The Review Of
DIABETIC
STUDIES OPEN ACCESS

Effect Of Diabetes Mellitus, Heart Disease And Vaccine On Mortality Rate In COVID-19 Patients In Iraq

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Abstract

Background, COVID-19 has created a significant global health concern, diabetes and heart disease are most commonly seen in severely ill cases. A retrospective analytical study was carried among 105 patients, who were COVID-19 cases confirmed by PCR.

Objective, to estimate the effect of diabetes mellitus, heart disease, and vaccine on the mortality rate in COVID-19 patients in Iraq

Methodology, Clinical data, vaccination background, and comorbidity status (heart disease and diabetes mellitus) were recorded. Biochemical parameters such as random blood sugar (RBS), glycated hemoglobin (HbA1c), and body mass index (BMI) were measured. Death was declared as the primary outcome. Statistical analysis was done using Jamovi, applying chi-square tests, t-tests, as well as logistic regression to determine independent predictors of death.

Results, out of 105 COVID-19 patients, 19 (18.1%) died. Heart disease was significantly associated with mortality (χ^2=14.1, p<0.001), with an odds ratio (OR) of 6.85 (95% CI: 2.31–20.3). In contrast, diabetes mellitus was not considered as a significant predictor of death (χ^2=0.675, p=0.411). Logistic regression analysis identified heart disease as the strongest independent predictor of mortality (OR=8.39, 95% CI: 2.24–31.4, p=<0.002), while HbA1c, RBS, BMI, vaccination status, and diabetes showed no statistically significant associations.

Conclusion, Heart disease was strongly associated with mortality among Iraq COVID-19 cases, while diabetes mellitus and glycemic indices failed to impact survival outcome significantly. These are valuable findings to impart that cardiovascular disease patients should benefit from stringent monitoring and management in COVID-19 infection.

Keywords: COVID-19, diabetes, heart disease, vaccine, mortality.

Introduction

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) caused by Coronavirus in 2019 (COVID-19)[1]. The disease started to spread from China to the world and become a worldwide speared

disease[2, 3]. The disease has a wide range of clinical symptoms, in some cases its asymptomatic infection to severe disease with respiratory failure, multi-organ failure, and even death. There is many risk factors that affects COVID-19 patients like diabetes mellitus (DM)[4]. Diabetes decreases innate and adaptive immunity, including cytokine signaling, and makes the patient to be susceptible to gain covid-19 disease [5]. Acquiring diabetes depends on many factors such as the genetic back ground and signal nucleotide polymorphism[6]. Poorly controlled diabetic patients, as reflected by increased RBS and HbA1c levels, have been shown to exhibit worse clinical outcomes like increased need for intensive care and higher mortality [7]. Similarly, cardiovascular complications like heart disease, heart failure, and arrhythmias is regarded as a risk factors contributing a higher mortality rate among covid-19 patients[8]. Furthermore, the systemic inflammatory reaction due to SARS-CoV-2 may aggravate myocardial injury, destabilize atheromatous plaques, and lead to acute cardiac events[9]. In those with previous heart disease, the physiological stress induced by COVID-19 may overwhelm compromised cardiac function, hence leading to complications and mortality[10]. Vaccination has been one of the most effective measures in reducing COVID-19 severity, with significant reductions in rates of hospitalization and mortality rates around the world[11]. However, not all individuals have the same level of protection following vaccination. Chronically ill individuals with diabetes mellitus and cardiovascular disease, for instance, are expanded to dysregulated immune responses, which could limit vaccine efficacy and predispose them to poorer outcomes[12]. Numerous studies have demonstrated that individuals who are vaccinated have a reduced risk of mortality in COVID-19 compared to those who are not vaccinated[13]. This suggests the importance of considering vaccination status in the estimation of mortality determinants in COVID-19 patients[11]. The goal of the research is to estimate the effect of diabetes mellitus cardiovascular disease and vaccination on the mortality rates among hospitalized patients of COVID-19 in Iraq. Based on the patient's history and the biochemical values like Body Mass Index (BMI), glycated hemoglobin (HbA1c), and random blood sugar (RBS), the study seeks to determine if these chronic disorders increase the chances of mortality among infected individuals.

Methodology

Sample Collection, and Medical History

105 participants were implicated in the study, confirmed COVID-19 patients by PCR test. Data were collected retrospectively from Lalav, Rzqary, Rozhawa and Emarat hospitals and central lab of Erbil in Iraq during the outbreak. Body Mass Index (BMI) for every participant was estimated. The medical history of diabetes Mellitus which was classified according a prior diagnosis or increased HbA1c. In addition, heart disease including open-heart surgery or if the individual was on long-term medication for cardiac conditions. All the data collected through the hospital medical history or personal contact directly with the patients or the relatives. vaccine status was documented from official sources.

