

Statistical Evaluation of Infant Mortality, COVID-19, and Tuberculosis in Iraq

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Abstract – A part of this study investigates the factors associated with infant death in Iraq based on the multiple indicator cluster survey round sex survey dataset. Furthermore, the other part of this study is to investigate the potential association between the COVID-19 pandemic and tuberculosis (TB) cases, consisting of 1381 TB patients recorded over 4 years (2019–2022) at Iraq TB hospitals. The methodology adapted for analyzing is known as binary logistic regression for predicting the probability of determinants that are related to infant death and its component periods in the region. Furthermore, we used TB cases in 2019 as a control group and baseline for comparison. To determine statistically significant differences in average TB cases between groups, we employed one-way analysis of variance with *post hoc* multiple comparisons. We analyzed TB case frequency by quarter. Our findings reveal a statistically significant increase in TB cases during the second and third quarters of 2022, coinciding with the decline of COVID-19 cases in the region. This suggests a stronger overall TB incidence after the pandemic's peak compared to pre-pandemic levels in 2020. These findings are highly beneficial for the fields of public health, epidemiology, and health policy-making. In practice, this analysis applies to strategic resource allocation and the design of targeted maternal-child health interventions. It helps policymakers identify high-risk demographic groups to reduce infant mortality and enables health systems to address the resurgence of neglected infectious diseases like TB.

Index Terms – Binary logistic regression, COVID-19, Infant mortality, Tuberculosis, One-way analysis of variance.

I. INTRODUCTION

There was a significant increase in infant mortality after UN sanctions against Iraq in 1990 due to worse socioeconomic conditions, but it decreased after 2000 due to the development of the economic situation (Nations, 2009; Aljumaily, Al-

Ani and Hantush, 2013; Chen, Oster and Williams, 2016). In general, the income source may affect the overall health of infants through the consumption of food, sanitation, healthcare, education, and housing. The age of the mother at delivery can be an important factor affecting both mother and infant survival (MacDorman and Mathews, 2009; Caldwell and McDonald, 1982; Kembo and Van Ginneken, 2009; Shah et al., 2011). Thus, it is crucial to investigate the determining factors affecting infant mortality in Iraq, which are gaining important attention from demographers, biometricians, and policymakers. Tuberculosis (TB) is a bacterial disease caused by *Mycobacterium* TB and spreads through the air when an infected person coughs, sneezes, talks, laughs, or shouts (Bouzeyen and Javid, 2022; Dong, et al., 2022). The emergence of the COVID-19 pandemic (COP) and the rise of drug-resistant TB strains have significantly complicated TB control efforts, despite a century of medical advancements (Qi, et al., 2023; Olarewaju et al., 2023). Much research has been conducted on the impact of COVID-19 on TB patients, using modeling to investigate the potential impact of the COP on HIV and TB. Due to the severe pressures on health systems, exacerbated by the COP, people with TB are likely to face reduced access to diagnostic and treatment services. As the COP unfolds, it is crucial not to neglect the ongoing TB epidemic, which remains a major cause of death from infectious diseases (Weng, et al., 2023; Zamparelli, et al., 2022). This study examines data from 1381 patients to determine how the COP may have affected TB incidence, diagnosis, and management. The period of 2019-2022 encompasses the time before, during, and potentially after the peak of the COP.

II. CASE REPORT

The two similar data collection methods and equivalent variable definitions all contributed to the decision to merge them. Data integration is methodologically appropriate because both studies looked at relevant features of the same health outcome in similar demographics and contexts. By combining the datasets, the sample size was increased, which improved statistical power, improved parameter estimate precision, and allowed for a more thorough assessment of the factors influencing the result. Variables were examined and standardized before analysis to

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guaranty uniformity in measurement and categorization between the two investigations.

A. Investigating Factors Affecting Infant Mortality

A total of 20,521 families were interviewed in the multiple indicator cluster survey 6 (MICS6) at the national level, across urban and rural areas, to estimate multiple indicators across Iraq. Modeling the association between the outcome variable and explanatory variable is a fundamental step in statistical modeling (Kadir, 2018). The most prevalent illustration of this is linear regression modeling, where the outcome covariate is numerical. Conversely, logistic regression analysis is appropriate when the outcome covariate is a binary response (Khudhur and Kadir, 2022; Kadir, et al., 2024). Our outcome variable in binary logistic regression is infant mortality, which takes the value 1 for the death of an infant below age 1 and 0 for the survival of an infant. Independent variables such as sex of the child, the mother's age at birth, Birth interval, Mother's education, place of residence, region, and wealth index.

