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Severity of COVID 19 and emergency intervention need in diabetic patients

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ABSTRACT

According to many studies, coronavirus disease is a major problem globally because it adds a health burden to governments and health authorities, as well as diabetes mellitus, which was suggested to be a predictor of COVID severity and ICU admission needs. In this study, we aimed to evaluate the severity of COVID in admitted diabetic patients if compared to non-diabetics. This retrospective study was conducted in KSMC, Riyadh, KSA in the period from 1 May to 1 July 2021. Our results found that diabetes in COVID patients is associated with a high percentage of severe disease. Vital signs on admission were also shown to be an indicator of disease severity.

Keywords: COVID, diabetes, severity, emergency, vital signs.

1. INTRODUCTION

In 2019, the SARS-CoV2 virus produced a global outbreak, which manifests as an acute respiratory illness. COVID-19 virus spreads through respiratory droplets, it can spreads quickly in crowded, poorly ventilated indoor spaces, in which most people spend their time. This is due to the fact that aerosols can float indefinitely or travel over great distances—far beyond the range of human speech (Long-range aerosol transmission) (WHO, 2022). COVID-19 infection is typically mild; however, some people develop severe infection symptoms due to impaired respiratory function (SpO2 93 percent; pulmonary infiltration, > 50% of the lung field during radiography; respiration rate of 30 breaths per minute; PaO2: FiO2 300) (CDC, 2022). A wide spectrum of clinical presentations, from asymptomatic infection to critical illness, has been observed in patients infected with SARS-CoV-2. Clinical overlap may occur

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between criteria for each category, and a patient's clinical condition may alter (CDC, 2022).

Diabetes is a leading cause of morbidity and mortality worldwide and it's one of the most prevalent comorbidities in COVID patients (Baradaran et al., 2020). In addition to that, its long period without good control was associated with higher mortality and severe COVID (Sarkar et al., 2021). At the moment of writing, there were 576,263,561 confirmed cases and 6,405,356 cases of deathas a results of COVID worldwide. The WHO stated that from January 3, 2020, to July 25, 2022, there were 807,591 confirmed cases of COVID-19 in KSA, with 9,239 deaths (WHO, 2022). There is insufficient evidence to determine if people with diabetes are more prone than the general population to get COVID-19. The issue for people with diabetes is that they are more susceptible to severe problems if they get the virus, not of their higher probability of acquiring it. There is a shortage of information and studies discussing COVID-19 in diabetic patients in KSA.

Our study aims to assess the severity of COVID-19 in diabetic patients when compared to non-diabetic patients also to assess the need for emergency interventions by diabetic COVID-19 patients and to find the correlation between vital signs on time of admission and the severity of COVID 19.

2. MATERIAL AND METHODS

This is a retrospective, hospital records-based study from 1 May to 1 Jul 2021 done at KSMC, which is a large medical complex in the Saudi capital of Riyadh (KSMC). Since its founding in 1956, this hospital has grown to become one of the largest tertiary care centers in KSA, with a total bed capacity of 1,500. Patients with COVID admitted to KSMC with age of 18 years and above, were included in the study. Data from patient files were collected, including demographic information (age and gender), diabetes history (diabetics or non-diabetics), COVID19 severity (according to the disease severity classification) (nih.gov, 2022) and comorbidities (according to the Charlson index of comorbidity).

COVID-19 severity is categorized as follows: Patients taken as asymptomatic or pre-symptomatic when they were SARS-CoV-2 RT-PCR positive, On the other hand, they do not exhibit any symptoms. Mild Illness: patients with COVID-19's symptoms (including: heat, chills, a dry hacking cough, a sore throat, a general feeling of malaise, a pounding head, aching muscles, nausea, vomiting and diarrhea), but not chest imaging abnormalities, symptoms of shortness of breath or dyspnea; Moderately sick patients with a SpO2 below 94% and lower respiratory illness symptoms. A respiratory rate that is greater than 30 breaths in a minute, a PaO2/FiO2 ratio that is less than 300 mm Hg, or a SpO2 that is lower than 94% are all indicators of severe sickness. Lung infiltrates that are greater than 50% also indicate severe disease. A critical disease is characterized by the dysfunction of numerous organs, the development of septic shock, and/or the respiratory failure (nih.gov, 2022). Comorbidity status was recorded by a checklist extracted from the Charlson comorbidity index and categorized as 0, 1, and 2 (mdcalc.com, 2022).