Inclusion and Exclusion Criteria

Patients aged 18 years or more, Laboratory-confirmed SARS-CoV-2 infection by RT-PCR, complete medical history and survival outcome known (alive or deceased) were included in the study. Furthermore, Incomplete or absent biochemical or demographic information History of malignancy, autoimmune disorder, or other chronic systemic disease not caused by diabetes or cardiovascular disease and pregnant women were left out of the study

Ethical Considerations

This study adhered to the ethical principles and the approval was obtained from the ministry of health in Iraq with the number 13293 in 24/10/2021. Data were anonymized to ensure confidentiality.

COVID-19 Diagnosis Confirmation

All study participants were RT-PCR positive for COVID-19. The PCR results were collected from local hospitals and Iraqi Ministry of Health accredited labs for ensuring the validity of diagnosis. Only patients with a confirmed diagnosis and recorded clinical status (alive or dead) were accounted in the statistical analysis.

Biochemical Testing

Biochemical parameters were carried out at Top Med Lab in Erbil. Random blood sugar (RBS) and glycated hemoglobin (HbA1c) were measured by Cobas-Roch E411 (Germany) device under the guidance of experienced laboratory technicians. The tests results were used to assess glycemic control for mortality risk. Cardiac disease history was also determined from hospital records, physician's notes, and drug profiles indicating chronic cardiac therapy.

Statistical Analysis

Statistical analysis was enrolled using Jamovi statistical software (Version X.X)[14]. The categorical variables (e.g., diabetes presence, heart disease presence, survival) were expressed as frequencies and percentages, while continuous variables (HbA1c, RBS, BMI) were presented as means ± standard deviations. Independent samples t-tests was performed to compare continuous variables in survivors and non-survivors. Chi-square tests were used to test the correlation of categorical variables with death. To identify predictors of death, a binomial logistic regression model was constructed using independent variables: HbA1c, RBS, BMI, diabetes status, heart disease status, and vaccination status. Reported results included Odds ratios (ORs) with 95% confidence intervals (CIs). A p-value below than 0.005 was considered statistically significant.

Results

Descriptive statistics

A total of 105 COVID-19 patients were enrolled in this study. 19 (18.1 %) died, and 86 (81.9%) survived. The frequencies of patients who had heart disease were 21% and diabetes were 39%. The mean of HbA1c was 5.38 ± 1.61 for survivors and 5.58 ± 1.02 for non-survivors. The mean of random blood sugar (RBS) levels was 155.12 ± 93.23 mg/Dl for survivors and 159.68 ± 56.98 mg/dL for non survivors.

Table 1, shows the descriptive statistics mean, median and standard deviation for random blood sugar, HbA1c and BMI tests.

Descriptives	**Death**	**R.B. S**	**HbA1C**	**BMI**
Number	**Alive**	86	86	86
	Dead	19	19	19
Mean	**Alive**	155	5.38	25.3
	Dead	159.6	5.58	25.6
Median	**Alive**	118	5.00	24.7
	Dead	152	5	23.8
Standard deviation	**Alive**	93.2	1.61	4.93
	Dead	57.0	1.02	5.47

Minimum	**Alive**	50	4	16.9
	Dead	70	4	18.7
Maximum	**Alive**	489	12	37.7
	Dead	342	8	39.5

Among 105 patients, vaccinated individuals were only 18 (17.1%), while 87 patients (82.9%) were unvaccinated. In addition, 22 individual (21%) were diagnosed with heart disease whereas the remaining 83 (79%) had no history of cardiac illnesses. Diabetes mellitus was present in 41 patients (39%) while 64 patients (61%) were non diabetic.

Table 2, shows the frequencies for heart disease, Diabetes mellitus and vaccination in patients and control group.

Heart Disease	**Counts**	**% of Total**	**Cumulative %**
Non	83	79.0%	79.0%
HD	22	21.0%	100.0%
Diabetes	**Counts**	**% of Total**	**Cumulative %**
DM	41	39.3%	39.0%
Non	64	61.0%	100.0%
Vaccine	**Counts**	**% of Total**	**Cumulative %**
Vaccinated	18	17.1%	17.1%
No Vaccine	87	82.9.%	100.0%

Comparison between survival and nonsurvivable group

T-test was enrolled to compare HbA1c, RBS, and BMI between the survival and no survival individuals, HbA1c ($t = -0.506$, $p = 0.614$) with a mean difference of -0.195 (95% CI: -0.961 to 0.571), RBS ($t = -0.205$, $p = 0.838$) with a mean difference of -4.568 (95% CI: -48.799 to 39.663), and BMI ($t = -0.178$, $p = 0.859$) with a mean difference of -0.227 (95% CI: -2.760 to 2.306).

Table 3, shows Independent T-Test results, all p-values > 0.05, no statistically significant **differences** in HbA1c, RBS, or BMI between patients who died and those who survived.

