Clinical and epidemiological characteristics and outcomes of Coronavirus disease-19 patients in a large longitudinal study

Muayad Aghali Merza¹, Serwan Mohamamed Aswad², Hushyar Musa Sulaiman³, Deldar Morad Abdulah⁴, Waleed Salih Rasheed⁵, Nezar Ismet Taib⁶

¹Department of Internal Medicine, Azadi Teaching Hospital, College of Pharmacy, University of Duhok, Iraqi Kurdistan, Iraq, ²Department of Community and Family Medicine, Lecture at College of Medicine, University of Duhok, Director of Directorate of Preventive Health Affairs, Duhok, Iraqi Kurdistan, Iraq, ³Director General Advisor, Duhok Directorate General of Health, Iraqi Kurdistan, Iraq, ⁴Community and Maternity Health Unit, College of Nursing, University of Duhok, Iraqi Kurdistan, Iraq, ⁵Department of Communicable Diseases, Directorate of Preventive Health Affairs, Duhok, Iraqi Kurdistan, Iraq, ⁶Director General of Health, Duhok Directorate General of Health, Iraqi Kurdistan, Iraq

Address for correspondence: Deldar Morad Abdulah, Lecturer at Community and Maternity Health Unit, College of Nursing, University of Duhok, Iraqi Kurdistan, Iraq. Phone: +9647507443319. E-mail: deldarmorad@gmail.com

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Objective: This study aimed to determine the clinical and epidemiological characteristics and outcomes of Coronavirus disease (COVID)-19 patients.

Methods: In this large cohort study, 15,409 confirmed patients with the COVID-19 of different severities were followed-up from three specialized COVID-19 hospitals between March 18 and October 11, 2020 in Iraqi Kurdistan. The predictors of mortality and severity were examined in binary logistic regression analysis.

Results: The incidence rate of severe/critical status was 12.3% with a median age of 36.0 and case fatality rate (CFR) of 1.98%. The incidence rate of severe/critical conditions and CFR rose with increased age groups; except for 0–14 years (11.9%). The incidence rate of severe/critical patients and CFR was 8.3% and 0.5%, 21.1% and 4.0%, and 23.7% and 8.7% in 15–49 years, 50–64 years, and 65 and older age groups, respectively. The severity of the disease and CFR was associated with coexisting chronic diseases such as cardiovascular diseases (18.2% and 3.1%) and diabetes mellitus (19.8% and 3.4%). The asymptomatic patients (8400 and 54.5%) had statistically higher CFR; 2.3% versus 1.6% (P = 0.006). The most common symptoms on diagnosis were fever (31.9%), cough (23.5%), loss of smell/taste (16.3%), sore throat (15.7%), shortness of breath (9.8%), and headache (9.5%). The results showed that being older was the only predictor of mortality and severity in COVID-19 patients.

Conclusions: This region has a low incidence of severe-critic status and CFR. The patients with coexisting medical conditions are more likely to have severe conditions and die of COVID-19. The older age predicts severe/critic status and higher CFR.

Keywords: COVID-19, case fatality rate, outcome, severity

Introduction

The novel coronavirus infection outbreak known as Coronavirus disease (COVID)-19 emerged from Wuhan in China in December 2019.¹ The coronavirus has been spread to other countries, including Iraqi Kurdistan.²³ Globally by November 11, 2020, there have been 50,810,763 confirmed cases of COVID-19, including 1,263,844 deaths, reported to the World Health Organization (WHO).²⁴ The WHO has presented deep concern about the spread of this pandemic.²⁵

Health-care systems are encountered with rapidly increasing demands due to the COVID-19 pandemic. The health systems are being overwhelmed, both directly from the coronavirus outbreak and indirectly from vaccine-preventable and treatable medical conditions. Maintaining the population’s trust in the capability of the health system is important to provide the safe essential required medical necessities and to control infection risk in medical settings. Infection control is a key step to ensuring appropriate care-seeking behavior and adherence to preventive measures.

The Kurdistan Regional Government (KRG) reported the first confirmed cases of the COVID-19 among the persons who returned from Iran in early February 2020. After that, the KRG released preventive health measures for travelers and community members. In this regard, public and private schools and universities were closed from February 26 to May 2, 2020. The curfew was applied between March 13 and April 23, 2020. The KRG has applied some other preventive measures; including reducing business hours; referring
suspected cases of the COVID-19 to special medical settings; quarantining the persons with close contact with the suspected cases; and increasing awareness about preventive measures through mass media.\textsuperscript{[6]}

The current disease has occurred by a different virus than previously known one. The clinical course of the COVID-19 disease caused by this new virus could be different and was not known completely.\textsuperscript{[7]} The common clinical features are fever, dry cough, shortness of breath (SOB), and pneumonia. The less common clinical features are headache, diarrhea, productive cough, runny nose, and hemoptysis.\textsuperscript{[8]} The clinical outcomes of the patients are different from mild to severe illnesses. The persons aged 65 years and older, smokers, and those with comorbid diseases such as diabetes mellitus (DM) and hypertension are more likely to have a severe situation.\textsuperscript{[9]} The median incubation period of the COVID-19 is between 5 and 6 days, but it could take up to 24 days\textsuperscript{[10]} with an uncertain period of infectivity.\textsuperscript{[11]} The primary goal of controlling this virus is preventing transmission. The patients with COVID-19 show various degrees of laboratory abnormalities such as leukopenia, leukocytosis, and lymphopenia.\textsuperscript{[12]}

The studies have shown that preventive measures such as lockdown and social distance are effective strategies to impede the COVID-19 outbreak across the countries.\textsuperscript{[13-15]} In England, many areas with previously high case incidence reduce sharply. However, the lockdown had not the same effect in every region. For instance, in Kent, the cases were continuously increased during the lockdown, despite having the same restrictions as other regions.\textsuperscript{[16]} Viruses constantly change by mutation result in new variants of a virus over time and sometimes the new variants emerge and disappear. Multiple variants of the virus caused by COVID-19 have been documented in the United States and globally during this pandemic. A new variant of Severe acute respiratory syndrome-coronavirus (SARS-CoV-2) emerged has been responsible for up to 70\% more transmissible than the previously known virus. In September 2020, the new variant represented one in four new diagnoses, while by mid-December, this rate was increased to almost two-thirds of new cases in London.\textsuperscript{[17]} A similar pattern was observed in South Africa as well.\textsuperscript{[18]}

The demographic and anthropometric characteristics of the diseases are different across geographic locations\textsuperscript{[19]} and these differences could affect clinical outcomes. We need to analyze the data from a large investigation to find out the disease, establish a specific treatment plan, and optimize resource allocation. There are several studies about COVID-19 from countries over all continents characterizing the nature of the disease. However, we have only one small study in Iraqi Kurdistan focused on the demographic and clinical outcomes of the COVID-19 patients published at the early stage of the outbreak.\textsuperscript{[23]} This study aimed to determine the clinical and epidemiological characteristics of COVID-19 patients. Besides, the association of clinical and epidemiological characteristics of COVID-19 patients with mortality rate was examined in this study.