B. Influence of the COP on TB

We analyzed data on all TB patients (1381) documented at the TB Hospital, Iraq, between 2019 and 2022. Patients diagnosed with TB in 2019 served as the control group for comparison, as 2019 predates the emergence of COVID-19. As our data met the assumptions of normality and homogeneity of variance for one-way Analysis of variance (ANOVA), we employed one-way ANOVA with *post hoc* multiple comparisons to determine if there were statistically significant differences in the mean number of TB cases between groups categorized by season or quarter due to the rapidly changing nature of COVID-19. The JMP-Pro Version 16 was used for statistical analysis.

III. RESULTS AND DISCUSSION

A. Factors Influencing Infant Mortality

The infant mortality rate in Iraq, based on MICS survey since 2007, is above the world average rate, having reduced from 32 in 2007 to 23.8 in 2018. The results were expressed as odds ratios, robust standard errors, p-values, and 95% confidence intervals. The total of live births in the 5 years of the preceding survey is 7,077 in Iraq, of which 277 have died, indicating the infant mortality rate per thousand live births is reduced from 32 in 2007 to 23.8 in 2018. The world average infant mortality rate in 2018 was 21 infant deaths per thousand live births. This means the infant mortality rate in Iraq is still above the world average. The Chi-square test to detect relationships between mortality and other factors showed that there are statistically significant relationships between mortality and region ($p = 0.04$), birth order ($p = 0.000$), wealth index ($p = 0.000$), having previous births ($p = 0.000$), and mother's education ($p = 0.000$), Table I. The Hosmer-Lemeshow test was used to determine the logistic regression model's goodness-of-fit. Before developing the model, multicollinearity between independent variables

TABLE I
ODDS RATIO OF LOGISTIC REGRESSION FOR THE IMPACT OF VARIABLES ON
INFANT MORTALITY IN 2018

Variables	Coefficients	Odds ratio (95% Confidence interval)	Standard error	p-value
Newborn sex Ref: Boy	Girl	1.06 (0.83, 1.35)	0.132	0.643
Birth order Ref: First baby	2 nd	0.18 (0.06, 0.56)	0.104	0.003
	3 rd	0.15 (0.05, 0.47)	0.087	0.001
	4 th and above	0.06 (0.02, 0.2)	0.037	0.000
Mother's age at birth Ref: <20 years	20–30 years	1.14 (0.76, 1.70)	0.232	0.528
	35+years	1.10 (0.64, 1.88)	0.302	0.741
Region Ref: Kurdistan Region	Central and southern Iraq	1.25 (0.75, 2.10)	0.330	0.398
Wealth index Ref: Poorest	Second	2.32 (1.67, 3.25)	0.396	0.000
	Middle	3.21 (2.20, 4.67)	0.616	0.000
	Fourth	3.06 (2.07, 4.54)	0.616	0.000
	Richest	4.11 (2.35, 7.18)	1.170	0.000
Previous birth interval Ref: First birth	<2 years	3.90 (1.28, 11.89)	2.218	0.017
	2 years	6.73 (2.17, 20.89)	3.889	0.001
	3 Years	10.52 (3.24, 34.12)	6.317	0.000
	4 Years or more	6.60 (2.11, 20.68)	3.846	0.001
Mother's education Ref: Uneducated	Primary	0.95 (0.89, 1.32)	0.159	0.777
	Lower secondary	1.41 (0.91, 2.20)	0.317	0.122
	Upper secondary	1.29 (0.83, 2.01)	0.293	0.265
Constant		7.95 (3.92, 16.11)	2.866	0.000

was investigated using tolerance statistics and the variance inflation factor. The final model did not include variables that showed signs of significant multicollinearity.

Birth order seems to be an essential factor affecting infant mortality. It means that children with a second birth order (82% lower infant mortality) are less likely to have infant mortality in comparison with children with a first birth order. Interestingly, the odds of infant mortality with the fourth order are also 99.5% lower than those with the first order. Furthermore, children with higher birth intervals have higher odds of infant mortality, in which children born with <2 years of interval have 3.90 (95% confidence interval [CI]: 1.28, 11.89) times higher infant mortality, and infants that have a birth interval of 3 years have 10.52 (95% CI: 3.24, 34.12) times the odds of dying in concordance with their first birth. In addition, the odds of infant mortality in richer families are higher. This means poor families are more likely to have high-survival infants. Nevertheless, the findings should be interpreted with caution, as regional variations may limit the extent to which the results can be generalized to the entire country.

