

# Examining and Investigating the Impact of Demographic Characteristics and Chronic Disease with Mortality of COVID-19: Retrospective Study

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## Research

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# Abstract

**Background:** The COVID-19 pandemic has burdened hospitals globally and there is currently no proven treatment available. The purpose of the study was to investigate whether demographic characteristics (age and gender) and non-communicable diseases (hypertension and diabetes mellitus) have a significant association with mortality in COVID-19 patients.

**Methods:** This is a retrospective design where we used descriptive and inferential analysis have been employed to analyze the data. Binary logistic regression was done to study the connection between comorbidities and mortality of COVID-19.

**Results:** 43 (86%) of the male patients were non-survivors while 7 (14%) of the female patients were survivors. The odds of non-survivors among hypertensive patients are 3.56 times higher than those who are not having a history of hypertension (HTN). The odds of non-survivors among diabetic patients are 5.17 times higher than those who are not having a history of diabetes (DM). The odds of non-survivors are 2.77 times higher among those who have a history of HTN and DM as compared to those who did not have a history of HTN and DM.

**Conclusions:** Those patients that had a history of hypertension and diabetes had a higher probability of non-survival in contrast to those who did not have a history of diabetes and hypertension. Further studies are required to study the association of comorbidities with COVID-19 and mortality.

## Introduction

The first case of SARS-CoV-2 infection was confirmed in Wuhan, China in December 2019 (1). Since then, the cases of infection of this novel virus have been rapidly ramping up which was eventually declared a pandemic by the World Health Organization (WHO) in March 2020. The rapidity of disease transmission has dampened consolidated research evidence regarding the prognostic associations of COVID-19 which has resulted in a profound and unexpected increase in case mortality on top of the fatality associated with COVID-19 infection itself. Furthermore, although several efforts are underway to explore the treatment options but currently, there has been no proven treatment available which adds to the growing concern.

In the present study, we extracted retrospective data of 116 patients admitted in in-patient medical wards and intensive care units (ICUs) with laboratory-confirmed COVID-19 from different hospitals in Riyadh, Saudi Arabia through 20 April to 20 June 2020. However, the purpose of the study is to investigate whether demographic characteristics (age and gender) and noncommunicable diseases (hypertension (HTN) and diabetes mellitus (DM)) have significant association with mortality in COVID-19 patients.

## Methods

### Design

A retrospective design was employed in the current study where data were retrieved from a tertiary private hospital group in Saudi Arabia. Data were recruited from April 2020 to June 2021, data collection included reviewing patients' electronic medical records, nursing notes, laboratory characteristics, management details and clinical outcomes. A data collection form was prepared to obtain the needed COVID-19 patient information. Prior to data collection, an expedite approval was obtained from Institutional Review Board (IRB Log No: RC. RC20.09.10). Patients were de-identified and personal information was collected and therefore no informed consent was deemed necessary. In the present study the ethical guidelines of Declaration of Helsinki and good clinical practice was followed.

## Data analysis

In this study, descriptive and inferential analysis have been employed to analyze the data. Descriptive analysis such as frequency as a percentage has been utilized to calculate frequency and percentage for demographic variables and for comorbidities of the patients. Furthermore, binary logistic regression has been conducted to examine the association between (demographic variables and comorbidities) and mortality of COVID-19. Logistic regression is an extension of simple linear regression where the dependent variable is dichotomous or binary in nature.

## Results

### Demographic characteristics of COVID-19 patients

Demographic characteristics have been grouped under survivors (recovered) and non-survivors (died). There are two demographic variables which are age and gender. By looking at age (survivors), 21 (31.8%) of the total patients were at the age range 30–40 years old, 16 (24.2%) were 21–30 years old and above 50 years old, 11 (16.7%) were 41–50 years old and 2 (3%) were 10–20 years old. Meanwhile, for (non-survivors), over half of the patients which comprised 33 (66%) of the total respondents above 50 years old, 12 (24%) were 41–50 years old and 5 (10%) were 30–40 years old. In terms of gender, among survivors, 39 (59.1%) were females while 27 (40.9%) were males. It was reported that 43 (86%) of the male patients were non-survivors while 7 (14%) of the female patients were survivors.