**Methods**

**Study design and patients**

In this large follow-up study, the confirmed patients with the COVID-19 of different severities were followed up by the discharge date from three specialized COVID-19 hospitals. The patients with non-severe medical status who were not admitted to the hospitals were followed up by the mobile medical teams. The patients whose medical conditions were escalated were admitted to the hospital as well. The patients were diagnosed by a certified physician in medical settings in the Duhok governorate of Iraqi Kurdistan between March 18 and October 11, 2020. The governorates of Iraqi Kurdistan are presented in a map in Figure 1.\textsuperscript{[20]} A total of 15,409 patients were diagnosed during the mentioned time. The medical doctors diagnosed the COVID-19 cases based on the WHO interim guidance for COVID-19\textsuperscript{[21]} and local guidelines of the Ministry of Health. The patients were included in this study regardless of disease severity, coexisting medical conditions, and socio-demographic aspects.

The individuals were tested for the COVID-19 for the following reasons in this region. The patients crossed the international border, had contact with a confirmed case, or became ill following visiting health facilities (suspected case). They returned from other governorates/places or they need a certificate of health to work in the private sector. Several persons were tested for the COVID-19 as a routine random screening/surveillance for the suspected cases included those persons who were in quarantine settings.

The patients who were included in this study were selected from different medical settings in the Duhok governorate. The patients who were diagnosed with severe disease were admitted to the following health settings. In early March 2020, the Burn and Plastic Surgery hospital was assigned for COVID-19. In addition, a new 100 beds hospital was made called “Lalav Infectious Diseases hospital” for treatment of the COVID-19 patients with severe and critical conditions. Thereafter, Azadi Teaching Hospital a main tertiary hospital in this region was devoted to treating the COVID-19 patients in early June 2020.

**Classification of the disease severity**

An infected case was defined as a SARS-CoV-2 positive real-time reverse-transcriptase polymerase chain reaction (RT-PCR) taken from a nasal and/or throat swab together. The cases were defined on having signs, symptoms, or radiological findings suggestive of COVID-19 pneumonia.\textsuperscript{[22]}

The criteria for severity of COVID-19 were defined according to the diagnosis and treatment protocol for novel coronavirus
pneumonia (Version 7) as mild, moderate, severe, and critical.\cite{23} We classified as non-severe and severe/critic in this investigation.

**The non-severe cases**

The non-severe cases compromised mild and moderate cases in this study. The patients with no sign of pneumonia on imaging were considered mild and patients with fever and respiratory symptoms and confirmed radiological outcomes on imaging were considered moderate cases. The severe and critical cases of children and adult populations were determined based on the criteria given in the diagnosis and treatment protocol for novel coronavirus pneumonia (Version 7).\cite{23}

**Management**

The patients who were diagnosed in this region had different severities and were managed as follows. The management of the cases was performed based on the medical regulation issued by the Ministry of Health of KRG numbered 4504 on February 30, 2020, and the Ministry of Health of Iraq numbered 27,429 on June 1, 2020. The patients were managed according to COVID-19 National Clinical guidelines.\cite{3}

*Figure 1: Map of kurdistan region with its estimated population at governorate level*
Diagnostic criteria

The RT-PCR diagnostic tests were performed according to the mean recovering time of the patients (14 days). The patients were discharged from the hospital according to the clinical improvement and viral clearance over RT-PCR (two negative results at least 24 h apart). The patients were informed of the possible recurrence of the disease. We did not document the recurrence in this study, because the study was so large.

Data collection

The information of the patients was collected in one of the following categories. The general information of the patients included age, gender, hospital stay (day), occupation (healthcare worker, or non-healthcare worker), and residence was recorded in the first category. The epidemiological and coexisting disorders included pregnancy in childbirth, reasons for testing, and medical conditions were recorded in the second category. At the end, the symptoms of the patients and outcomes were recorded in the third category. The outcomes were documented as recovered or death.

Statistical methods

The general and epidemiological information of the patients was presented in the median (interquartile range) or no. (%). The incidence rates of symptoms and mortality were calculated by dividing the infected or dead patients by the total number of included patients and determined in no. (%). The comparison of incidence rates of severity and mortality in patients with different epidemiological characteristics, coexisting disorders, and symptoms was examined in Pearson Chi-squared tests. The predictors of mortality in patients with COVID-19 were examined in binary logistic regression. The significant level of difference was determined in a P < 0.05. The statistical calculations were performed by statistical package for social sciences version 25 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). The box plots of this study were drawn by JMP SAS 14.3.

Ethical considerations

This study was supported and approved by the institutional ethical board of Duhok General Directorate of Health and Ministry of Health of the KRG registered as 13,878 in 2020. We protected the confidentiality of the personal information of patients through de-identification of the patients’ personal information. We did not apply any intervention for patients who were included in this study. The study has no risk to the patents.

Results

The total number of COVID-19 patients was 15,409, of whom 12.3% (n = 1888) were severe/critical. The median age of the patients was 36.0 aged between 0 and 103 years; the majority were 15–49 years. The patients were males (9868, 64.0%) and females (5541, 36.0%). The incidence rate of severe/critical conditions rose with increased age groups; except for 0–14 years (11.9%). The patients with severe/critical disease were older than those with non-severe illness with a median of 9 years. The incidence rate of severe/critical patients was 8.3%, 21.1%, and 23.7% in 15–49 years, 50–64 years, and 65 and older age groups, respectively. Female and non-healthcare worker patients were more likely to have severe/critical condition; 13.0% and 12.4% compared to males and healthcare workers; 11.9% and 9.2%, respectively. Concerning pregnancy, 123 (0.08%) were infected in different trimesters (P = 0.434). The patients were from Duhok (97.8%), other Kurdish governorates (1.0%), Iraqi governorates (1.1%), and other countries (0.2%), as shown in Table 1.

The severity of the disease was more likely to be associated with certain coexisting chronic diseases such as cardiovascular diseases (18.2%) and DM (19.8%); however, chronic lung disease, renal impairment, malignancy, and immunodeficiency did not show this association [Table 2].

There were 8400 (54.5%) asymptomatic and 7009 (45.5%) symptomatic patients. The most common symptoms on diagnosis were fever (31.9%), cough (23.5%), loss of smell/taste (16.3%), sore throat (15.7%), SOB (9.8%), and headache (9.5%). Severe COVID-19 was more likely found in patients with SOB (11.6%), loss of appetite (2.7%), or headache (8.0%), Table 3 and Figure 2.