		Statistic	**df**	**p**	**Mean difference**	**SE difference**	**95% Confidence Interval Lower**	**95% Confidence Interval Upper**

HbA1C	**Student's t**	-0.506	103	0.614	-0.195	0.386	-0.961	0.571
RBS	**Student's t**	-0.205[a]	103	0.838	-4.568	22.302	-48.799	39.663
B.M.I	**Student's t**	-0.178	103	0.859	-0.227	1.277	-2.760	2.306

Among 105 individuals heart disease patients, 12 out of 22 (54.5%) survived and 10 (45.5%) passed away, whereas among non-heart disease patients, 74 out of 83 (89.2%) survived and 9 (10.8%) passed away, indicating higher mortality rate in heart disease patients. In case of diabetes mellitus, 32 of 41 diabetic patients (78.0%) survived and 9 (22.0%) died, while 54 of 64 non-diabetic patients (84.4%) survived and 10 (15.6%) died.

Table 4, shows the frequencies of alive and dead patients in heart disease and diabetes mellitus,

Heart Disease				**Diabetes Mellitus**			
Death	**non**	**HD**	**Total**	**Death**	**DM**	**non**	**Total**
Alive	74	12	86	Alive	32	54	86
Dead	9	10	19	Dead	9	10	19
Total	83	22	105	Total	41	64	105

Heart disease and diabetes mellitus VS mortality rates

The following table displays Chi-square test and odds ratio for heart disease and diabetes mellitus versus mortality. Chi-square for heart disease is 14.1 and it has 1 degree of freedom with the p-value less than 0.01, odds ratio = 6.8 and 95% confidence interval of 2.31-20.3. For diabetes mellitus, Chi-square is 0.675 with 1 degree of freedom and a p-value of 0.41, odds ratio of 0.685, and 95% confidence interval of 0.0242 to 1.79

Table 5, shows chi-square test for heart disease and diabetes mellitus

Disease	**X^2 test**	**Odd ratio**
Heart Disease	P-value = < 0.01 Value = 14.1 Df = 1	Value = 6.8 Lower = 2.31 Upper = 20.3
Diabetes Mellitus	P-value = 0.41	Value = 0.685

	Value = 0.675 Df = 1	Lower = 0.0242 Upper = 1.79

Deferent predictors against mortality rates

Logistic regression analysis determined the association of different predictors with mortality. Heart disease with odds ratio 8.39 (95% CI: 2.24–31.45, p = 0.002), diabetes mellitus with odds ratio 1.41 (95% CI: 0.21–9.36, p = 0.723), and vaccination with odds ratio 0.98 (95% CI: 0.18–5.32, p = 0.982). Among continuous variables, the odds ratio of HbA1c was 1.20 (95% CI: 0.70–2.07, p = 0.499), RBS had an odds ratio of 0.997 (95% CI: 0.985–1.10, p = 0.616), and the odds ratio of BMI was 1.008 (95% CI: 0.91–1.13, p = 0.891).

Table 6, Logestic regression shows the prediction of heart disease, diabetes, vaccine, HbA1c, RBS and BMI in increaing the mortality rates in COVID-19 patients.

Predictor	**Odd- ratio**	**95%CI**	**P-value**
Heart Disease	8.39	2.24-31.45	0.002
Diabetes mellitus	1.41	0.21-9.36	0.723
Vaccination	0.98	0.18-5.32	0.982
HbA1c	1.20	0.70-2.07	0.499
RBS	0.997	0.985-1.10	0.616
BMI	1.008	0.91-1.13	0.891

Diseases- vaccine interaction

Binomial Logistic Regression to asses the effect of heart disease and diabetes on the efficiency of the vaccine. Diabetic patients, vaccination had an odds ratio of 0.70 (95% CI: 0.18–2.76, p = 0.681). Similarly, in heart disease patients, vaccination had an odds ratio of 0.71 (95% CI: 0.18–2.76, p = 0.681).

Table 7, Binomial Logistic Regression. Shows the effect of the disease on vaccination in COVID-19 patients.

Predictor	**Odds Ratio (OR)**	**95% CI**	**p-value**
Diabetes vs vaccine	0.70	0.18–2.76	0.681
Heart disease vs vaccine	0.71	0.18–2.76	0.681

