Review

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A critical review of health and financial implications of obesity during the COVID-19 pandemic

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Abstract

The COVID-19 was reported in Wuhan, China, in December 2019. There is a link between increased mortality and obese individuals with the disease. The disease has been claimed to have disproportionately affected non-Hispanic blacks and Hispanics. The rise in food accessibility and the drop in the relative cost of junk food items are the two most significant changes in dietary patterns. Around the world, 2.8 million people die from being overweight or obese, and those with more body fat also have a higher risk of diabetes (44%) and heart disease (23%). Obesity weakens the immune system because adipose cells infiltrate the bone marrow, spleen, and thymus. Obesity was substantially more common among COVID-19 patients who were hospitalized than those who were not hospitalized. Over 900 000 adults in the United States are hospitalized due to a COVID-19 infection. Hospitalizations in 271 700 (30.2%) cases have been attributed to obesity. Obese patients may be experiencing reduced thoracic expansion following bariatric surgery. Less tracheal collapse and air-trapping at end-expiration chest computed tomography (CT) were observed post-surgery, and patients reported reduced dyspnea. COVID-19 is estimated to cost the European Union €13.9 billion in secondary care, with 76% of that cost attributed to treatment for overweight and obese individuals. The average price per hospitalized patient also increased with increasing BMI. Screening for obesity, preventive measures, and recommendations for healthy lifestyle changes should be of the utmost importance to decrease both the health and financial implications of COVID-19.

Keywords: obesity, COVID-19, economic costs, mortality rates

Introduction

COVID-19 was reported first from Wuhan, China, a new coronavirus strain, quickly spread globally and was formally announced as a pandemic by the WHO in March 2020. In New York, the United States of America (USA) became the epicenter of the SARS-CoV-2[1]. There is a link between increased mortality and obese individuals with COVID-19[2].

HIGHLIGHTS

- This comprehensive review underscores the critical intersection between obesity and the COVID-19 pandemic, revealing obesity as a significant risk factor for severe illness and mortality from the virus.
- By examining the etiology, epidemiology, and health implications of obesity during the pandemic, we unveil the disproportionate burden faced by obese individuals and marginalized communities, emphasizing the urgent need for targeted interventions, preventive measures, and equitable access to healthcare resources to mitigate the dual health and financial impacts of obesity and COVID-19.
- Through collaborative efforts among healthcare providers, policymakers, and communities, we advocate for proactive strategies to promote healthy behaviors, support weight management, and enhance healthcare outcomes amidst the ongoing global health crisis.

The WHO defines obesity as the abnormal or excessive buildup of fat that constitutes a health risk. Globally, this disease currently ranks as the fifth leading cause of death[3]. According to more recent modifications, the WHO emphasizes the multifaceted nature of obesity, noting genetic, behavioral, and environmental variables as major contributors. According to the Centers for Disease Control and Prevention (CDC), 66% of adults and 33% of children and adolescents are overweight, indicating that obesity has reached epidemic proportions and received worldwide attention[4].

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Obesity, affecting 35% of adults in 22 U.S. states, is a significant risk factor for severe COVID-19 outcomes. Individuals with a BMI greater than or equal to 40 kg/m² are particularly vulnerable. Pandemic-related factors, such as reduced physical activity and disrupted routines, contribute to weight gain during this period[5]. Obesity may be linked to decreased pulmonary function because of excessive weight and disrupted immune and thrombosis responses to pathogens due to chronic inflammation, as well as a risk determinant for different protracted diseases, such as certain malignancies, type 2 diabetes, and heart disease[6]. This is especially prevalent in specific demographics, such as non-Hispanic blacks and Hispanics; the COVID-19 pandemic has also been claimed to have disproportionately affected these groups[1]. The CDC has reported that a body mass index (BMI) of greater than or equal to 40 kg/m^2 is an accepted clinical factor concerning poor prognosis and mortality in individuals with COVID-19 infection[7].

Furthermore, the COVID-19 pandemic has dramatically increased the risk of obesity. A retrospective study conducted in 2020 on patients from a bariatric surgery clinic found that during the COVID-19 pandemic, 69.6% of patients were unable to meet their weight loss targets, 47.9% reduced their exercise time, 49.6% stored large amounts of food, and 61.2% increased food consumption due to increased anxiety[8]. Several proposed causes of growing obesity include decreased time spent on sports, longer sleep lengths, and more screen time[9]. Lockdown measures and social isolation have also disrupted daily routines, resulting in decreased physical activity and increased consumption of high-calorie meals as coping techniques for stress and boredom. The economic cost of obesity during the COVID-19 pandemic is also considerable. The increased healthcare costs associated with treating obesity-related disorders, combined with the economic pressures of the pandemic, have placed enormous strain on healthcare systems and economies around the world. Employers face higher costs due to increased absenteeism and low productivity among obese workers, exacerbating the financial consequences of obesity during the pandemic. The purpose of this study is to assess the literature on obesity's causes, epidemiology, and financial effects during the COVID-19 pandemic. Understanding the complex relationship between obesity and COVID-19 allows us to better address the issues raised by these two overlapping health concerns and develop more effective preventative and control strategies.