The case fatality rate (CFR) was 1.98%, with a higher rate of aged patients. Lethality increased with age, except for the 0–14 age group (0.7%). The CFR was 0.5%, 4.0%, and 8.7% in 15–49 years, 50–64 years, and 65 and older, respectively. The median hospital stay was 4.0 days in dead patients. The mortality rate was significantly higher in non-healthcare workers compared to healthcare workers; 2.0% versus 0.6; P = 0.005. The lethality was higher in pregnant women during the second trimester (2.3%). However, the overall comparison of mortality was not statistically substantial in women with different trimesters. Regarding reasons for COVID-19 testing, there was no significant difference between patients who attended the clinic settings and those in different governorates (P = 0.258), Table 4 and Figure 3.

The patients with chronic diseases, cardiovascular diseases, or type 2 DM had a significantly higher CFR rate; 3.1%, 4.4%, and 3.4%, respectively. The patients with other coexisting disorders have not had significantly higher CFR. The asymptomatic patients had statistically higher CFR compared to symptomatic patients; 2.3% versus 1.6 (P = 0.006). Furthermore, the patients with SOB had higher CFR compared to patients without SOB; 2.8% versus 1.9%; P = 0.012 [Table 5].

The results showed that being older was the only predictor of mortality and severity in COVID-19 patients (Except for
A similar pattern was found in the analysis of mortality predictors in patients aged ≥ 65 years old. However, older age was shown to associate with severe/critical medical conditions in patients aged ≥ 65 years old [Table 6].

**Discussion**

To the best of our knowledge, this is the first large observational study of confirmed COVID-19 patients in Iraq. The median age of the patients was 36.0 aged 0-103 years, though it is different across the world. The median age was lower compared to studies from Italy (65.0 between 18 and ≥75 years);[22] China (47.0 between 0 and ≥65 years);[23] and (56.0 between 18 and 87 years);[24] and the United States (63.0 between 0 and

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**Table 1: Epidemiological characteristics between non-severe and severe COVID-19 patients**

| Patients' characteristics | All patients (n=15,409) | Disease severity | P-value |
|--------------------------|-------------------------|------------------|---------|
|                          | None-severe (13,521, 87.7%) | Severe/Critic (1888, 12.3%) |         |
| **Age (0–103 year)**    | 36.0 (21.0)               | 36.0 (19.0)       | 45.0 (28.0) | <0.001* |
| **Median (IQR-year)**   |                         |                  |         |
| 0–14 years              | 688 (4.5)                 | 606 (88.1)        | 82 (11.9) | <0.001b |
| 15–49 years             | 10543 (68.4)              | 9665 (91.7)       | 878 (8.3) |
| 50–64 years             | 2454 (15.9)               | 1935 (78.9)       | 519 (21.1) |
| 65 and older            | 1724 (11.2)               | 1315 (76.3)       | 409 (23.7) |
| **Hospital stay (1–22 days); Median (IQR-day)** | 4.0 (6.0) | 5.0 (5.0) | 3.5 (7.5) | 0.965a |
| **Sex**                 |                         |                  |         |
| Male                    | 9868 (64.0)               | 8698 (88.1)       | 1170 (11.9) | 0.045b |
| Female                  | 5541 (36.0)               | 4823 (87.0)       | 718 (13.0) |
| **Occupation**          |                         |                  |         |
| Healthcare workers      | 718 (4.7)                 | 652 (90.8)        | 66 (9.2) | 0.010b |
| Non-Healthcare workers  | 14691 (95.3)              | 12869 (87.6)      | 1822 (12.4) |
| **Residence**           |                         |                  |         |
| Duhok governorate       | 15074 (97.8)              | 13231 (87.8)      | 1843 (12.2) | 0.484b |
| Other Kurdistan governorates | 147 (1.0) | 131 (89.1) | 16 (10.9) |
| Other Iraqi governorates | 162 (1.1)                | 136 (84.0)        | 26 (16.0) |
| Other countries         | 26 (0.2)                  | 23 (88.5)         | 3 (11.5) |
| Pregnancy in childbearing women | 123 (0.8) | 3 (11.5) | 0.434b |
| First trimester         | 26 (0.2)                  | 23 (88.5)         | 3 (11.5) |
| Second trimester        | 44 (0.3)                  | 37 (84.1)         | 7 (15.9) |
| Third trimester         | 53 (0.3)                  | 49 (92.5)         | 4 (7.5) |
| **Reasons for testing COVID-19** | | | |
| Border crossing         | 600 (3.89)                | 543 (90.5)        | 57 (9.5) | 0.195b |
| Contact with a confirmed case | 8040 (52.18) | 7000 (87.1) | 1040 (12.9) |
| Ill person and visited health facilities (Suspect) | 5802 (37.65) | 5114 (88.1) | 688 (11.9) |
| Return from other governorates | 58 (0.38) | 48 (82.8) | 10 (17.2) |
| Random screening/surveillance | 425 (2.76) | 385 (90.6) | 40 (9.4) |
| Get a certificate of health | 97 (0.63) | 88 (90.7) | 9 (9.3) |
| Others                  | 72 (0.47)                 | 62 (86.1)         | 10 (13.9) |
| Contact with a confirmed case and become ill | 304 (1.97) | 270 (88.8) | 34 (11.2) |
| Contact with a confirmed case in other governorates | 1 (0.01) | 1 (100.0) | 0 (0.0) |
| Crossed the border and visited health facilities | 2 (0.01) | 2 (100.0) | 0 (0.0) |
| Contact with a confirmed case and crossed the border | 1 (0.01) | 1 (100.0) | 0 (0.0) |
| Visited health facilities and need a certificate | 2 (0.01) | 2 (100.0) | 0 (0.0) |
| Screening of returnees from other governorates | 5 (0.03) | 5 (100.0) | 0 (0.0) |

A Mann–Whitney U-test and b Pearson Chi-squared tests were performed for statistical analyses. The bold numbers show a significant difference. COVID: Coronavirus disease, IQR: Interquartile range.
The lower median age of the affected persons could be due to the median age of 20 in Iraq’s population. In this study, the incidence rate of severe/critical COVID-19 patients was 12.3% and it was linked with increasing age group except for 0–14 years old. It is well documented in the literature that worse outcomes are associated with increasing age. Overall, increasing age is associated with impaired immunity and there is an increased prevalence of comorbid diseases such as DM and hypertension. The different rates of severe/critical conditions were reported in the literature, for instance, 15.74%. The studies have reported that COVID-19 patients with severe/critical conditions are older with different median years, 9 years in this study (Iraqi Kurdistan), 7 years in China. In agreement with this study, the literature has reported similar findings. This study reveals that 54.5% of the patients were asymptomatic on visiting a medical doctor. Fever, cough, loss of smell/taste, sore throat, SOB, and headache are prevalent symptoms in COVID-19 patients. Those with SOB, loss of appetite, or headache are more likely to have severe/critical situations. The literature has reported that fever and cough on admission are the most prevalent symptoms in COVID-19 patients. Guan et al. reported that 43.8% and 88.7% had a fever on admission and during hospitalization, respectively, and 67.8% had a cough. In addition, the patients with coexisting illness were more likely to have the severe disease compared to non-severe patients, 38.7% versus 21.0%, respectively. Similar findings were reported in other parts of the words in terms of symptoms.