We enrolled all COVID-positive diabetic (109 patients) and non-diabetic (COVID positive) hospitalized patients during the study period (108 patients) at KSMC. The data was processed using SPSS v24. Descriptive analysis was performed for continuous variables and frequency analysis for categorical variables. Comparisons were made using the chi-square test (with fisher exact test). We tested diabetic condition (diabetics vs. non-diabetics) with COVID severity according to the classification of SARS-CoV-2 infection severity (asymptomatic, mild illness, moderate illness, severe illness, and critical illness). The chi squire test (with fisher exact test) was also used in order to establish a connection between diabetes and the requirements for nasal cannula, face mask, ICU monitoring, and mechanical ventilation, and ECMO treatment. A p-value of 0.05 or less will be considered significant. We also used Pearson's correlation to correlate COVID severity with age, vital signs, SpO2, glucose check on admission, and diabetes mellitus duration.

KSMC approved the study and waived consent (H1RI-01-Aug22-01). The research facility kept all forms private. This study didn't mention patient names or sensitive information. Only investigators, statisticians, and data collectors will have access. The researchers have no conflict of interest or favoritism in this research.

3. RESULTS

Study covered 217 patients. All of them had COVID19 confirmed by RT-PCR while 50.2 % were diabetic. Table 1 shows the mean duration of diabetes was 6.7 years (SD 9.5). Table 2 shows all patients were admitted to KSMC in Riyadh, KSA. This study included 217 patients, with a mean age of 56.9 years (SD 17.03) years (Table 2) and 59.4% being female (Table 1). Regarding comorbidity, the mean score was 4.3 (SD 3.4) according to the Charlson comorbidities scale, Table (2). 99.5% of patients needed emergency measures on arrival, table (1). Vital signs (body temperature, blood pressure, heart rate, and respiratory rate) on admission are described in table 2. Patients with critical COVID-19 were (83.2%) and their vital signs, Charlson comorbidity scale, and SpO2, shown in table 3.

Table 1 Demographic and clinical data of the patients

	Frequency	Percent
Gender		
Male	88	40.6
Female	129	59.4
Complain of diabetes		
Yes	109	50.2
No	108	49.8
Did the patient needed emergency measures on arrival?		
Yes	216	99.5
No	1	.5
Severity of COVID19		
Mild illness	33	15.2
Moderate illness	42	19.4
Sever illness	59	27.2
Critical illness	83	38.2

Table 2 Descriptive statistics of age, comorbidities, duration of diabetes and vital signs

	Minimum	Maximum	Mean	Std. Deviation
Duration of diabetes in years	.00	54.00	6.7926	9.58820
Age	18.00	92.00	56.9539	17.03259
Charlson Comorbidities scale	.00	16.00	4.3226	3.43149
Body temperature	37.00	391.00	42.7516	40.34877
Systolic blood pressure	43.00	201.00	122.0369	35.46815
Diastolic blood pressure	23.00	133.00	74.5207	18.90891
Heart rate	38.30	148.00	111.6465	12.87432
Respiratory rate	18.00	40.00	26.4977	5.69041

Table 3 Vital signs of patients with critical COVID19

Descriptive Statistics				
	Minimum	Maximum	Mean	Std. Deviation
Body temperature	37.00	391.00	46.4241	53.53694
Systolic blood pressure	43.00	189.00	107.2410	35.66018
Diastolic blood pressure	23.00	125.00	67.4217	17.95191
Heart rate	38.30	148.00	119.0518	15.55136
SpO2	69.00	94.00	84.0723	5.80114
Respiratory rate	20.00	40.00	30.9880	5.38628
Charlson comorbidities scale	.00	14.00	5.6747	3.43621

