Prevalence of Modified Risk Factors in COVID-19 Patients Admitted to Intensive Care Unit in Kingdom of Bahrain

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ABSTRACT

Objective: The objective of this study was to examine the prevalence of modifiable risk factors associated with intensive care unit (ICU) admission and their impact on outcomes at the Hereditary Blood Disorder Center (HBDC) in Bahrain during the period from March 2020 to March 2021. The purpose of this analysis was to generate valuable data for health educators and authorities.

Materials and Methods: This retrospective cross-sectional observational study aimed to investigate the prevalence of modifiable risk factors among 320 laboratory-confirmed COVID-19 patients admitted to the Intensive Care Unit (ICU) at the Hereditary Blood Disorder Center (HBDC) in Bahrain during the peak period of COVID-19 from March 2020 to March 2021 which. Descriptive and univariate and multivariate analyses were employed to explore the prevalence of these risk factors among ICU patients and to assess their association with patient outcomes.

Results: A study of 320 COVID-19 patients admitted to the ICU found that the mean age was 53.7 years old, 30.9% were male, and 97.8% were not vaccinated. The most common risk factors were hypertension (44.4%), diabetes (40.3%), dyslipidemia (31.9%), and smoking (15.9%). 16.9% (54 patients) died due to COVID-19 or its complications. In the univariate analysis, patients older than 60 years old were more likely to die than patients younger than 60 years old (P = 0.001). Hypertensive patients were also more likely to die than non-hypertensive patients (P = 0.003), as were patients with dyslipidemia (P = 0.03). The patient's gender, vaccination status, smoking, and diabetes status were not associated with the patient's final outcome. In the multivariate analysis, the only significant risk factor for death was being 60 years old or older (P = 0.048). Hypertension and dyslipidemia were not significant risk factors in the multivariate analysis.

Conclusion: The study found that older age was the most significant risk factor for death in COVID-19 patients admitted to the ICU. Hypertension and dyslipidemia were also associated with an increased risk of death in the univariate analysis, but this association was not significant in the multivariate logistic regression analysis.

Keywords: COVID-19, Intensive Care Unit, Risk Factors, Bahrain

INTRODUCTION

The World Health Organization (WHO) declared the coronavirus illness (COVID-19) a pandemic in March 2020. It is caused by the novel coronavirus severe acute respiratory syndrome (SARA-CoV-2) that was discovered in Wuhan, China, in December 2019. [1]. The coronavirus is transmitted via respiratory droplets. COVID-19's most common symptoms are fever, cough, exhaustion, and loss of taste or smell, but more severe cases can cause respiratory distress and multi-organ system failure.[2]. The development of COVID-19 vaccines has been a critical step in reducing the number of deaths and morbidities caused by the virus. [3].As of August 2023, there have been over 696.6 million confirmed cases of COVID-19 worldwide, with over 6.95 million deaths reported to the WHO. In Bahrain, the first confirmed case was reported on February 24th, 2020, and by August 2023, there had been 726 thousand confirmed cases and 1,536 deaths. Vaccination efforts in Bahrain have resulted in the administration of over 3.47 million vaccine doses until August 2023[4].

The increased rate of morbidity and mortality among different age groups is a significant concern, particularly for high-risk patients with specific factors such as diabetes, hypertension, dyslipidemia, smoking,

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and vaccination status. Various factors contribute to a worse prognosis for patients, leading to hospitalization and even ICU admission. [5,6,7].