### Table 2: Comparison of prevalence rates of coexisting disorders between non-severe and severe/critic patients

| Coexisting disorders (n=15409) | All patients (n=15,409) | Disease severity | P-value |
|-------------------------------|------------------------|-----------------|---------|
|                               | All patients           | None-severe     | Severe/Critic |
|                               | (n=15,409)             | (13,521, 87.7%) | (1888, 12.3%) |         |
| Patients with chronic disease | Yes                    | 1998 (13.0)     | 1653 (82.7) | 345 (17.3) | <0.001 |
|                               | No                     | 13,411 (87.0)   | 11,868 (88.5) | 1543 (11.5) |
| Patients with cardiovascular diseases | Yes | 1150 (7.5)     | 941 (81.8) | 209 (18.2) | <0.001 |
|                               | No                     | 14,259 (92.5)   | 12,580 (88.2) | 1679 (11.8) |
| Patients with diabetes        | Yes                    | 832 (5.4)       | 667 (80.2) | 165 (19.8) | <0.001 |
|                               | No                     | 14,577 (94.6)   | 12,854 (88.2) | 1723 (11.8) |
| Patients with chronic lung disease including asthma and COPD, TB | Yes | 124 (0.8) | 103 (83.1) | 21 (16.9) | 0.110 |
|                               | No                     | 15,285 (99.2)   | 13,418 (87.8) | 1867 (12.2) |
| Patients with Renal Impairment | Yes | 129 (0.8) | 114 (88.4) | 15 (11.6) | 0.828 |
|                               | No                     | 15,280 (99.2)   | 13,407 (87.7) | 1873 (12.3) |
| Patients with malignancy      | Yes                    | 33 (0.2)        | 28 (84.8) | 5 (15.2) | 0.611 |
|                               | No                     | 15,376 (99.8)   | 13,493 (87.8) | 1883 (12.2) |
| Patients with immunodeficiency | Yes | 46 (0.3) | 42 (91.3) | 4 (8.7) | 0.461 |
|                               | No                     | 15,363 (99.7)   | 13,479 (87.7) | 1884 (12.3) |

Pearson Chi-squared test was performed for statistical analyses. The bold numbers show a significant difference. COPD: Chronic obstructive pulmonary disease.
The common symptoms reported by systematic reviews were fever (85.6%), cough (68.7%), and fatigue (39.4%). The frequent comorbidities are hypertension (17.4%), diabetes (3.8%), and coronary heart disease (3.8%). The critical cases with complications are 9%, intensive care unit admission is required in 7.3%, invasive ventilation in 3.4%, and mortality is 2.4%. Another meta-analysis confirmed that fever and cough are the most frequent symptoms. A meta-analysis of 148 articles of 24,410 adults with confirmed COVID-19 from nine countries reported that fever 78% [95% CI 75–81%], a cough 57% [95% CI 54–60%], and fatigue 31% [95% CI 27–35%] are the most prevalent symptoms. The main concern of the authors is that a considerable percentage of patients have chronic diseases. These patients are more likely to have severe/critical disease conditions and more likely to die.

The CFR was 1.98% of 15,409 patients who were followed-up and included in this study. The CFR rate was significantly increased with increasing age, and having chronic diseases, including cardiovascular diseases, or type 2 DM. We found that asymptomatic patients had statistically higher CFR compared to symptomatic patients; 2.3% versus 1.6, respectively. The CFRs are different based on the coexisting chronic conditions, clinical features, and epidemiological factors. The early findings reported from China revealed that CFR is 1.4% in laboratory-confirmed COVID-19 patients[24] and 24.0% in Italy[22]. The Italian study reported that patients aged older than 65 years (HR 3.17, 95% CI 1.84–5.44, \(P < 0.001\)), history of coronary artery disease (HR 2.93, 95% CI 1.77–4.86, \(P < 0.001\)), and active cancer (HR 2.32, 95% CI 1.15–4.67, \(P =0.001\)) as independent factors related to increased mortality risk. Zhou et al.[25] performed

### Table 3: Incidence rates of symptoms in patients with confirmed cases of COVID-19

| Patients' characteristics (n=15409) | All patients (n=15409) | Disease severity | \(P\)-value |
|-----------------------------------|-----------------------|-----------------|-------------|
| Symptom presence                  |                       |                 |             |
| Asymptomatic                      | 8400 (54.5)           | 7351 (54.4)     | 1049 (55.6) |
| Symptomatic                       | 7009 (45.5)           | 6170 (45.6)     | 839 (44.4)  |
| Fever                             | 4915 (31.9)           | 4314 (31.9)     | 601 (31.8)  |
| Chill and rigors                  | 45 (0.3)              | 39 (0.3)        | 6 (0.3)     |
| Sore throat                       | 2414 (15.7)           | 2140 (15.8)     | 274 (14.5)  |
| Cough                             | 3615 (23.5)           | 3173 (23.5)     | 442 (23.4)  |
| SOB                               | 1517 (9.8)            | 1298 (9.6)      | 219 (11.6)  |
| Loss of smell and/or taste        | 2515 (16.3)           | 2231 (16.5)     | 284 (15.0)  |
| Loss of appetite                  | 306 (2.0)             | 255 (1.9)       | 51 (2.7)    |
| Malaise                           | 116 (0.8)             | 101 (0.7)       | 15 (0.8)    |
| Fatigue (including feeling weak)  | 956 (6.2)             | 850 (6.3)       | 106 (5.6)   |
| Nausea and Vomiting               | 285 (1.8)             | 254 (1.9)       | 31 (1.6)    |
| Diarrhea                          | 677 (4.4)             | 599 (4.4)       | 78 (4.1)    |
| Headache                          | 1464 (9.5)            | 1313 (9.7)      | 151 (8.0)   |
| Ioin pain                         | 21 (0.1)              | 18 (0.1)        | 3 (0.2)     |
| Generalized body ache             | 795 (5.2)             | 704 (5.2)       | 91 (4.8)    |
| Back ache                         | 123 (0.8)             | 104 (0.8)       | 19 (1.0)    |
| Abdominal pain                    | 71 (0.5)              | 66 (0.5)        | 5 (0.3)     |
| Leg pain/Lower Limb               | 70 (0.5)              | 63 (0.5)        | 7 (0.4)     |
| Joint Pain                        | 21 (0.1)              | 17 (0.1)        | 4 (0.2)     |
| Dizziness                         | 113 (0.7)             | 93 (0.7)        | 20 (1.1)    |
| Chest pain                        | 204 (1.3)             | 181 (1.3)       | 23 (1.2)    |
| Sleep disturbance                 | 2 (0.0)               | 2 (0.0)         | 0 (0.0)     |
| Epigastric pain                   | 27 (0.2)              | 24 (0.2)        | 3 (0.2)     |
| Hemoptysis                        | 4 (0.0)               | 4 (0.0)         | 0 (0.0)     |
| Fainting                          | 4 (0.0)               | 4 (0.0)         | 0 (0.0)     |
| Flu like symptoms                 | 125 (0.8)             | 112 (0.8)       | 13 (0.7)    |

