The Correlation between Obesity and COVID-19 in Public Health

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ABSTRACT
COVID-19 and obesity are thought to pose a dual threat to public health care systems. Obesity has been identified as a vital risks factor toward COVID-19 in several researches, trials, and medical reports; specifically, and has been identified as the predominant risk factor among younger individuals. This work uses literature searches, case studies, and data analysis to investigate the interrelation between Novel Coronavirus and obesity in order to enhance research papers, related scientific articles, and periodicals on the subject. During the investigation, it was discovered that several hospitals, medical institutes, and organizations did not place enough emphasis on COVID-19 treatment in obese individuals. The author believes that obese patients with Novel Coronavirus complications would have more severe physical responses, and that obesity-related risk factors, such as inflammation and blood clotting, lead to severe COVID-19.

Keywords: *COVID-19, Obesity, Public health*

1. INTRODUCTION

COVID-19, which is caused by the severe acute respiratory syndrome coronavirus 2 (so-called SARS-CoV2) infection, and obesity, which is defined as an accumulation of body fat to the point where it begins to damage health, are currently threatening worldwide public health to a great extent [2]. These two epidemics will increase the burden on medical infrastructure, potentially leading to the collapse of health-care systems. In the meantime, obese people are more likely to get a serious illness, as well as have higher hospitalization and mortality rates. This paper focuses on literary, case, and data analysis studies of the correlation between COVID-19 and obesity, factors associated with higher COVID-19 risks with obesity, and public health strategies and responses to COVID-19 and obesity epidemics, primarily in order to increase the awareness and vigilance of medical health workers and hospital leaders to pay more attention to the complications of obesity and COVID-19 and targeted patients. However, it pays little attention to scientific articles and news items on related research issues published in the media. In this case, the author obtains secondary sources such as the experimental process, case studies and conclusions of scholars, and relevant data information via Google Scholar and the websites of some prestigious universities and medical academies such as Harvard, Johns Hopkins, Oxford, Cambridge, and others.

2. THE CORRELATION BETWEEN OBESITY AND COVID-19

Risk Factors for Severe COVID-19 Symptoms: Obesity nowadays is not only a public health problem but also a serious social and economic problem. The way to measure it is called body mass index, BMI, which is consisted of two pieces of information - weight in kilograms and height in meters, simply obtained by dividing the weight by the height squared. As follows, people with a body mass index (BMI) higher than 30 kg/m^2 are classified into the group who are obese. Similarly, individuals with a BMI of 40 kg/m^2 or higher are classified as severe obesity group.

Categorized BMI	Body Weight Condition
≤ 18.5	Underweight
18.5 - 25	Normal Weight
25 - 30	Overweight
> 30	Obese
≥ 40	Severe Obesity

Figure 1 Classifications of BMI (Body Mass Index) and Corresponding Body Weight Condition

The 'Centers for Disease Control and Prevention (CDC)' have classified those with severe obesity as 'vulnerable'. While both overweight and obesity have been identified as a kind of potential risk factors for poor COVID-19 results by the WHO and the World Obesity Federation. The majority of COVID-19 patients hospitalized to the intensive care unit (ICU) were obese, according to case studies, researches and reports [1].

Patients with obesity, according to Angela Fitch, associate director of the Massachusetts General Hospital Weight Center, require more ICU care among persons who have the virus. According to Matthew Hutter, MD, director of the Weight Center and president of the American Society for Metabolic and Bariatric Surgery, obesity has not always been considered a disease in the United States, but it is now recognized as a common comorbidity among COVID-19 patients with the severe form. As a result, individuals admitted to the hospital with COVID-19 are more likely to require intensive care units (ICU) with obesity syndrome [5]. As a result, the link between COVID-19 and obesity is of great clinical significance worldwide [1].

