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THE IMPACT OF OBESITY ON COVID-19 SEVERITY: A CROSS-SECTIONAL STUDY AT SUB POPULATION OF KARACHI.

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ABSTRACT:
BACKGROUND: The introduction of SARS-CoV-2 has caused considerable hurdles to healthcare systems globally, particularly for people with pre-existing health disorders. Due to viral reservoirs in adipose tissue and dysregulated inflammatory reactions, obesity has become a distinct risk factor for severe SARS and MERS infections. To understand the impact of obesity as a risk factor for many health disorders, particularly COVID-19, more research is required.**METHODOLOGY:**The current cross-sectional study was carried out at Ziauddin University to look into the connection between obesity and the severity of COVID-19. Between 2021 and 2022, PCR-positive patients who sought medical attention at the hospital's OPDs or received inpatient services were included. Data were gathered from medical records while adhering to ethical standards. The data were analyzed using descriptive statistics and Chi-Square testing, with a significance level of p 0.05. **RESULTS:**In this study, the majority of patients were male and older than 50, and there was a strong correlation between age and illness severity. Common signs of disease severity included fever, coughing, and dyspnea. Several inflammatory markers, including CRP 0.001, TLC 0.001, ferritin 0.001, and LDH 0.001, were found to be strongly related to COVID-19 severity. Age and gender had no discernible influence on the outcome; however, fever was discovered to be connected to it. Additionally, the study classified patients' Body Mass Index BMI into several ranges, finding no link between gender and disease severity as determined by BMI. **CONCLUSION:**The current study demonstrates that age, symptoms, and specific inflammatory markers significantly contribute to the severity of COVID-19, while gender and BMI do not exhibit significant associations.
KEY WORDS: Obesity, SARS-CoV-2, BMI, Inflammatory markers, MERS

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INTRODUCTION

The advent of SARS-CoV-2 has placed considerable strain on healthcare systems worldwide, with a particular focus on individuals afflicted by pre-existing medical conditions that render them disproportionately susceptible to grave respiratory ailments [1]. Consequently, scientists are mandated with identifying vulnerable individuals and developing appropriate interventions to mitigate the virus' effects [2]. Concerning COVID-19 severity, which ranges from mild to severe, medical experts have given priority to looking at risk factors [3,4]. Obesity has emerged as a discernible predisposing element in the context of severe manifestations of severe acute respiratory syndrome SARS and Middle East respiratory syndrome MERS infections, standing as an independent risk factor.Furthermore, there is an 80% genetic connection between SARS-CoV-2 and its viral equivalents, SARS-CoV and MERS-CoV, with the latter having a 50% likeness. These intriguing findings imply that obesity may be a risk factor for the severity of COVID-19 [5]. Obesity's association with COVID-19 can be explained by several mechanisms. First off, in

obese people, adipocytes may operate as a reservoir for the virus since they express ACE2 more highly than do the lungs. This makes them more vulnerable to viral invasion. This can lead to a persistent viral load and trigger an inflammatory response, contributing to adverse outcomes [6]. Secondly, obesity alters the balance of adipocytokine production from adipose tissue, leading to persistent inflammation and weakened immune function. In severe COVID-19 cases, this imbalance may exacerbate the inflammatory process and contribute to a hyperinflammatory condition [7]. A notable proportion exceeding 70% of adult COVID-19 patients requiring ICU admission display overweight or obesity [8]. This implies that excess adipose tissue and its dysregulated release of inflammatory chemicals may contribute to systemic and pulmonary inflammatory responses that result in lung damage and respiratory failure [9,10]. Chronic inflammation in obese people is expected to exacerbate the immunopathology associated with SARS-CoV-2 infection and increase the risk of severe organ damage. However, this relationship is not entirely understood [11,12]. They have discerned a multitude of preexisting conditions encompassing hypertension, cardiovascular ailment, diabetes, chronic respiratory disorder, and malignancy. [13,14], and more recently, obesity, as major risk factors for developing severe COVID-19 [15]. Obesity is a known risk factor for respiratory problems, diabetes, and cardiovascular illnesses. It has the potential to enhance ventilation demand, breathing workload, respiratory muscle inefficiency, and respiratory compliance. These factors, particularly COVID-19, can aggravate respiratory difficulties and make respiratory diseases more severe[16]. Obesity is becoming more prevalent, having doubled in 73 nations since 1980, in both developed and developing nations[17,18]. Obesity, afflicting approximately 12% of the adult population equivalent to 603.7 million individuals and 5% of children totaling 107.7 million, underscores the urgency to delve deeper into its potential implications as a risk factor in an array of health ailments, encompassing the enigmatic realm of COVID-19 [19]. A growing body of research supports a strong association between increased body weight as determined by the body mass index BMI and increased vulnerability to catastrophic outcomes in COVID-19 cases brought on by the SARS-CoV-2 virus. This includes a raised possibility of needing hospitalization and a higher likelihood of requiring interventions for intensive care. Additionally, mortality rates surge among individuals with higher BMI who contract COVID-19. Furthermore, according to recent studies, people under 60 who have an obese BMI have a stronger tendency to end up in the hos[pital]20. These related findings demonstrate the crucial role played by weight status, in determining the seriousness and prognosis of COVID-19. Research indicates that irrespective of viral status, individuals with obesity face an elevated likelihood of hospitalization. Moreover, when confronted with influenza, obese individuals exhibit a greater vulnerability to hospital admission compared to those with normal body weight[21]. Obesity alters the viral life cycle and immune response, worsening COVID-19 outcomes. Prolonged viral clearance and higher viral load are observed in obese individuals with SARS-CoV-2. Angiotensin-converting enzyme 2 in adipose tissue connects obesity, non-communicable diseases, and COVID-19 severity. Viral load, influenced by obesity, contributes to increased risk and severity of the disease [4r].

