

Association between BMI (body mass impact) and COVID-19

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Abstract: The 2019 novel the Corona Virus Disease 2019, known as COVID-19, has sickened more than 1 million people and killed nearly 600,000 in Wuhan, China. The binding of Angiotensin-converting enzyme 2 receptor binding causes SARS-CoV-2 to affect various organs. There is growing evidence linking severe COVID-19 to overweight, obesity and malnutrition (abnormal BMI). The aim of the study was to investigate the relationship between abnormal BMI and COVID-19 and determine the causes of negative outcomes.

Key words: BMI, COVID-19, obesity, overweight, malnutrition

1. Introduction

The global health catastrophe brought on by the coronavirus disease 2019 (COVID-19) pandemic is unprecedented and is spreading rapidly. The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the cause of COVID-19, which is a kind of, single-stranded ribonucleic, membrane-wrapped acid virus. [1] The SARS-CoV-2 virus is a 29.9 kB single-stranded positive RNA virus, whose genome has 14 open reading frames (ORFs) that encode for 27 distinct proteins.[2].It has a 5' untranslated region (UTR), replication complex (ORF1a and ORF1b), Envelope (E) gene, Spike (S) gene, Membrane (M) gene, Nucleocapsid (N) gene, 3' UTR, multiple unidentified non-structural ORFs, and a poly (A) tail.[3] .The clinical manifestations of SARS-CoV-2 virus-infected patients range from mild to severe symptoms, and these patients have a large number of nonclinical manifestations. The most common clinical manifestations were fever (80%), cough (80%), and shortness of breath (30%). [4] There are many factors that can increase the risk of disease or infection, such as older age, gender, diabetes, cardiovascular diseases, malignancy and other chronic diseases. This is because, they are able weakening lung function, heart, circulation, excretion of waste products, as well as weakening the immune system.[5]According to reports, the body mass index (BMI) may potentially have a role in COVID-19. However, this is still unknown. The purpose of this study was to look at the relationship between BMI and COVID-19. Body mass index (BMI), which is a ratio of a person's height to weight, is commonly used to measure a person's weigh status. According to the study of WHO, people with a BMI over 25 are overweight, while those with a BMI over 30 are considered obese.

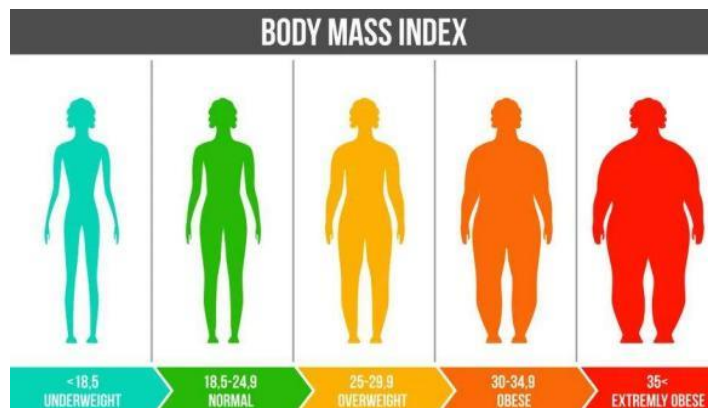


Figure1: The relationship between BMI and body size

The meta-analysis comprised sixteen studies, nine of which showed BMI as a continuous outcome and ten of which indicated that BMI as a dichotomous outcome. COVID-19 patients who had a poor composite outcome had a higher BMI, with a mean difference of 1.12. Meanwhile, obesity was linked to a bad composite outcome with an odds ratio (OR) of 1.78. The link between BMI and obesity on composite bad outcome was shown to be altered by gender, age, two types of diabetes, and hypertension in multivariate meta-regression.[6].

2. High BMI and severe outcomes

Obesity is defined as a BMI more than or equal to 28, while overweight is defined as a BMI between 24 and 28, normal weight is defined as a BMI between 18.5 and 24, underweight is defined as a BMI less than 18.5. High BMI levels link to a more serious outcome of COVID-19. Between 2015 and 2016, the obesity prevalence in the United States was 39.8%, and by 2030, it is anticipated to rise to 48.9% [7]. Obesity is on the rise in developing countries like China, where a high number of COVID-19 patients are fat.[8] According to existing information in scientific literature, over 40% of hospitalized patients are obese with a high BMI, according to the experts. They note that morbid obesity, for example, is often associated with a severe clinical course of the disease. [9]

Obesity appears to be one of the most typical diseases related with coronavirus illness, according to a growing body of studies (COVID-19). Indeed, 40% of COVID-19 hospitalized patients are obese [10].