These factors can be classified as modifiable or non-modifiable. Chronic illnesses like hypertension and diabetes, as well as smoking, fall under the modifiable category, while age and gender are non-modifiable factors. In the Kingdom of Bahrain, the prevalence of hypertension, hyperlipidemia, and diabetes is notably high. For instance, hypertension prevalence reached 36.9% between October 2010 and March 2011, and diabetes prevalence in Bahrain reached 16.3% in 2020, for a total of 202,700 cases. [8,9]

Despite the decreasing number of COVID-19 cases globally and in Bahrain due to vaccination efforts and awareness campaigns, the identification and characterization of well-established modifiable risk factors, as well as an understanding of their prevalence and distribution within a population, can be used to predict potential morbidity and mortality rates at the population level. This information can be instrumental in making informed policy decisions and designing an optimized public health response. Additionally, while the presence of a statistical association between a potential risk factor and COVID-19 outcomes does not imply causality, the identification of such risk factors can offer valuable insights into the underlying mechanisms of pathogenesis. Elucidating these mechanisms can, in turn, facilitate the development of new therapeutic options and effective non-pharmaceutical interventions against COVID-19.

METHODS

Study Design, Population, and Eligibility Criteria: This is a retrospective cross-sectional observational study that was conducted at the Hereditary Blood Disorder Center (HBDC) in Bahrain during the peak of the pandemic in the period from March 2020 to March 2021. The study included 320 patients between the ages of 18 and 92 with a laboratory-confirmed COIVD-19 infection. Confirmed cases of COVID-19 were defined by a positive result on a reverse transcriptase-polymerase chain reaction (RT-PCR) assay of a specimen collected on a nasopharyngeal swab that tested positive for the first time. All patients without a positive COVID-19 test were excluded from the study. The admission criteria were according to the guidelines published by the Kingdom of Bahrain for the management of patients with confirmed COVID-19 pneumonia. The study was approved by the institutional scientific and ethics committees of the National COVID Research Committee in the Kingdom of Bahrain.

Data collection: Data was collected through the hospital's electronic medical record system by the research team members according to the research form. The extracted variables included demographic data, vaccination status, and the presence of risk factors such as diabetes mellitus, hypertension, dyslipidemia, and smoking. Outcome measures included recovery from the COVID-19 infection or death.

Statistical Analysis: IBM SPSS version 23 was used for data analysis. Descriptive statistics using frequencies and percentages were calculated for categorical variables. The Chi-square test was used in univariate analysis to evaluate the association between the independent categorical variables and the outcome of the ICU-admitted patient. Odd ratios (OD) were used to evaluate the association between some risk factors and the final outcome. The odds ratio (OR) represented the association between potential risk factors and the final outcome (alive vs. death). OR values suggest the odds that an outcome occurs due to an exposure compared to the outcome that is due to the absence of that particular exposure. Depending on the OR values, it is possible to study the incidences of outcomes (OR < 1 indicates decreased occurrences

of an event, and OR > 1 indicates increased occurrences of an event). For the multivariate assessment of risk factors, the multivariate logistic regression model was used. Adjusted odds ratios controlling for confounding variables included in the final model were evaluated to assess the association between the risk factors and the final outcome (alive vs. death). Calculating odds ratios for each factor separately before and after adjusting for a potential confounder such as age, vaccination status, smoking, and the presence of comorbidities such as hypertension, diabetes, and dyslipidemia.

RESULTS

Demographic data and risk factors: A total of 320 COVID-19 patients who were admitted to the ICU were enrolled in the study. The mean age of the patients was 53.7±16.32 years old; 30.9% (n = 99) were males, and 97.8% (n = 313) were not vaccinated. According to the risk factors and comorbidities, 44.4% (n = 142) were hypertensive, 40.3% (n = 129) were diabetic, 31.9% (n = 102) had dyslipidemia, and 15.9% (n = 51) were smokers. 16.9% (n = 54) died due to COVID-19 or a complication (Figure 1).
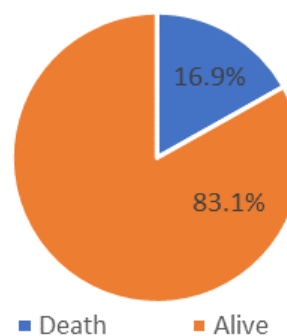
Figure 1. The outcome of COVID-19 patient who admitted intensive care unit patients at HBDC

Clinical characteristics of deceased patients: Out of 54 patients who died due to COVID-19 and its complications and were admitted to the ICU during the period from March 2020 to March 2021, 25.9% (n = 14) were males, 59.3% (n = 32) were 60 and older, 100% (n = 54) were not vaccinated, 63% (n = 34) had hypertension, 50% (n = 27) had diabetes mellitus, and 44.4% (n = 24) had dyslipidemia.

