

EFFECT OF SOCIAL ISOLATION AND QUARANTINE ON TUBERCULOSIS CASES IN FOUR IRAQI GOVERNORATES

Y.M. Abdulateef¹, S.Q. Taha Al-Quhli¹, S.A. Ghanim², N. Ibraheem³, A.H. Hassoon^{2*}

¹ Department of Medical Microbiology, Medical College, University of Anbar, Anbar, Iraq;

² Department of Biology, College of Education for Pure Science (Ibn-Al-Haitham), University of Baghdad, Baghdad Iraq;

³ Department of Gynaecology and Oncology, Baghdad Teaching Hospital, Baghdad, Iraq.

* Corresponding author: athraahassoon@yahoo.com

Abstract. Social isolation and quarantine have been implemented globally during outbreaks of a highly transmissible microbe. For instance, they were employed during the plague outbreak in 1894 and the COVID-19 pandemic in 2019. While these methods have proven effective against highly transmissible infections, they have also had significant negative consequences. In specific regions like Anbar, Diyala, Salahaddin, and Kirkuk, social isolation occurred during the period of ISIS occupation. After their liberation, these regions experienced a COVID-19 outbreak, and quarantine measures were put in place. This study aimed to investigate the effect of social isolation and quarantine on tuberculosis. Patients from Anbar, Diyala, Salahaddin, and Kirkuk districts were diagnosed with pulmonary or extrapulmonary tuberculosis according to the World Health Organization (WHO) guidelines, using methods like chest X-rays, acid-fast positive sputum slide method, culture, and Mycobacterium tuberculosis gene pert testing. All cases were documented at the Iraqi Ministry of Health. All four districts had the same population, socioeconomic status, and medical guidelines. Anbar showed a significant difference compared to the other districts, while the remaining three districts had no significant differences among themselves. The percentage of extrapulmonary tuberculosis was higher than the global average, indicating misdiagnosis. The age group of less than four years old had the lowest percentage of cases compared to other age groups, indicating the effective management of the BCG program. It can be concluded that social isolation and quarantine implemented during the COVID-19 pandemic might have led to an increase in cases of extrapulmonary tuberculosis in the studied regions.

Keywords: pulmonary, extrapulmonary, tuberculosis, social isolation, quarantine, COVID-19.

List of Abbreviations

COVID-19 – Coronavirus disease 2019

WHO – World Health Organization

TB – tuberculosis

LJ – Lowenstein-Jensen medium

PCR – Polymerase chain reaction

SAS – Statistical Analysis System

Introduction

Tuberculosis, pulmonary, and extrapulmonary, is a slow-progressing infectious disease that is diagnosed late because it shows a low-grade fever and a mild form of cough that might be clinically misdiagnosed (Haitham *et al.*, 2019). A delay in the diagnosis of tuberculosis allows this microorganism to spread in the population, especially in highly crowded cities (Aljanabi *et al.*, 2020). Anbar, Diyala, Salahaddin, and Kirkuk governorates follow the same guidelines of the MTB program in Iraq, and case documentation is reported annually.

All investigations and medications for tuberculosis in Iraq are free, which will allow the population below the national poverty line to gain access to therapy (WHO, 2018). All four governorates are similar in many factors, including population, economic status, degree of education, lifestyle, type of meals, and medical services, and were the target of ISIS (Alwan, 2022). ISIS was eradicated from these governorates in the same year. Laws were highly restrictive, and firm, and in some cities, they were in a way that only people from those cities were allowed to enter. Until today there is a poor economic exchange between Diyala, Salahaddin, and Kirkuk, but still, none with Anbar (Adnan, 2019).

The geographical difference between these four governorates is in the distance separating their towns, cities, and villages. The civil communications and economic exchange in each governorate are still poor (Ministry of Planning

Iraq, 2022). In Anbar, the cities are highly separated, and rarely do people travel from one city to another. Most of their communication is with Baghdad or Jordan. The population living below the national poverty line is between 14-25% (Mahmoud, 2015; Mahde *et al.*, 2015). Salahaddin governorate shows the highest restrictive cities where only people from the same city, town, or village are allowed to enter. Most of the people there communicate with people in Kirkuk, Arbil, and Mosul. The population living below the national poverty line is between 38-49% (Fadhil, 2013; IMO Iraq, 2021; Hasim, 2014). Diyala and Kirkuk lie on the highway between Baghdad and Arbil, which makes them both highly visited governorates. Some of their cities show restrictive laws to enter them. The population living below the national poverty line in Diyala is between 26-37%, while in Kirkuk, it is between 4-13% (Fadhil, 2013; Samir *et al.*, 2021).