Obesity and severe COVID-19 are linked by four distinct risk factors, according to Dr. Fitch and Dr. Hutter: (1) Inflammation: An inflamed body inhibits the immune system's ability to respond effectively to an infectious pathogen. Dr. Fitch further stated that extra body fat causes an overall inflammatory physical state in the body. In other words, COVID-19 exacerbates the inflammation already existing as a result of obesity, potentially leading to more severe symptoms. (2) Blood Clotting: Inflammation, which can be caused by fat or a virus, can cause clotting of the blood in the lungs. "If you're already at a higher risk of clotting because of obesity, and then you're in this illness state where one of the virus's pathologies is blood clotting," Dr. Fitch explains, "that might lead to deteriorating difficulties." (3) ACE Receptors: Research has demonstrated that the Novel Corona-virus enters cells via the ACE receptor (angiotensin converting enzyme 2), and that a higher number of ACE receptors on lung tissue causes COVID-19 symptoms to be more severe. Because fat cells contain more ACE receptors, one idea suggests that the virus is more likely to cause severe sickness to a large extent. The immune reaction can then produce ARDS (acute respiratory distress syndrome), which overwhelms the person's capacity to get enough oxygen and necessitates the use of a ventilator. (4) Obesity-Related Diseases: Metabolic syndrome is linked to various illnesses like diabetes, hypertension, and high cholesterol. Hypoventilation syndrome, according to Dr. Hutter, is one of the problems directly related to obesity, in which excess chest wall tissue makes it difficult for people with obesity to take complete and deep breaths, and the combination worsens symptoms in those who have COVID-19 [5].

3. FACTORS THAT THE RISKS OF COVID-19 ARE HIGHER WITH OBESITY SYNDROME

3.1 Factors on Physics

People with a BMI of 35 or higher, signifying significant obesity, always have excess weight in the belly, which is located below the diaphragm. Every time a person breathes, the diaphragm goes toward the feet; consequently, more pounds in the diaphragm cause a tougher breathing process, which can lead to respiratory problems. COVID-19 causes the membranes that split the lung airway sacs to separate and the blood vessels that surround them to leak, enabling fluid to enter the airways, which makes it difficult to transfer oxygen from the air to the blood, forcing the diaphragm to work significantly harder - and obesity limits this.

3.2 Factors on Inflammation

Fat is metabolically active and creates a lot of immune proteins called pro-inflammatory cytokines. It's as if the body is constantly fighting itself—a miniature war sparked by fat cell signals that the immune system responds to, resulting in a low level of background inflammation. Therefore, if someone is overweight, this is where they should start. People are now superimposing a greater fight with a novel infection that has never been seen before, forcing the immune system to become hyper-activated. That's not a winning combination [6].

3.3 The Role of the ACE2 Protein in Fat Cells

Because it must connect to a cell, the COVID-19 virus relies on the ACE2 protein to get entrance. Fat cells, it turns out, express ACE2 at rather high levels, and other respiratory viruses have been shown to target fat, survive in fat, and shed fat more slowly. Obese people may become more infectious even if their symptoms improve [6].

4. DATA SURVEY ABOUT THE CORRELATION BETWEEN OBESITY AND COVID-19

A retrospective analysis of BMI stratified by age in COVID-19 is conducted by Oxford - positive symptomatic patients who reported to a big university hospital system in New York City. Patients with the sign of respiratory distress who presented to the emergency department (ED) were admitted to the hospital [6].

BMI, kg/m^2	No. (%)	Admission to Acute (vs Discharge From ED), OR (95% CI)	*P* Value	No. (%)	ICU Admission (vs Discharge From ED), OR (95% CI)	*P* Value
Age ≥ 60 y						
BMI 30–34	141 (19)	0.9 (.6–1.2)	.39	57 (22)	1.1 (.8–1.7)	.57
BMI ≥35	99 (14)	0.9 (.6–1.3)	.59	50 (19)	1.5 (.9–2.3)	.10
Age < 60 y						
BMI 30–34	173 (29)	2.0 (1.6–2.6)	<.0001	39 (23)	1.8 (1.2–2.7)	.006
BMI ≥35	134 (22)	2.2 (1.7–2.9)	<.0001	56 (33)	3.6 (2.5–5.3)	<.0001

Abbreviations: BMI, body mass index; CI, confidence interval; COVID-19, coronavirus disease 2019; ED, emergency department; ICU, intensive care unit; OR, odds ratio.