Pearson Chi-squared test was performed for statistical analyses except for the following symptoms. Fisher's exact test for sleep disturbance, hemoptysis, and flush-like symptoms. The bold numbers show a significant difference. COVID: Coronavirus disease, SOB: Shortness of breath
Figure 2: Prevalence rates of symptoms in patients with COVID-19

Figure 3: Comparison of median age between patients with different outcomes, (a) age of recovered and dead patients, (b) age of non-severe and severe/critic patients, (c) age of non-severe and severe/critic patients in recovered and dead patients, (d) hospital day of non-sever and sever/critic patients
a multivariable regression and showed that in-hospital mortality is associated with older age (odds ratio 1·10, 95% CI 1·03–1·17), higher Sequential Organ Failure Assessment score (5·65, 2·61–12·23), and d-dimer greater than 1 µg/mL (18·42, 2·64–128·55) on admission.

In agreement with the literature, this study showed that being severe/critical or non-severe or being asymptomatic or symptomatic, or having chronic diseases are not the predictors for mortality and severity in patients with COVID-19. The older age was the only predictor of mortality and severity in COVID-19 patients. However, some other factors have been reported to be predictors for mortality. For example, Fabio et al.[22] reported that through multivariable analysis that older age, coronary artery disease, cancer, low lymphocyte count, and high Radiographic Assessment of Lung Edema score as factors independently associated with an increased risk of mortality. Other investigations have reported that older

| Patients’ characteristics | Outcome                  | P-value |
|--------------------------|--------------------------|---------|
|                         | Recovered 15,104 (98.02%)| Dead 305 (1.98%) | <0.001|
| Age (0–103 year)         | 36.0 (20.0)              | 60.0 (18.0) | <0.001|
| Median (IQR-year)        |                          |         |       |
| Age distribution         |                          |         |       |
| 0–14 years               | 683 (99.3)               | 5 (0.7)  |       |
| 15–49 years              | 10492 (99.5)             | 51 (0.5) |       |
| 50–64 years              | 2355 (96.0)              | 99 (4.0) |       |
| 65 and older             | 1574 (91.3)              | 150 (8.7)|       |
| Hospital stay (1–22 days); Median (IQR-day) | 4.0 (6.0) | NA |
| Sex                      |                          |         | 0.521|
| Male                     | 9678 (98.1)              | 190 (1.9)|       |
| Female                   | 5426 (97.9)              | 115 (2.1)|       |
| Occupation               |                          |         | 0.005|
| Healthcare workers       | 714 (99.4)               | 4 (0.6)  |       |
| Non- Healthcare workers  | 14390 (98.0)             | 301 (2.0)|       |
| Residence                |                          |         | 0.258|
| Duhok governorate        | 14771 (98.0)             | 303 (2.0)|       |
| Other Kurdistan governorates | 147 (100.0)               | 0 (0.0)  |       |
| Other Iraqi governorates | 160 (98.8)               | 2 (1.2)  |       |
| Other countries          | 26 (100.0)               | 0 (0.0)  |       |
| Pregnancy in childbearing women |                  |         | 0.405|
| First trimester          | 26 (100.0)               | 0 (0.0)  |       |
| Second trimester         | 43 (97.7)                | 1 (2.3)  |       |
| Third trimester          | 53 (100.0)               | 0 (0.0)  |       |
| Reasons for testing COVID-19 |                      |         | 0.240|
| Border crossing          | 595 (99.2)               | 5 (0.8)  |       |
| Contact with a confirmed case | 7854 (97.7)             | 186 (2.3)|       |
| Ill person and visited health facilities (Suspect) | 5699 (98.2) | 103 (1.8) |       |
| Return from other governorates | 58 (100.0)               | 0 (0.0)  |       |
| Random screening/surveillance | 419 (98.6)               | 6 (1.4)  |       |
| Get a certificate of health | 95 (97.9)                | 2 (2.1)  |       |
| Others                   | 72 (100.0)               | 0 (0.0)  |       |
| Contact with a confirmed case and become ill | 301 (99.0)               | 3 (1.0)  |       |
| Contact with a confirmed case in other governorates | 1 (100.0)               | 0 (0.0)  |       |
| Crossed the border and visited health facilities | 2 (100.0)               | 0 (0.0)  |       |
| Contact with a confirmed case and crossed the border | 1 (100.0)               | 0 (0.0)  |       |
| Visited health facilities and need a certificate | 2 (100.0)               | 0 (0.0)  |       |
| Screening of returnees from other governorates | 5 (100.0)               | 0 (0.0)  |       |

COVID: Coronavirus disease, IQR: Interquartile range
age and the presence of comorbidities are associated with an increased mortality rate in COVID-19 patients.\[25,32,36\]

We confirmed the previously published findings in patients from China,\[37\] the United States,\[26\] and Italy.\[22\] They reported that older age, coexisting medical conditions such as coronary artery disease, history of hypertension, diabetes, chronic obstructive pulmonary disease, and chronic renal failure, and cancer are related to increased mortality. We back the effect of chronic diseases on increased mortality to their effect on immunity.\[38\]

The current findings give us the utmost importance to reduce the burden of the general health system, targeting the efforts for sufficient screening of the patients at risk.

The role of age in immune system suppression must not be ignored in this disease. The countries with higher infection rates have an older population compared to the countries with low infection rates,\[39\] France and Italy compared to Iraq and

### Table 5: CFR in COVID-19 patients with coexisting disorders and different symptoms

| Coexisting disorders (n=15,409) | Recovered 15,104 (98.02%) | Dead 305 (1.98%) | P-value |
|---------------------------------|----------------------------|------------------|---------|
|                                 | With coexisting disorder   | Without coexisting disorder | With coexisting disorder | Without coexisting disorder |
| Patients with chronic disease   | 1936 (96.9)                | 13,168 (98.2)    | 62 (3.1) | 243 (1.8) | <0.001 |
| Patients with Cardiovascular diseases | 1099 (95.6) | 14,005 (98.2) | 51 (4.4) | 254 (1.8) | <0.001 |
| Patients with diabetes          | 804 (96.6)                 | 14,300 (98.1)    | 28 (3.4) | 277 (1.9) | 0.003  |
| Patients with chronic lung disease including asthma and COPD, TB | 122 (98.4) | 14,982 (98.0) | 2 (1.6) | 303 (2.0) | 0.769  |
| Patients with Renal Impairment  | 126 (97.7)                 | 14,978 (98.0)    | 3 (2.3)  | 302 (2.0) | 0.777  |
| Patients with malignancy        | 31 (93.9)                  | 15,073 (98.0)    | 2 (6.1)  | 303 (2.0) | 0.092  |
| Patients with immunodeficiency  | 45 (97.8)                  | 15,059 (98.0)    | 1 (2.2)  | 304 (2.0) | 0.924  |