The World Health Organization (WHO) guidelines published on the 11th of September 2020 recommended the use of quarantine as a method to prevent the spread of COVID-19. The method of quarantine or social isolation is an old method used to prevent highly transmissible microbial infections globally. For example, in 1894 villages and towns were closed as a result of the plague outbreak. It was and still is a method to decrease morbidity and mortality (WHO, 2020; Allami, *et al.*, 2023). The problems with quarantines and social isolations are that they induce a socio-economical problem of poverty with high numbers of unemployment that will lead to psychological diseases, stress, malnutrition, and will cause weakness of the immune system that could increase the risk of tuberculosis (Jurblum *et al.*, 2020).

The present study was conducted to investigate the effect of social isolation and quarantine on cases of tuberculosis in four Iraqi governorates.

Materials and Methods

A cross-sectional descriptive study and sample analysis

A cross-sectional descriptive study was conducted in Baghdad at the National TB Institute

in collaboration with the Medical Microbiology Department, College of Medicine, University of Anbar, Anbar, Iraq from the 1st of March 2022 to the 10th of September 2022. A total of 1,248 patients were diagnosed positive for pulmonary and extrapulmonary tuberculosis by chest X-rays, and the acid-fast positive sputum slide method. All results were confirmed by blood mycobacterium tuberculosis complex detection polymerase chain reaction (PCR) kit for extrapulmonary tuberculosis, cultured on Lowenstein-Jensen (LJ) medium, and confirmed by mycobacterium tuberculosis Gen X-pert 2021 for pulmonary tuberculosis.

Ethical approval

The research was ethically approved by the Ethical Committee at the University of Anbar and the Ministry of Higher Education in Iraq. All 1,248 cases documented in the National TB Institute and National TB Control Program were included in this research. Patients who were documented in these governorates and had a vacancy outside were excluded. Also, patients documented as cases of follow-up from the year 2020 were excluded. Patients showing positive screening tests and negative-specific tests were excluded.

Statistical analysis

The Statistical Analysis System (SAS; version 2012) program was used to detect the effect of different factors in the study parameters. A Chi-square test was employed to significantly compare between percentages in this study.

Results

The sample size calculator by Raosoft, Inc. determined that a 3.6% margin of error and a 95% confidence level were acceptable for the sample size. The 1,248 TB patients from the national surveillance data were the source of all the data used in this study. Of these, 699 patients were diagnosed with pulmonary TB, and 549 patients were diagnosed with extrapulmonary tuberculosis. The female-male ratio was 1:1.2. In every governorate, the proportion of females was higher. Ages ranged from less than

4 to 65+ years. The highest age incidence was between 15–24 years (19.5%) while the lowest age incidence was less than 4 years (3.0%). HIV testing was negative in every case. In all four governorates, including Anbar, the percentage of extrapulmonary tuberculosis was higher than that of pulmonary tuberculosis, as presented in Figure 1. Table 1 shows that Anbar, with a slightly higher population than the rest governorates, has a significantly different total inci-

dence of tuberculosis than the other governorates, although all four governorates use the same diagnosis guidelines and treatment regimens. When the remaining three governorates were compared to one another (Tables 2 and 3), there was no significant difference between them, and Diyala's total incidence of tuberculosis decreased, suggesting that the three governorates were implementing effective control measures.