Figure 2 Adult Patients Who Tested Positive for COVID-19 During 3 March - 4 April 2020 (N=3615)

775 people, or 21% of the 3615 persons who tested positive for COVID-19, had a BMI of 30 to 34, whereas 595 people, or 16% of the overall cohort, had a BMI of 35 or higher. Out of a total of 3615 patients, 1853 (51%) were discharged from the emergency department (ED), 1331 (37%) were admitted to the hospitalization in acute care, and 431 (12%) were either directly admitted or transferred to the intensive care unit (ICU) during admission. To wrap up, the disparities generated between admission and ICU care in patients less than 60 years old with varied BMI are striking (Table 1).

Patients under 60 years old with a BMI of 30-34 were 2.0 (95 percent confidence interval [CI], 1.6–2.6; P =.001) and 1.8 (95 percent confidence interval [CI], 1.2–2.7; P =.006) times more likely to be admitted to acute and critical care, respectively, than those with a BMI of less than 30 (Table 1). Patients under 60 years old with a BMI more than or equal to 35 were 2.2 (95 percent CI, 1.7–2.9; P.0001) and 3.6 (95 percent CI, 2.5–5.3; P.0001) times more likely to be admitted to acute and critical care, respectively, than patients in the same age group with a BMI less than 30 [2].

Obesity appears to be a previously unknown risk factor for hospital admission and the need for critical care, even though patients aged less than or equal to 60 years are traditionally considered a lower-risk group for COVID-19 disease severity, according to data from their institution. Nearly 40% of adults in the United States are obese, with a BMI of 30 or above. The BMI range of the participants in this study appears to be representative of the country, with 37% of the patients having a BMI of less than 30. There is regional heterogeneity in reported mortality, with case fatality rates of 0.8, 2.3, and 7.2 in South Korea, China, and Italy, respectively, and regional risk factors such as smoking prevalence, pollution, or an aging population have been identified. Obesity in adults under the age of 60 is unfortunately a newly found epidemiologic risk factor that may contribute to the rising morbidity rates seen in the United States [2].

David Kass, a Johns Hopkins cardiologist, is the director of the Institute of CardioScience at the Johns Hopkins School of Medicine. His research related a greater BMI to more severe COVID-19 cases. He specifically mentioned that obesity is a key prior factor in younger COVID-19 patients. Professor Kass claims that, on the one hand, the observation was important even with just roughly 20 patients at the time. On the other hand, it's a shame that if someone were to look up "COVID-19 and obesity" on Google, they'd find virtually nothing. Later, he compiled early findings from six ICUs across the United States, stating in a Lancet study that "COVID-19 will affect younger generations more than previously observed in populations with a high prevalence of obesity." In March, individuals cases with confirmed COVID-19 began to arrive at Johns Hopkins Hospital in Baltimore, and some unexpected observations were made in the ICU. Because of the prevalence of obesity in America, which reached 42 percent of the rate of obesity in 2018, these observations mostly focused on cases relevant in the United States.

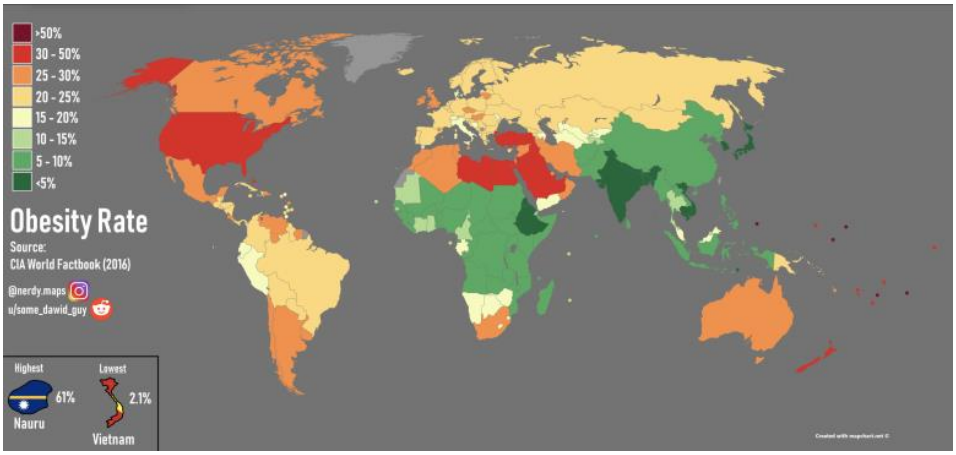

Figure 3 Obesity Rates Map Worldwide [7]