Symptoms

| Symptoms                          | With symptom | Without symptom | With symptom | Without symptom | P-value |
|-----------------------------------|--------------|----------------|--------------|----------------|---------|
| Symptom presence                  | 6894 (98.4)  | 8210 (97.7)    | 115 (1.6)    | 190 (2.3)     | 0.006  |
| Fever                             | 4836 (98.4)  | 10,268 (97.8)  | 79 (1.6)     | 226 (2.2)     | 0.023  |
| Chill and rigors                  | 43 (95.6)    | 15,061 (98.0)  | 2 (4.4)      | 303 (2.0)     | 0.234  |
| Sore throat                       | 2370 (98.2)  | 12,734 (98.0)  | 44 (1.8)     | 261 (2.0)     | 0.547  |
| Cough                             | 3552 (98.3)  | 14,982 (98.0)  | 2 (1.6)      | 303 (2.0)     | 0.769  |
| SOB                               | 1474 (97.2)  | 13,630 (98.1)  | 43 (2.8)     | 262 (1.9)     | 0.012  |
| Loss of smell and/or taste        | 2471 (98.3)  | 12,633 (98.0)  | 44 (1.7)     | 261 (2.0)     | 0.366  |
| Loss of appetite                  | 298 (97.4)   | 14,806 (98.0)  | 8 (2.6)      | 297 (2.0)     | 0.421  |
| Malaise                           | 115 (99.1)   | 14,989 (98.0)  | 1 (0.9)      | 304 (2.0)     | 0.386  |
| Fatigue (including feeling weak)  | 943 (98.6)   | 14,161 (98.0)  | 13 (1.4)     | 292 (2.0)     | 0.156  |
| Nausea and vomiting               | 279 (97.9)   | 14,825 (98.0)  | 6 (2.1)      | 299 (2.0)     | 0.878  |
| Diarrhea                          | 670 (99.0)   | 14,433 (98.0)  | 7 (1.0)      | 298 (2.0)     | 0.071  |
| Headache                          | 1442 (98.5)  | 13,662 (98.0)  | 22 (1.5)     | 283 (2.0)     | 0.169  |
| Loin pain                         | 21 (100.0)   | 15,083 (98.0)  | 0 (0.0)      | 305 (2.0)     | 0.515  |
| Generalized body ache             | 783 (98.5)   | 14,321 (98.0)  | 12 (1.5)     | 293 (2.0)     | 0.329  |
| Back ache                         | 121 (98.4)   | 14,983 (98.0)  | 2 (1.6)      | 303 (2.0)     | 0.778  |
| Abdominal pain                    | 71 (100.0)   | 15,033 (98.0)  | 0 (0.0)      | 305 (2.0)     | 0.230  |
| leg pain/Lower Limb               | 69 (98.6)    | 15,035 (98.0)  | 1 (1.4)      | 304 (2.0)     | 0.740  |
| Joint Pain                        | 21 (100.0)   | 15,083 (98.0)  | 0 (0.0)      | 305 (2.0)     | 0.515  |
| Dizziness                         | 113 (100.0)  | 14,991 (98.0)  | 0 (0.0)      | 305 (2.0)     | 0.129  |
| Chest pain                        | 200 (98.0)   | 14,904 (98.0)  | 4 (2.0)      | 301 (2.0)     | 0.985  |
| Sleep disturbance                 | 2 (100.0)    | 15,102 (98.0)  | 0 (0.0)      | 305 (2.0)     | 1.000  |
| Epigastric pain                   | 27 (100.0)   | 15,077 (98.0)  | 0 (0.0)      | 305 (2.0)     | 0.460  |
| Hemoptysis                        | 4 (100.0)    | 15,100 (98.0)  | 0 (0.0)      | 305 (2.0)     | 1.000  |
| Fainting                          | 4 (100.0)    | 15,100 (98.0)  | 0 (0.0)      | 305 (2.0)     | 1.000  |
| Flu like symptoms                 | 123 (98.4)   | 14,981 (98.0)  | 2 (1.6)      | 303 (2.0)     | 0.760  |

Pearson Chi-squared test was performed for statistical analyses except for the following symptoms. Fisher's exact test was performed for sleep disturbance, hemoptysis, and fainting. The bold numbers show a significant difference. CFR: Case fatality rate, COVID: Coronavirus disease, SOB: Shortness of breath, COPD: Chronic obstructive pulmonary disease

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Table 6: Univariate predictors of mortality in COVID-19 patients

| Predictors (n=15,409) | Dependent variable: Outcomes of COVID-19 patients |  | Dependent variable: Severity |
|----------------------|--------------------------------------------------|---|-----------------------------|
|                      | OR (95% CI)                                      | P-value | OR (95% CI)                           | P-value |
| Severity             |                                                  |         |                                      |         |
| Non-severe           | 0.996 (0.743–1.335)                              | 0.979   | <0.001                                  | <0.001 |
| Severe/critic        |                                                  |         | 0.677 (0.531–0.863)                  | 0.002   |
| Age distribution     |                                                  |         | 1.984 (1.539–2.557)                  | <0.001 |
| 0–14 years           |                                                  |         | 2.320 (1.791–3.006)                  |         |
| 15–49 years          | 0.693 (0.275–1.746)                              | 0.436   | <0.001                                  | <0.001 |
| 50–64 years          | 5.991 (2.420–14.834)                             | <0.001  | <0.001                                  | <0.001 |
| 65 and older         | 13.190 (5.365–32.426)                            | <0.001  | <0.001                                  | <0.001 |
| Sex at birth         |                                                  |         |                                       |         |
| Male                 | 1.011 (0.794–1.287)                              | 0.930   | 1.060 (0.957–1.174)                   | 0.264   |
| Female               |                                                  |         |                                       |         |
| Occupation           |                                                  |         |                                       |         |
| Healthcare workers   | 1.854 (0.679–5.058)                              | 0.228   | 1.133 (0.870–1.476)                   | 0.353   |
| Non–healthcare workers |                                              |         |                                       |         |
| Cardiovascular diseases|                                            |         |                                       |         |
| Yes                  | 0.894 (0.617–1.296)                              | 0.555   | 1.118 (0.927–1.348)                   | 0.242   |
| No                   | 1.251 (0.805–1.943)                              | 0.319   | 0.821 (0.671–1.003)                   | 0.053   |
| Type 2 DM            |                                                  |         |                                       |         |
| Yes                  | 1.850 (0.443–7.729)                              | 0.399   | 0.801 (0.492–1.304)                   | 0.372   |
| No                   | 1.366 (0.420–4.439)                              | 0.604   | 1.441 (0.826–2.514)                   | 0.198   |
| Chronic lung disease |                                                  |         |                                       |         |
| Yes                  | 0.557 (0.115–2.693)                              | 0.466   | 1.009 (0.372–2.739)                   | 0.985   |
| No                   | 1.684 (0.193–14.730)                             | 0.637   | 1.754 (0.602–5.111)                   | 0.303   |
| Renal Impairment     |                                                  |         |                                       |         |
| Yes                  | 1.366 (0.420–4.439)                              | 0.604   | 1.441 (0.826–2.514)                   | 0.198   |
| No                   | 1.850 (0.443–7.729)                              | 0.399   | 0.801 (0.492–1.304)                   | 0.372   |
| Malignancy           |                                                  |         |                                       |         |
| Yes                  | 0.557 (0.115–2.693)                              | 0.466   | 1.009 (0.372–2.739)                   | 0.985   |
| No                   | 1.684 (0.193–14.730)                             | 0.637   | 1.754 (0.602–5.111)                   | 0.303   |
| Immunodeficiency     |                                                  |         |                                       |         |
| Yes                  | 1.366 (0.420–4.439)                              | 0.604   | 1.441 (0.826–2.514)                   | 0.198   |
| No                   | 1.850 (0.443–7.729)                              | 0.399   | 0.801 (0.492–1.304)                   | 0.372   |
| Symptoms presence    |                                                  |         |                                       |         |
| Asymptomatic         | 0.940 (0.716–1.235)                              | 0.657   | 1.033 (0.928–1.149)                   | 0.551   |
| Symptomatic          |                                                  |         |                                       |         |