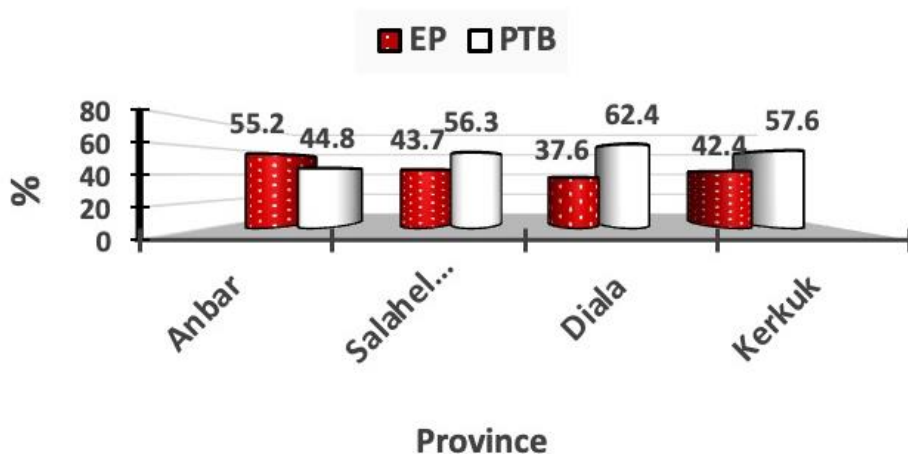


Fig. 1. Percentage of patient's extrapulmonary EP and pulmonary tuberculosis PTB in province

Table 1

Comparison between Anbar and Salaheddin, Diyala, and Kirkuk governorates for the total infection rate in each governorate

| Total incidence | Population | Rate of incidence % | Total incidence | Population | Rate of incidence % | P-value |
|-----------------|------------|---------------------|-------------------|------------|---------------------|---------|
| Anbar | | | Salaheddin | | | |
| 250 | 1,818,318 | 0.0137 | 348 | 1,637,232 | 0.0213 | 0.001 |
| | | | Diyala | | | |
| | | | 346 | 1,680,328 | 0.0206 | 0.001 |
| | | | Kirkuk | | | |
| | | | 304 | 1,639,953 | 0.0185 | 0.001 |

Table 2

Comparison between Salaheddin, Diyala, and Kirkuk governorates for the total infection rate in each governorate

| Total incidence | Population | Rate of incidence % | Total incidence | Population | Rate of incidence % | P-value |
|-------------------|------------|---------------------|-----------------|------------|---------------------|----------------------|
| Salaheddin | | | Diyala | | | |
| 348 | 1,637,232 | 0.0213 | 346 | 1,680,328 | 0.0206 | 0.676 ^{N.S} |
| | | | Kirkuk | | | |
| | | | 304 | 1,639,953 | 0.0185 | 0.081 ^{N.S} |

Table 3

Comparison between Diyala and Kirkuk governorates for the total infection rate in each governorate

| Diyala | | | Kirkuk | | | P-value |
|-----------------|------------|---------------------|-----------------|------------|---------------------|----------------------|
| Total incidence | Population | Rate of incidence % | Total incidence | Population | Rate of incidence % | |
| 346 | 1,680,328 | 0.0206 | 304 | 1,639,953 | 0.0185 | 0.181 ^{N.S} |