The chi squire test with Fisher's Exact Test was used to correlate the severity of COVID 19 (mild, moderate, severe, critical) with the history of diabetes mellitus (had diabetes, hadn't). The chi-square test P-value (asymptotic significance (2-sided)) was 0.000, which is significant (less than 0.05). 51.4% of patients with history of diabetes developed critical COVID. While no one with mild COVID-19 reported having a history of diabetes, Table 4 and Figure 1. The comorbidity was categorised into: (0, 1, ≥2) and cross tabulation was done with the severity of COVID19. The result was significant with a p value of 0.000, giving 45.2% of patients with 2 comorbidities and above developed critical COVID 19 (Table 4). Gender was also cross tabbed with COVID-19 severity, but no significant results were detected.

Another chi squire test with Fisher's Exact Test was done to correlate diabetes status with (the need for nasal cannula, face mask, ICU monitoring, mechanical ventilation, and ECMO treatment), a significant relationship appeared with the patient's need for oxygen by face mask and the patient's need for ICU, p-value 0.045 and 0.000, respectively (Table 5). A Pearson correlation was done to compare COVID 19 severity with (vital signs, SpO2, glucose check) on admission time and the duration of diabetes in years, and the results were as follows: all of the variables tested showed a significant correlation except body temperature. Glucose check on admission, heart rate, duration of diabetes in years, and respiratory rate demonstrated a positive correlation with COVID 19 severity, while systolic blood pressure, diastolic blood pressure, and oxygen saturation (SpO2) all had a negative correlation (Table 6).

Table 4 Chi squire for diabetes history and COVID19 severity

Factor		Severity of COVID19				P-value
		Mild illness N (%)	Moderate illness	Sever illness	Critical illness	
Complain of DM	No	33 (30.6)	23 (21.3)	25 (23.1)	27 (25.0)	
	Yes	0 (0)	19 (17.4)	34 (31.2)	56 (51.4)	0.000
Comorbidity scale	0	22 (56.4)	9 (23.1)	3 (7.7)	5 (12.8)	
	1	2 (16.7)	3 (25.0)	4 (33.3)	3 (25.0)	0.000
	2 and above	9 (5.4)	30 (18.1)	52 (31.3)	75 (45.2)	
Note: chi squire test, p*-value less than 0.05 Abbreviations: DM, diabetes mellitus; C, charlson						

Table 5 Chi square for diabetes history and patient need for certain measures

		Complain of Diabetes Mellitus		p-value
		No n (%)	Yes n (%)	
Did the patient needed oxygen by nasal cannula	Yes	86 (50.3)	85 (49.7)	0.448
	No	22 (47.8)	24 (52.2)	
Did the patient needed oxygen by face mask	Yes	50 (43.9)	64 (56.1)	0.045
	No	58 (56.3)	45 (43.7)	
Did the patient needed intensive care unit "or ICU monitoring	Yes	60 (41.4)	85 (58.6)	0.000
	No	48 (66.7)	24 (33.3)	
Did the patient needed intubation on Mechanical ventilator	Yes	36 (43.4)	47 (56.6)	0.089
	No	72 (53.7)	62 (46.3)	
Did the patient needed "ECMO" treatment	Yes	0 (0.0)	3 (100.0)	0.125
	No	108 (50.5)	106 (49.5)	
Note: chi squire test, p*-value less than 0.05				