Saudi Arabia, respectively. Adults aged 65 years and older and patients with coexisting medical conditions are more likely to have a severe-even deadly-coronavirus infection. Therefore, the high infection and mortality rates in high-income countries could be due to aging and accordingly low immunity level.

The effects of aging on the immune system are presented at multiple levels. The production of B and T cells in bone marrow and thymus is decreased first. The functions of mature lymphocytes in secondary lymphoid tissues are diminished accordingly. Therefore, the aged populations unable to respond to the immune challenges as the young populations.

Some other factors have been reported to be associated with the mortality rate in the literature. For example, Abdulah and Hassan in a global ecological study reported that the crude mortality rate is increased by raising consuming sugar-sweetened beverages and decreased by increasing fruit consumption and beans and legumes. The anti-inflammatory strategies inside foods, nutrients, or medicines are suggested as viable options for the management of COVID-19 since the
coronavirus has serious inflammatory consequences for acute pneumonia in persons. The human coronavirus infections cause mild to severe diseases, systemic inflammation, high fever, cough, and acute respiratory tract infection, and dysfunction in internal organs leading to death.

Except for the insufficient age-related micronutrient, the nutritional status of the population has a role in the overall development of the SARS-CoV-2 infection, the clinical status, and outcomes. Therefore, the individuals need the maintenance of host macro- and micronutrient status to avoid the COVID-19 infection.

The older individuals aged 60–65 years old have less ability to respond to the immune challenges and pathogens, antigens, and mitogens decreases due to immune dysregulation. Characteristics of the immune system in older people are a reduction of circulating lymphocytes and loss of immune cells. Besides, the older persons have reduced the production of T cells in the involved thymus. Accordingly, this decreases the function of mature lymphocytes in secondary lymphoid tissues.

Implications and limitations

The main strong point of this study is that we tried to include as much as possible the patients with sufficient information that allowed us to present a clearer picture of clinical features of the COVID-19 in this region. The predictors reported in this study could assist clinicians to determine at an early stage patients with COVID-19 with poor prognosis. However, the study was not exempt from the limitations. We could not record the radiological and laboratory-based information of this large study. Anyhow, we suggest that a large study of radiological and laboratory-based information study be performed in a multi-center investigation.

The world requires serious investment in research and development to find out the current epidemics and prepare for possible future ones. Besides, we need to establish our healthcare system to develop new diagnostic and therapeutic solutions, invest in vaccines and broad-spectrum antivirals. Moreover, we need to take into account the social aspects.

Conclusions

This study showed that patients with COVID-19 have a low incidence rate of severe/critical status in Iraqi Kurdistan. The incidence rate of severe/critical condition was significantly increased with increasing age and was more common in female and non-healthcare worker patients. We found that older COVID-19 patients and those with coexisting medical conditions were more likely to have severe/critical status and a high rate of CFR. Having older age was determined to be the only factor that predicted the severe/critical status and higher mortality.

Authors’ Declaration Statements

Availability of data and material

The data used in this study are available and will be provided by the corresponding author on a reasonable request.

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Authors’ Contributions

The corresponding author claim that all authors whom their names were reported in this study had sufficient contribution to the concept, design, review, analysis, and final approval.

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References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727-33.
2. Abdulah DM, Qazli SS, Suleman SK. Response of the public to preventive measures of COVID-19 in Iraqi Kurdistan. Disaster Med Public Health Prep 2020;1-9.
3. Merza MA, Al Mezori AA, Mohammed HM, Abdulah DM. COVID-19 outbreak in Iraqi Kurdistan: The first report characterizing epidemiological, clinical, laboratory, and radiological findings of the disease. Diabet Metab Synd Clin Res Rev 2020;14:547-54.
4. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. Geneva: World Health Organization; 2020. Available from: https://www.covid19.who.int. [Last accessed on 2021 Feb 02].
5. Nacoti M, Ciocca A, Giupponi A, Brambillasca P, Lussana F, Pisano M, et al. At the epicenter of the Covid-19 pandemic and humanitarian crises in Italy: Changing perspectives on preparation and mitigation. NEJM Catal Innov Care Deliv 2020;1:1-5.
6. Kurdistan Regional Government. Situation Update Coronavirus (COVID-19), What the KRG is Doing. United States: Kurdistan Regional Government; 2020. Available from: https://www.gov.krd/coronavirus-en/situation-update. [Last accessed on 2021 Feb 02].
7. Cucinotta D, Vanello M. WHO declares COVID-19 a pandemic. Acta BioMed 2020;91:157-60.
8. Adhikari SP, Meng S, Wu YJ, Mao YP, Ye RX, Wang QZ, et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: A scoping review. Infect Dis Poverty 2020;9:1-12.
9. Centers for Disease Control Prevention. Novel Coronavirus, Wuhan, China. United States: Centers for Disease Control Prevention; 2020. Available from: https://www.cdc.gov/coronavirus/2019-ncov/summary.html. [Last accessed on 2021 Feb 02].
10. Kolifarhood G, Aghaali M, Saadati HM, Taherpour N, Rahimi S,
Izadi N, et al. Epidemiological and clinical aspects of COVID-19: a narrative review. AAEM 2020;8:620.