Table 1  
Baseline Demographic characteristics of COVID-19 patients

Demography Variables	Survivors		non-survivors	
	n	%	n	%
Age				
10–20 Years Old	2	3.0		
21–30 Years Old	16	24.2		
30–40 Years Old	21	31.8	5	10.0
41–50 Years Old	11	16.7	12	24.0
Above 50 Years Old	16	24.2	33	66.0
Gender				
Male	27	40.9	43	86.0
Female	39	59.1	7	14.0

The results of Table 2. demonstrated that about 74 (63.8%) had no history of chronic diseases (HTN and DM). Meanwhile, 23 (19.8%) had one of the disease (HTN or DM), and 19 (16.4%) had a history of both HTN and DM.

Table 2  
Baseline Chronic disease (Hypertension and Diabetes) of COVID-19 patients

Comorbidities	Frequency	Percentage
No history of HTN & DM	74	63.8
Having one of them (HTN or DM)	23	19.8
Having history of both (HTN & DM)	19	16.4
Total	116	100.0

### The association between demographic characteristics and mortality of covid-19

Binary logistic regression has been computed to examine the association between demographic characteristics of the patients (age and gender) and mortality. The findings demonstrated that age [b = 0.077,df = 1,exp = 1.08] and gender [b = 2.183,df = 1,exp = 8.873] have significant association with mortality. The odds of non-survivors are 1.08 times among older patients as compared to younger.

According to gender, the odds of non-survivors among male patients are 8.873 times as compared to female patients.

Table 3  
Binary logistic regression model for Demographic characteristics & mortality of COVID-19

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Age						
Age	0.077	0.015	25.260	1	≥ 0.0005	1.080
Constant	-4.057	0.787	26.582	1	≥ 0.0005	0.017
Gender						
Gender	2.183	0.478	20.829	1	≥ 0.0005	8.873
Constant	-1.718	0.410	17.510	1	≥ 0.0005	0.179

### The association between history of chronic disease and mortality of COVID-19

Binary logistic regression was used to investigate the association between mortality and history of chronic disease (HTN and DM). The results of logistic regression showed that the history of HTN [b = 1.27,df = 1,exp = 3.56] and DM [b = 1.64,df = 1,exp = 5.17] have significant association with mortality. The odds of non-survivors among hypertensive patients are 3.56 times higher than among normotensive patients. Similarly, the odds of non-survivors among diabetic patients are 5.17 times higher than those who are not having a history of diabetes.

Table 4  
Binary logistic regression model for chronic disease and mortality of COVID-19

Variables	B	S.E.	Wald	Df	Sig.	Exp(B)
Hypertension						
HTN	1.27	0.46	7.49	1.00	0.01	3.56
Constant	-0.58	0.22	6.83	1.00	0.01	0.56
Diabetes						
DM	1.64	0.44	13.63	1.00	≥ 0.0005	5.17
Constant	-0.77	0.24	10.45	1.00	≥ 0.0005	0.46

Univariate logistic regression was computed to determine whether the history of a combination of HTN and DM may lead to higher mortality due to COVID-19. The findings demonstrated significant findings indicating that these factors contribute to mortality [b = 1.019, df = 1, exp = 2.77]. The odds of non-

survivors are 2.77 times higher among those who have a history of HTN and DM as compared to those who did not have a history of HTN and DM.

Table 5  
Univariate logistic regression model for combination HTN &DM with mortality of COVID-19

	<b>B</b>	<b>S.E.</b>	<b>Wald</b>	<b>Df</b>	<b>Sig.</b>	<b>Exp(B)</b>
HTN_VS_DM	1.019	0.279	13.367	1	≥ 0.0005	2.770
Constant	-1.836	0.464	15.671	1	≥ 0.0005	0.159
a. Variable(s) entered on step 1: HTN_VS_DM.						

## Discussion

Our study illustrates a significant relationship between variations in age and gender, prevalence of DM and HTN, and the overall COVID-19 related mortality. The results demonstrate that advanced age, male gender, and history of DM and HTN among COVID-19 patients are disproportionately prevalent among non-survivors and thus suggest that these mentioned demographic and disease elements are poor prognostic factors leading to an increased incidence of mortality. The binary logistic regression analysis used in our study quantitatively suggests that the COVID-19 patients who have age > 50 years, who are males, or who have history of HTN and/or DM may have up to 9-fold increased chances of mortality than those patients who are young, who are females and are nondiabetic and normotensive. This is in line with the previous reports that suggest similar correlation between mortality and these factors (2, 3, 4, 5, 6, 7).