Univariate analysis: In a univariate analysis of 320 patients admitted to the ICU with COVID-19, older age, hypertension, and dyslipidemia were independently associated with increased mortality. Patients 60 years of age or older are more likely to die compared to patients younger than 60 (32 [25.0%], P = 0.001). Hypertensive patients who are admitted to the ICU due to COVID-19 were more likely to die (34 [23.9%], P = 0.003) in comparison to patients who did not have hypertension. A similar trend applies for patients who had dyslipidemia (24 [23.5%], P = 0.03). In contrast, the patient's gender, vaccination status, smoking status, and diabetes mellitus status were not significantly associated with mortality. (Table 1).

A univariate analysis of factors associated with COVID-19 death in ICU patients found that older age, hypertension, and high blood cholesterol were independent risk factors. Specifically, the odds of death were 2.576 times higher in patients aged 60 years or older (OR 2.58, 95% CI 1.417□4.683, P = 0.002). Patients who died were also 2.487 times more likely to have hypertension (OR 2.487, 95% CI 1.359–4.55, P = 0.003). High blood cholesterol was also a significant risk factor, with patients

Table 1. Demographic and risk factors of COVID-19 intensive care unit patients classified by the final outcome of how the patient was discharged from the hospital (Alive versus Deceased)

Chi-Square Test	Outcome	Total (%)'		Alive Count (%)'		Deceased Count (%)'		P-Value
Age (years)	<60	192	60%	170	88.5%	22	11.5%	
	>=60	128	40%	96	75.0%	32	25.0%	**0.001***
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	
Gender	Female	221	69.1%	181	81.9%	40	18.1%	
	Male	99	30.9%	85	85.9%	14	14.1%	0.382
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	
Vaccination	Vaccinated	7	2.20%	7	100%	0	0.00%	
	Non-vaccinated	313	97.8%	259	82.7%	54	16.9%	0.228
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	
Smoking	Yes	51	15.9%	43	84.3%	8	15.7%	
	No	269	84.1%	223	82.9%	46	17.1%	0.805
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	
Hypertension	Yes	142	44.4%	108	76.1%	34	23.9%	
	No	178	55.6%	158	88.8%	20	11.2%	**0.003***
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	
Diabetes mellitus	Yes	129	40.3%	102	79.1%	27	20.9%	
	No	191	59.7%	164	85.9%	27	14.1%	0.111
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	
Dyslipidemia	Yes	102	31.9%	78	76.5%	24	23.5%	
	No	218	68.1%	188	86.2%	30	13.8%	**0.030***
	Total	**320**	**100.0%**	**266**	**83.1%**	**54**	**16.9%**	

Table 2. Odds Ratio and Confidence Interval for Significant and Confounding Variables for the risk factor associated with death in ICU patients

ratio	Reference	Unadjusted odds ratio			Adjusted odds ratio		
		Odd	95% C.I. for odd ratio		Odd ratio	95% C.I. for odd ratio	
			Lower	Upper		Lower	Upper
Gender	Male vs. Female	1.342	0.693	2.598	1.306	0.63	2.708
Age	>=60 vs. <60	2.58*	1.47	4.683	1.998*	1.01	3.968
Vaccination	Yes vs. No	0	0.0	∞	0	0	∞
Smoking	Yes vs. No	0.902	0.398	2.045	0.886	0.358	2.191
Hypertension	Yes vs. No	2.5*	1.359	4.55	1.9	0.89	4.055
Diabetes mellitus	Yes vs. No	1.6	0.893	2.894	0.985	0.465	2.088
Dyslipidemia	Yes vs. No	1.93*	1.060	3.507	1.019	0.458	2.268

C. I: Confidence Interval. * Significant Variable in The Logistic Model at the 0.05 level (2-tailed).

who died being 1.928 times more likely to have high blood cholesterol (OR 1.928, 95% CI 1.06–3.507, P = 0.031). Other variables, such as gender, vaccination status, and diabetes mellitus, were not significant predictors of death.

