Mortality Rates of COVID-19 Disease A Biometric Study

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ABSTRACT

Background: COVID-19 disease has been associated with disproportionate mortality amongst the world population. National and international health agencies have been monitoring the mortality of this disease day after day. So far, this has ranged from 0.9% in Russia to 18.3% in France and affected by many factors.
Aim: To estimate the case fatality rate of COVID-19 in Iraq and each Iraqi province including sex difference, and to compare the case fatality rate with the neighboring countries.
Methods: To achieve the aim of the present study, a biometric descriptive study design was adopted. Collecting the cumulative number of COVID-19 cases and deaths for ٢٨ Months: from February 24, 2020, till August 6, 2022, and then after that the case fatality rate and recovery rate were estimated and comparing them among the eighteen Iraqi province and neighboring countries. With an extension period until 13 April 2024 to recognize the temporal changes in case fatality rates. Sources of data were the Iraqi Ministry of Health and World Health Organization.
Results: The case fatality and recovery rates for Iraqi people till August 6, 2022, were 1.033 % and 98.226 %, respectively. There was a wide variation in case fatality rates among the eighteen Iraqi provinces. Highest in Sulaymaniyah (2.15 %) followed by Kirkuk (1.65 %), Thi-Qar (1.58 %), Babil (1.53 %) and Erbil (1.47 %), and lowest in Anbar (0.41%), and Wassit (0.56 %) and the capital in-between (Baghdad 0.76 %). It was also found higher proportional mortality in males than in females (54.6 % Vs. 45.4 %) which reflects the global trends. No significant temporal changes in the cumulative case fatality rate of COVID-19 in Iraq between August 6, 2022, and April 13, 2024, (1.033 %, and 1.029 % respectively) were noticed.
Conclusions: The study revealed that the mortality rate from COVID-19 in Iraq is within the average level world-wide and lower than that of the neighboring countries. With a non-significant reduction in cumulative mortality in the last two years.

Keywords: COVID-19, Case fatality rate, Mortality indicator.

معدلات الوفيات لمرض كوفيد-١٩ دراسة المقياس الحيوي

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الخلاصة

الخلفية: ارتبط مرض كوفيد-١٩ بمعدل وفيات غير متناسب بين سكان العالم. وترصد الوكالات الصحية الوطنية والدولية معدل الوفيات الناجمة عن هذا المرض يوما بعد يوم. تراوحت هذه النسبة حتى الآن بين ٠.٩٪ في روسيا إلى ١٨.٣٪ في فرنسا وتتأثر بالعديد من العوامل.
الهدف: احتساب معدل وفيات الحالات الناجمة عن كوفيد-١٩ في العراق وفي كل محافظة عراقية بما في ذلك الاختلاف بين الجنسين ومقارنة معدل الوفيات الحالات مع الدول المجاورة.
الطريقة: لتحقيق الهدف من هذه الدراسة تم اعتماد تصميم دراسة المقياس الحيوي. تم جمع العدد التراكمي لحالات ووفيات كوفيد-١٩ لمدة ٢٨ شهرا: منذ ٢٤ شباط ٢٠٢٠ حتى ٦ آب ٢٠٢٢، ثم بعد ذلك تم احتساب معدل وفيات الحالات ونسبة الشفاء ومقارنتها بين المحافظات العراقية ودول الجوار. مع فترة تمديد حتى ١٣ نيسان ٢٠٢٤ للتعرف على التغيرات الزمنية في معدلات الوفيات الناجمة عن ذلك. حيث كان مصدر البيانات هو وزارة الصحة العراقية ومنظمة الصحة العالمية.

