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## COVID-19 Infection Mortality Rate Among Genders, Residence And Age Groups; Along With Its Correlation To Comorbidities, In Thi-Qar Provenance South Of Iraq

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### ABSTRACT

Iraq had witnessed two waves of the COVID-19 pandemic during the years 2020 and 2021, with date-dependent fluctuations of the mortality rate. However, Thi-Qar governorate, like all other Iraqi governorates, had witnessed the two waves of the pandemic attacks. **Methodology:** This study evaluates and statistically analyzes the mortality rate, taking into account the influences of gender, age, the date of death, and the city or district of residence. Mortality) are categorized according to gender, method of diagnosis, date of passing out, and age group and evaluated during the study period extending from February 2020 to April 2022. **Results:** The study has shown that of the 2129 victims who passed out, 59.4% are males and 40.6% are females, with an age range of a few days to 110 years old, yet around 75.5% are positive for RT-CPR, while the others are diagnosed using CT- scans, X-ray radiological examinations, and clinical examinations, of which 73.23% are admitted as severe cases. In fact, there is no statistically significant correlation between the gender of the victims and the diagnosis method used (p\_value: 0.77), but there is a very highly significant relation (P\_value < 0.0001) between the mortality rate and method of diagnosis. Remarkably, 99.9% of the mortality cases were unvaccinated; besides, the mortality rate is 91.73 deaths/100,000, or 9.173/million, of population, while the case fatality rate was 2.067%, which is as double as the Iraq case fatality rate at the end of March 2022, which was 1.086%, where there is a statistically significant relation between mortalities, gender, and residence district (p\_value: 0.022), particularly for males and females of both Marshlands/east and intermediate north districts of Thi-Qar, which has the greatest contribution to total fatalities. However, there is no statistically significant correlation between mortalities gender and the city of residence, although both Al-Nasiriya, followed by Al-Shatra cities, have the greatest contribution to the total number of fatalities. In addition, there is no significant relation between mortalities age group and gender (p\_value: 0.09), as well as the district of residence (p\_value: 0.898), yet age group mortalities have a highly significant relation (p\_value: 0.003) with the city of residence, where both Al-Nasiriya followed by Al-Shatra as cities of residence have the greatest contribution to the total number of fatalities, although in the three cases, the age group of over 65 years old has the greatest contribution to the total fatalities. Remarkably, it has been found that according to 10-15-year-old dividing of age groups up to 65 years old, there is no statistically significant relation between mortalities, gender, and comorbidity (p\_value: 0.717), although co-morbidity combinations such as cardiovascular diseases, diabetes, and respiratory diseases have a significantly greater contribution to the total fatalities on the one hand, yet there is a very high significant relation between mortalities, age group, and comorbidity (p\_value: < 0.001), particularly those of 55-65 and over 65 years old on the other hand. Meanwhile, it is worthy to note that according to 15-year dividing of age groups for those below 44 years old and 20 years old for those 45 years old, there is a very significant relation between the victims age group and co-morbidities (p-value < 0.001), although there is no statistically significant correlation between the victims age group and gender, residence city, and residence district with corresponding p-values of 0.069, 0.939, and 0.375, respectively. During the two successive years of the pandemic 2020 and 2021, two pairs of mortality rate peaks escalations have been observed, one pair for each year. The summer peak started in May of the two years and declined to the base line in autumn in both years, preceded by a winter-to-spring peak. However, characteristic troughs have been observed occurring approximately at the same interval (October), just after the end of the imam Al-Hussein Bin Ali Ziyarat AL-Arbaeen rituals that had involved several hundred thousand to millions of the pilgrims in close proximity to each other, and continuing to around a three-month interval in contrast to what was expected of gathering and approximation negative impact on COVID-19 infection expansion/acquisition. **Conclusion:** The variations in fatality rates between genders could be related to gene-related hormonal influences on the victims immune surveillance; however, the variations in fatalities among residence districts and cities are residence population-attributed incidence rate, ethnic, race, educational, as well as personal hygiene-attributed variations. The remarkable difference in monthly mortality pattern between the year 2020 of the pandemic and 2021 encourages presuming the arising/involvement of a new SARS-CoV-2 virus strain in the second year, although it was probably less virulent than that of the first one. However, there is no significant correlation between the mortalities and the date of death among the two genders.

**Key words:** COVID-19, Thi-Qar, Mortality, Factors, Co-morbidity.

## 1. INTRODUCTION:

On the 19th of December 2019, a novel coronavirus emerged in Wuhan, Hubei province, China, manifesting as severe cases of unknown origin pneumonia [1-5] to be declared later as a global pandemic health condition, which is denoted by the WHO on the 11th of February 2020 as severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) [6-10], while the disease is called Corona virus disease-19 (COVID-19) [11, 12]. This outbreak of the extensively lethal and ferocious virus leading to serious fatalities in China as a local country epidemic along with its silent global spreading, however, prior to the beginning of 2020 [8, 13, 14]. However, on the 11th of March 2020, WHO announced that this infection is a pandemic condition [15] caused by the novel identified SARS-CoV-2 virus infection [16]. This infection has spread rapidly world-wide to the Middle East countries, manifesting severe disease conditions including septic shock, metabolic acidosis, and bleeding, leading to a poor prognosis that is dependent on the patient's age along with the patient's co-morbidities, which are the concomitant disease conditions [17-20], hence attracting global attention [21]. In fact, the COVID-19 crisis has represented a tremendous global health, social, and economic challenge [22-24], particularly in countries encountering political as well as military conflicts within the first half of 2020, like Yemen and Iraq [25]. Nevertheless, with time, the prevalence, severity, and fatality rates simultaneously have declined [26], although crowding that brings about close contacts had an impact on some outbreak flares besides being a contributing factor for community-dependent immunity development [27, 28]. The virus infection expansion and mortalities have tremendously varied between various countries despite its variation among different regions of a single one, which unfortunately remains to expand despite the various measures of their authorities [29], along with its unique, subversive, and diverse pattern of prevalence as well as mortality over the globe, even at the city level, which has been unpredictable since the beginning of the pandemic regardless of the involvement of various predictors governing the virus as well as affected population behavior [30]. However, despite countries measures, the infection expands to around 200 countries, territories, and regions, including Iran, Iraq, Saudi Arabia, and Turkey, giving rise to an overall mortality rate of 3.7% [31, 32]. For example, on September 2020, 25 million infection cases along with 800 thousand mortalities have been reported [33], yet on the 9th of November 2020, over 50 million infection cases along with over 1.24 million

mortalities are reported [34, 35], while, on October 2021, the global infection cases approach 240 million infection cases along with 5 million mortalities; more than one-third of each are in the USA, India, and Brazil [36]. In fact, COVID-19 has been reported to come in the third order of highest cause of mortalities in the USA [37]. However, in Iraq, on the 20th of November 2020, 529,226 infection cases have been confirmed [38]. Unfortunately, on April 20, 2022, more than 6.1 million mortalities have been caused by SARS-CoV-2 infection [39], and the numbers have escalated to 6.4 million deaths on the 20th of July 2022 [40].

Remarkably, despite that, the majority of infections have brought about mild to moderate conditions; however, 19% of the cases have brought about severe conditions that develop to critical cases, sometimes ending with multiple organ failure, including respiratory failure, besides other system failures and involvement, particularly those with asthma as well as neoplasms, medical history, and death [41-45]. At the beginning of the pandemic, one-third of cases in Wuhan had required ICU admission, along with a higher mortality rate of 10% than that reported for the globe at the end of 2021; nevertheless, 50% of the fatalities have been reported for 50-year-old patients that have died within the third week of the infection [46, 47]. However, at the beginning of 2020, over 8.5 million cases along with 500,000 mortalities have been encountered globally [48]. In fact, many uncertainties have been reported for the capability of the virus itself to cause severe illness as well as mortality by itself, despite the reported true mortality rates [49].

Regarding Iraq, the first reported case has been reported for religion studies Iranian student, who recently came from Iran, on the 24th of February 2020, in Najaf city; however, the Iraqi health authority has declared that the 27th of February 2020 is the "day zero" of the epidemic infection in Iraq, as a 42-year-old Iraqi male, who also recently returned from Iran, is diagnosed with COVID-19 in the Euphrates general hospital, Baghdad, health custody [22, 50]. However, on the 30th of March 2020, the first COVID-19 infection mortality case was reported in Sulaymaniyah governorate [51], after which the mortalities have escalated. For example, on the 31st of August 2020, 234,934 infection cases along with 7042 mortalities have been reported [52], while on the 22nd of 2021, 1,164,149 infection cases along with 16,158 mortalities have been reported, as two waves of outbreaks have stricken; the second starts in mid-January 2021, including a brief three-month decline

period in the mortality rate in the Kurdistan region of Iraq in the period extending from November 2020 to February 2021 [53]. The first pregnant female SARS-CoV-2 infection case in Iraq was reported on the 13th of April 2020 as she presented to the antenatal care unit of Al-Kadhemia Teaching Hospital, Baghdad, in her third trimester (28th week) of pregnancy. The woman had premature labor of a 2.2 kg male baby of negative COVID-19 infection. Fortunately, both the mother and the fetus discharged healthy and alive 15 days post admission [54]. However, the premature delivery is attributed to the excessive blood prostaglandin level due to the viral infection caused by the viral infection accompanying a cytokine storm due to the non-specific immune response [55, 56]. As formerly mentioned, Iraq has witnessed political conflicts as well as protests (lasts to February 2020), including massive gatherings. Besides the long-term grueling health system, this has led to a fire-like expansion of the COVID-19 infection despite all of the authorities imposed measures of mass quarantine, total/partial curfew, social distance, border/airport closure, etc. [57–59]. However, unlike Kuwait City, Baghdad city has witnessed a decline in air PM2.5 pollution due to cars as well as oil burning, associated with an inclining infection/mortality rate of 22.3% (lower than the WHO level of 24%), which has led to lower infection as well as mortality rates in Baghdad [22]. Furthermore, unexpectedly, despite the crowding being a major predictor/risk factor to incline COVID-19 infection rates, the infection as well as mortality rates have witnessed a significant decrease in the middle and south of Iraq during 2020 post the massive gathering of the 40th Safar Arba'een religious ceremony occurring in Karbala, as compared to the northern regions, which have experienced the reverse of inclined infection as well as mortality rates [60]. Like some other countries, Iraq experienced a relatively long-term first wave before witnessing the resurgence of the second wave of infection with a relatively elevated number of infections [61], although Middle Eastern countries have exploited a modest pandemic time frame with the exception of Iran, where there was an exponential incline in the infection as well as mortality cases even after the first wave of infection. While in the Arab countries such as Saudi Arabia, Qatar, Egypt, Oman, and Iraq, the flare of the first wave starts in late spring and the beginning of summer 2020, where the rate of prevalence and fatality have inclined, followed by Palestine, Lebanon, and Jordan. However, the second wave flare has been extensively severe in some countries such as India, Turkey, Brazil, and Iraq; besides, Middle East countries has been extensively severe in some countries such as India, Turkey, Brazil, and