B. Influence of the COP on TB

TB mean scores based on the first quarter (Q1) of each year

Table I (Sup. Info) displays the mean scores of the TB cases for the first quarter of each year. It shows that the mean scores of the TB cases for the first quarters of 2019, 2020, 2021, and 2022 are 33.667, 23, 29.333, and 36, with

a difference in the standard deviation of 9.8150, 8.5440, 0.8819, and 7. The lower and higher bounds of the 95% CI for the population mean TB cases are (9.2850, 58.0484) for the first quarter of 2019, (1.7755, 44.2245) for the first quarter of 2020, (25.5388, 33.1279) for the first quarter of 2021, and (18.6110, 53.3890) for the first quarter of 2022.

ANOVA tests if the means of TB cases between the groups (first quarter of each year) are equal.

H_0 : $\mu(\text{TB of } Q1_{2019}) = \mu(\text{TB of } Q1_{2020}) = \mu(\text{TB of } Q1_{2021}) = \mu(\text{TB of } Q1_{2022})$

H_1 : The mean scores between at least two of the groups are significantly different

Where:

- H_0 is a null hypothesis.
- H_1 is an alternative hypothesis.

According to the results in Table II (Sup. Info), since the $p = 0.2296$ is more than 0.05, there is no evidence to reject the null hypothesis H_0 , indicating no statistically significant differences between the TB cases of the first quarters of each year.

According to Table III (Sup. Info), there is no statistically significant difference between the first quarters of the year on the TB cases because their $p > 0.05$. Furthermore, the lower levels of the 95% CIs are negative (-), and the upper levels are (+). There is a zero between them. Therefore, the average difference between the two groups may be zero, and that is why it is not significant.

TB cases are based on the second quarter (Q2) of each year

Table IV (Sup. Info) shows that the mean scores of the TB cases for the second quarters of 2019, 2020, 2021, and 2022 are 28.667, 22.333, 28.667, and 31.667, with a difference in the standard deviation of 2.8868, 1.5275, 2.8868, and 4.0415, respectively. The lower and higher bounds of the 95% CI for the population mean TB cases are (21.4956, 35.8378) for the second quarter of 2019, (18.5388, 26.1279) for the second quarter of 2020, (21.4956, 35.8378) for the second quarter of 2021, and (21.6271, 41.7061) for the second quarter of 2022.

ANOVA tests if the means of the TB cases between the groups (second quarter of each year) are equal.

H_0 : $\mu(\text{TB of } Q2_{2019}) = \mu(\text{TB of } Q2_{2020}) = \mu(\text{TB of } Q2_{2021}) = \mu(\text{TB of } Q2_{2022})$

H_1 : The mean scores between at least two of the groups are significantly different

According to the results in Table V (Sup. Info), since the p -value of 0.0271 is < 0.05 , there is evidence to reject the null hypothesis H_0 and accept the alternative hypothesis H_1 , indicating statistically significant differences between the mean TB cases of the second quarter of each year.

According to Table VI (Sup. Info), the p -value associated with the average difference between the mean scores of TB for the years 2022 and 2020 is 0.0205, indicating statistical significance. In addition, the 95% CIs for both years do not contain a zero value between their lower and upper limits. Therefore, it can be concluded that there is a statistically significant difference between the mean of TB cases for the

years 2022 and 2020. Furthermore, their lower levels of 95% CIs are negative (-), and the upper levels are (+).

TB cases mean scores based on the third quarter (Q3) of each year

Table VII (Sup. Info) depicts the mean scores of the TB cases for the third quarter of 2019, 2020, 2021, and 2022, which are 30.667, 25.667, 28.667, and 34.667, with a difference in the standard deviation of 4.0415, 1.5275, 4.0415, and 2.3094, respectively. Furthermore, the lower and higher bounds of the 95% CI for the population mean TB cases are (20.6271, 40.7062) for the third quarter of 2019, (21.8721, 29.4613) for the third quarter of 2020, (18.6271, 38.7062) for the third quarter of 2021, and (28.9298, 40.4035) for the third quarter of 2022.