النتائج: بلغت معدلات الوفيات والشفاء للعراقيين حتى ٦ آب ٢٠٢٢ ١.٠٣٣ ٪ و٩٨.٢٢٦٪ على التوالي. وكان هناك تباين كبير في معدلات الوفيات بين المحافظات العراقية الثمانية عشر. حيث كانت الأعلى في السليمانية (٢.١٥٪) تليها كركوك (١.٦٥٪) وذي قار (١.٥٨٪) وبابل (١.٥٣٪) وأربيل (١.٤٧٪) والاقل في الأنبار (٠.٤١٪) وواسط (٠.٥٦٪) وكانت العاصمة بينهما (بغداد ٠.٧٦٪). كما وجد أن معدل الوفيات النسبي أعلى بين الذكور منه عند الإناث (٥٤.٦ % مقابل ٤٥.٤ %). لم يلاحظ أي تغيرات زمنية كبيرة في معدل الوفيات التراكمي لحالات كوفيد-١٩ في العراق بين ٦ آب ٢٠٢٢ و١٣ نيسان ٢٠٢٤ (١.٠٣٣٪، ١.٠٢٩٪ على التوالي).

الاستنتاجات: كشفت الدراسة أن معدل الوفيات الناجمة عن كوفيد-١٩ في العراق ضمن المستوى المقبول عالميا وأقل من معدل الوفيات في دول الجوار. مع انخفاض غير ملحوظ في معدل الوفيات التراكمية في العامين الماضيين. ومن الضروري إجراء المزيد من دراسات المقياس الحيوي في المستقبل لرصد هذه الأحداث الناشئة والمرتبطة بالصحة باستمرار.

الكلمات المفتاحية: كوفيد-١٩، معدل وفيات الحالات، مؤشر الوفيات.

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the sixth human coronavirus, was identified in Wuhan, Hubei province, China, amid the pneumonia outbreak in January 2020 [1]. As of 20 May 2020, the virus has disseminated globally, infecting 4,806,299 individuals and resulting in 318,599 fatalities. [2]. SARS-CoV-2 as well as SARS-CoV and Middle East respiratory syndrome coronavirus cause severe pneumonia with a fatality rate of 2.9%, 9.6%, and 36%, respectively [3]. The remaining four human coronaviruses, OC43, NL63, HKU1, and 229E, typically induce self-limiting illnesses characterized by minor symptoms [4].

COVID-19 has several characteristics that differentiate it from other infectious illnesses, such as elevated infectivity throughout the incubation period, the temporal lag between actual dynamics and the daily reported number of confirmed cases, and the impact of enforced quarantine and control measures. The incubation period of COVID-19 is reported to range from 3 to 7 days, with a maximum of 14 days, exhibiting significant variability across patients [2]. The novel coronavirus is thought to be transmissible throughout the incubation period when patients exhibit no symptoms, a significant trait that distinguishes COVID-19 from its near sibling SARS [5].

Epidemiology

In the study of epidemics, a critical and complex issue is forecasting future trends, such as the daily infection rate, the cessation of epidemic spread, the necessary policies and actions, and their impact on the epidemic, among other considerations [6,7]. Following the emergence of an epidemic, the behaviors of both individuals and the government are significantly influenced by our comprehension of its prospective trajectory. The SARS outbreak in 2003, the H1N1 influenza in 2009, and the recent COVID-19 pandemic are a few prominent instances [8].

Globally, the COVID-19 virus has affected more than 770 million cases worldwide from its beginning till the 9th of March 2025, with the United States and China being the most reported cases according to WHO. In Iraq around 2.5 million cases have been reported to the date mentioned above [9].

The COVID-19 pandemic in Iraq was a segment of the global pandemic of COVID-19 induced by SARS-CoV-2. Iraq documented their inaugural confirmed instances of SARS-CoV-2 infections on 22 February 2020 in Najaf during the epidemic. By April, the verified cases in Baghdad, Basra, Sulaymaniyah, Erbil, and Najaf had surpassed one hundred [10].

Case Fatality Rate

The case fatality rate (CFR) quantifies a pathogen's or virus's capacity to infect or harm a host in infectious diseases, defined as the ratio of deaths to the total number of cases within a certain population, expressed as a percentage [11]. CFRs indicate the degree of disease severity, and CFR is essential for establishing priorities in public health measures aimed at mitigating risk severity [11]. Preliminary research indicated a global fatality rate of 3 % for COVID-19. Estimating the CFR using national data necessitates evaluating the interval between the reporting of country-specific COVID-19 instances and subsequent fatalities, alongside the potential underestimation and underreporting of death-related cases, which may remain unidentified [12].