Iraq; besides, Middle East countries have reflected various patterns of infection, mortality, and case recovery profiles [62] that could be related in part to case reporting variability in some countries [63], the capability of the virus to mutate to a more virulent or infectious strain, leading to the emergence of a new generation of the SARS-CoV-2 virus; besides, the variation of the strength and readiness of the countries health system responses and measures [62]. In Iraq, despite the lockdown measure imposed by the authorities starting from the 28th of February 2020 and on, the outcomes have been satisfactory only in the early weeks of the epidemic [64], yet, later on, as mentioned above, the country has passed a severe first wave flare for the next months of the year that sharply declined in early October 2020. Unfortunately, shortly later, in late January 2021, the second wave of infection started and continued to the early July of the same year because, like other countries, the preventive measures are not perused perfectly as social distancing is associated with a 30% and 35% reduction in the prevalence and mortality rates, respectively [65, 66]. Besides, the various populations respond to these measures as well as health authorities instructions [67]. Iraqi perimeter countries have witnessed various prevalence and mortality profiles; for example, on October-September 2020, a prevalence rate of 475674, 107592, 336766, 17464, 4411, and 326046 infection cases in Iran, Kuwait, Saudi Arabia, Jordan, Syria, and Turkey, respectively; in Iraq, 382949. While the fatality cases/rate have been 27192 (6.48%), 628 (0.58%), 4898 (1.45%), 110 (0.63%), 207 (4.69%), and 8498 (2.61) for Iran, Kuwait, Saudi Arabia, Jordan, Syria, and Turkey, respectively; in Iraq, 9464 (2.47%), where Iraq takes the lead in the number of infections between the Arab countries of its perimeter while Syria takes the lead in mortality rate despite the lower number of fatalities compared to Iraq [38, 68, 69]. In fact, higher estimates have been reported by some authors; for example, Wang et al. (2022) have suggested 18.2 million mortalities over the globe of all ages and genders could be the victims of COVID-19, which corresponds to around 120.3 fatalities per 100,000 population by the 31st of December 2021, which have occurred since the beginning of the pandemic rather than 5.94 million. However, in some countries it may exceed 300 fatalities per 100,000 of the population, indicating that the reported mortalities constitute only a partial count of the pandemic, as the reporting varies between countries and regions over time, probably due to political interference in some instances, the impact of age, gender, and the pre-existing co-morbidity that has mutually affected the universal agreement of accusing COVID-19 of mortality by the medical community, vaccination

state, besides economical, social, and authorities measures including firm lockdowns. Thus, the total actual estimates of deaths probably were 3 to 7 folds of the reported one. In this context, the highest mortality estimate has been for Bolivia of 734.9 deaths per 100,000 of population; however, for Middle East countries, high mortality estimates have been reported: 160.5, 280.1, 114.4, 41.1, 416.2, 141.1, 132.2, 27, 46.4, 61.7, 118.6, 91.3, and 108 per 100,000 population for Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, the United Arab Emirates, and Yemen, respectively, where Iraq has come second after Lebanon in the highest deaths estimations. However, their reported mortality rates are 77.1, 36.9, 53.5, 28.5, 105, 47.5, 48.9, 10.7, 12.5, 6.6, 52.9, 21.1, and 3.3 per 100,000 of population for Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, the United Arab Emirates, and Yemen, respectively, where Iran has come second after Lebanon in the highest reported deaths. While, surprisingly, the ratio of excess mortality rate to reported COVID-19 mortality rate was low in low-income countries like Iran and Yemen (33.04) as compared to high-income countries like the USA [34, 70-73]. Among these countries, the first reported cases of the first pandemic wave in the Gulf Cooperation Council countries have been reported in late February 2020; nevertheless, the second wave started in November 2020 and peaked up in June 2021, where a greater prevalence and fatality rate have been reported [74-77]. Meanwhile, the country of greatest infection prevalence as well as mortality rate in the second wave is Bahrain [78].

Furthermore, in the early pandemic, most of the mortalities have happened within the high-income countries elderly, especially those of long-term residents in health care facilities [79]. However, according to the data of the first seven months of the pandemic, WHO has reported that the first data of death of any country is irrelevant to the first case. One of the potential explanations is a potential virus mutation to a more virulent strain, although the countries with the highest mortality rate could be the least affected if their death ratio is compared to their population. In addition, the higher the number of deaths from the first case in China, the lower the number of days from the first death, and vice versa, which is related to their prevention measures. That's why Qatar has had the lowest prevalence rate, although analyses have demonstrated that the total number of infected cases is unrelated to the date of the first reported cases and first confirmed deaths. Thus countries with a lower number of deaths since the first one in China takes longer time to report the first case as well as the first death. Studies indicate

that health authorities controlling measures and affected population immunity; thus, only 21 countries over the globe have reported more than a 5% rate of mortality; one of them is Iran (5.66%) and Yemen (28.28%), while Turkey (2.42%) and Iraq (3.565%) have mortality rates lower than 5%. Furthermore, in Iran, the first case of death is reported on the same day as its first case, although many countries haven't the first case identifying ability and have besides been unable to identify their first death. Probably some countries reported both of their first infection as well as first death cases in March 2020, as in the case of Turkey and Saudi Arabia; however, most of the countries in the world have reported their first case of infection in January/February 2020, while their first case of death was in March 2020, as in the case of Iraq, indicating a more virulent strain of the virus had been involved. Meanwhile, the early first three months of the pandemic (December 2019, January 2020, and February) have shown a weakly virulent strain with a mortality rate with a mortality rate of less than 2%. Moreover, there are around 50 days separating the first reported died cases and the first reported cases in China with regard to Iran and Iraq, around sixty days with regard to Qatar and Saudi Arabia, and around seventy days with regard to Turkey. In fact, Iran comes in the 11th position of mortality with 0.39% mortality case of population regarding country-wise reports of COVID-19 mortalities, followed by Turkey in the 18th position with 0.29% mortality case of population, followed by Iraq in the 21st position with 0.38% mortality case of population, followed by Yemen in the 133rd position with 0.01% mortality case of population of 215 countries studied that have lost one hundred thousand of lives due to COVID-19 in its first wave of spread. Nevertheless, some European high-income countries like the UK, France, and Italy have demonstrated a mortality rate exceeding 14% along with around 0.5% death cases per population despite a lower number of deaths than other countries, while the USA and Brazil take the top of the list regarding the number of deaths, knowing that the officially reported global mortality rate ranges from 0.75% to 3% [80]. Various studies have been issued studying country, region, or even location-specific mortality rates of all gender/age/co-morbidity causes of the COVID-19 pandemic using different analysis models to predict the mortality rate of each cause and make comparisons between them, particularly during the first wave of infection [81-83].

## 2. METHODOLOGY:

### 2.1 Study setting, design, and participants:

An observational retrospective cohort exploratory and descriptive analysis along with an observational cross-sectional study was conducted using the data electronic patient record of a cohort of 2129 patients resident in Thi-Qar provenance cities as well as districts. The study population including (1265) male and (864) female aged between (first month of life to 110 years old) years old of positive nasopharyngeal swap real time polymerase chain reaction (RT-PCR) positive (performed according to WHO guidelines for diagnosis of COVID-19 and it's done by the Central Laboratory of MOH in Dhi-Qar) and/or radiological features of chest CT scan as well as X-ray conformed SARS-COV.2 admitted to several the quarantine isolation health care centers/hospitals in various regions of Thi-Qar provenance in Iraq (including marshlands district, capitol of the provenance, north district of Dhi-Qar, and far north district of Dhi-Qar) to the period of (25th of February 2020 up to 22nd of March 2022) obtained from Dhi Qar Health Department/ the Directorate of public Health, Iraq. We have used these electronic medical records for each individual in order to obtain personal data, including demographic characteristics (age, sex, place of residence, and current occupation) and previous medical history (considering associated co-morbidity). Data were compiled in an inventory containing numbers of cases confirmed by the Dhi Qar Health Department/ the Directorate of public Health, Iraq as well as age, gender, associated co-morbidities (mainly cardiovascular diseases, and diabetes mellitus). The extracted observational data from the electronic medical records of the infected patients were tabulated according to the age group of each gender recorded for each region of the provenance considering the associated co-morbidity such as cardiovascular as well as diabetes (defined as glycated hemoglobin (HbA1c) 6.5% or any diagnostic mean before admission) comorbidities, then analyzed for disease prevalence according to the ethics of scientific research to elucidate the epidemiological characteristics of COVID-19. The patients of each gender were sorted according to the following age groups, including the associated co-morbidity. The sample size was based on a minimum sensitivity and specificity of 95%.

The mortality rates (MR) were calculated as the total number of COVID-19 confirmed mortalities (tm) up to (22nd of March 2022) divided by the total population (p) of the province times 100,000 calculated and evaluated according to the reporting guidelines for Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).

$$MR = \frac{tm}{p} \times 100,000$$

## 2.2 Ethical Approval:

Study approval was provided by the Institutional Review Board, University of Thi-Qar Scientific Board, University of Thi-Qar research and ethics committee (Ministry of Higher Education and Scientific Research-Iraq), and by the Central Research Committee at the Directorate General of Thi-Qar Health Services/Directorate of Public Health in the Dhi Qar Health Department. However, the use of these data was approved by the Public Health Directorate in accordance with the regulations of the Ministry of Health in Iraq in accordance with the relevant guidelines and regulations, which provide the ethical permission for data extraction and analysis.

## 2.3 Statistical analysis:

The extracted data tables were manually prepared, while the epidemic curves were prepared using Microsoft Excel sheets and functions 2017. The frequency tables were used to show the descriptive results from the study. Parameters were analyzed and categorized according to the following variables: (a) age groups, (b) gender, (c) residence, (d) diabetes mellitus, (e) cardiovascular diseases. The definition of the numerical data was determined using the frequencies and percentage (%). The statistical analysis proceeded in all groups of study; descriptive statistics were analyzed by using chi-square. The p-value  $\leq 0.01$  was considered to be significant. All analyses were performed with the statistical package for the social sciences, SPSS for Windows (version 26.0, SPSS Inc., Chicago, 111).

## 3.RESULTS:

The study population (n = 2129), including (1265, 59.4%) males and (864, 40.6%) females aged between the first month of life and 110 years old, of which (870, 40.86%) are positive nasopharyngeal swap real-time polymerase chain reaction (RT-PCR) positive (performed according to WHO guidelines for diagnosis of COVID-19 and it's done by the Central Laboratory of MOH in Dhi-Qar), yet (301, 34.6%) of the cases are along with CT scan, (1258, 59.1%) radiological features of chest CT scan as well as X-ray conformed SARS-COV.2, yet more than half (1182) are along with clinical exam evidence; however, a sole case is relied upon clinical examination. Remarkably, both gender as well as method of examination are statistically of no significance in specifying the mortality rate (p\_value: 0.77) as shown in both table (1) and figure (1), yet there is a very highly significant relation (P\_value < 0.0001) between the mortality rate and method of diagnosis. Of the mortalities, solely two victims are vaccinated with the AstrZeneca® vaccine, while 2127, 99.9%, were unvaccinated. CT scan can be considered as disease severity; thus, at least 1559 (73.23%) had been admitted with severe cases of

COVID-19.