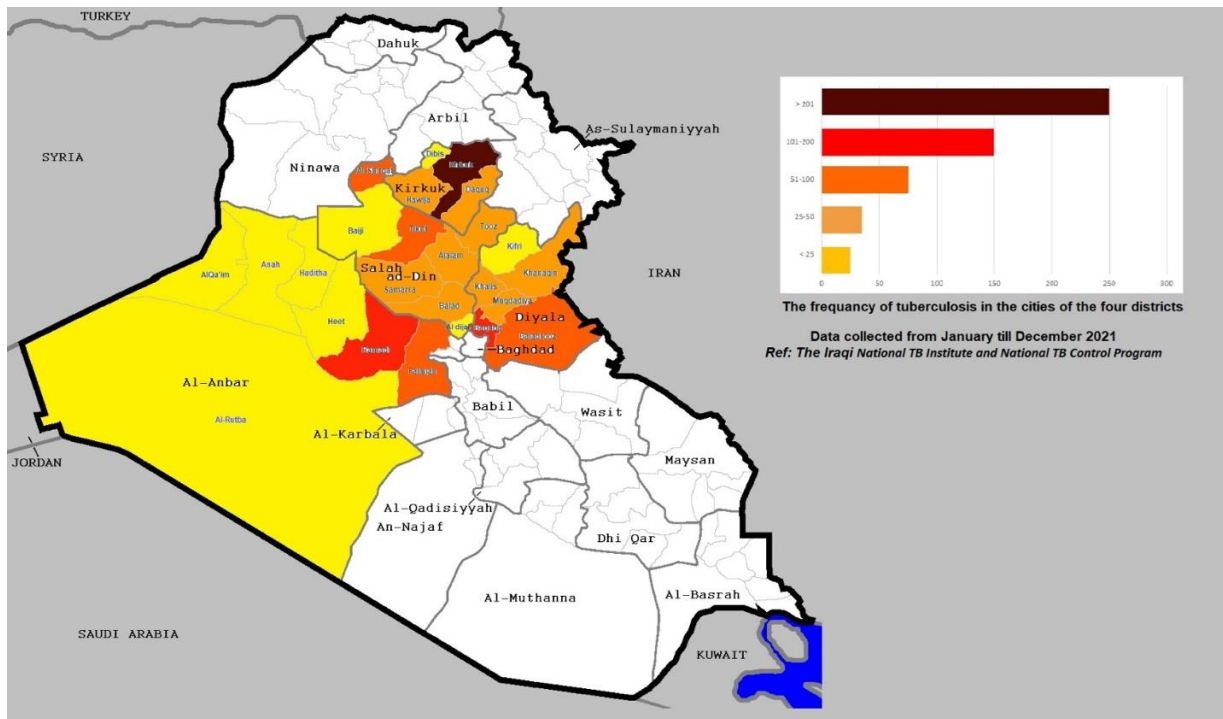


Fig. 2. The frequency of Tuberculosis in the cities of the four governorates

Discussion

Only 16% of tuberculosis cases worldwide are extrapulmonary; the remainder are pulmonary (WHO, 2018). All of the cases of extrapulmonary tuberculosis were greater than 16% of the total cases of tuberculosis (Fig. 1). This could be explained by the fact that a large number of cases in 2020–2021 were either misdiagnosed as COVID-19 or connected to it, given that the majority of patients (89.65%) had a history of the virus and that all of them had come into contact with a relative infected with the virus. This observation is in agreement with the WHO report on the impact of COVID-19 on tuberculosis, which stated that there was a global reduction in tuberculosis care of about 21%

since 2019, and might even lead to 500,000 more deaths due to tuberculosis (WHO, 2021; Hassoon, 2022). Even though the TB program is the same in all three governorates, Anbar needs special attention because it has higher rates of extrapulmonary tuberculosis than pulmonary TB and differs significantly from the other two (Table 1). In addition, the governorate has the highest rate of misdiagnosis and has experienced longer social isolation from ISIS than the other governorates, which has caused many cases to delay seeking medical attention. This finding agrees with the Chinese and European Union, both stating that extrapulmonary tuberculosis is the most challenging diagnosis because of its diversity in symptoms

and that many of them failed to reach the primary cause (Solovic *et al.*, 2013). There was no significant difference between the Diyala, Salahaddin, and Kirkuk governorates in the cases of the total amount of tuberculosis (Tables 2 and 3). Diyala, Salahaddin, and Kirkuk governorates have a common degree of communication economically, and socially. Since 2014, they have shown an internal migration, and their major market is in Kirkuk although, Diyala has more relation with Baghdad since it is closer to it and a lot of the family relatives live or migrated to Baghdad. In addition, Diyala cities have better social and economic connectivity, which may help to explain why the city has a higher tuberculosis rate than the other governorates (Hussam *et al.*, 2022). Given that Diyala's occupancy is lesser and its connectivity with Baghdad is higher, it makes more sense to classify it with the governorates that surround Baghdad rather than as governorates that are under ISIS control. Also, Salahaddin and Kirkuk governorates are similar in their percentage, although people from Kirkuk rarely go to Salahaddin since its cities are restricted only to their occupiers (Fig. 1). More so, poverty is a key risk factor for tuberculosis and is more prevalent in Salahaddin, particularly in urban areas where agriculture is the primary source of income (Amin 2017; Buniya *et al.*, 2018).