Discussion

This study assessed the impact of diabetes mellitus, heart disease, vaccination, and metabolic variability on mortality from COVID-19 patients in Iraq. The outcomes suggested that cardiovascular disease is a significant independent predictor of mortality, the infected individuals with heart disease had more than 8 times higher odd ratio of mortality (8.39) (Table 6), which indicates having heart diseases increases the mortality rates more than 8 times compared to a COVID-19 patient without a heart disease, chi square test showed the same results that heart disease able to effect mortality rates p-value <0.01 (table 5),. However, diabetes mellitus, RBS, HbA1c, BMI, as well as vaccination status did not show a statistical difference linked with higher mortality rates in patients of COVID-19 (Table 6). The logistic regression also suggested that heart disease can be used as predictor to increase the mortality rates in individuals who have COVID-19, P-value = < 0.002 which stands against other parameters and diabetes P-value > 0 (Table 6).The association between heart disease and COVID-19 mortality is consistent with robust findings from worldwide studies[15] a meta-analysis which suggested that the mortality rate increased in covid-19

patients that have heart disease in hospitals. In addition a study in Wuhan- China suggested that heart disease elevate the mortality rates among COVID-19 patients[16]. Another study in Wuhan China suggested that hypertension increases the mortality rate of covid-19 patients[17], hypertension is related to heart disease[18]. Study in Iraq suggested that heart disease increases the mortality rates among patients of covid-19 [19]. The pathophysiology for this enhanced susceptibility is multi-factorial, covid-19 infection creates a systematic inflammation, endothelial damage as well as prothrombotic state that effects the heart pathology, COVID-19 can also cause acute cardiac events, arrhythmias or heart failure[20, 21]. These factors in combination probably damages the heart and increases the mortality rate in COVID-19 patients[21]. The lack of association between diabetes and increasing the mortality rate among COVID-19 patients in this study p-value = 0.723 is opposite numerous studies which suggested that diabetes mellitus increases the risk of mortality in COVID-19 patients (Table 6). Lung injury and pneumonia were increased in COVID-19 patients due to the use of insulin[22], which indicates that diabetes increases the risk of mortality in COVID-19 patients. Type 2 diabetes and hyperinsulinemia increases the risk mortality in COVID-19 patients in Iraq [23, 24]. Some studies are in agreement with ours in illustrating no independent relation between diabetes and increased mortality of COVID-19 patients in Denmark [25], and in Mexico[26]. Some studies conclude that controlled blood sugar reduced excessive risk of mortality. A fairly low mean HbA1c in this sample suggests improved glycemic control, perhaps explaining the observed lack of statistical significance in the effect of diabetes on risk of death. Another possibility is that the moderately small sample size as well as the complicated interaction among other factors affected this result[27]. On the other hand vaccination tend towards protection: Vaccinated patients experienced lower death rates compared to unvaccinated patients[11]. nevertheless, in our study it is not significant: The p-value > 0.05, which means that the observed difference may be due to the small sample size or distribution of patients. Immunization may reduce the risk of mortality among diabetic and cardiac patients[28], but this study did not provide enough evidence (Table 7). Furthermore, there was no significant differences in HbA1c, RBS and BMI between survivors and non survivors (Table 4). This is in contrast to studies that report higher HbA1c or hyperglycemia as independent predictor of poor outcomes[29, 30]. Likewise, obesity commonly assessed by BMI dose not increase the mortality rates in COVID-19 patients[31]. Nonetheless, BMI alone may not be adequate in studies that suggest BMI is not alone in its associations[32]. It is possible that in this current group, the lack of significant association is due to the normal body mass index range as whole and perhaps limited metabolic derangement. Or, unquantified variables such as nutritional status, ethnic factors, or inflammatory markers might predict differences in outcome. Lack of pronounced protective effect from vaccination on mortality was unexpected. Furthermore There are large-scale studies globally, that have proven large reductions in severe COVID-19 and death risk from vaccination[33] which stand against of our findings . Various reasons for this unexpected discrepancy are small sample size, interval between vaccination and infection, type and number of vaccine doses, or partial vaccine efficacy due to viral variants.

Conclusion

This study confirms that pre-existing heart disease significantly increases mortality risk among COVID-19 patients to affirm the global research on cardiovascular susceptibility. In contrast, diabetes mellitus, glycemic parameters, BMI, and vaccination status were not independent predictors for mortality among this Iraqi study group, due to small size study sample, or study limitations. These findings highlight the critical value of precise cardiovascular assessment and management in COVID-19 cases to improve outcomes. Failure to report benefit from vaccination and metabolic markers necessitates large-scale, prospective studies with elaborate clinical as well as immunological profiling in the region.

Acknowledgement

The authors declare that this research was not funded by any particular grant or external funding from public, private, or not-for-profit organizations. They carried out the research using facilities and equipment of Top Med lab in Erbil/ Iraq, for which they are thankful. There were no industrial partnerships,

commercial collaborations, or external funding sources that influenced the conduct or report of this research.

Author contributions

All authors contributed in this study, concept of the research, study design, material preparation, data collection, laboratory work, drafting the MS, and analysis were performed by Sally Khaleel Baqer. Sample collection, laboratory work, preparing the tables were performed by Asmaa Ameen Ghareeb. Sample collection, acquisition of data, laboratory work, revision was performed by Omer Rashed Ghayyib.

Conflict of interest

No conflict of interest

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