ANOVA is used to test if the means of the TB cases between the groups (third quarter of each year) are equal.

H_0 : $\mu(\text{TB of } Q3_{2019}) = \mu(\text{TB of } Q3_{2020}) = \mu(\text{TB of } Q3_{2021}) = \mu(\text{TB of } Q3_{2022})$

H_1 : The mean scores between at least two of the groups are significantly different

According to the results in Table VIII (Sup. Info), since the p -value of 0.0454 is < 0.05 , there is evidence to reject the null hypothesis H_0 , and accept the alternative hypothesis H_1 , indicating statistically significant differences between at least two of the TB mean scores of the third quarter. Another way to illustrate whether a difference between two or more groups is statistically significant is to use the *post hoc* multiple comparison techniques. According to Table IX (Sup. Info), the p -value for the difference in mean scores of TB cases between the third quarters of 2022 and 2020 is 0.0343, which is < 0.05 , indicating that there is a statistically significant difference between the third quarters of the years 2022 and 2020 in the mean scores of TB cases. Furthermore, the 95% CIs for both years do not contain a zero value between their lower and upper limits. Therefore, it can be concluded that there is a statistically significant difference between the TB cases for the years 2022 and 2020. In contrast, there is no statistically significant difference between the third quarters of the other years on the TB cases mean scores because their $p > 0.05$. Therefore, since other p -values are higher than 0.05, there is no significant difference between them.

TB cases mean scores based on the fourth quarter (Q4) of each year

Table X (Sup. Info) explains that the mean scores of the TB cases for the fourth quarter of 2019, 2020, 2021, and 2022 are 23.333, 27.667, 29.667, and 28, with a difference in the standard deviation of 9.2376, 6.6583, 5.8595, and 6.2450, respectively. The lower and higher bounds of the 95% CI for the population mean TB cases are (0.3859, 46.2808) for the fourth quarter of 2019, (11.1265, 44.2069) for the fourth quarter of 2020, (15.1109, 44.2224) for the fourth quarter of 2021, and (12.4866, 43.5134) for the fourth quarter of 2022.

ANOVA is used to test if the means of the TB cases between the groups (fourth quarter of each year) are equal.

H_0 : $\mu(\text{TB of } Q4_{2019}) = \mu(\text{TB of } Q4_{2020}) = \mu(\text{TB of } Q4_{2021}) = \mu(\text{TB of } Q4_{2022})$

H_1 : The mean scores between at least two of the groups are significantly different

According to the results in Table XI (Sup. Info), since the $p = 0.7363$ is greater than the significance level of 0.05, there is no evidence to reject the null hypothesis H_0 , indicating no statistically significant differences between the TB cases of the fourth quarter. Another way to illustrate whether a difference between two or more groups is statistically significant is to use the *post hoc* multiple comparison techniques. According to Table II, the p-value for the difference in mean scores of TB between the fourth quarters of the pair years is more than 0.05, indicating that there is not a statistically significant difference between the fourth quarters of the years in the TB mean scores. In addition, the lower levels of 95% CIs are negative (-), and the upper levels are (+). There is a zero between them. Therefore, the average difference between the two groups may be zero, and that is why it is not significant.

TB cases mean scores based on the years

Table XII (Sup. Info) shows that the mean scores of the TB cases for the years 2019, 2020, 2021, and 2022 are 29.0833, 24.6667, 29.0833, and 32.25, with a difference in the standard deviation of 7.2796, 5.2107, 3.3029, and 5.7544, respectively. Furthermore, the lower and higher bounds of the 95% CI for the population mean TB cases are (24.4581, 33.7086) for 2019, (21.3559, 27.9774) for 2020, (26.9422, 31.2245) for 2021, and (28.5938, 35.9062) for 2022. Now, we can test whether or not the mean TB cases differ significantly between the two pairs of years by conducting a one-way ANOVA. ANOVA tests if the means of the TB cases between the groups (years) are equal.