Multivariate analysis: The multivariate logistic regression analysis showed that the only significant risk factor for death for COVID-19 ICU patients was being 60 years of age or older (OR 1.998, 95% CI 1.01-3.968, P = 0.048). The other factors that were significant in the univariate analysis, such as hypertension and dyslipidemia, were not significant in the multivariate analysis (Table 2).

Discussion

The analysis of 320 COVID-19 patients admitted to the Intensive Care Unit (ICU) yielded a noteworthy observation: a significant majority (98%) of these patients were unvaccinated. It is essential to contextualize this finding within the early stages of the COVID-19 vaccine rollout, which explains the low percentage of vaccinated patients[10-13]. This highlight the pivotal role of vaccination in mitigating severe COVID-19 illness and mortality, as demonstrated by a noticeable reduction in mortality rates following widespread vaccination among the Bahraini population[14]. Multiple studies have furnished compelling evidence of vaccination's effectiveness in substantially reducing the risk of COVID-19-related death, with multiple studies done in the United kingdom, The United states and Brazil demonstrating a remarkable reduction in such risk among elderly[15-17].

Additionally, a substantial portion of the patient population presented risk factors associated with severe COVID-19, including 44% with hypertension, 40% with diabetes, and 32% with dyslipidemia. This underscores the critical importance of effectively managing these risk factors to prevent severe illness. The study's high mortality rate (17%) serves as a stark reminder of the gravity of COVID-19, particularly among unvaccinated individuals with pre-existing risk factors. Consequently, these findings reinforce the existing recommendations advocating for vaccination and the management of risk factors to mitigate the severity of COVID-19 illness.

Furthermore, this research discerned that individuals aged 60 years or older faced a significantly higher risk of mortality while in the ICU due to COVID-19. This aligns with previous studies highlighting

age as a prominent risk factor for severe COVID-19 outcomes[18-21]. Notably, some risk factors identified in the univariate analysis, such as hypertension and dyslipidemia, did not retain significance in the multivariate analysis, potentially due to their correlation with age, which emerged as the most potent predictor of death.

Furthermore, it is worth noting that the study did not comprehensively evaluate all potential risk factors for COVID-19-related mortality. Other factors, including obesity and chronic lung disease, and cardiovascular disease warrant consideration[21]. A review of 44 studies from 18 countries found that obesity is a risk factor for severe COVID-19 complications. People with a higher body mass index (BMI) are more likely to be hospitalized, admitted to the ICU, and require intubation. They are also more likely to die from COVID-19[22].

It is imperative to acknowledge the study's limitations, including its relatively modest sample size and its confinement to a single hospital setting. Nonetheless, despite these constraints, the study's findings offer valuable insights into the risk factors associated with severe COVID-19 illness and emphasize the roles of vaccination and risk factor management in its prevention.

CONCLUSION

The study found that older age was the most significant risk factor for death in COVID-19 patients admitted to the ICU. Hypertension and dyslipidemia were also associated with an increased risk of death in the univariate analysis, but this association was not significant in the multivariate logistic regression analysis. The findings of this study have important implications for the management of COVID-19 patients. Older patients and patients with hypertension and dyslipidemia should be closely monitored and given the most aggressive treatment possible. Vaccination is also important for all patients, but it is especially important for older patients and patients with underlying medical conditions.

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