

Association of Body Mass Index with the Severity of SARS-COVID-19 Pneumonia in Hospitalized Patients

Zara Zafar, Wasim Alamgir, M. Zill-e-Humayun, Aayesha Rehman, Qurat Ul Ain, Sumaira Ilyas*

Pak Emirates Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, *Armed Force Institute of Pathology/
National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To determine the association of body mass index with the severity of COVID-19 pneumonia in hospitalized patients.

Study Design: Cross-sectional study.

Place and Duration of Study: Pak Emirates Military Hospital, Rawalpindi Pakistan, form May to Jun 2021.

Methodology: Patients diagnosed with COVID-19 pneumonia on PCR and chest imaging and admitted to our hospital were included in the study. Body mass index was calculated on the first day of hospital admission, and they were followed up for two weeks during the disease. Increased oxygen demand, duration of admission, CT severity score and use of non-invasive ventilation were compared in patients with normal and increased body mass index.

Results: A total of 800 COVID-19 patients admitted to the hospital were included in the final analysis. The mean age of the study participants was 41.36±4.55 years. Out of 800 patients, 337(42.1%) had normal BMI, 420(52.5%) were classed in the category of overweight and 43(5.4%) were obese. Furthermore, it was seen that increased demand for oxygen, high CT severity score and longer duration of hospital admission had a statistically significant relationship (p -value<0.05) with high body mass index.

Conclusion: More than half of the patients admitted after diagnosis of COVID-19 had higher than normal body mass index. A significant association was found between increased demand for oxygen, high CT severity score, longer hospital admission duration, and high body mass index.

Keywords: Body mass index, COVID-19, Outcome.

How to Cite This Article: Zafar Z, Alamgir W, Humayun MZ, Rehman A, Ain Q, Ilyas S. Association of Body Mass Index with the Severity of SARS-COVID-19 Pneumonia in Hospitalized Patients. *Pak Armed Forces Med J* 2022; 72(6): 2063-2066. DOI: <https://doi.org/10.51253/pafmj.v72i6.7639>

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INTRODUCTION

Pandemics have been a consistent feature in human history. Each time they take a large number of lives and disrupt human life across the globe.¹ This time, COVID-19 affects the whole world, including Pakistan.² Severity of COVID-19 has been variable across different patients and clinicians and researchers from day one have been looking for the factors which could determine the severity of illness.^{2,3} Multiple laboratory and clinical parameters have been assessed which could be linked to severe disease among the patients suffering from COVID 19.^{4,5} Chronic metabolic or inflammatory diseases have been related to more severe forms of illness in patients with COVID-19. Moreover, several biochemical markers, including C reactive protein and ferritin have been found statistically significantly deranged among patients with severe COVID pneumonia as compared to a mild form of illness.⁶

Indices regarding COVID-19 have been

fluctuating since the start of the pandemic. However, huge data has been published covering various aspects of this viral illness.^{7,8} For example, a recent study in Pakistan summarized that ground glass opacities with multilobe involvement and bilateral, peripheral, and basal predominance were common findings on HRCT scans of COVID-19 patients.⁹ In addition, they found the CT severity score a helpful tool in categorizing pneumonia into mild, moderate, and severe types.¹⁰ Limited local data is available regarding the relationship between body mass index and severity of COVID-19 in Pakistan. Therefore, we designed this study to determine the association of body mass index with the severity of COVID-19 pneumonia in hospitalized patients.

METHODOLOGY

This cross-sectional study was conducted at Pak Emirates Military Hospital, Rawalpindi Pakistan between May to June 2021. Ethical approval was taken from the Ethical Committee of the hospital (via Letter no A/28/EC/320/2021). The sample size was calculated using the WHO calculator, taking the population proportion of raised BMI in COVID patients as

Correspondence: Dr Zara Zafar, Room No. 12, Army Medical College Officers Mess, Rawalpindi, Pakistan

Received: 09 Nov 2021; revision received: 10 Jan 2022; accepted: 14 Jan 2022

21.6%.¹¹ Non-probability consecutive sampling was used to gather the sample.

Inclusion Criteria: All the COVID-19 PCR-positive patients aged 18 and 65 years admitted to the hospital within the study period were included in the study.

Exclusion Criteria: Patients with any malignancy or chronic infections were made part of the exclusion criteria. Pregnant females were also not included in the study. Patients with autoimmune disorders or using any immunosuppressive medications were excluded from the study. Patients who had complications (radiological or clinical) at the time of diagnosis or were discharged against medical advice during admission were also not included.

Patients positive for COVID-19 on the Polymerase Chain Reaction test who were admitted to the hospital were included in the study. BMI was calculated at the time of admission by a consultant medical specialist as per the set protocol of the hospital. The same weighing machine and height chart were used to measure the weight and height of all the study participants included in the study. Body mass index was interpreted as Normal weight-BMI greater than or equal to 18.5 to 24.9kg/m², Overweight-BMI greater than or equal to 25 to 29.9kg/m² and Obesity-BMI greater than or equal to 30 kg/m².¹² Patients were followed up for two weeks to look for increased oxygen demand (>4L at any point), duration of admission, CT-severity score (>20/40) and use of non-invasive ventilation. Increased oxygen demand was assessed by a consultant pulmonologist or intensivist, while the treating team decided on non-invasive ventilation based on the clinical condition. A consultant radiologist calculated the CT severity score for all the study participants.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Frequency and percentage were calculated for the qualitative variables, whereas mean and standard deviation were calculated for the quantitative variables. The Chi-square test was used to examine the association between increased oxygen demand, duration of admission, CT severity score and use of non-invasive ventilation with body mass index among the target population. The *p*-value ≤0.05 was considered significant.