CDC analyzed the connection between (BMI) body mass index and risk of serious COVID-19 outcomes, for example, hospitalization, intensive care unit [ICU] stepdown unit admission, invasive mechanical ventilation, or even death. Between March and December 2020, 238 U.S. hospitals identified 148,494 patients with COVID-19 during ED or inpatient visits; of them, almost 50.8% were obese and 28.3% were overweight. Overweight was a risk factor for invasive mechanical ventilation, and obesity was a risk factor for hospitalization and mortality, especially among persons aged 70 and older. The risks of hospitalization, ICU admission, and mortality were lowest in individuals with BMI of 24.2 kg/m², 25.9 kg/m², and 23.7 kg/m², respectively, and subsequently rose dramatically as BMI climbed. The severe outcomes of invasive mechanical ventilation rose over the whole BMI range, from 15 kg/m² to 60 kg/m². [11]. In addition, doctors need to consider the possibility of poor outcomes in patients with greater BMI, particularly those who are severely overweight, while designing useful treatment regimens for patients of COVID-19. [12] Based on the findings, people must prioritize nutritious meals and physical activities that improve and maintain healthy BMIs.

Also, At the New York institution SUNY DHS University, which Governor Andrew Cuomo named as a COVID-only hospital, then a professional analysis of patients who had been tested for COVID-19 was carried out. There were 150 patients (30%) who were overweight, 139 patients (27%) with normal BMI, and 215 patients (43%). After adjusting for gender, age, two types of diabetes, qSOFA grade, and hypertension, the overweight and obese groups both had a significantly higher risk of death compared to those with normal BMI. Similarly, the overweight and obese groups had a significantly higher relative risk of tubage in the contrast to individuals with will-balanced BMI. BMI. Obesity had no effect on, ACI, AKI and ARDS rates. Additionally, males seem to be more at risk of dying from obesity and overweight than women. [11]

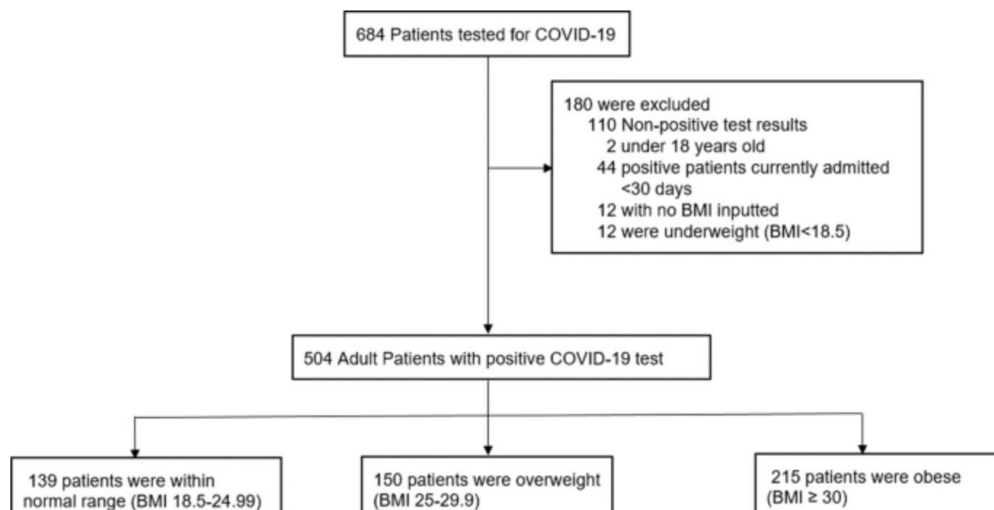


Figure 2: Illustrates the detailed process of study demonstrated by Andrew Cuomo as a COVID-only hospital

3. Impact of high BMI on COVID-19 vaccines

It is a heated debate that how well COVID-19 vaccinations work in patients with obesity and other high-risk situations such as diabetes or cardiovascular problems. Based on evidence of immune cell poor regulations and negative changes in inflammatory signaling pathways, many researchers have speculated that these vaccinations might provide less protection in people with obesity and high BMI.[12].