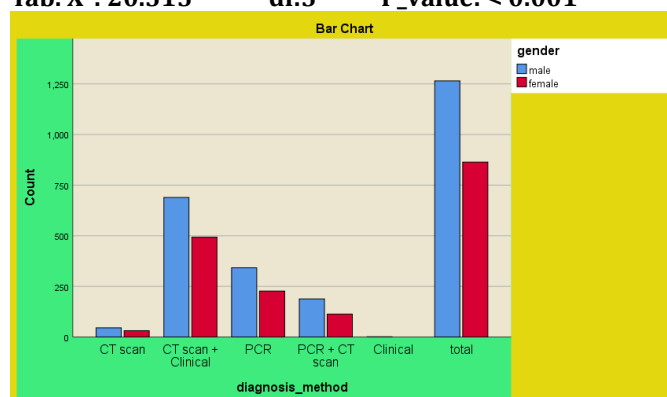
In addition, the calculated mortality rate was 91.73 deaths/100,000, or 9.173/million, of population; however, the case fatality rate percent was 2.067%. Moreover, there was a significant relation between mortalities, gender, and residence district (p\_value: 0.022) as shown in table (2) and figure (2), where males and females of both Marshlands/east and intermediate north districts of Thi-Qar have the greatest contribution to total fatalities; meanwhile, there was no significant relation between mortalities, gender, and city of residence as shown in both tables (3), where both Al-Nasiriya followed by Al-Shatra cities have the greatest contribution to the total number of fatalities as shown in figure (3), yet there is a very highly significant relation between the district of residence and mortality rate. Furthermore, regarding the influence of gender and age group on fatality distribution and rate, there was no significant relation between mortalities, gender, and age group (p\_value: 0.09) as shown in table (4), where the age group of over 65 years old has the greatest contribution to the total fatalities as shown in figure (4). In addition, there was no significant relation between mortalities, age group, and the district of residence (p\_value: 0.898) as shown in Table 5, yet the age group of over 65 years old has the greatest contribution to the total number of mortalities generally in the four districts, although it has the lowest count in the far north district as shown in Figure 5. However, there was a highly significant relation between mortalities, age group, and city of residence as (p\_value: 0.003) shown in table (6), where again the age group of over 65 years old has the greatest contribution to the total fatalities while both Al-Nasiriya, followed by Al-Shatra, as cities of residence have the greatest contribution to the total number of fatalities as shown in figure (6). Nevertheless, regarding the contribution of the existence of accompanying disease comorbidity in both genders of the infected patients to the total fatalities, there was no significant relation between mortalities, gender, and comorbidity (p\_value: 0.717) as shown in table (7), although the co-existence of cardiovascular diseases, diabetes, and respiratory diseases combined has a significantly greater contribution to the total fatalities, as shown in figure (7) on the one hand. On the other hand, there was a very significant relationship between mortality, age group, and comorbidity (p\_value: < 0.001). Nevertheless, the co-

existence of cardiovascular diseases, diabetes, and respiratory diseases in both age groups 55-65 and over 65 years old has a significantly greater contribution to the total fatalities, as shown in figure (8). Finally, of the total number of COVID-19 infections in Thi-Qar during the study interval (n = 103015), the fatality rate has not exceeded 2.07%.

**Table (1):** the provenance mortalities according to gender and diagnostic method.

Method		Gender		Total
		Female	Male	
CT scan	Count	31	45	76
	%	40.8%	59.2%	100.0%
CT scan + Clinical	Count	493	689	1182
	%	41.7%	58.3%	100.0%
PCR	Count	227	342	569
	%	39.9%	60.1%	100.0%
PCR + CT scan	Count	113	188	301
	%	37.5%	62.5%	100.0%
Clinical	Count	0	1	1
	%	0.0%	100.0%	100.0%
Total	Count	864	1265	2129
	%	40.6%	59.4%	100.0%

Gender and diagnosis method Cal.X<sup>2</sup>: 2.572  
 Tab.X<sup>2</sup>:5.989 df:5 p\_value: 0.776 (> 0.2)  
 Total and diagnosis method Cal.X<sup>2</sup>: 4874.27  
 Tab. X<sup>2</sup>: 20.515 df:5 P\_value: < 0.001



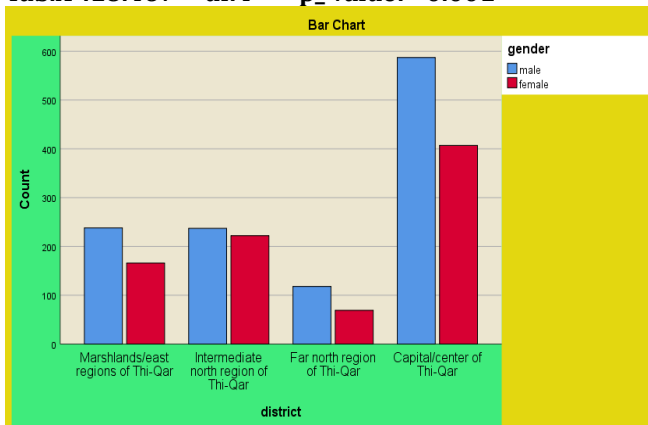
**Figure (1):** Di-Qar governorate mortalities according to gender along with the method of diagnosis.

**Table (2):** fatality distribution according to district of residence versus gender.

District		Gender		Total
		Female	Male	
Marshlands/east regions of Thi-Qar	Count	166*	238*	404*
	% of total provenance	41.09%	58.91%	100%

Intermediate north region of Thi-Qar	Count	222*	237*	544*
	% of total provanance	40.81	59.19	100%
Far north region of Thi-Qar	Count	69	118	187
	% of total provanance	36.9%	63.1%	100%
Capital/center of Thi-Qar	Count	407*	587*	994*
	% of total governorate	40.95%	59.05%	100%
Total of governorate	Count	864	1265	2129
	%	40.58%	59.42%	100%

Gender and district of residence Cal.X<sup>2</sup>: 11.429  
 Tab.X<sup>2</sup>:11.143 df:4 p\_value: 0.022 (> 0.01)  
 Total and district of residence Cal.X<sup>2</sup>: 2804.938  
 Tab.X<sup>2</sup>:18.467 df:4 p\_value: <0.001



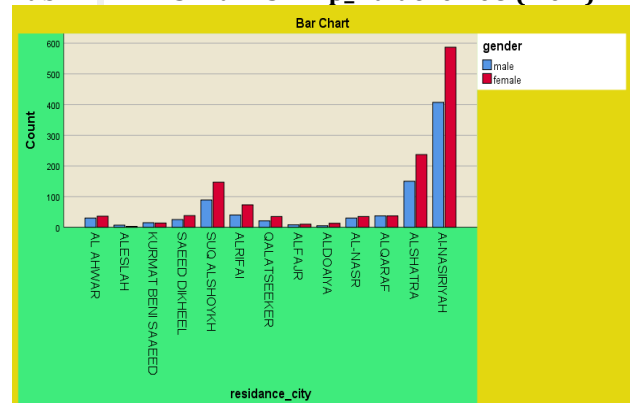
**Figure (2):** fatalities according to district of residence and gender of the patient.

**Table (3):** fatality distribution according to the city of residence versus gender.

Total districts of Thi-Qar				
Districts		Female	Male	Total
AL AHWAR	Count	30	36	66
	%	45.45%	54.55%	100%
ALES LAH	Count	7	3	10
	%	70%	30%	100%
KURMAT BENI SAAEED	Count	15	14	29
	%	51.72%	48.28%	100%
SAEED DIKHEEL	Count	25	38	63
	%	39.68%	60.32%	100%
SUQ-ALSHOYKH	Count	89	147	236
	%	37.71%	62.29%	100%
ALRIFAI	Count	40	73	113
	%	35.4%	64.6%	100%

QALATSEEKE	Count	21	35	56
	%	37.5%	62.5%	100%
ALFAJR	Count	8	10	18
	%	44.44%	55.56%	100%
ALDOAIYA	Count	5	13	18
	%	27.78%	72.22%	100%
AL-NASR	Count	30	35	65
	%	46.15%	53.85%	100%
ALQARAF	Count	37	37	74
	%	50%	50%	100%
ALSHATRA	Count	150	237	387
	%	38.76%	61.24%	100%
Al-Nasiriya	Count	407	587	994
	%	40.95%	59.05%	100%
TOTAL	Count	864	1265	2129
	%	40.58%	59.42%	100%

Gender and city of residence Cal.X<sup>2</sup>: 13.521  
 Tab.X<sup>2</sup>: 11.143 df:13 p\_value: 0.408 (> 0.2)



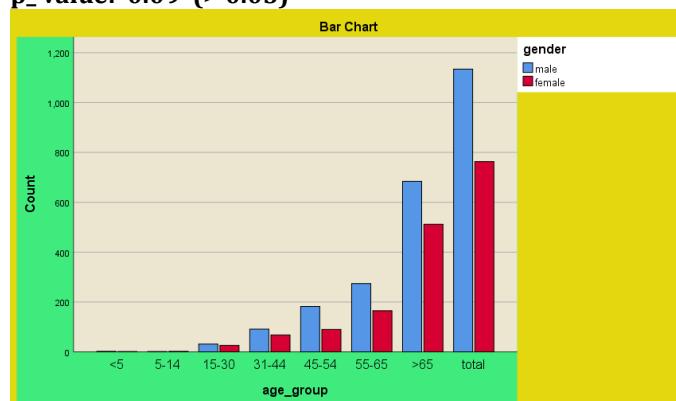
**Figure (3):** fatalities according to the city of residence and gender of the patient.

**Table (4):** fatality distribution according to the age group and gender.

Age Group		Gender		Total
		Female	Male	
<5	Count	1	2	3
	%	33.33%	66.67%	100%
5-14	Count	2	1	3
	%	66.67%	33.33%	100%
15-30	Count	26	31	57
	%	45.61%	54.39%	100%
31-44	Count	68	91	159
	%	42.77%	57.23%	100%
45-54	Count	90	182	272
	%	30.09%	66.91%	100%
55-65	Count	165	274	439
	%			

65	%	37.59%	62.41%	100%
>65	Count	512	684	1196
	%	42.81%	57.19%	100
Total	Count	763	1134	2129
	%	35.84%	53.26%	100%

Cal.X<sup>2</sup>: 12.326      Tab.X<sup>2</sup>: 12.017      df: 7  
p\_ value: 0.09 (> 0.05)

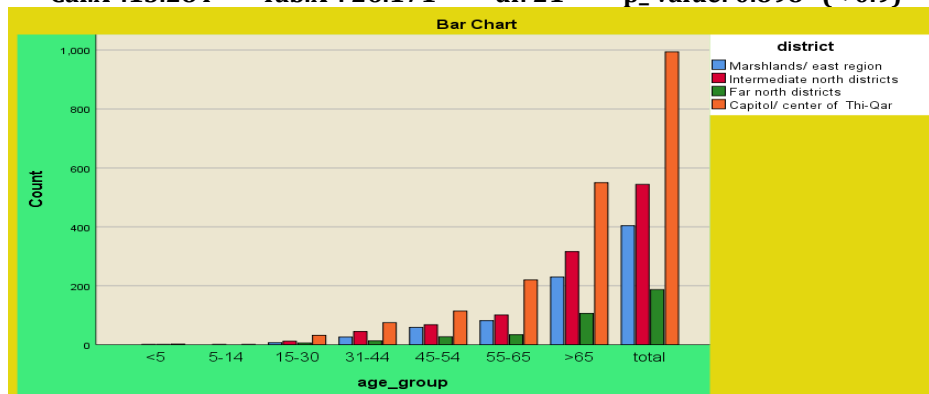


**Figure (4):** fatalities according to age group and gender of the patient.

**Table (5):** fatality distribution according to the age group versus the district of residence.

Age group (years)		District				Total
		Marshlands/ east region	Intermediate north districts	Far north districts	Capitol/ center of Thi-Qar	
<5	Count	0	1	1	2	4
	%	0%	25%	25%	50%	100%
5-14	Count	0	1	0	1	2
	%	0%	50%	0%	50%	100%
15-30	Count	7	12	6	32	57
	%	12.28%	21.05%	10.53%	56.14%	100%
31-44	Count	26	45	13	75	159
	%	16.35%	28.3%	8.18%	47.17%	100%
45-54	Count	59	68	27	114	268
	%	22.02%	25.37%	10.08%	71.7	100%
55-65	Count	82	101	34	220	437
	%	18.8%	23.11%	7.78%	50.34%	100%
>65	Count	230	316	106	550	1202
	%	19.13%	26.29%	8.82%	45.76%	100%
Total	Count	404	544	187	994	2129
	%	18.98%	25.55%	8.78%	46.69%	100%

Cal.X<sup>2</sup>:13.284      Tab.X<sup>2</sup>: 26.171      df: 21      p\_ value: 0.898 (< 0.9)

