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## **The association between body mass index and severity of coronavirus disease 2019 (COVID-19): A retrospective study**

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**Abstract**---Background and purpose: The coronavirus disease 2019 (COVID-19) pandemic presents an unprecedented health crisis to the entire world. As reported, the body mass index (BMI) may play an important role in COVID-19; however, this still remains unclear. The aim of this study was to explore the association between BMI and COVID-19 severity and mortality. Methods: A retrospective, single-centred study including 88 participants with laboratory-detected SARS-CoV-2 infection admitted to designated COVID-19 centre in a tertiary care hospital from March to October, 2020 was done. Clinical records, laboratory data, and radiological findings were analysed. The impact OF BMI was evaluated to analyze their association with the severity of Covid-19 infection in these patients. Results: The severity of illness tended to increase in patients with higher BMI levels and lower BMI levels; the severity of illness in patients with BMI < 18.5 kg/m<sup>2</sup> was highest (90%) followed by BMI > 25.0 kg/m<sup>2</sup> was 79.2% when compared to patients with BMI 18.5–22.9 kg/m<sup>2</sup> (77.8%). The occurrence of death also increased in patients with higher BMI levels and lower BMI levels; the occurrence of death in patients with BMI < 18.5 kg/m<sup>2</sup> was highest 70% followed by BMI > 25.0 kg/m<sup>2</sup> was higher 66.7% when compared to patients with BMI 18.5–22.9 kg/m<sup>2</sup> (48.1%). Conclusions: Evidence from this analysis suggested that BMI is associated with COVID-19 severity and mortality but the association was not found significant.

**Keywords**---SARS-CoV-2, basal metabolic index (BMI), mortality.

## **Introduction**

The coronavirus disease 2019 (COVID-19) pandemic has led to worldwide research efforts to identify individuals at greatest risk of developing critical illness and dying. Initial data indicated that diabetes, cardiovascular disease, and respiratory or kidney disease were associated with an increased risk of adverse outcomes in patients with COVID-19. Increasing numbers of reports have linked obesity to more severe COVID-19 and mortality.<sup>1</sup> Kulapong Jayanama et al. found that patients having a BMI <18.5, 18.5–22.9, 23.0–24.9, and >25.0 kg/m<sup>2</sup> were 12.9%, 38.1%, 17.7%, and 31.3%, respectively. The rates of pneumonia and severe pneumonia tended to be higher in patients with higher BMI, whereas the rates of AKI and ICU stay were higher in patients with BMI <18.5 kg/m<sup>2</sup> and >25 kg/m<sup>2</sup>, when compared to patients with normal BMI. After controlling for age, sex, diabetes, hypertension and dyslipidemia in the logistic regression analysis, having a BMI >25.0 kg/m<sup>2</sup> was associated with higher risk of severe pneumonia (OR 4.73; 95% CI, 1.50–14.94; *p* = 0.003) compared to having a BMI 18.5–22.9 kg/m<sup>2</sup>.<sup>2</sup>

Among 148,494 adults who received a COVID-19 diagnosis during an emergency department (ED) or inpatient visit at 238 U.S. hospitals during March–December 2020, 28.3% had overweight and 50.8% had obesity. Overweight and obesity were risk factors for invasive mechanical ventilation, and obesity was a risk factor for hospitalization and death, particularly among adults aged <65 years. Risks for hospitalization, ICU admission, and death were lowest among patients with BMIs of 24.2 kg/m<sup>2</sup>, 25.9 kg/m<sup>2</sup>, and 23.7 kg/m<sup>2</sup>, respectively, and then increased sharply with higher BMIs. Risk for invasive mechanical ventilation increased over the full range of BMIs, from 15 kg/m<sup>2</sup> to 60 kg/m<sup>2</sup>. As clinicians develop care plans for COVID-19 patients, they should consider the risk for severe outcomes in patients with higher BMIs, especially for those with severe obesity.<sup>3</sup> Although several factors have been clearly identified that contribute to the development of severe COVID-19, such as increasing age, male sex, geographic region, and multiple chronic comorbidities, obesity is emerging as an important risk factor, especially in industrialized countries.<sup>4</sup> The aim of this study was to assess to assess the association between body mass index (BMI) and the severity of COVID-19.