Regardless of coexisted diseases, excess weight causes biological mechanisms and systemic variables, which may increase the danger of unfavorable outcomes. Reduced expiratory reserve volume, functional capacity, and respiratory system compliance are caused by increased ventricular pressure and diaphragmatic upward displacement. [13].Inflammatory chemokines may cause endothelial dysfunction and aggravate a prothrombotic condition. Obese mice exhibited longer viral shedding times due to slowed viral clearance, more secondary bacterial infections, and more respiratory epithelial damage, according to preliminary research.[14]Furthermore, the efficacy of COVID-19 vaccine may be worse in overweight individuals because baseline changes in systemic cytokine production may result in muted , the adaptive and innate immune responses to vaccination are staggered.[15] For influenza immunization, those who are obese have lower vaccine effectiveness[16].

In addition, individuals who are subjected to the Omicron SARS-CoV-2 variants, groundbreaking SARS-CoV-2 vaccine infections and reinfections occur frequently. The association between obesity and vaccination effectiveness is yet unknown, however because T-cell responses in overweight patients are impaired, the vaccination of COVID-19 will be less efficient in fat individuals.[17]. Recent data suggest that obesity,or overweight and other metabolic body problems may cause vaccine-breakthrough Infections with SARS-CoV-2. [18]

4. Why are persons who have a high BMI and are obese more likely to contract COVID-19?

Obesity is linked to a number of systematic risks for COVID-19, for instance: high blood pressure, metabolic disorders, two types of diabetes, chronic kidney diseases and liver disease. Before the emergence of the severe acute respiratory syndrome coronavirus in Guangdong China, in 2002, coronaviruses were thought to induce only mild respiratory diseases. The outbreak of SARS-CoV was eventually limited because of the virus's weak infectivity when symptoms first appear, which allowed enough time for affected persons to be identified and isolated.[19]During the 2009 flu

pandemic, overweight was identified as a unique risk factor for serious influenza morbidity and death. The flu pandemic in 2009 was caused by an epidemic of the upper respiratory influenza A H1N1 virus[20]. With viral respiratory infections, being overweight increases the likelihood of illness, seriousness, and, in rare circumstances, fatality, raising the notion that obesity may also independently increase the risk for COVID-19, or other acute viral illness. Multiple sources analyze the existing understanding of SARS-CoV-2 pathogenicity and immune response based on evidence from animal and human investigations. [21] Notably, the mechanism(s) behind increased COVID-19 severity in obese people are unclear. However, lessons from other viral illnesses, such as influenza, and epidemiological research provide some insight into how obesity raises the chance of COVID-19 severity.