The significant direct and indirect effects of the COVID-19 pandemic have required policy responses that, when appropriate, balance the need to mitigate the immediate health consequences of the pandemic with the necessity of limiting the long-term societal damage that may result from protective measures. The mortality impact of COVID-19 is a critical input metric in justifying the restrictiveness of regulations [13].

Efforts to assess the overall mortality impact of COVID-19 are underway across multiple avenues.

Advancements are occurring in the assessment of the infection fatality rate of COVID-19 and its potential variability among sub-populations [14]. Extensive, organized worldwide collaborations have been established to gather data documenting deaths linked to COVID-19. Efforts to quantify total increased mortality associated with COVID-19 are in progress and highlighted as a significant metric [15]. Each study path and its corresponding health metrics (infection rate, mortality, and excess mortality) are crucial for informing the public and policymakers of the mortality effects of COVID-19. Nevertheless, each possesses its constraints. Infection mortality rates pertain solely to the limited sub-population confirmed to have the disease, and in the absence of accurate data on the actual number of infected individuals, these rates are intrinsically challenging to assess. COVID-19-related fatalities may either overestimate or underestimate the actual mortality attributed to the disease, as the standards and methods for categorizing these deaths are still in the process of being created and standardized. Excess death methodologies that evaluate mortality rates during the COVID-19 pandemic relative to a baseline rely on accurate estimation of that baseline [13].

In 2020, Globally the CFR range: was ~2.0 % - 14.9 % (varies by country and testing capacity) [16], Early estimates were biased due to limited testing, with higher CFRs in countries like Italy (13.8 %) and Spain (10 %) compared to Germany (4.3 %). A meta-analysis estimated an overall pooled CFR of 10.0 % (95 % CI: 8.0-11.0) in hospitalized patients [17]. In the U.S. (pre-vaccination, May–Dec 2020), CFR was 1.9 % for males and 1.5 % for females, with the highest rate (24.0 %) in those > 85 years old [18].

In 2021, the CFR range: was ~0.7 % - 4.2 % (declining due to vaccination and variants), A study comparing 21 OECD countries found that CFR decreased with higher vaccination rates and the rise of the Omicron variant later in the year [19].

In 2022, the CFR range: was ~0.2 % - 1.5 % (further decline with Omicron dominance) and the adjusted CFRs varied by country, with vaccination, healthcare capacity, and age structure as key determinants [19].

In 2023, the CFR range: was ~0.1 % - 0.8 % (continued decline due to hybrid immunity). A study analyzing 156 countries found that CFR was influenced by vaccination rates, aging populations, and disease burden, with sub-Saharan Africa and Latin America having higher CFRs due to low vaccination [20].

In 2024, the CFR estimates: was ~0.05 % - 0.5 % (very low due to widespread immunity). A 2024 study highlighted that geographic inequities in CFR persist, with tailored interventions needed for high-risk regions. The CFR of COVID-19 declined significantly from 2020 to 2025 due to vaccination, prior immunity, and less severe variants (e.g., Omicron). However, disparities remain based on healthcare access, demographics, and response strategies [20].

The current study aimed to estimate the CFR of COVID-19 in Iraq and each Iraqi province including sex differences and to compare the CFR with the neighboring countries from 24 February 2020 until 6 August 2022. Moreover, to determine the temporal changes in the cumulative CFR and recovery rates of COVID-19 in Iraq between August 6, 2022, and April 13, 2024.

METHODS

Study Design

A descriptive biometric study design was adopted to achieve the aim of the present research.

Study Setting and Period

This biometric descriptive study was conducted across all eighteen provinces of Iraq to capture nationwide COVID-19 trends. Data were collected over 28-months (24 February 2020 – 6 August 2022), with an extended period until 13 April 2024, to evaluate temporal changes in CFR and recovery rate. Unfortunately, the data for inter-provinces variations and sex differences in the extension period were not available.