A meta-analysis conducted by Li et al. which looked over 1,994 COVID-19 patients exhibited an increased mortality among patients who were males and suggested a case fatality rate of 7% (8). Another meta-analysis conducted by Pranata et al. (2020, n = 6520) showed that hypertension was linked to increased mortality among COVID-19 patients (RR 2.21 (1.74–2.81), p < 0.001) (5). Although many of the studies involving the association of hypertension with COVID-19 related mortality were confounded by other risk factors like age and gender, but the meta-analysis by Liu et al. (2020, n = 15302) proved that hypertension is an independent risk factor altogether and leads to an escalated risk of adverse outcomes including death in COVID-19 patients (9).

Onder et al. (2020, n = 22512), in a case fatality study conducted in Italy segregated the patients diagnosed with COVID-19 on the basis of age and showed that patients in the advanced age groups had proportionately increased case fatality rates reaching up to 20% in patients > 80 years of age (10). This is especially crucial keeping in view the progressive aging of the worldwide population as the number of older individuals aged 60 years or above is expected to increase from 962 million globally (2017) to 2.1 billion by 2050 (11); this means that the associated prognostic challenges associated with COVID-19 infection among elderly patients is expected to accrue with time.

DM has also been proven to significantly exacerbate the prognostic outcomes among COVID-19 patients (12). Barron et al. (2020, n = 23698) showed that DM was associated with more than three-fold increased risk of in-hospital mortality in COVID-19 patients than in nondiabetics (13). A study by Zhang et al. (2020, n = 72314) revealed a crude mortality rate of about 7.3% among COVID-19 patients who were diabetics, in comparison to a rate of only 0.9% among nondiabetic COVID-19 patients (15). Furthermore, in another retrospective case-control study, a mortality rate of around 35% was found in diabetic COVID-19 patients (16). All these studies reflect a strong impact of disease prevalence and demographic factors on the prognosis of COVID-19 infection.

However, there have been studies that have shown that diseases like HTN and DM may have no association with increased mortality. Wang et al. (2020, n = 209) showed that although HTN apparently seemed to increase the risk of mortality in univariate analysis (OR = 5.000, 95% CI [1.748–14.301]), but the multivariate analysis done in the same study proved otherwise and removed the possible association between HTN and mortality (OR = 1.099, 95% CI [0.264–4.580]) (17). Another study by Cummings et al. (2020, n = 257) showed the same pattern for both DM and HTN that the mortality association of both diseases disappeared when multivariate analysis was used in COVID-19 patients (18).

Nevertheless, our study has limitations. Firstly, the results may be confounded with other concomitantly prevalent risk factors which were not taken into account like smoking, obesity, asthma, cardiovascular morbidity etc. Secondly, the severity, associated disease complications, and the extent of disease control was not documented in patients with DM and HTN which could also affect the mortality in COVID-19 patients. Thirdly, subgroup analysis was not done to stratify the diabetic and hypertensive patients according to age and gender which may also have led to disproportionately skewed results.

We suggest a multivariate analysis in COVID-19 patients with multi-level stratification of comorbidities, their severity, complications and control, with gender and age distribution across all the subgroups to better establish a correlation between independent risk factors and mortality.

## **Conclusion**

The findings concluded that Demographic characteristics age and gender do have an impact on mortality rate of COVID-19. As reported that older patients more likely to non-survival as compared to younger patients. Besides that, it was recorded that male patients have higher tendency to non-survival as compared to female. In addition, those with history of Hypertension and Diabetes have higher probability to non-survival as compared with those who are not having history of Hypertension and Diabetes.

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ABBAS AL MUTAIR: Conceptualization, writing-original draft preparation, supervision, ethical approval; ALYA AL MUTAIRI: Formal analysis, Data analysis, Interpretations, supervision; ABDUL REHMAN ZIA ZAIDI: Methodology, writing-review and editing; SYED MAAZ ABDULLAH: Resources, data curation, writing-original draft preparation; SAAD ALHUMAID: Resources, data curation, writing-review and editing; AWAD AL-OMARI: Resources, data curation, writing-original draft preparation.

**Ethics approval and consent to participate:**

This study was approved by the Institutional Review Board (IRB Log No: RC. RC20.09.10).

**Consent for publication:**

As this was a retrospective study, no informed consent was deemed necessary, and data were identified for the use of this publication. This study adhered to the ethical guidelines of the Declaration of Helsinki and good clinical practice.

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