METHODOLOGY

Patient Selection:

This cross sectional study was conducted at Ziauddin University, approaching the individuals using consecutive sampling who tested positive for COVID-19 through PCR admitted in hospital ward, ICU or attended the outpatient department from August 2022 to March 2023. Stringent adherence to ethical guidelines was ensured, including obtaining informed consent from all participants after seeking the approval from the ethical review committee on August 24, 2022 Reference number: 5540622UTNN. Patients who did not sign informed consent, children, mentally disabled patients on chemotherapy or radiotherapy and having the genetic diseases and any kind of tumor were excluded.

Clinicopathological parameters and inflammatory markers:

The determination of SARS-CoV-2 RNA positivity was done using qualitative RT-PCR with in vitro diagnostic kits, following the manufacturer's recommendations. The assay included positive control template and RNA internal extraction control. Demographic information, clinical characteristics, medical

history, presenting symptoms and BMI measurements were extracted from the medical records. Disease severity was categorized into asymptomatic, mild, moderate, severe, and critical according to the Disease Control and Prevention CDC guidelines depending upon the signs and symptoms 23. Inflammatory markers were determined in venous blood collected for routine diagnostic tests from patients. C-reactive protein concentrations were determined in the turbidimetric immunoassay with the Abbott Allinity analyzer while the Procalcitonin was measured using the ELISA-PCT-001 kit with the sandwich ELIZA technique. Other plasma inflammatory parameters, such as ferritin, LDH and de-dimers were tested by the Dry Fluorescent Immunoassay SKY-300, China.

STATISTICAL ANALYSIS

SPSS version 21 was used to conduct the statistical analysis for this study. For the COVID-19 dependent variables, descriptive statistics were computed, including frequencies and percentages. The Chi-Square test was used to look at the association between these factors and clinicopathological characteristics. The criterion for statistical significance was set at a p-value of less than 0.05.

RESULTS

Demographic and clinical characteristics of patients:

The present study enrolled a predominantly male population 376; 58.2% with a majority of patients aged above 50 years 459; 71.1%. Among these patients, a considerable proportion had severe disease 255;39.5%, followed by moderate 142;22.0%, mild 140;21.7%, critical 89;13.8%, and asymptomatic 20;3.15% cases. Notably, the analysis revealed a significant association between age and disease severity, with a p-value of 0. 005. The presence of symptoms such as fever 423;65.5%, cough 326;50.5%, and dyspnea 425;65.8% showed a significant association with disease severity $p < 0.001$. The study found that almost every inflammatory marker examined displayed elevated levels, with CRP 577;89.3% being the most prevalent marker. Table: 1

Table: 1. Statistical significance of demographics and clinicopathological characteristics with the severity of disease