Source of Data and Procedure

The data were retrieved from accurate databases including the WHO COVID-19 database and reports from the Ministry of Health in Iraq [9]. The essential data needed to proceed with the analysis includes the number of cases due to COVID-19, the number of deaths due to COVID-19, and the number of recoveries due to COVID-19.

Measuring the CFR, recovery rates, and proportional mortality depending on the formulas below:

$$\text{CFR} = \frac{\text{No. of Deaths due to COVID} - 19}{\text{No. of cases of COVID} - 19} \times 100$$

$$\text{Recovery Rate} = \frac{\text{No. of cases recoverd from COVID} - 19}{\text{No. of cases of COVID} - 19} \times 100$$

$$\text{Proportional mortality in male} = \frac{\text{No. of Deaths due to COVID} - 19 \text{ in male}}{\text{No. of Deaths due to COVID} - 19 \text{ in both sex}} \times 100$$

Case Definition

A COVID-19 death is defined for biometric analysis as a death resulting from a clinically compatible illness in a probable or confirmed COVID-19 case unless there is a clear alternative cause of death that cannot be related to COVID-19 disease (e.g. trauma). There should be no period of complete recovery between illness and death [9].

Data Analysis and Statistical Tests

Descriptive and analytic statistics were performed using Minitab version 21 software statistical program. The descriptive statistics include frequencies, percentages, CFR, and recovery rates. Z-test of two proportions was used for comparison between CFR in Iraq and neighboring countries independently. P-values ≤ 0.05 were considered statistically significant throughout data analysis.

RESULTS

The case fatality and recovery rates for Iraqi people till August 6, 2022, were 1.033 % and 98.226 %, respectively. There was a wide variation in CFR among the eighteen Iraqi provinces. Highest in Sulaymaniyah (2.15 %), followed by Kirkuk (1.65 %), Thi-Qar (1.58 %), Babil (1.53 %), and Erbil (1.47 %), and lowest in Anbar (0.41%), and Wassit (0.56 %), and the capital in-between (Baghdad 0.76 %). Whereas the highest recovery rates were in Anbar (99.06 %) and Diyala (99.05 %), and the lowest in Sulaymaniyah (96.37 %) as shown in Table 1.

Table (1): The CFR and recovery rates of COVID-19 according to Iraqi provinces from February 24, 2020, to August 6, 2022.

No.	Province	Cases	Deaths	Recovered	CFR %	Recovery rate %
1	**Baghdad**	702131	5361	693919	**0.76**	**98.83**
2	**Basrah**	239978	1565	235425	**0.65**	**98.10**
3	**Sulaymaniyah**	159322	3426	153544	**2.15**	**96.37**
4	**Dahuk**	154976	1846	151483	**1.19**	**97.75**
5	**Erbil**	148734	2186	145049	**1.47**	**97.52**
6	**Wassit**	137149	772	133659	**0.56**	**97.45**
7	**Thi-Qar**	102651	1617	100282	**1.58**	**97.69**
8	**Najaf**	98361	731	97154	**0.74**	**98.77**
9	**Kerbala**	97361	967	95897	**0.99**	**98.50**
10	**Kirkuk**	91066	1507	89541	**1.65**	**98.33**
11	**Missan**	89292	916	87722	**1.026**	**98.24**
12	**Diyala**	86683	587	85860	**0.68**	**99.05**
13	**Ninevah**	83346	1006	82182	**1.21**	**98.60**
14	**Diwaniya**	77088	826	75754	**1.07**	**98.27**
15	**Babil**	70079	1073	68755	**1.53**	**98.11**
16	**Salah Al-Din**	53357	501	52491	**0.94**	**98.377**
17	**Muthanna**	35286	341	34914	**0.97**	**98.95**
18	**Anbar**	23777	97	23553	**0.41**	**99.06**
	Iraq	**2 450 637**	**25 325**	**2 407 184**	**1.033**	**98.226**

Table 2 displays the temporal changes in the cumulative CFR and recovery rates of COVID-19 in Iraq between August 6, 2022, and April 13, 2024. There was a little increase in the number of cases and deaths during that time which did not significantly affect the reduction in the CFR (from 1.033% to 1.029%, p = 0.643). However, the increase in recovery rate was significant (from 98.226 % to 98.944 %, p = 0.008).