The cluster distribution in both governorates was not equally distributed and shows the highest percentage in urbanized cities mostly in Kirkuk (Fig. 2). Salahaddin should have shown the highest numbers of tuberculosis since it is an agriculture-dependent governorate. Still, the rural cities had a lower percentage than that of the urbanized, especially Tikrit indicating that the BCG vaccination program is quite effective, and the cases of infection are mostly driven from Kirkuk. This could help in the eradication of tuberculosis by constructing a screening program for Kirkuk and treating the undetected cases in that governorate, which might improve the case number in Salahaddin. That is if bacterial transmissibility is taken as a higher risk factor than poverty. The similarity in the incidence of pulmonary, and extrapulmonary tuberculosis in the three governorates in comparison to the

population of each one might be explained by the proper distribution of the tuberculosis centers in each governorate. Still, the picture of high levels of extrapulmonary tuberculosis requires attention. Anbar has a low communication activity with the other governorates, and even its cities show a low communication activity besides being distant from each other. It also went through two periods of social isolation: the first occurred during the ISIS occupation, and the second was during the COVID-19 outbreak (Hassoon *et al.*, 2017). This governorate showed a significant difference among the rest three governorates. It also showed the highest number of extrapulmonary tuberculosis among them and in comparison, to pulmonary tuberculosis, it is regarded among the non-poor governorates in Iraq making it easy to explain the results as misdiagnosis. Therefore, there is a need to follow up on the TB program methodology in that governorate. In Anbar, social isolation did not improve the outcome or decrease the case number because it showed a higher number of extrapulmonary tuberculosis indicating that these cases were pulmonary tuberculosis one to two years previously and were misdiagnosed. It also proved that social isolation hurt the control program for tuberculosis either throw difficulty to reach the centers or the misdiagnosis. Poverty is still viewed as a significant disadvantage, even though quarantine is one of the main strategies for containing highly transmissible infections and is approved by the WHO (WHO report, 2021). The risk of extrapulmonary tuberculosis has been shown to increase in China in the last few years i.e., during the COVID-19 pandemic. It was thought to be related to the development of highly resistant strains of the MBT complex. Social isolation and quarantine have a higher effect than resistant microorganisms because in all four governorates, the disease was treatable by the Iraqi TB control program and there were less than 1% of resistant cases (Pang *et al.*, 2019; Abdulrazaq *et al.*, 2016).

Conclusion

Following the COVID-19 quarantine, there has been a significant rise in the number of ex-

trapulmonary tuberculosis cases globally (more than 16%) and in Anbar, even reached higher levels than pulmonary tuberculosis, which requires attention. Following the global experience with quarantine techniques, an analysis of the program between countries that strictly implement it and those without quarantine laws ought to be performed. These studies should

take into consideration mycobacterium tuberculosis as it is a slow-progressing microbial pathogen.

Acknowledgements

The authors are sincerely grateful to the National TB Institute and National TB Control Program.