Parameters	Frequency n=646	Severity					p value*
		Asymptomatic 20 3.1%	Mild 140 21.7%	Moderate 142 22.0%	Severe 255 39.5%	Critical 89 13.8%	
Age Years <=50 >50	18728.9% 45971.1%	11 1.7% 9 1.4%	52 8.0 88 13.6%	40 6.2% 102 15.8%	62 9.6% 193 29.9%	22 3.4% 67 10.4%	0.005[a]
Gender **Male** **Female**	376 58.2% 270 41.8%	11 1.7% 9 1.4%	85 13.2% 55 8.5%	77 11.9% 65 10.1%	151 23.4% 104 16.1%	52 8.0% 37 5.7%	0.830
Fever **Yes** **No**	423 65.5% 223 34.5%	1 0.2% 19 2.9%	95 14.7% 45 7.0%	89 13.8% 53 8.2%	195 30.2% 60 9.3%	43 6.7% 46 7.1%	0.001[a]
Cough **Yes** **No**	326 50.5% 32049.5%	0 0.0% 20 3.1%	76 11.8% 64 9.9%	63 9.8% 79 12.2%	141 21.8% 114 17.6%	46 7.1% 43 6.7%	0.001[a]
Dyspnea **Yes** **No**	425 65.8% 221 34.2%	0 0% 203.1%	67 12.2% 73 9.8%	79 12.2% 63 9.8%	214 33.1% 41 6.3%	65 10.1% 24 3.7%	0.001[a]
TLC **Decreased**	264.0%	0 0% 18 2.8% 20.3%	10 1.5% 82 12.7% 48 7.4%	5 0.8% 71 11.0% 66 10.2%	71.1% 89 13.8% 159 24.6%	4 0.6% 27 4.2% 58 9.0%	0.001[a]

Normal **Raised**	287 44.4% 33 51.5%						
De-Dimer **Normal** **Raised**	163 25.2% 483 74.8%	16 2.5% 4 0.6%	40 6.2% 100 15.5%	38 5.9% 104 16.1%	51 7.9% 204 31.6%	18 2.8% 71 11.0%	0.001[a]
Ferritin **Normal** **Raised**	22534.8% 42165.2%	16 2.5% 4 0.6%	54 8.4% 86 13.3%	51 7.9% 91 14.1%	78 12.1% 177 27.4%	26 4.0% 63 9.8%	0.001[a]
LDH **Normal** **Raised**	95 14.7% 551 85.3%	12 1.9% 8 1.2%	20 3.1% 120 18.6%	29 4.5% 113 17.5%	23 3.6% 232 35.9%	11 1.7% 78 12.1%	0.001[a]
CRP **Normal** **Raised**	69 10.7% 577 89.3%	17 2.6% 3 0.5%	15 2.3% 125 19.3%	14 2.2% 128 19.8%	18 2.8% 237 36.7%	5 0.8% 84 13.0%	0.001[a]
Pro-calcitonin **Normal** **Raised**	72 11.1% 574 88.9%	0 0.0% 20 3.1%	15 10.7% 125 19.3%	32 5.0% 110 17.0%	22 3.4% 233 36.1%	3 0.5% 86 13.3%	0.001[a]
Pro.BNP **Normal** **Raised**	231 35.8% 415 64.2%	20 3.1% 0 0.0%	27 4.2% 113 17.5%	82 12.7% 60 9.3%	68 10.5% 187 28.9%	34 5.3% 55 8.5%	0.001[a]

TLC: Total leukocyte count, LDH: Lactate dehydrogenase, CRP: C-reactive protein, [a] significant p value $P < 0.05$, [*]Chi square test

The study also sought to determine the effect of several parameters on the outcome of COVID-19. The findings found that age p=0.540 and gender p=0.251 had no effect on the outcome. However, fever was found to have a significant association with the outcome p=0.011. Among the laboratory measures, TLC p=0.023, ferritin p=0.013, LDH p=0.001, and C-reactive protein CRP p=0.001 were substantially linked with outcomes. However, D-dimer, pro-calcitonin, and pro-BNP levels had no significant relationships with the result p>0.05. Table: 2

Table: 2 **Association of demographic and clinical characteristics with the Outcome of the diseases**