## **Materials and Method**

A retrospective, single-centred study including 88 participants with laboratory-detected SARS-CoV-2 infection admitted to designated COVID-19 centre in a tertiary care hospital from March to October, 2020 was done. Clinical records, laboratory data, and radiological findings were analysed. The impact OF BMI was evaluated to analyze their association with the severity of Covid-19 infection in these patients. The patients were classified into three groups: Underweight <18.5, normal weight: 18.5-24.9 and overweight >25 (kilogram/mm<sup>2</sup>)

|  | <b>Severity of illness<br/>prevalence<br/>n (%)<br/>(N=70/88)</b> | <b>Occurrence of death<br/>n (%)<br/>(N=49/88)</b> |
|--|---|--|
| <b>Underweight</b>   | 9 /10 (90%)   | 7/10 (70%)   |
| <b>Normal</b>  | 42 /54 (77.8%)  | 26/54 (48.1%)                                      |
| <b>Overweight</b>  | 19 /24 (79.2%)  | 16 /24 (66.7%)                                     |
| <b>p value<br/>(Association using<br/>Chi square test)</b> | p =0.678  | p = 0.197  |

**p > 0.05 – no significant association**                      **\*p<0.05 – significant association**

## Results

The severity of illness tended to increase in patients with higher BMI levels and lower BMI levels; the severity of illness in patients with BMI > 25.0 kg/m<sup>2</sup> and BMI < 18.5 kg/m<sup>2</sup> was higher 79.2% and 90% when compared to patients with BMI 18.5–22.9 kg/m<sup>2</sup> (77.8%). The occurrence of death also increased in patients with higher BMI levels and lower BMI levels; the occurrence of death in patients with BMI > 25.0 kg/m<sup>2</sup> and BMI < 18.5 kg/m<sup>2</sup> was higher 66.7% and 70% when compared to patients with BMI 18.5–22.9 kg/m<sup>2</sup> (48.1%) although the association was not found significant.(p=0.678 and p=0.197)

## Discussion

Among 88 participants with laboratory-detected SARS-CoV-2 infection admitted to designated COVID-19 centre in a tertiary care hospital from March to October, 2020 included in this study 11.36% of patients were underweight, 61.36% of patients were of normal weight, and 27.27% were overweight, respectively. Our research showed that both underweight and overweight significantly increased the severity of illness and mortality in patients with COVID-19. As the COVID-19 pandemic is unfolding around the world, increasing evidence indicates that obesity is an independent risk factor for severe illness and death from COVID-19. There is an urgent need to further clarify the relationship between BMI and the severity of COVID-19. The prevalence of obesity has been increasing over several decades, it is defined as “abnormal or excessive fat accumulation that may impair health” and is categorized by BMI (kg/m<sup>2</sup> ). Adipose tissue may serve as a reservoir for SARS-CoV2 owing to its high levels of expression of angiotensin-converting enzyme-2 (ACE-2), the transmembrane enzyme that SARS-CoV-2 uses for cell entry. Asians often display lower cardiorespiratory fitness and carry

proportionally more fat tissue at lower BMIs, so the dangers of obesity are even more pronounced in Asians.<sup>5</sup>

Previous studies on COVID-19 only paid attention to the harm of obesity, but we found that in addition to obesity, the incidence of severity of covid 19 in underweight patients was also increased, even higher than the obese patients. . The poor prognosis among underweight patients may be related to a reduced capacity to tolerate surgery because of their underlying malnutrition and skeletal muscle mass loss, termed sarcopenia.<sup>6,7</sup> In several other studies, low BMI was an independent risk factor of morbidity and mortality in patients who underwent pulmonary lung resection and the incidence of cerebrovascular and pulmonary complications tended to be higher in patients with low BMI than in other even obese patients. Besides, being underweight is a risk factor for death among patients with chronic obstructive pulmonary disease (COPD). Earlier studies found that death among underweight patients with COPD might be attributable to diaphragmatic weakness and respiratory failure related to a poor nutritional status. In adults with COVID, metapneumovirus, parainfluenza, and rhinovirus, underweight and morbidly obese participants had more severe diseases than normal-weight participants.<sup>8</sup>

## Conclusion

In conclusion, results from this analysis indicate that obesity as well as underweight is associated with an increased risk of critical COVID-19 and mortality. Moreover, the dose-response analysis showed that with an increase in BMI, the risk of severe COVID-19 and mortality increased linearly. So, patients with both COVID-19 and obesity or leanness should be paid more attention to in hospitals.

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