H_0 : $\mu(\text{TB of 2019}) = \mu(\text{TB of 2020}) = \mu(\text{TB of 2021}) = \mu(\text{TB of 2022})$

H_1 : The mean scores between groups are significantly different

According to the results in Table XIII (Sup. Info), since the $p = 0.0177$ is < 0.05 , there is evidence to reject the null

TABLE II
ORDERED DIFFERENCES REPORT FOR TB CASES MEAN SCORES BASED ON THE
FOURTH QUARTER (Q4) OF EACH YEAR

Level	- Level	Difference	p-value	Lower 95% CI	Upper 95% CI
2021	2019	6.333	0.7056	-12.2936	24.96023
2022	2019	4.667	0.8516	-13.9602	23.29356
2020	2019	4.333	0.8763	-14.2936	22.96023
2021	2020	2	0.9850	-16.6269	20.62689
2021	2022	1.667	0.9912	-16.9602	20.29356
2022	2020	0.333	0.9999	-18.2936	18.96023

CI: Confidence interval, TB: Tuberculosis

TABLE III
THE OVERALL MEAN TB CASES ARE BASED ON THE QUARTER OF THE YEAR

Quarter	2019	2020	2021	2022
Q1	33.6667	23	29.3333	36
Q2	28.6667	22.3333	28.6667	30.3333
Q3	30.6667	25.6667	28.6667	34.6667
Q4	23.3333	27.6667	29.6667	28

hypothesis H_0 and accept the alternative hypothesis H_1 , indicating statistically significant differences between at least 2 years for TB cases' mean scores. To demonstrate if a difference between two or more groups is statistically significant, we can use the *post hoc* multiple comparison techniques. Table XIV (Sup. Info) shows that the difference in mean TB cases between 2022 and 2020 has a $p = 0.0093$, which is < 0.05 , indicating that their difference is statistically significant. On the other hand, since other $p > 0.05$, there is no significant difference between those pairs of years in TB cases' mean scores. Furthermore, the lower and upper levels of 95% CIs for the mean difference between 2022 and 2020 are positive (+), and no zero value lies within the range. It is evidence of a statistically significant difference in the TB case's mean scores between them. Fig. 1 shows the *post hoc* mean comparisons between the two pairs of means. The selected mean will have a bold red circle and a variable label. The mean score that is significantly different from the selected mean will have a gray circle and gray italicized variable labels. In contrast, the circle's red color and variable label indicate no difference. Thus, the TB cases' mean score of 2020 significantly differs from the TB cases' mean score of 2022. In contrast, the other difference between years for the TB cases is insignificant because of the same red color.

TB cases mean scores among the groups of years

Table III and the graph depict the significant shift in TB cases' mean scores among the years 2019, 2020, 2021, and 2022. According to the results in Fig. 2, the mean scores of the diagnosed TB cases for Q1 moved toward a higher level in 2022, which is 36, compared to other years. In such a way, the TB cases' mean score for 2020 decreased by

$$\left(\frac{23 - 33.6667}{23} \times 100 = -46.37696\% \right) \text{ compared to 2019. TB}$$

cases' mean score for 2021 decreased by

$$\left(\frac{29.3333 - 33.6667}{29.3333} \times 100 = -14.77297\% \right) \text{ compared to}$$

2019. TB cases' mean score for 2022 increased by

$$\left(\frac{36 - 33.6667}{36} \times 100 = +6.481389\% \right) \text{ compared to 2019.}$$

Likewise, the mean scores of the diagnosed TB cases for Q2 moved toward a higher level in 2022, which is 30.3333 compared to other years. In such a way, the diagnosed TB cases for 2019 and 2021 are the same, which is 28.6667. TB cases for 2020 decreased by

$$\left(\frac{22.3333 - 28.6667}{22.3333} \times 100 = -28.35855\% \right) \text{ compared to 2019.}$$

TB cases' mean score for 2022 increased by

$$\left(\frac{30.3333 - 28.6667}{30.3333} \times 100 = +5.494292\% \right) \text{ compared to 2019.}$$

Furthermore, the mean scores of the diagnosed TB cases for Q3 moved toward a higher level in 2022, which is 34.3333