Parameters	**n=646**	**Outcome**				
		Discharge 483 74.8%	**Expired 141 21.8%**	**LAMA 16 2.5%**	**Transfer 6 0.9%**	P-Value*
Age Years **<=50** **>50**	18728.9% 45971.1%	139 21.5% 344 53.3%	42 6.5% 99 15.3%	3 0.5% 13 2.0%	3 0.5% 3 0.5%	0.540
Gender **Male** **Female**	376 58.2% 270 41.8%	274 42.4% 209 32.4%	85 13.2% 56 8.7%	12 1.9% 4 0.6%	5 0.8% 1 0.2%	0.251
Fever		304 47.1%	98 15.2% 43 6.7%	15 2.3% 1 0.2%	6 0.9% 0 0.0%	0.011[a]

Yes **No**	423 65.5% 223 34.5%	17927.7%				
Cough **Yes** **No**	326 50.5% 32049.5%	232 35.9% 251 38.9%	78 12.1% 63 9.8%	12 1.9% 04 0.6%	4 0.6% 2 0.3%	0.073
Dyspnea **Yes** **No**	425 65.8% 221 34.2%	307 47.5% 17627.2%	102 15.8% 39 6.0%	12 1.9% 4 0.6%	4 0.6% 2 0.3%	0.225
TLC **Decreased** **Normal** **Raised**	264.0% 28744.4% 33351.5%	182.8% 220 34.1% 245 37.9%	6 0.9% 53 8.2% 8212.7%	2 0.3% 12 1.9% 2 0.3%	0 0.0% 20.3% 4 0.6%	0.023
De-Dimer **Normal** **Raised**	163 25.2% 483 74.8%	131 20.3% 352 54.5%	28 4.3% 113 17.5%	2 0.3% 14 2.2%	2 0.3% 4 0.6%	0.199
Ferritin **Normal** **Raised**	22534.8% 42165.2%	185 28.6% 298 46.1%	33 5.1% 108 16.7%	5 0.8% 11 1.7%	2 0.3% 4 0.6%	0.013[a]
LDH **Normal** **Raised**	95 14.7% 551 85.3%	87 13.5% 396 61.3%	7 1.1% 134 20.7%	1 0.2% 15 2.3%	0 0.0% 6 0.9%	0.001[a]
CRP **Normal** **Raised**	69 10.7% 577 89.3%	65 10.1% 418 64.7%	4 0.6% 137 21.2%	0 0.0% 16 2.5%	0 0.0% 6 0.9%	0.001[a]
Pro-calcitonin **Normal** **Raised**	72 11.1% 574 88.9%	62 9.6% 421 65.2%	8 1.2% 133 20.6%	1 0.2% 15 2.3%	1 3.4% 5 36.1%	0.101
Pro.BNP **Normal** **Raised**	231 35.8% 415 64.2%	186 28.8% 297 45.0%	44 6.8% 97 15.0%	1 0.2% 15 2.3%	0 0.0% 6 0.9%	0.007

TLC: Total leukocyte count, LDH: Lactate dehydrogenase, CRP: C-reactive protein, [a] significant p value $P < 0.05$, [*]Chi square test

The highest percentage of people with a body mass index BMI in the healthy range 256;39.6% was followed by overweight people 160;24.8%, obese people 166;25.7%, and morbidly obese people 18;2.8%. The research revealed a significant relationship between age and COVID-19 severity p = 0.005. There was no statistically significant correlation between gender and the severity of the disease p = 0.034. Among the symptoms observed, fever 428;65.5%, cough 326;50.5%, and dyspnea shortness of breath 425;65.8% were the most common. The study also found that several inflammatory markers, including TLC, D-dimer, ferritin, LDH, CRP, pro-calcitonin, and pro-BNP, showed significant

associations with the severity of COVID-19. The most prevalent inflammatory marker was CRP 577;89.3%. Table: 3

Table: 3 Statistical significance of demographics, clinicopathological and BMI with the severity of disease