References

- ABDULRAZAQ M., SALIH L., MANKHI A., AL-SIKAFI H., ALDOORI H., ZAIDAN A., AMEEN A. & RAJEB T. (2016): Rifampicin and INH monoresistance prevalence among Iraqi smear-positive pulmonary tuberculosis cases. *European Respiratory Journal* **48**, 2676.
- AHMED N.M. (2015): The impact of the security Variables on the costs of investment in the province of Anbar. *AL-Anbar University Journal of Economic and Administration Sciences* **7**(14), 290–320.
- AL-SAADY A.F. (2013): Geography of poverty in Iraq. *Basic Education College Magazine For Educational and Humanities Sciences* **4**(12), 399–414.
- ALJANABI Y.M., LAFI S.A. & EYADA H.N. (2020): Tb Laboratory diagnosis, A comparative study in Baghdad, IRAQ. *Medico-Legal Update* **20**(4), 855–860.
- ALJAWAREEN A.F. (2019): Iraqi Economy Post ISIS: Challenges and Opportunities. *Management and Economics Research Journal* **5**(10), 2134–2144.
- ALLAMI R.H., HASSOON A.H., ABDULATEEF Y.M., GHANI A.A. & AL-FALAHY S.J. (2023): Genetic Association of Angiotensin-converting enzyme 2 ACE-2 (rs2285666) Polymorphism with the Susceptibility of COVID-19 Disease in Iraqi Patients. *Tropical Journal of Natural Product Research* **7**(2), 2346–2351.
- BUNIYA H.K., HASSOON A.H. & HAMEED A.K. (2018): Molecular genetic variability in the d-loop region for females with breast cancer and the effect of the chemotherapy, *Research Journal of Pharmacy and Technology*, **11**(9), 3787–3792.
- CENTRAL ORGANISATION FOR STATISTICS AND INFORMATION TECHNOLOGY (IRAQ) (2022): Governmental agency ministry of planning and development. Cooperation report.
- EYAD H.N., ADBULATEED Y.A. & LAFI S.A. (2019): Abnormal presentation of TB Patients: anthropological study. *Annals of Tropical Medicine & Public Health* **22**(6), 46–55
- HASIM H.M. (2014): Microtakaful as an Islamic Financial Instrument, for Poverty Alleviation in Iraq. *Middle-East Journal of Scientific Research* **21**(12), 2315–2325.
- HASSOON A.H. (2022): Evaluating the role of mitochondrial DNA quantification in blastocyst transfer potential. *AIP Conference Proceedings* **2386**, 020046.
- HASSOON A.H., BUNIYA H.K. & HAMEED A.K. (2017): Sequences of mitochondrial D-loop region in Iraqi persons. *Pak. J. Biotechnol.* **14**(4), 595–600.
- HUSSAM S. & ADNAN A. (2017): Geographical Deportation of Migration Phenomenon in Iraq after 2003. *Lark journal for philosophy, linguistic and social science* **2**(45), 877–933.
- JALAL H.A. (2020): Trends and size of migration in the province of Kirkuk. *Journal of Al-Farahidi's Arts* **9**(30), 349–373.
- JURBLUM M., NG C.H. & CASTLE D.J. (2020): Psychological consequences of social isolation and quarantine: Issues related to COVID-19 restrictions. *Australian Journal of General Practitioners.* **49** (12), 778–782.
- KHALIFAH, R.S. & AL-TAI A.A.H. (2021): Cartographic analysis of the types of population densities for Diyala Governorate: A systematic review and meta-analysis. *The American Journal of Emergency Medicine* **41**, 110–119.
- MAHDE N., KHAI AF A.H. & MOHAIN M.Z. (2015): Poverty and education in Iraq (Reality and challenges). *Al-Fatih journal* **11**(64), 311–332.
- NURI M.A. (2022): The Impact of Terrorism on Development in Conflict-Affected Areas. *Journal of Al-Farahidi's Arts* **14**(48) Second Part, 75–93.

- PANG Y., AN J., SHU W., HUO F., CHU N., GAO M., QIN S., HUANG H., CHEN X. & XU S. (2019): Epidemiology of Extrapulmonary Tuberculosis among Inpatients, China, 2008–2017. *Emerg Infect Disease* **25**(3), 457–464.
- SOLOVIC I., JONSSON J., KORZENIEWSKA-KOSEŁA M., CHIOTAN D.I., PACE-ASCIAK A., SLUMPE E., RUMETSHOFER R., ABUBAKAR I., KOS S., SVETINA-SORLI P., HAAS W., BAUER T., SANDGREN A. & VAN DER WERF M.J. (2013): Challenges in diagnosing extrapulmonary tuberculosis in the European Union, 2011. *Europe's Journal on Infectious Disease Surveillance* **18**(12), 20432–20442.
- TANG N.L.S., CHAN P.K.S., WONG C.K., TO K.F., WU A.K.L., SUNG Y.M., HUI D.S.C., SUNG J.J.Y. & LAM C.W.K. (2005): Early enhanced expression of interferon-inducible protein-10 (CXCL-10) and other chemokines predicts adverse outcomes in severe acute respiratory syndrome. *Clinical Chemistry* **51**(12), 2333–2340.
- THE INTERNATIONAL ORGANIZATION FOR MIGRATION (IOM) IRAQ (2021): Return dynamics in Salahadin governorate. International Organization for Migration.
- WORLD HEALTH ORGANISATION (2018): *Global Tuberculosis Report*. WHO/CDS/TB/2018.20. Geneva: The Organization.
- WORLD HEALTH ORGANISATION (2018): *Global tuberculosis report*. WHO/CDS/TB/2018.25. Geneva: WHO.
- WORLD HEALTH ORGANISATION (2020): *Country COVID-19 intra-action review (IAR): final report template*. 23 July 2020.
- WORLD HEALTH ORGANISATION (2021): *Impact of the COVID-19 pandemic on TB detection and mortality in 2020*. 22 March 2021.
- WORLD HEALTH ORGANISATION (2021): *More than half a billion people have or pushed further into extreme poverty due to health care costs*. 12 December 2021.