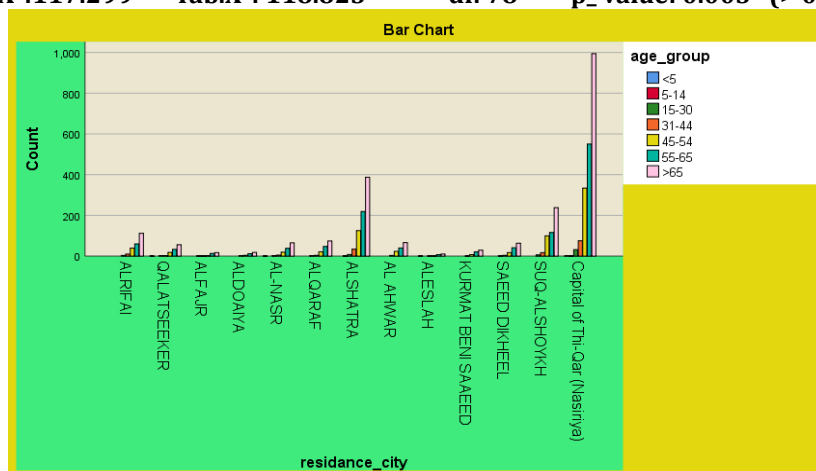


**Figure (5):** fatalities according to age group and the district of residence.

**Table (6):** fatality distribution according to the age group versus the city of residence.

Residence city	Entry	Age group (years)							Total
		> 5	5-14	15-30	31-44	45-54	55-65	> 65	
ALRIFAI	Count	0	0	3	10	16	23	60	112
	%	0.0%	0.0%	2.68%	8.93%	14.29%	20.54%	53.57%	100%
QALATSEEKER	Count	1	0	2	2	10	8	33	56
	%	1.79%	0.0%	3.57%	3.57%	17.86%	14.29%	58.93%	100%
ALFAJR	Count	0	0	1	1	1	1	13	17
	%	0.0%	0.0%	5.88%	5.88%	5.88%	5.88%	76.47%	100%
ALDOAIYA	Count	0	0	0	2	2	2	12	18
	%	0.0%	0.0%	0.0%	11.11%	11.11%	11.11%	66.67%	100%
AL-NASR	Count	1	0	2	5	10	9	38	65
	%	1.54%	0.0%	3.08%	7.69%	15.38%	13.85%	58.46%	100%
ALQARAF	Count	0	0	2	4	5	16	47	74
	%	0.0%	0.0%	2.7%	5.41%	6.76%	21.62%	63.51%	100%
ALSHATRA	Count	0	1	8	34	51	74	219	387
	%	0.0%	0.26%	2.07%	8.79%	13.18%	19.12%	56.59%	100%
AL AHWAR	Count	0	0	0	3	10	13	40	66
	%	0.0%	0.0%	0.0%	4.55%	15.15%	19.7%	60.61%	100%
ALES LAH	Count	0	1	0	1	1	0	7	10
	%	0.0%	10%	0.0%	10%	10%	0.0%	70%	100%
KURMAT BENI SAAEED	Count	0	0	0	1	1	6	21	29
	%	0.0%	0.0%	0.0%	3.45%	3.45%	20.69%	72.41%	100%
SAEED DIKHEEL	Count	0	0	1	4	7	10	41	63
	%	0.0%	0.0%	1.59%	6.35%	11.11%	15.87%	65.08%	100%
SUQ-ALSHOYKH	Count	0	0	6	17	40	59	116	238
	%	0.0%	0.0%	2.59%	7.33%	17.24%	22.84%	50.0%	100%
Capital of Thi-Qar (Nasiriya)	Count	2	1	32	75	114	220	550	994
	%	0.2%	0.1%	3.22%	7.55%	11.47%	22.13%	55.33%	100%
Total of governorate	Count	4	3	57	159	268	441	1197	2129
	%	0.19%	0.14%	2.68%	7.47%	12.59%	20.715	56.22%	100%

Cal.X<sup>2</sup>:117.299 Tab.X<sup>2</sup>: 118.823 df: 78 p\_value: 0.003 (> 0.005)



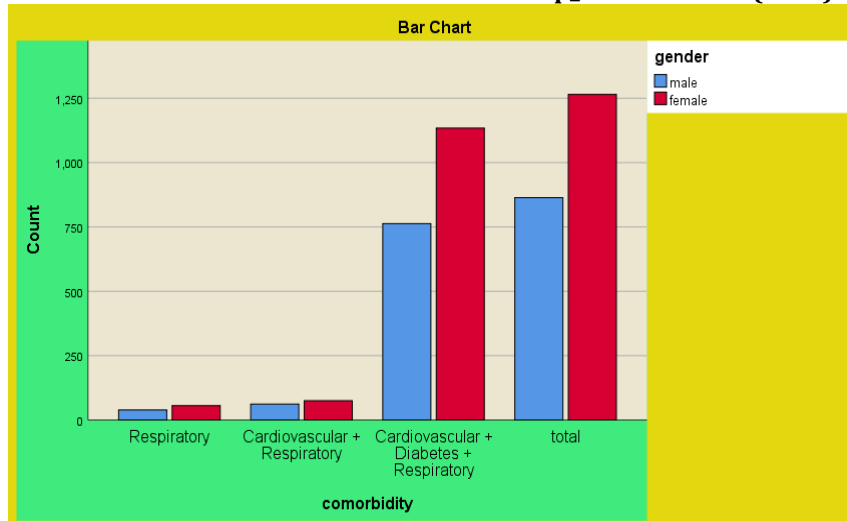
**Figure (6):** fatalities according to age group and the district of residence.

**Table (7):** contribution of comorbidities in both patients' genders to the total fatalities.

Comorbidity	Gender	Total		
		Female	Male	
Cardiovascular	Count	0	0	0
	%	0%	0%	0%
Diabetes	Count	0	0	0
	%	0%	0%	0%
Respiratory	Count	39	56	95
	%	41.05%	58.95%	100%
Cardiovascular + Diabetes	Count	0	0	0

	%	0%	0%	0%
<b>Cardiovascular + Respiratory</b>	<b>Count</b>	<b>62</b>	<b>75</b>	<b>137</b>
	<b>%</b>	<b>45.26%</b>	<b>54.74%</b>	<b>100%</b>
<b>Diabetes + Respiratory</b>	<b>Count</b>	<b>0</b>	<b>0</b>	<b>0</b>
	<b>%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>
<b>Cardiovascular + Diabetes + Respiratory</b>	<b>Count</b>	<b>763</b>	<b>1134</b>	<b>1897</b>
	<b>%</b>	<b>40.22%</b>	<b>59.79%</b>	<b>100%</b>
<b>Total</b>	<b>Count</b>	<b>864</b>	<b>1265</b>	<b>2129</b>
	<b>%</b>	<b>40.58%</b>	<b>59.42%</b>	<b>100%</b>

Cal.X<sup>2</sup>:1.352 Tab.X<sup>2</sup>: 0.216 df: 3 p\_value: 0.717 (> 0.9)



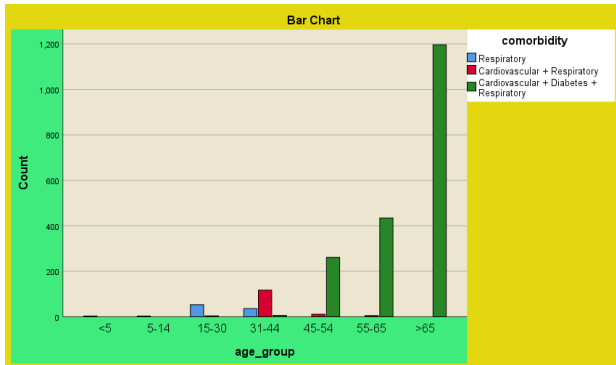
**Figure (7):** The impact of comorbidities existence in both patients' genders on the total fatalities.

**Table (8):** contribution of comorbidities in both patients' age groups to the total fatalities.

Age group (years)		Comorbidities							Total
		Cardiovascular	Diabetes	Respiratory	Cardiovascular + Diabetes	Cardiovascular + Respiratory	Diabetes + Respiratory	Cardiovascular + Diabetes + Respiratory	
< 5	Count	0	0	3	0	0	0	0	3
	%	0.0%	0.0%	100%	0.0%	0.0%	0.0%	0.0%	100%
5-14	Count	0	0	3	0	0	0	0	3
	%	0.0%	0.0%	100%	0.0%	0.0%	0.0%	0.0%	100%
15-30	Count	0	0	53	0	4	0	0	57
	%	0.0%	0.0%	92.98%	0.0%	7.02%	0.0%	0.0%	100%
31-44	Count	0	0	36	0	117	0	6	159
	%	0.0%	0.0%	22.64%	0.0%	73.58%	0.0%	3.77%	100%
45-54	Count	0	0	0	0	11	0	261	272
	%	0.0%	0.0%	0.0%	0.0%	4.04%	0.0%	95.96%	100%
55-65	Count	0	0	0	0	5	0	434	439
	%	0.0%	0.0%	0.0%	0.0%	1.14%	0.0%	98.86%	100%

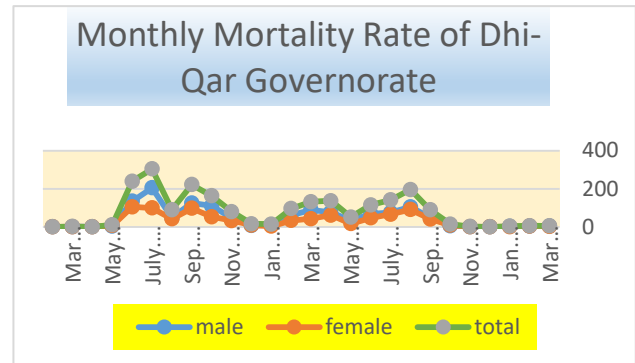
> 65	Count	0	0	0	0	0	0	1196	1196
	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%	100%
Total	Count	0	0	95	0	137	0	1897	2129
	%	0.0%	0.0%	4.46%	0.0%	6.43%	0.0%	89.1%	100%

Cal.X<sup>2</sup>: 2747.742 Tab.X<sup>2</sup>: 36.123 df: 14 p\_value: (< 0.001)



**Figure (8):** The impact of comorbidities existence among age groups of the patient on the total fatalities.

Furthermore, regarding the monthly COVID-19 mortality victims reported in Thi-Qar governorate reported in table (9) have revealed approximately 92 deaths/100,000 of the population, meanwhile, according to figure (9) two pairs of infection murdering peaks escalations, one of them during the summer starting in May of each year, which is higher than the autumn wave that started in August within the first year of the pandemic and a previous winter-to-spring prior wave in the second year. However, two characteristic troughs of minimum to no mortalities are being shown within the same time interval in the two years starting each October (coinciding/just after the end of the imam Al-Hussein Bin Ali Ziyarat AL-Arbaeen rituals that had involved several hundred thousand to millions of the pilgrims in close proximity to each other) and continue to around a three-month interval in contrast to what was expected of gathering and approximation negative impact on COVID-19 infection expansion/acquisition. In addition, the remarkable difference in monthly mortality pattern between the year 2020 of the pandemic and 2021 encourages presuming the arising/involvement of a new SARS-CoV-2 virus strain in the second year, although it was probably less virulent than that of the first one. However, there is no significant correlation between the mortalities and the date of mortality among the two genders.