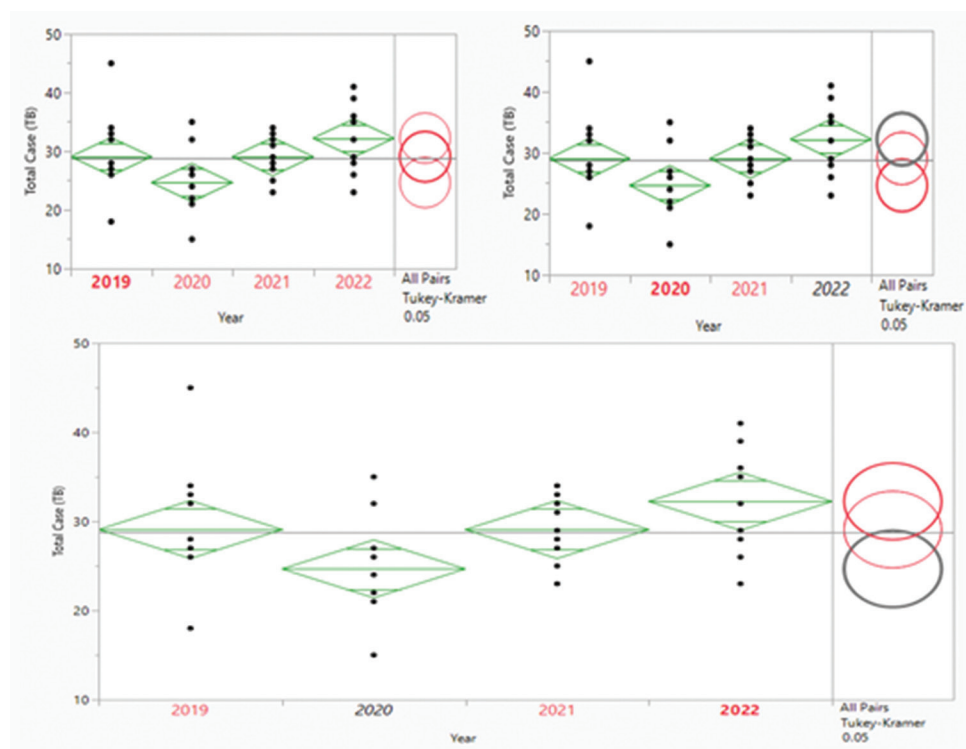


Fig. 1. *Post hoc* of means comparisons for the tuberculosis cases' mean scores of the years.

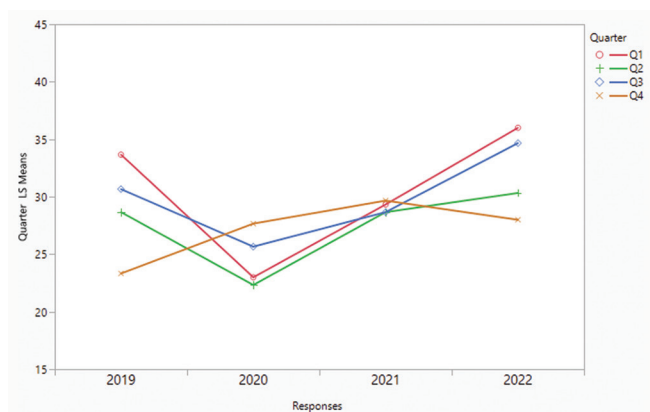


Fig. 2. Overall means of diagnosed tuberculosis cases based on the quarters among the years of 2019–2022.

compared to other years. In such a way that, compared to 2019, the TB cases' mean score for 2020 decreased by $\left(\frac{25.6668 - 30.6667}{25.6667} \times 100 = -19.4801\%\right)$, the TB cases for

2021 decreased by $\left(\frac{28.667 - 30.6667}{28.6667} \times 100 = -6.97569\%\right)$,

and increased by $\left(\frac{34.6667 - 30.6667}{34.6667} \times 100 = +11.53845\%\right)$.

When it comes to Q4, the mean scores of the diagnosed TB cases for Q4 moved toward a higher level in 2021, which is 29.6667 compared to other years. In such a way that, compared to 2019, the TB cases mean score for 2020 increased by $\left(\frac{27.6667 - 23.3333}{27.6667} \times 100 = +15.66287\%\right)$, for

2021 increased $\left(\frac{29.6667 - 23.3333}{29.6667} \times 100 = +21.34852\%\right)$,

and for 2022 increased by $\left(\frac{28 - 23.3333}{28} \times 100 = +16.66679\%\right)$.