Parameters	**Frequency n=646**	**Body Mass Index BMI**					**p value***
		Underweight 46 7.1%	**Healthy 256 39.6%**	**Overweight 160 24.8%**	**Obese 166 25.7%**	**Morbid obese 18 2.8%**	
Age Years **<=50** **>50**	 18728.9% 45971.1%	 12 1.9% 34 5.3%	 74 11.5% 182 28.2%	 50 7.7% 110 17.0%	 46 7.1% 120 18.6%	 5 0.8% 13 2.0%	0.947
Gender **Male** **Female**	 376 58.2% 270 41.8%	 33 5.1% 13 2.0%	 157 24.3% 99 15.3%	 78 12.1% 82 12.7%	 97 15.0% 69 10.7%	 11 1.7% 7 1.1%	0.034 [a]
Fever **Yes** **No**	 423 65.5% 223 34.5%	 38 5.9% 8 1.2%	 170 26.3% 86 13.3%	 98 15.2% 62 9.6%	 105 16.3% 61 9.4%	 12 1.9% 6 0.9%	0.103
Cough **Yes** **No**	 326 50.5% 32049.5%	 25 3.9% 21 3.3%	 131 20.3% 125 19.3%	 83 12.8% 77 11.9%	 80 21.4% 86 13.3%	 7 1.1% 11 1.7%	0.79
Dyspnea **Yes** **No**	 425 65.8% 221 34.2%	 25 3.9% 21 3.3%	 172 26.6% 84 13.0%	 102 15.8% 58 9.0%	 116 18.0% 50 7.7%	 10 1.5% 8 1.2%	0.261
TLC **Decreased** **Normal** **Raised**	 264.0% 28744.4% 33351.5%	 10.2% 22 3.4% 23 3.6%	 111.7% 113 17.5% 13220.4%	 8 1.2% 75 11.6% 77 11.9%	 5 0.8% 68 10.5% 93 14.4%	 10.2% 9 1.4% 8 1.2%	0.902
De-Dimer **Normal** **Raised**	 163 25.2% 483 74.8%	 11 1.7% 35 5.4%	 65 10.1% 191 29.6%	 40 6.2% 120 18.6%	 42 6.5% 124 19.2%	 5 0.8% 13 2.0%	0.998
Ferritin **Normal** **Raised**	 22534.8% 42165.2%	 14 2.2% 32 5.0%	 80 12.4% 176 27.2%	 63 9.8 % 97 15.0 %	 59 9.1% 107 16.6%	 9 1.4% 9 1.4%	0.272
LDH **Normal** **Raised**	 95 14.7% 551 85.3%	 9 1.4% 37 5.7%	 29 4.5% 227 35.1%	 26 4.0% 134 20.7%	 28 4.3% 138 21.4%	 3 0.5% 15 2.3%	0.383
CRP **Normal**	 69 10.7%	 5 0.8% 41 6.3%	 29 4.5% 227 35.1%	 13 2.0% 147 22.8%	 19 2.9% 147 22.8%	 3 0.5% 15 2.3%	0.738

Raised	577 89.3%						
Pro-calcitonin **Normal** **Raised**	72 11.1% 574 88.9%	8 1.2% 38 5.9%	21 3.3% 235 36.4%	17 2.6% 143 22.1%	23 3.6% 143 22.1%	3 0.5% 15 2.3%	0.208
Pro.BNP **Normal** **Raised**	231 35.8% 415 64.2%	24 3.7% 22 3.4s%	89 13.8% 167 25.9%	56 8.7% 104 16.1%	58 9.0% 108 16.7%	4 0.6% 14 2.2%	0.572

TLC: Total leukocyte count, LDH: Lactate dehydrogenase, CRP: C-reactive protein, [a] significant p value $P < 0.05$, [*]Chi square test

DISCUSSION

The arrival of SARS-CoV-2 and the ensuing COVID-19 pandemic have unleashed a worldwide calamity, presenting formidable perils to communities and the very fabric of healthcare systems across the globe. As medical researchers strive to understand the factors influencing the severity of COVID-19, identifying risk factors has become crucial. While preexisting conditions like hypertension, cardiovascular disease, diabetes, chronic obstructive pulmonary disease, and cancer have been acknowledged as risk factors, new research has also highlighted the substantial role of obesity as an independent risk factor for severe COVID-19 24. The current study observed a higher proportion of males among severe cases of COVID-19, indicating a potential male predominance in disease severity. This could be attributed to factors such as variations in immune system receptors, sex-related immunological differences, hormonal mechanisms, and the expression levels of the ACE2 receptor 25. The study conducted by I . Nachtigall, et al. 2021 found that male patients had a higher likelihood of requiring intensive care, mechanical ventilation, and experiencing worse clinical outcomes26.Furthermore, the current study supports the well-established association between advanced age ≥50 years and an increased risk of severe COVID-19. This susceptibility among older individuals can be attributed to age-related alterations in immune function and a higher prevalence of underlying health conditions, including cardiovascular disease, diabetes, and respiratory disorders 27. The current study also revealed that fever was significantly associated with the outcome of COVID-19, emphasizing its importance as a clinical indicator 28. Elevated inflammatory markers, notably CRP, were seen in our investigation, which is consistent with earlier research associating higher inflammatory markers to disease severity in COVID-19. This shows that COVID-19-induced systemic inflammatory response may contribute to disease severity. The relationship between high CRP levels and tissue damage provides evidence that inflammation plays a role in COVID-19 etiology 29.