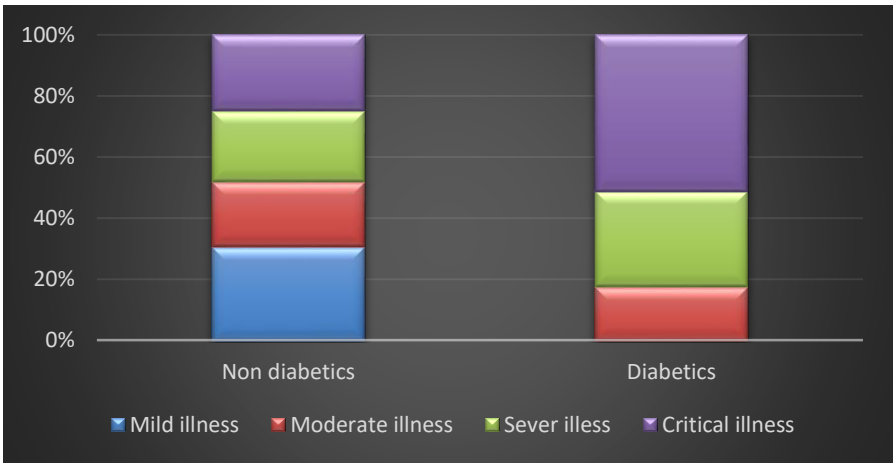

Figure 1 Illustrate the variation in COVID severity if diabetes history was considered

Table 6 Pearson correlation between COVID 19 severity and certain variables

Correlations		
		Severity of COVID19
Glucose check on admission	Pearson Correlation	.334**
	Sig. (2-tailed)	.000
Body temperature	Pearson Correlation	.088
	Sig. (2-tailed)	.197
Systolic blood pressure	Pearson Correlation	-.314-**
	Sig. (2-tailed)	.000
Diastolic blood pressure	Pearson Correlation	-.212-**
	Sig. (2-tailed)	.002
Heart rate	Pearson Correlation	.457**
	Sig. (2-tailed)	.000
Duration of diabetes in years	Pearson Correlation	.344**
	Sig. (2-tailed)	.000
SpO2	Pearson Correlation	-.592-**
	Sig. (2-tailed)	.000
Respiratory rate	Pearson Correlation	.638**
	Sig. (2-tailed)	.000
Age	Pearson Correlation	.506**
	Sig. (2-tailed)	.000
**. Correlation is significant at the 0.01 level (2-tailed).		
*. Correlation is significant at the 0.05 level (2-tailed).		

4. DISCUSSION

Our study found that diabetes mellitus was associated with critical illness of COVID19, diabetes also associated with raising the need for ICU. While pre-existing DM does not appear to be a precipitating factor for COVID19 infection, a study by Sarkar et al., (2021) found that it is one of the major comorbidities in COVID-19 patients. Also a systematic literature review study was done in 2020 highlighted that, there's double increase of COVID19 mortality and disease severity if the patient had a history of diabetes mellitus if compared to non-diabetics (Aggarwal et al., 2020; Huang et al., 2020). A meta-analysis of 83 observational studies was done in 2020 to analyze diabetes as COVID mortality predictor; the researcher concluded that association of DM with COVID19 severity is still not well understood, and the analysis of observational studies associate diabetes with a greater risk of critical illness in hospitalized patients (Mantovani et al., 2020).

Our study also concluded that severity of COVID 19 increased when the comorbidities increase. Supporting to our results an electronic literature search was performed to analyze comorbidity and its impact on COVID19 patients, results come in line with our study, that patients with comorbidities such as HTN and DM, are more expected to develop a critical illness, also older patients (older than 65 years) with comorbidities, at higher risk of ICU admission (Sanyaolu et al., 2020). When looking at the co-morbidities of severe COVID19, another systematic literature analysis revealed that cerebrovascular disease was most strongly associated, followed by CVS disease, and finally hypertension was least associated (Honardoost et al., 2021). Additionally a considerable predictor for severe COVID and even death were emphasized when Ge et al., (2021) related pre-existing comorbidities with COVID19 severity. According to Yan et al., (2020) independent risk variables for COVID-19 severity and poor treatment success, were, fatty liver disease, hyperlipidaemia, other lung illnesses, and electrolyte imbalance. Comorbidities in women were associated with more severe disease, while in men they were associated with poorer treatment outcomes.