Table (2): Temporal changes in the cumulative CFR and recovery rates of COVID-19 in Iraq between August 6, 2022, and April 13, 2024.

Date	Cases	Deaths	Recovered	CFR %	Recovery rate %
August 2022	2 450 637	25 325	2 407 184	1.033	98.226
April 2024	2 465 545	25 375	2 439 497	1.029	98.944
P-value*	---	---	---	0.643	**0.008**

* A Z-test of two proportions was used.

Figure 1 shows proportional mortality due to COVID-19 according to sex in Iraq. It was found that higher proportional mortality in males than in females (54.6 % Vs. 45.4 %, p = 0.005).

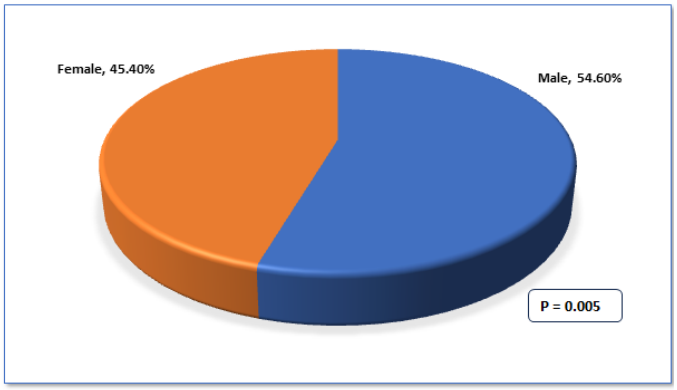

Figure (1): Proportional mortality due to COVID-19 according to sex in Iraq from February 24, 2020, to August 6, 2022.

From the beginning of the pandemic till August 6, 2022. The CFR in Iraq was lower than in neighboring countries except for Jordan (0.819 %), and Kuwait (0.390 %), and the highest was found in Syria (5.574 %), followed by Turkey (2.00 %). These differences in CFR were significant (p = 0.001), Table 3.

Table (3): Comparison in CFR of COVID-19 between Iraq and neighboring countries till August 6, 2022.

No.	Neighboring countries	CFR %	P-value*
	Iraq	1.033	---
1	**Saudi Arabia**	1.142	**0.001**
2	**Jordan**	0.819	**0.001**
3	**Syria**	5.574	**0.001**
4	**Turkey**	2.000	**0.001**
5	**Iran**	1.915	**0.001**
6	**Kuwait**	0.390	**0.001**

* The Z-test of two proportions was used to compare every country with Iraq independently.

DISCUSSION

Early in the pandemic (2020), the global observed CFR was on the order of ~2 %–3 % as many severe cases were detected [21]. Over time, with improved testing; the detection of more mild cases; better treatments, and vaccines, the global CFR steadily declined. A recent analysis of worldwide data found that the global CFR fell from about 2.4 % in 2020 to around 0.9 % by 2023. [22]. For example, by mid-2022, the cumulative global CFR was ~1.19 % (6.32 million deaths out of 533 million cases), and by January 2023, it had dropped to ~0.90 % [23]. This decline could reflect the emergence of the less-lethal Omicron variant and broad immunization, which greatly reduced the risk of death per infection. There is also wide regional variation – high-income countries overall reported a lower average CFR (~0.6 %) compared to lower-income countries (~1.6 %) [22], which could be due to differences in demographics, healthcare capacity, and case ascertainment. Africa, for instance, had the highest regional CFR (~2.0 % cumulative), whereas Oceania had the lowest (~0.2 %).