The distribution of BMI categories in the current study population reveals that a significant proportion is overweight or obese. The observed BMI category distribution in the study population lends support to the idea that obesity may be linked to a higher likelihood of COVID-19 severity. This result demonstrates the consistency of the corpus of research relating obesity to poor COVID-19 outcomes. Raquel Alencastro et al. conducted a study examining the association between COVID-19 mortality rates and the prevalence of overweight and obesity in Brazil's state capitals and the Federal District, uncovering valuable insights into this correlation. The study found a strong positive link between obesity prevalence and COVID-19 overall mortality rate r=0.380, p=0.034. This association shows that obesity may play a role in COVID-19-related poor outcomes. 30. Furthermore, a study was carried out by Tadayon Najafabadi et al. to determine how obesity affected COVID-19 results. Their meta-analysis revealed that individuals with class III obesity BMI 40 kg/m2 or greater had a higher risk of death than those with normal BMI or no fat. Higher obesity classes were also linked to an increased likelihood of needing mechanical ventilation. Obesity plays an independent predictive effect in COVID-19

severity and death, according to these findings 31. Jayanama et al. investigated the relationship between BMI levels and COVID-19 severity in 147 adult participants in a cohort study. The study provided important information on the intricate association between BMI and the severity of the disease in an effort to better understand it. In COVID-19 patients, it was discovered that obesity was linked to a higher chance of developing severe pneumonia as well as other unfavorable outcomes such acute renal impairment, elevated liver enzyme levels, and protracted ICU hospitalizations32. Similarly, F.Y. Alqahtani et al. explored the relationship between body mass index BMI and COVID-19 severity in a retrospective analysis of COVID-19 data from the Saudi Arabian Ministry of Health. The study included 950 patients admitted to Riyadh hospitals and revealed that those with a BMI of 40 kg/m2 obese class III were significantly more likely to acquire a severe form of the illness. These persuasive results clarify how obesity may play a role in predisposing COVID-19 patients to negative outcomes 33. Motaib et al. conducted a retrospective study with 107 adult patients to explore the effect of obesity on the severity of COVID-19. The study found that obese patients were more likely to be admitted to the intensive care unit ICU compared to non-obese people. Obesity was revealed to be a risk factor for ICU admission even after controlling for other risk factors.34. However, the lack of a significant association between BMI and COVID-19 severity except for BMI with gender p- value 0.034^{a} in this study is unexpected, given the known link between obesity and adverse outcomes in COVID-19. Several factors could account for these insignificant results. For starters, the study's sample size may have been quite small, limiting the statistical ability to find meaningful relationships. Furthermore, the distribution of BMI categories among research participants may have been insufficiently diverse to identify significant changes. If the majority of individuals had BMI values in a small range, the ability to detect significant relationships may be hampered. Furthermore, the presence of confounding factors that were not taken into account in the study could have altered the link between BMI and COVID-19 severity. Underlying health issues, socioeconomic variables, and genetic factors could all have influenced the outcomes. Finally, the study population's features may have been different from those of other populations where substantial relationships were found. Factors such as age distribution, co-morbidities, and access to healthcare may influence the link between BMI and COVID-19 severity.
Further research with larger sample sizes and comprehensive analyses is needed to fully comprehend the connection between BMI and the severity of COVID-19 in this context.

CONCLUSION

The emergence of the SARS-CoV-2 virus has posed substantial challenges to healthcare systems around the world. It has been determined that obesity, which is characterized by excessive body weight and fatty tissue, may increase the chance of developing serious respiratory infections. This study shows that gender and BMI have no significant impact on the severity of COVID-19, although age and symptoms do. Further research should focus on clarifying the underlying mechanisms and developing additional biomarkers to improve disease prognosis. The limitations of this study include its cross-sectional design and the need for larger sample sizes to validate the findings and ensure generalizability.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE:written and verbal consent was taken from subjects and next of kin.

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AUTHORS' CONTRIBUTIONS:

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

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