RESULTS

A total of 800 COVID-19 patients admitted to the hospital were included in the final analysis. The mean age of the study participants was 41.36±4.55 years. 590(73.75%) were male, while 210(26.25%) were female. Out of 800 patients, 337(42.1%) had normal

BMI, 420(52.5%) were classed in the category of overweight and 43(5.4%) were obese. The mean duration of hospital stay in these patients was 8.23±3.48 days. The general characteristics of COVID-19 patients were shown in the Table-I. 551(68.8%) had a CT severity score of less than 20/40, while 249(31.2%) had a CT severity score of more than 20/40. In addition, 550(68.75%) were serving or retired military personnel, while 250(31.25%) were civilian patients.

Table-I: Characteristics of Study Participants (n=800)

Parameters	n(%)
Age (years)	
Mean±SD	41.36±4.55 years
Range (min-max)	19 years - 65 years
Gender	
Male	590(73.75%)
Female	210(26.25%)
Body Mass Index	
Normal	337(42.1%)
Overweight	420(52.5%)
Obese	43(5.4%)
Mean duration of admission	8.23±3.48 days
High Resolution CT Severity Score	
<20/40	551(68.8%)
>20/40	249(31.2%)

It was seen that increased demand for oxygen (*p*-value=0.004), high CT severity score (*p*-value<0.001) & longer duration of hospital admission (*p*-value=0.5) had a statistically significant relationship with high body mass index. At the same time, non-invasive ventilation techniques (*p*-value=0.615) in these patients were not associated with high body mass index (Table-II).

DISCUSSION

High body mass index was statistically significantly associated with poor outcome parameters in patients suffering from COVID-19. Cases of COVID-19 have been on the rise in almost all parts of the world in the last two years, and Pakistan has been no exception.^{13,14} Due to the complexity of various factors interacting and impacting the outcome, it has been difficult to find clinical variables linked to poor outcomes in patients suffering from this potentially lethal viral illness. Therefore, we planned this study to determine the link between the BMI of patients and clinical outcomes associated with coronavirus disease.

Zhuc *et al.*¹⁵ in 2020 analyzed population bases cohort data from the United States of America regarding how obese patients cope with COVID-19 and the relationship of BMI with clinical outcomes in these patients. They concluded that 33% of their patients had BMI between 18.5-24.9kg/m², 43% had between 25.0-

29.9kg/m², and 24% had >30kg/m², and patients with any obesity were found at more risk of having a severe form of illness as compared to those who were not obese. Our results supported their results as more than half of the patients admitted after diagnosis of COVID-19 had higher than normal BMI in our study. In addition, a significant association was found between increased demand for oxygen, high CT severity score, longer hospital admission duration, and high BMI.

Chu *et al.*¹⁶ in 2020 tried to gather data from similar relevant studies to look for the relationship between obesity and the severity of illness with unfavourable outcomes among patients suffering from COVID-19. They included 22 studies in their analysis and came up with the findings that patients who had a severe form of illness were significantly more obese and overweight as compared to those who got a mild illness. Our results were not very different, and clinical and radiological evidence of the severity of illness was found more in patients who were overweight or obese as compared to those with normal body mass index.

An interesting meta-analysis was published by Du *et al.*¹⁷ in 2021, highlighting COVID-19 outcomes and the severity of illness in patients who were obese. They revealed that the relationship between the severity of illness and body mass index was linear, and high BMI patients were more at risk of mortality and mortality. We did not include mortality in our study, but severity parameters were statistically significantly found more in patients with higher BMI in our analysis.

Jayanama *et al.*¹⁸ aimed to look for a correlation between high BMI and poor outcomes among patients suffering from COVID-19. They targeted critical patients and concluded that patients with high BMI had the poor outcome of pneumonia and increased incidence of adverse outcomes such as acute kidney injury, transaminitis and longer critical care unit stay. They also emphasized that patients with lower than normal BMI should also be closely observed for complications.

Multiple clinical and laboratory parameters have been associated with poor outcomes and severity of illness. However, this study is unique because it established an association between basic health parameters like body mass index and the severity of COVID-19.

LIMITATIONS OF STUDY

The main limitation was that patients who were shifted to the critical care unit, died or were discharged against medical advice were not included in the study. Non-

inclusion of these parameters makes our data less generalizable to the local population. Moreover, admission in military hospitals involves disease severity as a criterion, and some organizational factors may also account for inpatient admission of dependent populations. Studies on a larger scale addressing these limitations may generate better results regarding the association between BMI and severity of illness in patients suffering from COVID-19.

CONCLUSION

More than half of the patients admitted after diagnosis of COVID-19 had higher than normal body mass index. Furthermore, a significant association was found between increased demand for oxygen, high CT severity score, longer duration of hospital admission, and high body mass index.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

ZZ & WA: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MZH & AR: Concept, data acquisition, critical review, approval of the final version to be published.

QA & SI: Data analysis, critical review, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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