Based on this study, patient vital signs and SpO2 on admission have a direct influence on COVID19 severity. Systolic blood pressure, diastolic blood pressure, and oxygen saturation (SpO2) displayed a negative link with COVID19 severity; nevertheless, glucose levels measured at admission, heart rate, years of diabetes, and respiratory rate all show a positive association with COVID19 severity. A retrospective study scope to check for association of vital signs in admitted COVID patient found that high respiratory rate, heart rate and decreased saturation of oxygen on initial assessment, play a role as a risk of death from COVID. According to a study conducted by Rechtman et al., (2020) and Sands et al., (2019), decreased oxygen saturation and DM history are

associated with increased odds of mortality in COVID patients. Another retrospective study of admitted COVID patients demonstrated that lower oxygen saturation on admission and higher admission respiratory rate and glucose were associated with higher mortality (Ikram & Pillay, 2022).

Our study found that age is positively associated with COVID severity. One theory for why elderly were more expected to contract COVID19 is because they are more expected to live in close quarters with one another, such as in nursing facilities or old houses. One Israeli study found that younger patients recovered more quickly on average and were less expected to develop severe symptoms requiring hospitalization in an ICU (Voinsky et al., 2020).

5. CONCLUSION

Our study concluded that diabetic patients are more suspected to get severe COVID if compared to non-diabetics. Also, the vital signs and age of COVID patients on admission are predictors of disease severity.

Abbreviations

KSA: kingdom of Saudi Arabia, DM: diabetes mellitus, CVS: cardiovascular system, COVID: corona virus disease, KSMC: king Saud medical city, HTN: hypertension, ICU: intensive care unit, CDC: centre of disease control and prevention, WHO: world health organization, SPSS: Statistical Package Social Sciences.

Author's contribution

Principal Investigator: Dr.Faheem Mohammed alanazi - Participated in all aspects of the study process, from the preparation of the proposal to the drawing of the conclusion, and also organized and supervised the entire project.

Co-author: 1-Hisham FahadAlyahya (Corresponding author): Assisted in the creation of the study proposal and took part in all other aspects of the research process. 2-Abdulrahman Sulaiman Yamani: Was in charge of creating the proposal and collecting the data, and contributed to most research steps, beginning with drafting the proposal and ending with the conclusion. 3- Ahmed Abdullah Alsaleh: was in charge of creating the proposal and collecting the data, and contributed to most research steps, beginning with drafting the proposal and ending with the conclusion. 4-Samah hamoud alshammari: questionnaire creator, gathering and analyzing data, and participating in most stages of the study process from proposal writing through report writing. 5-Ahad Mohammed ALqubaidie: was contributed in writing the study's discussion and conclusion and participated in all but the proposal stage. 6-Yazeed Abdulaziz Alrashed: questionnaire creator, gathering and analyzing data, and participating in most stages of the study process from proposal writing through report writing. 7-Shoug abdullahalshiky: questionnaire creator, gathering and analyzing data, and participating in most stages of the study process from proposal writing through report writing. 8-Bayan Saleh alghamdi: Questionnaire developer, collecting data, analyzing data, and other stages of the research process from proposal to report. 9-Hassan Munthir Abdulmohsen Alabbad: Questionnaire developer, collecting data, analyzing data, and other stages of the research process from proposal to report. 10-Hussam Mohammed Alzahrani: Questionnaire developer, collecting data, analyzing data, and other stages of the research process from proposal to report. 11-Abdullah Mashan Alanazi: contributed to the research in many ways, including the idea, analysis, discussion, and conclusion. 12-Ali Hassan Almasskin: contributed to the research in many ways, including the idea, analysis, discussion, and conclusion. 13-Saleh hazzaaAlharbi: contributed to the research in many ways, including the idea, analysis, discussion, and conclusion.

Further information

All authors have said they have no financial relationships to any groups or institutions that would be interested in their work. All authors have confirmed that they have no affiliations or activities that could influence the submitted work.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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