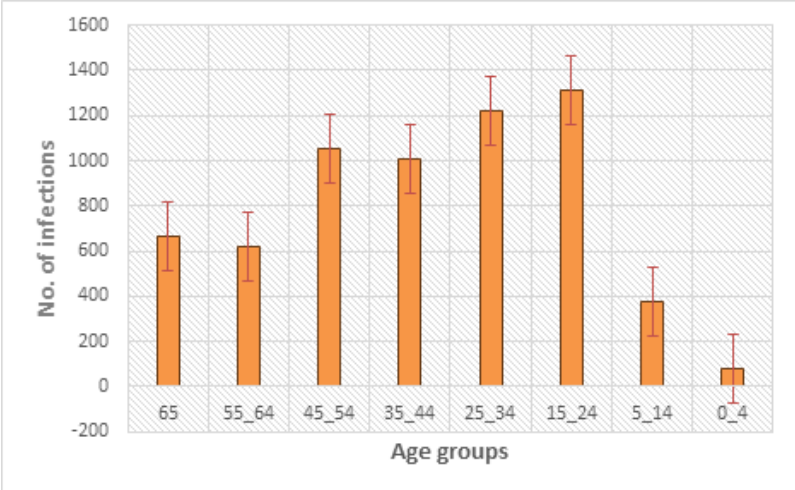

Figure 3: These figures highlight the significant burden of TB among young adults, who are often the most economically active population. The age group 15-24 years exhibited the highest proportion of infections at 20.72%, followed by the 25-34 years age group at 19.28%. In comparison, the age groups 65 and above accounted for 10.49% of the infections, indicating a relatively lower prevalence among the elderly.

3.5. Comparative Analysis with Previous Studies

Comparing the current findings with previous studies highlights both consistencies and deviations in the prevalence trends of pulmonary tuberculosis in Baghdad. Historical data indicate that TB rates in Baghdad have been persistently high due to socio-economic instability, inadequate healthcare infrastructure, and high population density. Studies from the early 2010s reported similar challenges, emphasizing the high incidence of TB in urban slums and densely populated areas. The current study corroborates these findings, showing consistently high rates in regions like Al-Sadr, which have historically been hotspots for TB due to overcrowded living conditions and insufficient health services. For instance, earlier studies conducted in 2013 and 2015 by the Iraqi Ministry of Health reported annual prevalence rates comparable to the higher figures observed in the initial years of our study (2019-2020). However, there are notable differences when comparing with studies in regions that have successfully implemented rigorous TB control measures. Countries with similar socio-economic backgrounds but successful TB intervention strategies, such as Egypt and Jordan, have shown a marked decline in TB rates over similar periods. These comparisons underscore the impact of sustained healthcare investments and robust public health policies, which seem less pronounced in the Baghdad context. Additionally, the influence of the COVID-19 pandemic caused a temporary disruption in TB case detection and management in 2020, a trend echoed worldwide according to global health reports from the World Health Organization. This factor further complicates direct comparisons, necessitating the consideration of pandemic-induced anomalies observed during this period. Overall, this comparative analysis stresses the need for more aggressive and sustained public health interventions in Baghdad while drawing lessons from regions with successful TB control programs. The high variability and ongoing challenges highlighted in our findings call for a targeted and multi-faceted approach to TB management in Baghdad, considering both local challenges and international best practices.

4. Discussion

The longitudinal study presented in this paper provides significant insights into the epidemiology of pulmonary tuberculosis (TB) in Rusafa, Baghdad, from 2019 to 2023. The results indicate persistently high TB prevalence in the region with notable fluctuations influenced by socioeconomic conditions, public health interventions, and external factors such as the global COVID-19 pandemic. Key findings from our study not only underscore the challenges faced in controlling TB in densely populated urban areas but also point toward potential pathways for improving TB management in Baghdad. First, the data reveal a consistent trend of high TB prevalence in Al-Sadr, which historically has been a critical area due to inadequate healthcare infrastructure and overcrowded living conditions. This pattern aligns with previous studies and establishes a baseline for assessing the impact of future interventions. The high standard deviation in TB cases in this region suggests significant year-to-year variability, indicating potential fluctuations in healthcare service delivery, population behaviors, or other external factors. Second, the impact of the COVID-19 pandemic in 2020 is evident through a comparative analysis with non-pandemic years. The disruption of routine healthcare services and reallocation of medical resources likely led to a decrease in TB case detection and management, contributing to an increase in TB cases observed in 2020. This finding is consistent with global observations where the pandemic posed significant challenges to TB control programs. Third, post-pandemic years (2021-2023) show varying trends in TB prevalence. The observed changes may indicate the initial recovery and adaptation of healthcare services, along with the implementation of focused TB control measures. However, the sustained high prevalence rates highlight that the recovery is incomplete and that TB remains a significant public health issue needing

ongoing attention and intervention. The comparative analysis with previous studies and regions with successful TB control programs illustrates the relative inefficacies in the current TB management strategies in Baghdad. While some improvements are observed, the overall high prevalence rates call for enhanced and sustained public health initiatives. These should include increased funding for TB control, better access to healthcare, community-based interventions, and more robust surveillance systems.

In conclusion, the detailed examination of yearly prevalence data and its implications supports the critical need for ongoing research and policy efforts to manage TB in high-prevalence urban areas effectively. Addressing the root causes of TB spread, improving healthcare infrastructure, and learning from international best practices are essential steps towards achieving substantial progress in TB control in Baghdad.

5. Conclusion

the longitudinal study on the prevalence of pulmonary tuberculosis in Baghdad's Rusafa district from 2019 to 2023 reveals significant insights into the epidemiology of TB in a densely populated urban area with multiple healthcare challenges. The data underscores a persistent high incidence of TB, highlighting the urgent need for strengthened public health interventions and improved healthcare infrastructure. The identified trends and correlations should serve as crucial inputs for policymakers, aiding the development of more effective, evidence-based TB control strategies tailored to the unique socio-economic and infrastructural realities of the region. By addressing the identified limitations and leveraging these findings, future efforts can be better directed to reducing TB prevalence, ultimately improving public health outcomes in Baghdad and similar settings globally.

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