**Figure (9):** monthly mortality pattern in Thi-Qar governorate during the two years (2020 and 2021) of the pandemic.

**Table (9):** monthly mortalities in Thi-Qar governorate along two years of COVID-19 pandemic.

Monthly mortality rate of Dhi-Qar governorate				
N o.	Month	Male	Female	Total
1	Feb.2020	0	0	0
2	March.2020	1	1	2
3	April.2020	1	0	0
4	May.2020	4	7	11
5	June.2020	13	105	239
6	July.2020	20	99	304
7	Aug.2020	48	42	90
8	Sep.2020	12	97	222
9	Oct.2020	11	53	163
10	Nov.2020	47	33	80
11	Dec.2020	7	9	16
12	Jan.2021	11	3	14
13	Feb.2021	62	34	96
14	March.2021	89	43	132
15	April.2021	76	61	137
16	May.2021	34	17	51

			7	
17	June.2021	68	4	11
			7	5
18	July.2021	75	6	14
			6	1
19	Aug.2021	10	9	19
		5	1	6
20	Sep.2021	48	4	89
			1	
21	Oct.2021	6	8	14
22	Nov.2021	1	1	2
23	Dec.2021	0	0	0
24	Jan.2022	2	1	3
25	Feb.2022	3	3	6
26	March.2022	3	2	5

Cal.X<sup>2</sup>: 37.52 Tab.X<sup>2</sup>: 38.076 df: 23 p\_ value: 0.029 (>0.025)

Furthermore, dividing the study population in age groups of 15 years for those of ages (0-44 years old) and 20 years and more for those of 45 years old has revealed a very significant relation between the victims age group and co-morbidities (p-value < 0.001), as shown in table (10) where the existence of cardiovascular + diabetes + respiratory diseases combination comorbidity is the most effective contributing factor to the observed mortalities figure (10), while there is no significant correlation between the victims age group and gender, residence city, and residence district with corresponding p-values of 0.069, 0.939, and 0.375, respectively, as shown in tables (11, 12, and 13).

**Table (10):** contribution of comorbidities in both patients' age groups to the total fatalities by the alternative age group dividing.

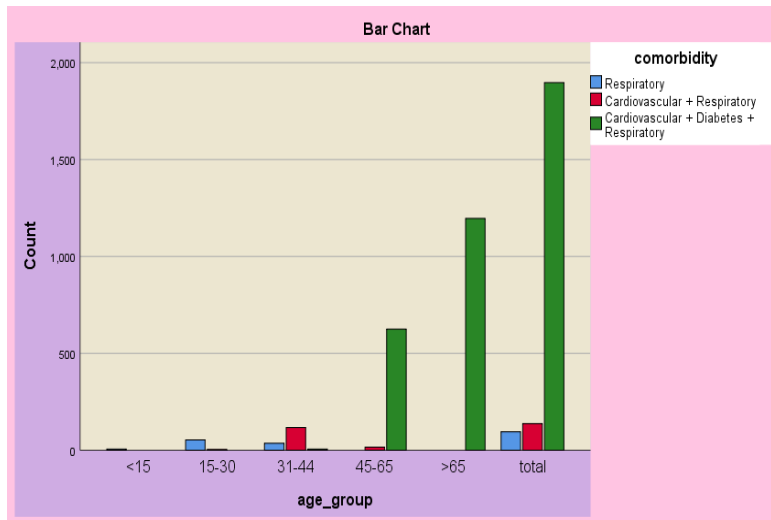
Age group (years)		Comorbidities						Total	
		Cardiovascular	Diabetes	Respiratory	Cardiovascular + Diabetes	Cardiovascular + Respiratory	Diabetes + Respiratory		Cardiovascular + Diabetes + Respiratory
< 15	Count	0	0	6	0	0	0	0	6
	%	0.0%	0.0%	100%	0.0%	0.0%	0.0%	0.0%	100%
15-30	Count	0	0	53	0	4	0	0	57
	%	0.0%	0.0%	92.98%	0.0%	7.02%	0.0%	0.0%	100%
31-44	Count	0	0	36	0	117	0	6	159
	%	0.0%	0.0%	22.64%	0.0%	73.59%	0.0%	3.77%	100%
45-65	Count	0	0	0	0	16	0	695	711
	%	0.0%	0.0%	0.0%	0.0%	4.04%	0.0%	95.96%	100%
> 65	Count	0	0	0	0	0	0	1196	1196
	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%	100%
Total	Count	0	0	95	0	137	0	1897	2129
	%	0.0%	0.0%	4.46%	0.0%	6.44%	0.0%	89.1%	100%

Cal.X<sup>2</sup>: 2696.159

df: 10

Tab.X<sup>2</sup>: 29.588

p\_ value: < 0.001



**Figure (10):** The impact of comorbidities existence among age groups of the patient on the total fatalities using an alternative age group dividing.

**Table (11):** fatality distribution according to the age group and the city of residence using an alternative age group dividing.

Residence city	Entry	Age group (years)					Total
		> 15	15-30	31-44	45-65	> 65	
ALRIFAI	Count	0	3	10	39	60	112
	%	0.0%	2.68%	8.93%	34.82%	53.57%	100%
QALATSEEKER	Count	1	2	2	18	33	56
	%	1.79%	3.57%	3.57%	32.14%	50%	100%
ALFAJR	Count	0	1	1	2	13	17
	%	0.0%	5.88%	5.88%	11.76%	76.47%	100%
ALDOAIYA	Count	0	0	2	4	12	18
	%	0.0%	0.0%	11.11%	22.22%	66.67%	100%
AL-NASR	Count	1	2	5	19	38	65
	%	1.54%	3.08%	7.69%	29.23%	58.46%	100%
ALQARAF	Count	0	2	4	21	47	74
	%	0.0%	2.7%	5.41%	28.38%	63.51%	100%
ALSHATRA	Count	1	8	34	125	219	387
	%	0.26%	2.07%	8.79%	32.3%	56.59%	100%
AL AHWAR	Count	0	0	3	23	40	66
	%	0.0%	0.0%	4.55%	34.85%	60.61%	100%
ALES LAH	Count	1	0	1	1	7	10
	%	10% <sup>00</sup>	0.0%	10%	10%	70%	100%
KURMAT BENI SAAEED	Count	0	0	1	7	21	29
	%	0.0%	0.0%	3.45%	24.14%	72.4%	100%
SAEED DIKHEEL	Count	0	1	4	17	41	63
	%	0.0%	1.59%	6.35%	26.98%	65.08%	100%
SUQ-ALSHOYKH	Count	0	6	17	99	116	238
	%	0.0%	2.52%	7.14%	41.6%	48.74%	100%
Capital of Thi-Qar (Nasiriya)	Count	3	32	75	334	550	994
	%	0.3%	3.22%	7.55%	33.6%	55.33%	100%
Total of governorate	Count	7	57	159	709	1197	2129
	%	0.33%	2.68%	7.47%	33.3%	57.22%	100%

Cal.X<sup>2</sup>: 68.014      df:65      Tab.X<sup>2</sup>: 74.351      p\_ value: 0.375 (> 0.2)

**Table (12):** fatality distribution according to the age group versus gender using an alternative age group dividing.

Age Group		Gender		Total
		Female	Male	
> 15	Count	3	3	6
	%	50%	50%	100%
15-30	Count	26	31	57
	%	45.61%	54.39%	100%
31-44	Count	68	91	159
	%	42.77%	57.23%	100%
45-65	Count	255	456	711
	%	35.86%	64.14%	100%
>65	Count	512	684	1196
	%	42.81%	57.19%	100%
Total	Count	763	1134	2129
	%	35.84%	53.26%	100%

Cal.X<sup>2</sup>: 10.224      df:5      Tab.X<sup>2</sup>: 11.07      p\_ value: 0.069 (> 0.05)

**Table (13):** fatality distribution according to the age group versus the district of residence using an alternative age group dividing.

Age group (years)		District				Total
		Marshlands/ east region	Intermedia te north districts	Far north districts	Capitol/ centre of Thi-Qar	
<15	Count	0	2	1	3	6
	%	0%	33.33%	16.67%	50%	100%
15-30	Count	7	12	6	32	57
	%	12.28%	21.05%	10.53%	56.14%	100%
31-44	Count	26	45	13	75	159
	%	16.35%	28.3%	8.18%	47.17%	100%
45-65	Count	141	169	61	334	705
	%	20%	23.97%	8.65%	47.38%	100%
>65	Count	230	316	106	550	1202
	%	19.13%	26.29%	8.82%	45.76%	100%
Total	Count	404	544	187	994	2129
	%	18.98%	25.55%	8.78%	46.69%	100%

Cal.X<sup>2</sup>: 7.588      df:15      Tab.X<sup>2</sup>: 6.262      p\_ value: 0.939 (> 0.975)

#### 4.DISCUSSION:

As predictors of magnitude of disease, severity risk and fatality, case fatality ratio, and cause-specific mortality rate and/or incidence rate, they have been thoroughly studied for the sake of effective public health, prevention, and treatment intervention [84]. As compared to western countries, Iraq has lower mortality magnitudes [85], yet the COVID-19 mortality rate has diverged across the different

continents of the world, particularly among the League of Arab States countries [86]. In fact, have claimed that Arabs have greater resistance to the Corona virus, which is genetically related to SNPS [85]. Meanwhile, have reported that among the four studied Middle East countries, Iraq occupies the fourth position after Iran, Bahrain, and Lebanon, with case fatality rate ratios of 7.3, 5.4, 2.8, and 0.4%, respectively, where Iraq has the greatest case

fatality ratio. Meanwhile, Iraq comes second after Lebanon with respect to a case-specific mortality rate/million ratio (CSMR/million) of 5.0, 48.5, 49.7, and 129.1 for the four countries, Lebanon, Iraq, Bahrain, and Iran, respectively [86]. However, in a later one-year-long study they reported that the case fatality rate is time-dependent as it has exhibited a decline from 9.6% on 26 March 2020 to 1.9% on late February 2021, yet, in comparison to 18 Arab League countries (including 10 Middle East countries) plus Iran, Iraq had come in the 12th position among the Arab League countries and the 10th position of the Middle East countries with a case fatality rate of 1.97, besides demonstrating a case-specific mortality rate of 332.4/million [62]. However, the picture and mortality pattern are changing over time. In fact, Alyassen (2020) has reported that the high case fatality ratio and incidence rate in Iraq and Iran follow a similar pattern [87], although it was attributed to health system limitations, besides the sum of severe/critical cases [88]. Iraq had come in the second place of the higher case fatality ratio among 9 countries, including three Middle Eastern countries (Lebanon, Bahrain, and Iran), while it came in sixth place with regard to the case-specific mortality ratio per million [87]. Meanwhile, has reported that Iraq occupies the third place with regard to the case fatality rate of the Arabic Asian of the EMRO countries after Yemen and Syria, with an average case fatality rate of 6.3%, which is much better than the global one in 2020 [6].