11. Zou L, Ruan F, Huang M, Liang L, Huang H, Hong Z, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. N Engl J Med 2020;382:1177-9.

12. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. Lancet 2020;395:507-13.

13. Mahmud I, Al-Mohaiweed A. COVID-19: Utilizing local experience to suggest optimal global strategies to prevent and control the pandemic. IJHS 2020;14:1.

14. Abalholmomen W, Sharig A, Rasheed Z. COVID-19: A global public health disaster. Int J Health Sci (Qassim) 2020;14:7-8.

15. Alunna R. Role of precautionary measures in containing the natural course of novel coronavirus disease. JMDH 2020;13:615.

16. Kirby T. New variant of SARS-CoV-2 in UK causes surge of COVID-19. Lancet Respir Med 2021;9:e20-1.

17. Centers for Disease Control and Prevention. About Variants of the Virus that Causes COVID-19. United States: Centers for Disease Control and Prevention; 2021. Available from: https://www.cdc.gov/coronavirus/2019-ncov/transmission/variant.html. [Last accessed on 2021 Feb 02].

18. Page ML, Conlon AM. South African covid-19 Variant (B.1.351). United Kingdom: New Scientist; 2021. Available from: https://www.newscientist.com/definition/south-african-covid-19-variant. [Last accessed on 2021 Feb 02].

19. Dulloo AG, Jacquet J, Solinas G, Montani JP, Schutz Y. Body composition phenotypes in pathways to obesity and the metabolic syndrome. Int J Obes 2010;34:S4-17.

20. Kurdistan Region Statistics Office. Kurdistan Map; 2015. Available from: http://www.krso.net/Default.aspx?page=categroty and c=kurdistan. [Last accessed on 2021 Feb 02].

21. World Health Organization. Global Surveillance for COVID-19 Disease Caused by Human Infection with the 2019 Novel Coronavirus, Interim Guidance. Geneva: World Health Organization; 2020.

22. Fabio C, Antonella C, Patrizia RQ, Annalisa R, Laura G, Caterina C, et al. Early predictors of clinical outcomes of COVID-19 outbreak in Milan, Italy. Clin Immunol 2020;217:1-20.

23. Srinivasan BS. Diagnosis and treatment protocol for novel coronavirus pneumonia (Version 7). Chin Med J 2020;133:1087-95.

24. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382:1708-20.

25. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. Lancet 2020;395:1054-62.

26. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York city area. JAMA 2020;323:2052-9.

27. World Population Review. Iraq Population 2020 (Live). India: World Population Review; 2020. Available from: https://www.worldpopulationreview.com/countries/iraq-population. [Last accessed on 2021 Feb 02].

28. Palaiodimos L, Kokkinidis DG, Li W, Karamanis D, Ognibene J, Arora S, et al. Severe obesity, increasing age and male sex are independently associated with worse in-hospital outcomes, and higher in-hospital mortality, in a cohort of patients with COVID-19 in the Bronx, New York. Metabolism 2020;108:154262.

29. Nguyen LH, Drew DA, Graham MS, Joshi AD, Guo CG, Ma W, et al. Risk of COVID-19 among front-line health-care workers and the general community: A prospective cohort study. Lancet Public Health 2020;5:e475-83.

30. Karlsson U, Fraenkel CJ. Covid-19: Risks to Healthcare Workers and Their Families. London, United Kingdom: BMJ Publishing Group; 2020.

31. Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Epidemiology of and risk factors for coronavirus infection in health care workers: A living rapid review. Ann Intern Med 2020;173:120-36.

32. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323:1061-9.

33. Lovato A, de Filippis C. Clinical presentation of COVID-19: A systematic review focusing on upper airway symptoms. Ear Nose Throat J 2020;99:569-76.

34. Sun P, Qie S, Liu Z, Ren J, Li K, Xi J. Clinical characteristics of hospitalized patients with SARS-CoV-2 infection: A single arm meta-analysis. J Med Virol 2020;92:612-17.

35. Grant MC, Geoghegan L, Arbyn M, Mohammed Z, McGuinness L, Clarke EL, et al. The prevalence of symptoms in 24,410 adults infected by the novel coronavirus (SARS-CoV-2; COVID-19): A systematic review and meta-analysis of 148 studies from 9 countries. PLoS One 2020;15:e0234765.

36. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. Lancet Respir Med 2020;8:475-81.

37. Ganatra S, Hammond SP, Nohria A. The novel coronavirus disease (COVID-19) threat for patients with cardiovascular disease and cancer. JACC CardioOncol 2020;2:350-5.

38. Bagatini MD, Cardoso AM, Reschke CR, Carvalho FB. Immune system and chronic diseases 2018. J Immunol Res 2018;2018:1-2.

39. Ofori-Assenso R, Chiu KL, Curtis AJ, Zomer E, Zoungas S, Liew D. Recent patterns of multimorbidity among older adults in high-income countries. Popul Health Manage 2019;22:127-37.

40. World Health Organization. Coronavirus Disease 2019 (COVID-19): Situation Report. Vol. 72. Geneva: World Health Organization; 2020.

41. Montecino-Rodriguez E, Berent-Maoz B, Dorschkind K. Causes, consequences, and reversal of immune system aging. J Clin Invest 2013;123:958-65.

42. Abdulah DM, Hassan A. Relation of dietary factors with infection and mortality rates of COVID-19 across the world. J Nutr Health Aging 2020;24:1011-8.

43. Kritas S, Ronconi G, Caraffa A, Gallenga C, Ross R, Conti P. Mast cells contribute to coronavirus-induced inflammation: New anti-inflammatory strategy. J Biol Regul Homeost Agents 2020;34:9-14.

44. Conti P, Ronconi G, Caraffa A, Gallenga C, Ross R, Frydas I, et al. Induction of pro-inflammatory cytokines (IL-1 and IL-6) and lung inflammation by coronavirus-19 (COVI-19 or SARS-CoV-2): Anti-inflammatory strategies. J Biol Regul Homeost Agents 2020;34:327-31.

45. Shi Y, Wang Y, Shao C, Huang J, Gan J, Huang X, et al. COVID-19 Infection: The Perspectives on Immune Responses. Berlin, Germany: Nature Publishing Group; 2020.

46. Gasmi A, Noor S, Tippairote T, Dadar M, Menzel A, Bjørklund G. Individual risk management strategy and potential therapeutic options for the COVID-19 pandemic. Clin Immunol 2020;215:108409.

47. Chandra RK. Nutrition and the immune system from birth to old age. Eur J Clin Nutr 2002;56:573-6.

48. Brodin P, Davis MM. Human immune system variation. Nat Rev Immunol 2017;17:21.

49. Saq M, Wasson B. COVID-19: Lost opportunities and lessons for the future. IJHS 2020;14:4.