IV. CONCLUSION

For the causes of infant mortality in Iraq, apart from external factors, the study found that wealth index, birth order, and previous birth interval were the most significant factors affecting infant mortality in Iraq. Also, this study found a decrease in TB incidence in the 1st year of the COP (2020) compared to the previous year, likely caused by the use of social distancing measures that reduced community transmission. Furthermore, the number of TB cases significantly increased in 2022 compared to the early months of the COVID-19 outbreak in 2020. This surge coincides with easing COVID-19 restrictions, suggesting a potential link. However, underestimation of mortality patterns and related risk variables may have resulted from the exclusion of infant deaths that were not formally reported or admitted to healthcare facilities because the analysis was based on verified hospital and health-facility data. In addition, despite the fact that the research shows that wealthier households had higher risks of infant death, this result should be viewed with caution because it contradicts the larger body of knowledge. Rather than a direct relationship between household wealth and infant survival, the observed link may be the result of residual confounding, regional disparities, reporting variations, or other unmeasured factors.

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SUPPORTING INFORMATION

Factors affecting infant mortality in Iraq: Influence of the COP on TB and statistical evaluation of its impact

TABLE I

TB CASES' MEANS AND STANDARD DEVIATIONS ARE BASED ON THE FIRST QUARTER (Q1) OF EACH YEAR

Level	Number of months	Mean score of TB cases	Standard deviation	Lower 95% CI	Upper 95% CI
2019	3	33.667	9.8150	9.2850	58.0484
2020	3	23	8.5440	1.7755	44.2245
2021	3	29.333	0.8819	25.5388	33.1279
2022	3	36	7	18.6110	53.3890

CI: Confidence interval, TB: Tuberculosis

TABLE II

ONE-WAY ANALYSIS OF VARIANCE FOR TUBERCULOSIS CASES BASED ON THE FIRST QUARTER (Q1) OF EACH YEAR

Source	DF	Sum of squares	Mean square	F	Prob >F p-value
First quarter (Q1)	3	293.66667	97.8889	1.7744	0.2296
Error	8	441.33333	55.1667		
C. total	11	735.00000			

TABLE III

ORDERED DIFFERENCES REPORT FOR TUBERCULOSIS CASES BASED ON THE FIRST QUARTER (Q1) OF EACH YEAR

Level	- Level	Difference	Lower 95% CI	Upper 95% CI	p-value
2022	2020	13	-6.4205	32.42051	0.2187
2019	2020	10.667	-8.7538	30.08718	0.3571
2022	2021	6.667	-12.7538	26.08718	0.6998
2021	2020	6.333	-13.0872	25.75385	0.7300
2019	2021	4.333	-15.0872	23.75385	0.8886
2022	2019	2.333	-17.0872	21.75385	0.9793

CI: Confidence interval, TB: Tuberculosis

TABLE IV

TB CASES' MEANS AND STANDARD DEVIATIONS ARE BASED ON THE SECOND QUARTER (Q2) OF EACH YEAR

Level	Number	Number of months	Mean score of TB cases	Lower 95% CI	Upper 95% CI
2019	3	28.667	2.8868	21.4956	35.8378
2020	3	22.333	1.5275	18.5388	26.1279
2021	3	28.667	2.8868	21.4956	35.8378
2022	3	31.667	4.0415	21.6271	41.7061

CI: Confidence interval, TB: Tuberculosis

TABLE V

ONE-WAY ANALYSIS OF VARIANCE FOR TUBERCULOSIS CASES FOR THE SECOND QUARTER (Q2) OF EACH YEAR

Source	DF	Sum of squares	Mean square	F	Prob >F p-value
Second quarter (Q2)	3	139	46.3333	5.2453	0.0271*
Error	8	70.66667	8.8333		
C. total	11	209.66667			

Bold values indicate statistical significance at p<0.05.

TABLE VI

ORDERED DIFFERENCES REPORT FOR TUBERCULOSIS CASES BASED ON THE SECOND QUARTER (Q2) OF EACH YEAR

Level	- Level	Difference	p-value	Lower 95% CI	Upper 95% CI
2022	2020	9.333	0.0205*	1.56219	17.10447
2019	2020	6.333	0.1153	-1.43781	14.10447
2021	2020	6.333	0.1153	-1.43781	14.10447
2022	2019	3	0.6233	-4.77114	10.77114
2022	2021	3	0.6233	-4.77114	10.77114
2021	2019	0	1.0000	-7.77114	7.77114

CI: Confidence interval, TB: Tuberculosis. Bold values indicate statistical significance at p<0.05. *Statistically significant difference at p<0.05.