The north African countries have demonstrated mortality rates that vary from those of the Middle East. have reported that the highest mortality rate has been reported in Lebanon, with an average mortality rate of 416.2 deaths/100,000 of population; however, it approaches 280.1/100,000 of population in Iraq [70]. However, although it has been reported that curing rates also varied between countries where Iraq has reflected 61% less curing rate than the other three Middle East countries, Iran, Turkey, and Jordan, while higher than other neighboring Arab Middle East countries with the exception of Saudi Arabia (fatality rate of 0.5%), Iraq still has a lower reported mortality rate (than Iran, for example) of 4%, of which 68% are males and 31% are females [89]. Frankly speaking, although vaccination is not covered that may govern mortality rates differences between the two neighboring countries, Iraq and Iran, yet have postulated involvement of the immune system/genetic

variation between the two countries, although there is no ethnicity difference between Arabs of Khuzestanis (Iran) and Arabs of Iraq, have supposed that the Iraqis' better hygienic level lies behind their lower mortality rates [90, 91] as the Iraqi large gathering religious Shia ceremonies have positively contributed to immune defense development against the new respiratory infection as proposed [90]. In this context, WHO has reported a lower mortality rate per million of population in Iraq as compared to Iran, despite the higher level of comorbidities in Iraq, as reported (2021) [92]. In contrast, a later short-term (21 February to 30 April 2020) study of had estimated a 3% national case fatality rate in Iraq [93]. In fact, have reported governorate specific fatality/ mortality rates during one year case fatality rate study of COVID-19 during the period of February 24, 2020 to February 23, 2021, where the overall case fatality rate of Iraq was 1.97% case mortality rate and 347.29/Million case specific mortality rate ratio, meanwhile, Thi-Qar have demonstrated the second case fatality rate (after Sulaimaniyah) of 3.13% and mortality rate of 404.1/million or 40.4/100,000 of population [30] which is much less than (less than half of) that calculated by our 2 years duration study contributing to the earlier reported high case fatality rate of Iraq, while, Dohuk, Nineveh, Erbil, and Wasit have low case fatality rate. Thus, special correlation is the cornerstone that governs case fatality rate variations between the provenances of Iraq. Meanwhile, [85] have reported that high incidence along with mortality rates are reported in provenances of high population: Baghdad, Najaf, and Basra, which contain around 24% of the Iraqi population. Although a low prevalence rate does not mean a low mortality rate, as encountered with the far western part of Iraq, yet low prevalence rate provenance rate eastern provenances, Diyala and Maysan have demonstrated an unexpectedly high mortality rate on one hand. On the other hand, the high prevalence rate provenance of Al-Najaf has exploited unexpectedly low case fatality, which was not the case with Baghdad, which has both high prevalence as well as case fatality rates [85], where the peak mortality rates have been reported on 2-Oct-2020 and 8-Jun-2020, whereas at the end of 2020 the Baghdad mortality rate approaches 2%. However, this higher mortality rate has been in part attributed to high air pollution with PM2.5 [22], despite Rahm (2021) having supposed that as the incidence rate inclines, the mortality rate inclines, leading to its contribution to the case fatality rate

increase such that countries have 15 fatalities or more per 10 thousand of population [94], which is not encountered by our calculations of Thi-Qar during our study period extending from February 2020 up to April 2022. Although the case fatality rate is a bad reflection of the disease severity or mortality threat [94].

Furthermore, have reported in a small study extended from 1 March up to May 21, 2020, that the mortalities (1.1% with a lower number of deaths) in the first wave of the pandemic in the Kurdistan Region, north of Iraq, were probably due to SARS-CoV-2 virus mild stain; however, a 3.73% mortality rate happens in the second wave [95, 96], which increases with age advancing. Besides, both of the mortality as well as survival rates are found to be significantly unrelated to both gender and age, along with a significant relation to ages above 60 years old in this region [96], as encountered in our study findings. However, in another small cross-sectional study (n = 204 patients) conducted in the West Erbil Emergency Hospital, Kurdistan region of Iraq, during the second wave (from the 10th of August to the 19th of November 2020) of the pandemic, a 31.1% mortality rate was observed [97], which is too much greater than our study finding. In addition, have reported in a short 6-month study extended from the 24th of February to the 8th of August, 2020, in the Kurdistan area, Sulaymaniyah Governorate came first in fatality cases, followed by Erbil, Halabja, and Duhok, with mortalities of (470), (219), (12), and (11) respectively, according to the Iraqi Ministry of Health reports [98]. Other short-term nine months (from February to November, 2020), conducted by Al-Imam et al. (2020) have shown that Iraq came in the eighth position (mortality rate 2.3%) among 13 countries included in the study and third among 7 Middle East countries, including Iraq, Iran, UAE, Jordan, Saudi Arabia, Qatar, Kuwait, and Lebanon, with the respect of order of inclining mortality rate. In fact, the mortality rate had declined with time with some inclining fluctuations in October; however, the highest mortality rate was in Sulaymaniyah (5.2%), and the lowest was in Wasit (1.32%); meanwhile, Thi-Qar came in the third position (3.39% mortality rate) with the respect of the order of declining mortality rate among the Iraqi governorates [69]. Later on, in a 17-month (extended from March 2020 to July 2021) study conducted according to the Iraqi Ministry of Health and its institution data base, an overall country mortality rate of 1.2% with the greatest mortality cases in Sulaimaniyah governorate in the North, as

compared to Diyala, Anbar, and Wasit in the middle region of Iraq [99].

However, in a small short-term study (from April to August 2020) conducted in Anbar Province, including 85 (70%) cases, the case fatality rate was high (16% and it was age dependent as the greater bulk of mortalities was among the geriatrics, and most of them were non-smokers; however, the majority was of overweight to morbidly obese patients (70%). In addition, as case severity increases, the mortality rate increases, according to the CT scan of the patients (85%); however, it was statistically unrelated to the patients' gender [29], which is in coincidence with our study, where the case severity was 73.23% of the fatalities according to the CT scan, besides being statistically unrelated to gender, although our study has involved around 40% positive RT-PCR cases. A discrimination between the mortality trend between the districts of Iraq was reported by Habib et al. (2020) indicated by the case fatality rates of 9.4%, 2.1%, 16.7%, and 8.7% in the Southern, Northern, Eastern, and Capital of Iraq, respectively [100]. Interestingly, in the case of our study, the case fatality rate was much lower than that reported for Iraq in [63,89,30,93] earlier discussed studies but comparable to [62] longer study, although much lower specific case mortality ratio/million than all of them, yet still male to female populations are close to what is reported in the [93] study. Although, in a very small study regarding COVID-19 patients admitted to Baghdad Teaching Hospital, Baghdad, in the second wave of the pandemic between October and December 2020, reported [101] including 31 males and 37 females, of whom 7 were unsurvived (4 males and 3 females), the mortality rate was 10.29%, which is higher than what is demonstrated by our study, while male fatalities constitute 57.1% while female fatalities constitute 42.9%, and all in the age group above 40 years old [101], which is in accordance with our study findings. Furthermore, a slightly greater fatality rate (2.7%) as compared to our study findings have been reported in a small, short-term (from August to October 2020) study conducted in Samara General Hospital, Salahaddin Province, Iraq [102]. Meanwhile, have reported that in the Middle East, Baghdad had the greatest infection cases as well as mortalities, where according to the official reports of the Iraqi ministry of health, at the end of 2020, the fatality rate was 2%, while at the end of 2021, the fatality rate approaches 1% [22], which is as much as what is observed by our study with

respect to the year 2020 while less than that observed by 2021. In addition, short term study conducted in Baghdad during the first wave including cases in the interval of 23rd of February to the 31st of May 2020 by the mortality rate was 3.8% [3] which is much than what is observed in our study, however, unlike our study males mortalities was much greater (93.33%) than females (6.67%), in addition, unlike our study no fatalities was below the age of 25 years old while the greatest proportion of fatalities had occurred in the age group of 56-60 (>65 years old) constituting 64.3% of the total mortalities indicating that those in the late fifties of age are of greatest mortality rate, hence reflecting obviously different pattern of infection prevalence and mortalities. Remarkably, have attributed the enhancement of infection incidence/mortalities during the month may to the elevation of weather temperature, like what is proposed which was found to decline with time [3, 103], while the marked difference in mortalities between males and females is due to genetic factors related to the X chromosome and estrogen that contribute to the immune system response/component variation [3]. Interestingly, in a very short 2-month comparative study conducted, it was reported that Baghdad encountered 2923 mortality cases (2%) that started with the first 2 deaths on the 4th of March 2020, which had increased with time as compared to 934 (1%) in Kuwait, which started with the first death on the 4th of April 2020, which was encountered with Baghdad, which is assumed to be population density and cases number dependent [22], which may explain the lower mortality cases of Thi-Qar observed in our studies despite the close mortality rate despite the shorter study interval of Halos et al. 2020.

Moreover, in the neighboring provenance of Basra, a small (n = 152 cases) short-term first wave (from the 24th of February to the 10th of April, 2020) had been conducted and found that the mortality rate was 9.9% (35 years old), 50% of them of ages 70 years old [100], which is unlike what was observed by our study; however, mortalities vary with age group, gender, and residence city like our study in Thi-Qar. In addition, the bulk of fatalities are in the capital of the provenance, like in our study. However, there is a significant relation between fatality and the existence of comorbidity and the case fatality ratio, although there were close mortality rates for males (53.33%) and females (46.67%) [103]. Furthermore, using data from the

Department of Public Health in Basrah, a short-term (from the 9th of March to the 20th of May, 2020) first wave small (n = 736) study was conducted [86] and found that the case fatality rate was 2.4%, which is higher than that observed in our study due to the higher population of Basra, yet the case fatality rate varies with age group, residence, and gender, as encountered with our study. Meanwhile, similar to their previous study, unlike our study, no fatality had been reported under the age of 30 years old, while, approximating our study, the greatest bulk of fatalities (20.5%) were at ages above 70 years old, which was not significantly related to the gender or city of residence like our study. However, older age and the existence of comorbidity are still significant predictors of fatality, like what is found in our study.

Moreover, like what is encountered in our long-term study in which age group has no significant correlation with residence location (city or district) as well as with gender, in an early short-term study (from March 9 to May 19, 2020) in the neighboring governorate, Basra have reported that age, chronic disease, travel history, gender, and residence are not predictors of the mortality rate [104], although in both studies, elders ages 55-65 years old are related to the greatest bulk of mortalities. In fact, in the later study, the reported 2.6% mortality rate is correlated to the age advancing and comorbidities existence [104], which is also in coincidence with the study of the second wave in Basra that brought about a 2.4% fatality rate [86] as well as with other studies abroad [105-107]. Finally, in comparison to the solely short-term 2-month (April-May, 2020) study found in Thi-Qar to the data of this article writing conducted in Al-Hussein Teaching Hospital, Thi-Qar governorate, southern Iraq (n = 300) with an age range of 15-85 years old, of which 6.7% have asthma (10% of them have died), indicating a very low mortality rate (2 cases, 0.67%) [108], which is much lower than what is encountered by our longer interval study 95 cases of respiratory conditions mortalities (4.46%). However, during a close two-year interval (from the 3rd January, 2020, to the 21st December, 2021), according to the infographic dashboard of Iraq, according to Ministry of Health records, there were 24,074 deaths with a mortality rate of 1.15% [109], which is lower than that encountered by our study.

Furthermore, globally, around 60% of COVID-19 incidence and mortalities are among males, which were attributed to genetic, sex hormones, comorbidity existence, and lifestyle differences [110,

111]. In fact, it is thoroughly reported that infected patients with ethnic as well as demographic subgroup variation, particularly those of comorbidity existence history, are correlating with high morbidity and mortality rates, especially in China [1, 112-115]. In this context, many studies have demonstrated that, independent of age, males are associated with high morbidity as well as mortality rate as compared to females [116-120]. However, in some other countries, female gender is related to enhanced mortalities and morbidities [121], as reported in some studies in Iraq due to a potential health as well as demographic factor [95]. Thus, as encountered in our study, other studies have reported that males are associated with greater contributions to the COVID-19 mortality rate than females [111, 122]. However, the extent of their contributions is dependent on demographic features and country [123, 124]. In fact, males have contributed to around two-thirds of the total mortalities as compared to one-third of females [122], even in the approximately equivalent number of infections among both genders [1, 21, 103, 112, 125]. This mortality difference was presumed to be related to gender-associated social and lifestyle habits by some authors [126] on the one hand. On the other hand, other authors have related these gender mortality differences to gene difference-associated immune variation, especially humoral immunity [125, 127].