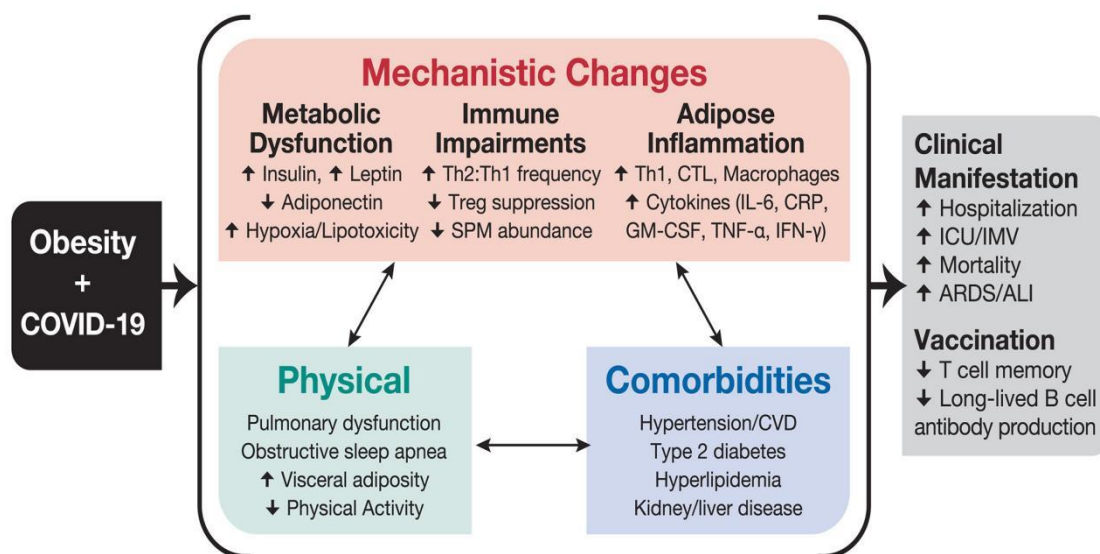


Figure3: shows the consequences of the physiological effects of overweight on the COVID-19 clinical results and the influence of these factors on an obese person's vaccine response is also possible. Other factors involved, home, and community—have a significant impact on our eating, exercising, and drinking habits, but their indirect impacts on COVID-19 are rarely discussed.

An further reason is that COVID19 has a strong affinity for human ACE 2. (ACE2). It has been established that the potential receptor for SARS-CoV-2 entry into host cells was identified as ACE2. [22] Issue expression of ACE2 varies between healthy and coronavirus-infected individuals' kidneys, hearts, and lungs[23]. Adipose tissue, a main target tissue for COVID-19, expresses ACE2 at a greater level than lung tissue[24]. This is a noteworthy finding since adipose tissue may possibly be COVID-19 susceptible. However, it should be mentioned that adipocytes and adipose tissue did not express the ACE2 protein differently. Two aspects of COVID19 should be highlighted. Individuals with and without obesity have different progenitor cells. Obese people, on the other hand, having more adipose tissue, which indicates that they have more ACE2 expressing cells and hence more ACE[24]. Treatment with particular antihypertensive drugs such as ACEIs and ARBs will also boost the special expression of ACE2 , increasing the susceptibility of patients to viral host cell invasion and spread.[25]

Obesity could also enhance an individual's vulnerability to COVID-19 because obesity alters adaptive immune responses, which includes modifications to T-cell number and functionality as well as diminished responses to the influenza vaccine. [26] Furthermore, Antiviral IFN responses are diminished in IFN-deficient conditions, which have been described. In addition, it has been demonstrated that people with atopic asthma are more likely than healthy controls to experience serious consequences after contracting the rhinovirus, lower respiratory tract infections occurring more frequently, and displaying more severe and lingering symptoms. [27] Obese people have high amounts of leptin in the blood, indicating a leptin resistant condition. This might be caused by an increase in the expression of the cytokine signaling suppressor 3 (SOCS-3). Importantly, the JAK-STAT pathway used for interferon signaling is severely affected by SOCS-3, demonstrating a

potential mechanism through which overweight may reduce interferon responses to respiratory infections.[26]

5. Conclusion

The COVID-19 pandemic is heavily influenced by obesity and high BMI, according to several studies mentioned above. For one thing, overweight can increase the seriousness of COVID-19, lead to many complications and reduce the effectiveness of the COVID-19 vaccine. For another thing, high BMI will increase the individuals' susceptibility of COVID-19. By making the above analysis, we may safely conclude that odds for serious results with COVID-19 infection increased with high BMI for people with, but not without, obesity. The correlation between them should be tested more in future research. We currently live in a "obesogenic environment," where over intake of readily available, high-energy processed foods has led to a more than doubling in the incidence of obesity since 1980, making it the most prevalent nutritional condition globally. To remain healthy and maintain a normal BMI, people should generally exercise more and consume less junk food in their everyday lives. From my perspective, officials should carry out planned, organized and systematic social education activities properly to make people consciously adopt healthy behaviors and lifestyles, eliminate or reduce risk factors affecting health, prevent diseases, promote health, improve the quality of life, and evaluate the effect of education. The core of health education is to educate people to establish health awareness, promote people to change unhealthy behavior and lifestyle, develop a good behavior and lifestyle in order to reduce or eliminate the risk factors affecting health. Only by raising people's awareness of keeping fit can individuals keep away with the infections of COVID-19 and become obese.

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Figure1: from Internet

Figure2:[6]Nakeshbandi, M., Maini, R., Daniel, P. et al. The impact of obesity on COVID-19 complications: a retrospective cohort study. *Int J Obes* 44, 1832-1837 (2020). <https://doi.org/10.1038/s41366-020-0648-x>

Figure3:[17]HFSA/ACC/AHA Statement Addresses Concerns Re: Using RAAS Antagonists in COVID-19 . Mar 17, 2020. ACC News Story