TABLE VII

TB CASES' MEANS AND STANDARD DEVIATIONS ARE BASED ON THE THIRD QUARTER (Q3) OF EACH YEAR

Level	Number	Number of months	Mean score of TB cases	Lower 95% CI	Upper 95% CI
2019	3	30.667	4.0415	20.6271	40.7062
2020	3	25.667	1.5275	21.8721	29.4613
2021	3	28.667	4.0415	18.6271	38.7062
2022	3	34.667	2.3094	28.9298	40.4035

CI: Confidence interval, TB: Tuberculosis

TABLE VIII

ONE-WAY ANALYSIS OF VARIANCE FOR TUBERCULOSIS CASES BASED ON EACH YEAR'S THIRD QUARTER (Q3)

Source	DF	Sum of squares	Mean square	F	Prob >F p-value
Third quarter (Q3)	3	128.25000	42.7500	4.2397	0.0454*
Error	8	80.66667	10.0833		
C. total	11	208.91667			

Bold values indicate statistical significance at p<0.05.

TABLE IX

ORDERED DIFFERENCES REPORT FOR MEAN TUBERCULOSIS CASES BASED ON THE THIRD QUARTER (Q3) OF EACH YEAR

Level	- Level	Difference	p-value	Lower 95% CI	Upper 95% CI
2022	2020	9	0.0343*	0.69720	17.30280
2022	2021	6	0.1737	-2.30280	14.30280
2019	2020	5	0.2894	-3.30280	13.30280
2022	2019	4	0.4582	-4.30280	12.30280
2021	2020	3	0.6677	-5.30280	11.30280
2019	2021	2	0.8652	-6.30280	10.30280

CI: Confidence interval. Bold values indicate statistical significance at p<0.05.

*Statistically significant difference at p<0.05.

TABLE X

TB CASES' MEANS AND STANDARD DEVIATIONS ARE BASED ON THE FOURTH QUARTER (Q4) OF EACH YEAR

Level	Number	Number of months	Mean score of TB cases	Lower 95% CI	Upper 95% CI
2019	3	23.333	9.2376	0.3859	46.2808
2020	3	27.667	6.6583	11.1265	44.2069
2021	3	29.667	5.8595	15.1109	44.2224
2022	3	28	6.2450	12.4866	43.5134

CI: Confidence interval, TB: Tuberculosis

TABLE XI
ONE-WAY ANOVA FOR TUBERCULOSIS CASES BASED ON THE FOURTH
QUARTER (Q4) OF EACH YEAR

Source	DF	Sum of squares	Mean square	F	Prob >F p-value
Fourth quarter (Q4)	3	65.66667	21.8889	0.4313	0.7363
Error	8	406.00000	50.7500		
C. total	11	471.66667			

TABLE XII
THE MEANS AND STANDARD DEVIATIONS FOR ANNUAL TB CASES

Level	Number	Number of months	Mean score of TB cases	Lower 95% CI	Upper 95% CI
2019	12	29.0833	7.2796	24.4581	33.7086
2020	12	24.6667	5.2107	21.3559	27.9774
2021	12	29.0833	3.3699	26.9422	31.2245
2022	12	32.25	5.7544	28.5938	35.9062

CI: Confidence interval, TB: Tuberculosis

TABLE XIII
ONE-WAY ANALYSIS OF VARIANCE FOR TUBERCULOSIS CASES BASED ON THE
YEAR

Source	DF	Sum of squares	Mean square	F	Prob >F p-value
Years	3	349.7292	116.576	3.7420	0.0177*
Error	44	1370.7500	31.153		
C. total	47	1720.4792			

Bold values indicate statistical significance at $p < 0.05$.

TABLE XIV
ORDERED DIFFERENCES REPORT FOR ANNUAL TUBERCULOSIS CASES MEAN
SCORES

Level	- Level	Difference	p-value	Lower 95% CI	Upper 95% CI
2022	2020	7.5833	0.0093*	1.49933	13.66734
2019	2020	4.4167	0.2272	-1.66734	10.50067
2021	2020	4.4167	0.2272	-1.66734	10.50067
2022	2019	3.1667	0.5124	-2.91734	9.25067
2022	2021	3.1667	0.5124	-2.91734	9.25067
2021	2019	0	1.0000	-6.08400	6.08400

CI: Confidence interval. Bold values indicate statistical significance at $p < 0.05$.

*Statistically significant difference at $p < 0.05$.