It can be seen that China's obesity rate in 2016 is 5-10%, and Italy's obesity rate is 15-20 %, therefore, in light of the conclusions drawn by China and Italy tend to report that the majority of virus endangered the elderly. However, the patients in Baltimore were younger than expected mainly due to the prevalence of obesity around 40% in the U.S., compared to the prevalence rates of about 6% in China and 20 % in Italy, respectively [6].

What's more, the rate of obesity is on the rise in the United States from 1999 to 2018. It also puts loads of pressure on public health organizations and governments.

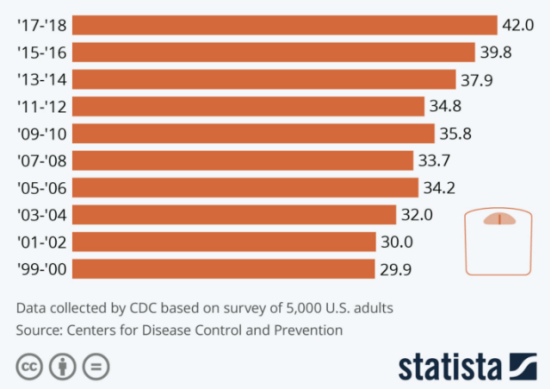

Figure 4 Obesity Rates Continue to Trend Up in U.S. (Percentage of U.S. adults who are obese based on height and weight survey)[8]

According to observations at Hopkins, the research concentrated on the association between owning a higher BMI (Body Mass Index) and younger age in the COVID-19 patients requiring intensive care was conducted.

In the younger patients, the study exerts an emphasis on the relationship between COVID-19 and BMI. They are less likely to have other major co-morbidities such as hypertension, heart disease, past stroke, and even diabetes, hence obesity may be the key factor influencing their COVID-19 outcome. Because the cardiac, vascular, and metabolic problems associated with obesity may not have had enough time to develop in a definite form in an immature body, the co-morbidities appear slightly earlier in younger individuals. Obesity, according to many research and reports, increases the likelihood that patients may have a more severe illness course and end up staying in the hospital or ICU.

5. PUBLIC HEALTH STRATEGIES AND RESPONSES OF COVID-19 AND OBESITY EPIDEMICS

5.1 Public Health Strategies and Policies of COVID-19.

5.1.1 Monitoring

Governments, particularly in South Korea and Singapore, investigate the entire community or parts of it by employing telemonitoring strategies and broad investigations in regional airports or borders, such as the use of Global Positioning System records or the development of websites for self-monitoring or psychological consultation services, among other things. The publicizing and popularizing of such tools and policies has given local residents a better grasp of the COVID-19, making it easier for the government to carry out focused governance.

5.1.2 Public Education:

Governments in some countries offer transparent information on coronavirus and provide the community some education on preventive measures and proper practices by delivering to community residents via diverse media news or videos and messaging services like knowledge base and think tank. Education can frequently serve as a source of a think tank. People will believe and follow the government's practical initiatives if people have a rudimentary understanding of the infection.

5.1.3 Crowd Controlling

Governments should announce and implement a variety of regulations and tactics to reduce crowding, including social distance, quarantining, street traffic control, school and university closures, event postponement, and company closure. Although this policy has an impact on people's lives, studies, and work, it is this form of virus control that can effectively minimize virus transmission from person to person. For example, China's closed policy, which includes the closing of cities, districts, offices, and learning zones, has practically achieved the goal of having no pedestrians or cars on the road. Highly-contagious infections can be quickly controlled in this manner. As Gao Fu of China Center for Disease Control and Prevention said, China has done a good job in the infrastructure of group prevention and control. Only when human beings unite, people will not provide the opportunity for the virus to mutate.