In addition, there is a gene-related SARS-COV2 entry receptor ACE2 as well as AGTR1, prostaglandin D2 receptor 2 (PTGDR2) expressions in the alveolar type I (AT1), type II (AT2) cells, the matrix fibroblasts, and pericytes of the human lung, which are attributed to its physiology and inflammation; besides, glycosphingolipid metabolism pathway-related gene, contributing to the virus attachment to the gangliosides; thus, males as well as ovariectomized females have demonstrated greater incidence as well as mortality rate [126, 128]; besides, longer disease course, which is Y gene-related [129]. On the other side, the females estrogen-protective higher survival rate is related to its vigorous innate immune response-mediated faster viral load clearance stimulatory influence [130]. In the Kurdistan region of Iraq, where male mortalities are greater than females, which is assumed due to gene-related immune variation assumption [131], yet similar outcomes have been reported in all age groups [132], which are in accordance with our study. In other long-term 17-month intervals (from March 2020 through July

2021), a study conducted, has demonstrated case fatality rate variability in age group, gender, and governorates using data from the Iraqi Ministry of Health. Males have a greater (1.3%) case fatality rate than females (1.1%), yet the males' predominance of case fatality rate has been found to be two-thirds (62.7%) of the total case fatality rate; half of them are of ages above 60 years old [99], approximating what is encountered by our study. In addition, there are global case fatality/mortality rate differences across countries as well as districts for which different reasons have been reported including host variability of genetic, immunological, environmental, socioeconomic, and demographic factors; thus, there were country-specific mortality differences [127, 133, 134], which are also encountered among different mortality rates of Thi-Qar city and districts. In fact, geriatric males suffering comorbidities have demonstrated greater [135] (three folds) of mortalities of geriatric females [103, 1, 112-115, 138, 139, 136]. For example, in Saudi Arabia, mortalities of males (2.8% of the cases) were greater than those of females (1.7%) [137].

The mortality rate age dependence is thoroughly reported by many research groups; indeed, it was reported to incline with age advancing; thus, the greatest mortality case distribution is reported among elderlies [138-140] since they have a high prevalence of comorbidities as compared to the pediatrics and those in the youth period of life. For example, have reported that in Saudi Arabia the case fatality rate had inclined from 0.2% in young victims (39 years old) to 14.8% in elderlies (> 80 years old) [137], while the Kuwaiti median age of fatality is 29.7 years old, yet its mortality rate is 581/1 million, which is close to that of Iraq but less than Iran (1833/1 million) at July 2022 [40], which is greater than encountered in Thi-Qar by our study. In fact, patients of advanced age over 65 years old have been reported to suffer severe COVID-19 conditions, leading to high mortality potential [141] due to the association with the existence or development of serious co-morbidities such as cardiovascular and respiratory diseases, diabetes, as well as immunological disorders [142, 143]. Remarkably, the majority of the global 2-3% case fatality rate, about 8% of them, occurs in the 70-90 year old age group [144], indicating that age advancement is a mortality risk factor, particularly the mortality vulnerable ages  $\geq 60$  years, although, in India, among males, 37.5% of the total male fatalities occur in the 18-35 year old age group in contrast to what is

globally reported [145, 146]. For example, in England, 90% of the 60% male fatalities were among elderly of ages over 60 years old [147]. However, regarding Iran, had reported, similar to the age distribution of our study, that the greatest portion of the case fatality ratio was among age groups of  $\geq 60$  years, constituting 26.4% of the total infected patients; much less case fatality rate (2.3%) had occurred in the 10-50 year old age group; meanwhile, no mortalities occurred in the age group less than 10 years old that in fact exploited mild symptoms of infection [148, 149], similar to what is globally reported [150], which is very close to what is encountered in our study in Thi-Qar, although a handful of fatalities occur in the age group less than 10 years old.

Regarding Iraq, the Kurdistan region [95] had reported that despite the small ratio of mortalities among young ages with no-comorbidity victims, elderly victims with ages  $> 55$  years old were with pre-existing co-morbidity such as hypertension, diabetes, or immune-compression [95]. Similarly, in other studies in Iraq, have reported that the minimum ratio of case fatality rate (0.4%) among children in age 9 years old is still low up to 59 years old; however, those older than 59 years old constitute the vast majority of the mortalities, of which 27.6% are in the age group 90 years old [132], which is very close to what is observed in our study of Thi-Qar as what is observed in table (10) and figure (10). Furthermore, also reported age-dependent fatality risk of the disease pattern in Iraq [90] as another conformation to our study. Meanwhile, in a third study conducted it had been reported that the dominant mortality rate contributing age group are those of 65 years old [99], which are in agreement with our observed results in this study. Finally, in agreement with [151], the variation in Thi-Qar cities and districts mortalities distribution can be age as well as comorbidities (cardiovascular diseases, chronic respiratory diseases, and diabetes). Furthermore, since the elderly are known to exploit an elevated level of glycosylated hemoglobin and fucosylated IgG, besides upregulating CD147, they seem to be more susceptible to COVID-19 infection as well as enhanced mortality hazard [113, 152].

Age advancing accompanied by comorbidity comprise cardiovascular diseases, diabetes, respiratory problems like chronic obstructive pulmonary disease and asthma, chronic kidney disease, hypertension, as well as cancer are among

the significant risk factors for enhanced fatality rate [1, 143, 153-155], which are associated with immune abnormalities [156]. In fact, have reported that cardiovascular disease, metabolic disorders, and pregnancy are associated with an elevated circulating plasmin level, which happens to activate the SARS-CoV2 spike protein, thereby enhancing infection prevalence as well as morbidity [54, 157]. Moreover, poorly controlled blood pressure is also associated with an elevated mortality rate due to its association with COVID-19 infection, which contributed to advanced atherosclerosis as well as organ damage [158]. However, although hypertension, physical inactivity, and smoking rates are lower in Iran as compared to Iraq [159, 160], both prevalence as well as mortality rates are higher.

In addition, diabetes mellitus is reported to enhance hospitalization and morbidity of COVID-19 infection as it contributes to chronic inflammation, inclining of coagulation function, besides attenuating the immune function [161, 162]. In fact, it has been reported that poorly controlled hyperglycemia is correlated to a greater mortality rate [163, 164]. In this context, have reported that 20–30% of the disease victims are with type-II diabetes comorbidity [165]. Consequentially, significant mortalities are also reported to be significantly correlated to the inclined mortality rate in a small retrospective study in Wuhan, China [165]. However, a higher mortality rate of 53.7% and 22.2% are associated with type-II diabetes mellitus in Kuwait and Iran, respectively [166, 167]. Meanwhile, like what is reported, in Iraq metformin therapy of type-II diabetes-infected patients is correlated with the decline in hospital mortalities [168, 169]. In our study, diabetes alone was not a risk factor associated with mortality rate in the study field as age group and residence, yet, in combination with respiratory as well as cardiovascular comorbidities, it looks to be of significant correlation (63.05% of which 40.31% are females, while 59.78% are males) with mortality rate in the age group of ages over 65 years old.

Moreover, it is also reported that acute kidney impairment is associated with COVID-19 severity as well as being a risk factor for in-hospital fatalities and is related to the high mortality rate in the US [170-172]. Besides, the disease itself causes retardation of kidney functions [173]. Meanwhile, unfortunately, acute kidney injury co-existence is

not covered by the data base of our study, which is one of the study limitations. In addition, some have considered that asthma is one of the co-morbidities associated with COVID-19 morbidity and mortalities, yet, a study from 14 states in US, have shown that 27 of 159 study sample have asthma, is associated with low mortality rate [174], which is in coincidence with our study that has revealed that only 4.4% of the mortalities have an exclusive respiratory conditions probably involving asthma co-morbidities particularly in age groups of 15-30, 31-44 years old where there is a significant correlation ( $P_{value} < 0.001$ ), between co-morbidity and age group, while, no significant correlation with gender ( $P_{value}: 0.717$ ), although, in combination with diabetes and cardiovascular comorbidities combination respiratory conditions are also involved in disease mortality contribution in our study.

In general, comorbidities such as diabetes, obesity, cardiovascular, and lung diseases are associated with poor outcomes of the COVID-19 pandemic in Iraq, including a high mortality rate [89]. However, according to the study, there is a very strong correlation (70% of the mortalities) between the existence of comorbidities and the mortalities in Iraq, according to the communicable diseases control center of the ministry of health in Iraq. According to this study, around half of the mortalities (49.7%) are due to cardiovascular comorbidities, diabetes COPDs, and cancer (especially in young patients) are associated with 39.3%, 2.9%, and 1.1% of the mortalities, particularly in the elderly, respectively [143], which is not in accordance with our study. Diabetes alone was not a risk factor associated with mortality rate; however, in combination with other comorbidities, it has its significant contribution to the observed mortality rate, although our study has the second limitation of not covering the contribution of cancer existence to mortality rate.

Meanwhile, studies from Kurdistan have shown that the above comorbidities have involvement in COVID-19 mortalities. In a large short-term (1 March to 1-May 2020) study involving the four governorates of Kurdistan (Erbil, Duhok, Sulaymaniyah, and Halabja), of the 5 mortality cases, 4 cases are with cardiovascular comorbidity and hypertension, while the fifth case is with diabetes and chronic renal impairment [96]. In this context, have reported that poor glycaemic control as well as insulin therapy is

associated with the elevated COVID-19 mortality rate in Duhok, particularly in the cases of type II diabetes on both oral hypoglycaemic as well as insulin therapy; besides, those of delayed hospital arrival have exploited severe disease and complications. In addition, other comorbidities are also reported in this study, such as diabetes mellitus (type-I on insulin therapy and type-II on oral hypoglycemia), gender, obesity, chronic lung diseases, D-dimer, and age category, particularly the elderly, to be correlated to the disease morbidity as well as mortality rate [175]. Furthermore, have reported that in the Kurdistan region of Iraq, there were 64 fatalities (31.1%) of 204 fatality cases, of which 36.8% were of diabetes comorbidity, while 26.7% of the fatalities were of hypertension comorbidity, along with a significantly elevated neutrophil-to-lymphocyte ratio [97], which is in agreement with our study where there is a significant relationship between comorbidity existence and the mortality rate, including diabetes, cardiovascular diseases, and respiratory diseases, although type of diabetes treatment is not involved in our study, which is a third limitation of our study.

In the middle of Iraq, in Al-Anbar provenance, around 99% of the mortalities were of at least having one comorbidity such as hypertension, diabetes, coronary heart disease, chronic obstructive lung disease, and chronic kidney disease, especially in the elderly [29], which is in accordance with our study on one hand. On the other hand, in Basra, south of Iraq, a provenance neighboring our study provenance has reported that among the 13.5% fatality cases, coexisting co-morbidity as well as travel history are the dominant ratio, especially among elderlies [86], which is in some agreement with our study. Finally regarding Thi-Qar provenance and other provenance Wasit short-term study (from March to May 2020) including 5568 study samples, including cases admitted to Al-Hussein Teaching Hospital, Thi-Qar, and Alkarama Teaching Hospital, Wasit, Iraq, revealed that of the 3.161% of mortalities, (86, 48.86%) were in the severe case criteria, while (77, 43.75%) were in the critical case criteria; however, (172, 97.73%) were of pre-existing comorbidity or health condition, which is very close to what is observed in our study. In fact, 35.8% of the mortalities were with hypertension comorbidity, 10.8% were of hypertension and type-II diabetes co-existence comorbidity, 18.75% were with type-I and type-II diabetes along with acute renal failure co-existing

comorbidity, 0.6% were with type-I and type-II diabetes along with acute renal failure co-existing comorbidity, 10.23% were with chronic obstructive pulmonary disease comorbidity, 1.7% were with COPD along with diabetes co-existing comorbidity, 0.6% were with COPD along with hypertension co-existing comorbidity, 0.6% were with chronic lung disease, 1.7% were with chronic kidney disease, 9.66% were with hypertension along with chronic kidney disease, 2.27% were with acute kidney disease comorbidity, and 2.27% were acute with pulmonary conditions [176], however, unlike this study, our study has revealed that no victim with exclusive cardiovascular comorbidity, our study has revealed that lower ratio (around one third of this study) of respiratory comorbidity existence, much higher ratio of mortalities with cardiovascular and respiratory co-existing comorbidity than this study, unlike this study, no victim was with cardiovascular and diabetes in our study, while, unlike this study, no victim was with diabetes and respiratory condition in our study. Unfortunately, our study data does not specify the type of diabetes as well as the co-existence of renal conditions (acute or chronic kidney diseases), which is also a limitation to our study. In addition, Al-Omer (2023) at the beginning of the pandemic, in a small (n = 2044) short-term (from 15 February to 15 May 2020) cohort study including cases admitted to Al-Hussein Teaching Hospital in Thi-Qar Governorate, Iraq, has reported that acute kidney injury is significantly correlated to the enhanced mortality rate, indicating that this condition is a significant risk factor to mortality incidence. Of the total mortality rate of 15.3%, the death rate of males with acute kidney injury is about 8-10% in age groups between 18 and 65 years of age; meanwhile, at ages exceeding 65 years old, it approaches 21.6% among males while 22.9% among females in the 164 infected patients who had developed acute kidney injury. However, unfortunately 15.2% of the survivors had passed away three months post-hospital departure [177]. Unfortunately, there is no follow-up in our database for the survivals post-hospital/quarantine center departure; besides, the co-existence/development of acute kidney injuries in our database, which is another limitation to our study.