The present study analyzed COVID-19 CFR throughout Iraqi provinces from February 2020 to August 2022, revealing notable regional variations. Sulaymaniyah exhibited the highest CFR at 2.15 %, followed by Kirkuk at 1.65 %, Thi-Qar at 1.58 %, and Babil at 1.53 %, although Anbar recorded the lowest at 0.41 %. These variances likely indicate disparities in healthcare infrastructure, population demography, and testing capacity, with regions such as Sulaymaniyah and Erbil—bordering Iran—exhibiting elevated CFRs, potentially attributable to cross-border transmission and overburdened local health systems. In contrast, the lower CFRs in Anbar and Wassit may suggest more effective outbreak control or

potential underreporting of fatalities. Baghdad's intermediate CFR of 0.76 % indicates a balance between urban healthcare accessibility and elevated population density. The overall CFR for Iraq was 1.033 % corresponding with global trends among middle-income countries, although it highlights the necessity for focused initiatives in high-mortality areas to rectify disparities in pandemic response.

Regarding the temporal changes in the cumulative CFR and recovery rates of COVID-19 in Iraq for the extension period between August 6, 2022, and April 13, 2024, in the current study. There was a little increase in the number of cases and deaths during that time with a non-significant reduction in cumulative mortality from COVID-19 in the last two years. However, the increase in recovery rate was more evident. This finding is likely to reflect better healthcare responses, immunity, or treatment advancements over time. Overall, Iraq maintained a high recovery rate of vaccination with minimal fluctuations in CFR, indicating stable pandemic management during this period. Unfortunately, the data of neighboring countries in this extension period were not available for the researcher to make more valuable comparisons.

In the current study Iraq showed that the male's mortality was significantly higher than females (54.6 % vs 45.4 %), this alliance with the global trend in many studies around the world. This suggests that males have a higher likelihood of dying from COVID-19 once infected even though women generally have higher infection rates in some countries. However, it's important to note that this analysis didn't contain an ICU-specific patient analysis.

A 2021 biometric analysis of COVID-19 in Iraq revealed markedly elevated mortality rates among male patients. In that study, around 59–63 % of COVID-19 fatalities were male, while about 37–41% were female. The CFR for confirmed cases was marginally elevated in men (about 1.3 %) compared to women (approximately 1.1 %). This signifies that while both genders experienced high infection rates, males endured a disproportionate number of deaths. The Iraqi results reflect global trends and are partially ascribed to contextual factors such as comorbidities and health-seeking behavior. Significantly, other surveys in Iraq indicated that males constituted almost two-thirds of the COVID-19 fatalities [24].

In Saudi Arabia's data echo the global male–female disparity in COVID-19 outcomes. In the first wave of the pandemic (March–August 2020), national surveillance showed a slightly higher fatality rate among male COVID-19 cases (≈2.1 %) than among female cases (≈1.8 %) [25].

Iran, one of the first regional hotspots, exhibited a pronounced male-female difference in COVID-19 mortality. Analyses of Iran's pandemic impact show that men have died at higher rates. A recent nationwide study of all-cause mortality (covering the pandemic through early 2022) found that the excess death rate for men was 331 per 100,000 population, versus 269 per 100,000 for women [26].

However, a study done in Italy by Quaresima et al. 2020 concluded that there was no significant difference in CFR between males and females the reason for that could be because it included specific ICU patients' CFR in their statistics.

In the present study comparing Iraq to the neighboring countries, the CFR revealed significant differences with Kuwait being the lowest at 0.39 % followed by Jordan at 0.81 % this could be due to better health facilities and enhanced diagnosis tools. However, Iraq is still lower than other neighboring countries.

CONCLUSIONS

The study revealed that the mortality rate from COVID-19 in Iraq is within acceptable levels world-wide and lower than in the neighboring countries. With a non-significant reduction in cumulative mortality from COVID-19 in the last two years. Further biometric studies in the future are necessary to continuously monitor such emerging health-related events.

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Conflict of Interest

None.

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