5.1.4 Care Facilities Preparation

Some governments build and prepare appropriate treatment settings, such as big hospitals with the greatest level of facilities and shelters for suspected or confirmed patients at both stages of therapy and recovery, which are established or assigned by local organizations. In the prevention and management of infectious diseases, medical facilities, supplies, and even the environment have all played indispensable roles. In most cases, the most fundamental and vital demand is the creation of medical infrastructures covering ten main categories of basic medical equipment (negative pressure ambulance, ventilator, ECG monitor, various thermometers, defibrillator, infusion pump, digital X-ray DR, extra-corporeal membrane oxygenator - ECMO, ultrasound, and X-ray CT).

5.2 Public Health Strategies and Policies for Obesity

Obesity rates have skyrocketed dramatically. There are almost a moiety of people worldwide have the overweight or obese syndrome, with twice as many overweight adults in the United States. Obesity is linked to major health issues such as cardiovascular disease and diabetes. Obesity has significant economic implications; direct costs account for around 7% of health-care costs in America, and indirect costs associated with obesity-related sick leave and disability account for 10% of lost worker productivity.

A multifaceted approach is required to deal with the complex problem of the obesity epidemic which doesn’t only have a single or simple solution.

Policymakers, state and local organizations, industry, school and community leaders, daycare and healthcare professionals, and individuals must work together to create an atmosphere that promotes healthy lives [10].

5.2.1 State and Local Programs

State, municipal, and territorial public health agencies, grantees, the federal, and local governments' roles in the food industry are really vital, and according to practitioners in the public health industry can access resources to help them communicate consistent public health recommendations and evidence-based practices. Education policy, food marketing, food labeling and packaging, and taxation on unhealthy foods are all promising policy areas where changes can be made to support healthy behaviors.

5.2.2 Community Efforts

According to the following research and report, the comprehensive study conducted by Health Care Without Harm indicated significant changes in hospitals' community benefit efforts to better understand and address food availability and diet-related health problems and in their communities. In their most recent community health needs assessment, 71 percent of hospitals identified obesity as a health issue in their communities, according to the study's nationally representative poll of hospital community benefit directors (CHNA). The following health needs were also identified by CHNAs:

A. Diabetes affects 40% of people to a large extent; B. 45 percent of diseases linked to diet which attach great importance on diet-related public health systems; C. 13%–food insecurity or access to nutritious foods; D. 22%–poverty, financial security, or unemployment.

A growing number of hospitals (57 percent of survey respondent facilities) are collecting data on the quality of neighborhood food environments, such as the prevalence of US Department of Agriculture "food deserts," as part of their assessments. Data on diet-related behaviors, such as fruit and vegetable consumption, was included in 40% of CHNAs.

To reverse the obesity epidemic, community efforts must focus on encouraging healthy food and physical activity in a variety of venues. In early childhood care, hospitals, schools, and foodservice settings, learning about various efforts can be a valuable technique. Community, school and company canteens should provide people with healthy and green food recipes.

5.2.3 Healthy Living

The public should understand that the key to reaching and maintaining a healthy weight is a long-term lifestyle that includes good eating and frequent physical activity and exercise, rather than a short-term dietary adjustment. Nowadays, many young people lose weight by fasting, but in fact it is irresponsible for their physical health.

6. CONCLUSION

This paper focuses on the interrelationship between COVID-19 and obesity, and concludes that obesity alters COVID-19 treatment due to inflammation, blood clotting, and other factors, and that health care centers should implement public health strategies such as monitoring, public education, crowd control, and care facility preparation in response to various situations in different countries. Meanwhile, there is still a lot of space for improvement in this work, because objective research and data on COVID-19 and obesity comorbidities are lacking both at home and abroad, and relevant data are few. As a result, this paper will be beneficial to the future medical system in terms of preventing and emphasizing such diseases. Furthermore, the author expects that the relevant hospitals and government institutions will be able to upload sufficient research papers and data, making it easier for future academics to dig deeper into such problems.

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