Regarding the case fatality rate, the time interval pattern varies globally, besides country-wise as well as provenance-wise, in addition to fluctuating with time. Globally, according to WHO, two mortality peaks have been reported, the first in April 2020 and

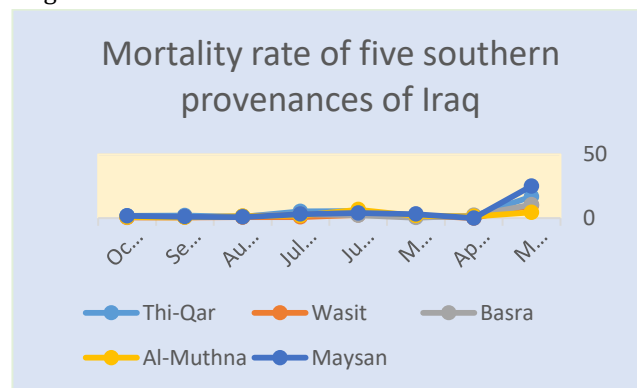
the second in January 2021 [178]. However, the countries at the parameter of Iraq, Jordan, and Syria had exploited the greatest mortality rate among these countries in the region of 4779 and 3800, respectively, in October 2020 [100], which is much greater than that observed in our study in Thi-Qar at the same time interval. In fact, at the first report interval, Iraq had the lowest infection threshold according to figure (9) in our study. In contrast (Al-Imam, 2020), permitted according to the COVID-19 worldmeter, at the 31st of October 2020, Iraq had the greatest mortality rate (2.3%) as compared to all neighboring countries in its parameter (less than 1%) with the exception of Iran, which had the greatest mortality rate (5.68%), which was supposed to be related to genetic variations including the virus receptor ACE gene [69], which is much less than our study results of 3.91% mortality rate at the same study interval.

In fact, the first reported mortality in Kuwait occurred on the 4th of April 2020, which had inclined dramatically to 11 mortalities, and on the 16th of May 2020, which had been attributed to the temperature elevation, where along with 1 CO weather temperature elevation, a 0.03% to 0.003% incline in the daily new mortality case happens. However, the humidity had a negative impact on the mortality rate, where 1% elevation of weather humidity causes a 0.01% and 0.002% incline in the daily new mortalities, while the first two cases in Baghdad happened on the 4th of March [22]. In another meta-analytic study, reported that the global case fatality rate approaches 7.2% during the last week of April 2020; however, among the five top most Middle Eastern countries in case fatality rate, Yemen is 28.9% [179]. However, the first two mortalities had been registered in Thi-Qar in March 2020, as observed in our study. In addition, in another study, the mortality rate had fluctuated from 5.9%, 8.7%, and 16.3% in March, April, and May 2020, respectively, then started to be inclined dramatically after June 2020, then started to decline gradually with time [3], yet, similarly in our study, the first peak of mortalities in the first wave (2020) is also observed in June to reach optimum mortalities in July, then decline to the minimum value in August. Furthermore, have reported that the peak numbers of mortalities in the two pandemic waves occurred in July 2020 in the first wave and July 2021 in the second wave, where Sulaimaniyah had the greatest case fatality rate [99], which is similar to our study infection pattern peaks.

However, in accordance with what had reported, at the Imman Al-Hussain Arbainia (40th) ceremony, the mortality registry is not affected by the massive crowding and the massiveness of the event [60]. However, our study has demonstrated that a sharp decline in the total mortalities happens very shortly after the ceremony in the two years of the pandemic and extends to the end of each year, 2020 and 2021. According to the WHO country office in Iraq, during the second wave in the second year of the pandemic, particularly during the seventh (282) and the eighth month (457) of the pandemic, the optimum peak of mortalities happened, which is supposed to be related to the spread of the virulent delta strain of the virus with a hospital 2.1% case fatality rate, while a previous surge of mortalities was also encountered during March and April [180], which is in accordance with our study results.

Interestingly, in their short-term study (from the 24th of February to the 8th of August), according to the ministry of health, the Iraq data report has demonstrated that Thi-Qar is among the provenances of the lowest four provenances, Thi-Qar, Al-Muthanna, Kirkuk, and Al-Qadisiyyah, in mortalities, which were 4, 4, 2, and 1, respectively, while the neighboring provenance Maysan was of the highest mortalities (121) [98], which is much further than our study finding, where our data base has revealed 90 disease victims of both genders. Meanwhile, have reported that the mortality rate had inclined in the first wave starting from March to October 2020. During the first four months of the pandemic, February, March, April, and May in all Iraq provenances formed the first peak, then declined gradually during the next four months, Jun, July, August, and September forming the first trough. However, the lowest mortality rates were at the end of the May and July-October intervals, which were 2.27% and 3.8-1.21, respectively, indicating fluctuation in the pandemic severity. Along the study period, the provenances with the highest mortality rates (>3%) were Babil, Thi-Qar, Kirkuk, and Sulaymaniyah, while those with the lowest mortality rates (<2%) were Najaf, Al-Anbar, Wasit, and Al-Muthana; however, at the end of October 2020, the mortality rates were inclined in Basra, Al-Muthana, and Maysan while declining in other provenances, including Thi-Qar. Fluctuations in the provenance mortality rates during the study interval where in Al-Qadisiyyah were 0%, 12.5%, 0%, and <2% during May, April, May, and October 2020, in Maysan were 0%, 3.06%, and >3% during May, April, May, and

October 2020, in Al-Muthana were 6.85%, and > 3% during June and October 2020, in Wasit were 0.88%, and < 2% during July and October 2020, while in Thi-Qar was 5.2% and <2% during July and October 2020 [69] Fluctuations in the mortality rates in Thi-Qar and its parameter provenances are shown in figure (11). Yet, in our study, the mortality rates in October 2020 were greater than 3% in contrast to the study and 4.96% during July 2020, which is lower than what is in the study. Fluctuations in the mortality rate profile are also seen in our study with time; however, the drop in mortality rate happened at the end of the first wave starting from the end of November 2020 along with a transient drop during August 2020.



**Figure (11):** mortality rates of five southern Iraqi provenances as reported by (Al-Imam, et al., 2020) <sup>69</sup>.

## CONCLUSIONS:

Like, what happens in the global Iraq had witnessed two waves of the COVID-19 pandemic during the years 2020 and 2021, with date-dependent fluctuations of the mortality rate. However, Thi-Qar governorate, like all other Iraqi governorates, had witnessed the two waves of the pandemic attacks. In this report, the mortality rate and the influences of gender, age, date of passing out, as well as city/district of residence are evaluated. The study sample (mortalities) are categorized according to gender, method of diagnosis, date of passing out, and age group and evaluated during the study period extending from February 2020 to April 2022. The study has shown that of (n = 103015) infected persons during the study period, 2129 victims had passed, of which 59.4% are males while 40.6% are females with an age range from a few days to 110 years old, yet around 75.5% are positive for RT-CPR, while the others are diagnosed using CT- scans, X-ray radiological examinations, and clinical examinations, of which 73.23% of the cases are admitted as severe cases. In fact, there is no statistically significant correlation between the gender of the victims and the diagnosis method used (p\_value: 0.77), but there is a very highly significant

relation ( $P_{\text{value}} < 0.0001$ ) between the mortality rate and method of diagnosis. Remarkably, 99.9% of the mortality cases were unvaccinated; besides, the mortality rate is 91.73 deaths/100,000, or 9.173/million, of population, while the case fatality rate was 2.067%, which is as double as the Iraq case fatality rate at the end of March 2022, which was 1.086%, where there is a statistically significant relation between mortalities, gender, and residence district ( $p_{\text{value}}$ : 0.022), particularly for males and females of both Marshlands/east and intermediate north districts of Thi-Qar, which has the greatest contribution to total fatalities. However, there is no statistically significant correlation between mortalities gender and the city of residence, although both Al-Nasiriya, followed by Al-Shatra cities, have the greatest contribution to the total number of fatalities. In addition, there is no significant relation between mortalities age group and gender ( $p_{\text{value}}$ : 0.09), as well as the district of residence ( $p_{\text{value}}$ : 0.898), yet age group mortalities have a highly significant relation ( $p_{\text{value}}$ : 0.003) with the city of residence, where both Al-Nasiriya followed by Al-Shatra as cities of residence have the greatest contribution to the total number of fatalities, although in the three cases, the age group of over 65 years old has the greatest contribution to the total fatalities. Remarkably, it has been found that according to 10-15-year-old dividing of age groups up to 65 years old, there is no statistically significant relation between mortalities, gender, and comorbidity ( $p_{\text{value}}$ : 0.717), although co-morbidity combinations such as cardiovascular diseases, diabetes, and respiratory diseases have a significantly greater contribution to the total fatalities on the one hand, yet there is a very high significant relation between mortalities, age group, and comorbidity ( $p_{\text{value}}$ :  $< 0.001$ ), particularly those of 55-65 and over 65 years old on the other hand. Meanwhile, it is worthy to note that according to 15-year dividing of age groups for those below 44 years old and 20 years old for those 45 years old, there is a very significant relation between the victims age group and co-morbidities ( $p_{\text{value}} < 0.001$ ), although there is no statistically significant correlation between the victims age group and gender, residence city, and residence district with corresponding  $p$ -values of 0.069, 0.939, and 0.375, respectively. Finally, in conclusion, the variations in fatality rates between genders could be related to gene-related hormonal influences on the victims immune surveillance; however, the variations in fatalities among residence districts and cities are residence population-attributed incidence rate, ethnic, race, educational, as well as personal hygiene-attributed variations, in this context, with the exclusion of Nasiriya, the capitol of Thi-Qar, where the vast majority of population is existing. Marshlands district has corresponding fatalities of both genders as well as almost all age groups to that

of Al-Shatra and intermediate north district of Thi-Qar of higher population. During the two successive years of the pandemic 2020 and 2021, two pairs of mortality rate peaks escalations have been observed, one pair for each year. The summer peak started in May of the two years and declined to the base line in autumn in both years, preceded by a winter-to-spring peak. However, characteristic troughs have been observed occurring approximately at the same interval (October), just after the end of the imam Al-Hussein Bin Ali Ziyarat AL-Arbaeen rituals that had involved several hundred thousand to millions of the pilgrims in close proximity to each other, and continuing to around a three-month interval in contrast to what was expected of gathering and approximation negative impact on COVID-19 infection expansion/acquisition. In addition, the remarkable difference in monthly mortality pattern between the year 2020 of the pandemic and 2021 encourages presuming the arising/involvement of a new SARS-CoV-2 virus strain in the second year, although it was probably less virulent than that of the first one. However, there is no significant correlation between the mortalities and the date of death among the two genders.

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