Etiology

Policy reactions to COVID-19 mitigation are negatively affecting the economy. The pandemic has necessitated all governments to set movement limits, social distancing, and economic restrictions on a wide range of non-essential jobs. These developments have resulted in food system issues, such as changes in food consumption, physical activity habits, and remote work situations, which may exacerbate present trends in the prevalence of obesity[10]. The lack of access to healthy food choices is one of the main causes of the increased obesity prevalence in the United States over the last 50 years[11]. Additionally, getting less than 6 or greater than 8 hours of sleep in adults or less than 10–11 h of sleep in children, a sedentary lifestyle, and increased screen time are related to weight gain. Today, wealth is inversely connected to obesity in the United States because people at the poverty level seem to have the highest proportions of obesity. This trend was reversed as a result of the supply of inexpensive and readily available food, as well as altered social attitudes[11]. According to a study by the National Center for Health Statistics, and the Centers for Disease Control and Prevention, the average American has gained at least 15 pounds during the past 20 years (Fig. 1). This report was based on the analysis of more than 19 000 individuals who underwent medical examinations by researchers[12].

The obesogenic environment fostered by advertising is one of the main risk factors contributing to the rise in the number of overweight people. The consumer is indirectly compelled to make unnecessary purchases as a result of advancements in eye-tracking technology and marketing research. The rise in food accessibility and the drop in the relative cost of junk food items are the two biggest changes in dietary patterns. Because more places sell food and there has been a significant change in the packaging and serving sizes that these places offer, more people can now afford the convenience of eating outside of their homes[13]. Recent research from the Harvard School of Public Health (HSPH) reported that the healthiest meals cost approximately $1.50 per day more than the least healthy diets. The study is premised on a thorough analysis up to now comparing the costs of nutritious meals and diet regimens to less nutritious ones[14].

Epidemiology

Obesity increases the likelihood of COVID-19 patients being admitted to the hospital. Obesity was substantially more common among COVID-19 patients who were hospitalized than those who were not hospitalized. For example, according to a report that included 5700 obese patients in New York City, 41.7% of hospitalized COVID-19 patients were obese, whereas the usual prevalence of obesity in New York City was 22%[10].

According to studies conducted in the USA in 2000, obesity was the cause of 15% of fatalities[11]. Additionally, in a recent survey of 6916 patients with COVID-19, a J-shaped association between BMI and mortality risk was found, especially in patients with BMIs of 40–44 kg/m^2 and greater than 45 kg/m^2, with relative risks of 2.68 [95% CI, 1.43–5.04] and 4.18 (CI, 2.12–8.26)[15]. According to a report from the CDC, the pre-

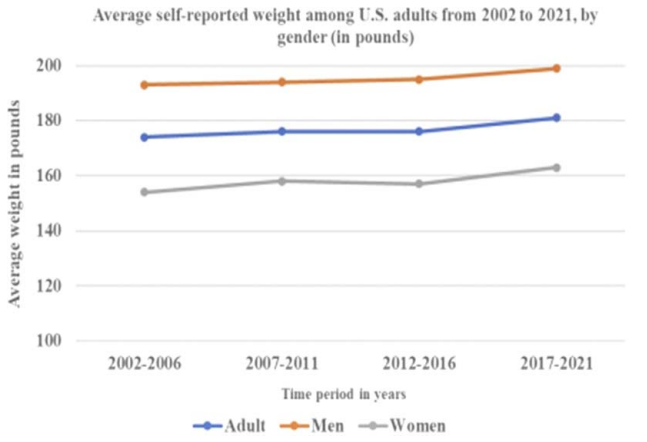

Figure 1. The total weight of adults, both men and women, increased from 2006 to 2021 in the United States.

Figure 2. The health expenditure of obesity per capita in the United States more than doubled from the year 2000 to 2019.

valence of obesity was 42.4% as of 2017[5], and according to estimates from another study[16], this will increase to 48.9% (95% CI, 47.7–50.1) by 2030, with significant variance among states.

According to WHO, about 1 billion people are obese globally, of which 650 million are adults, 340 million are adolescents, and children comprise 39 million[17]. Obesity is estimated to be 42.5% in the US, 43% in men, and 42.1% in women. From 1999 to 2018, the US's obesity prevalence rose from 30.5 to 42.4%, and the rate of severe obesity grew from 4.7 to 9.2%[18]. Around the world, 2.8 million people die from being overweight or obese, and those who have more body fat also have a higher risk of diabetes (44%), ischemic heart disease (23%), and several types of cancer (7–41%)[19]. For those who were overweight or obese, 620 000 bariatric surgeries were performed. Although there was a 3.32% annual increase in obesity, only 2.47% of those people qualified for surgery. Although the prevalence of extreme obesity increased from 7.70 to 9.95%, surgery rates decreased from 0.588 to 0.566 per 100 qualified applicants[20].

The CDC estimates that obesity costs the US $147 billion annually. Compared to people with a healthy BMI, obese people spend $1429 more each year. In the United Kingdom (UK), there are 7163 cases of morbid obesity and 1406 cases of diabetes. The first 1000 bariatric procedures cost £9.16 million in direct costs, while other lifetime medical expenses came to £15 million (Fig. 2)[21].

COVID-19 can present with a broad spectrum of symptomatology from asymptomatic to multiorgan failure such as mild upper respiratory tract infection (URTI), myalgia, acute respiratory distress syndrome (ARDS), pneumonia, anosmia, ageusia, meningoencephalitis, etc. On a global scale, over 6.6 million new cases were reported every week from 18 July to 24 July 2022, matching the figure from the previous week. Additionally, with over 12 600 fatalities, the number of new weekly deaths was close to the number reported during the previous week. Globally, more than 6.3 million fatalities and over 567 million confirmed cases have been reported as of 24 July 2022[22]. As previously stated, the percentage of obesity in hospitalized patients with COVID-19 was greater than in non-hospitalized patients with COVID-19, and this article will explore the direct relationship between the virus and increased body fat.

Increased susceptibility to COVID-19 infection in obese patients

The CDC has reported that an elevated BMI increases the risk of severe illness from COVID-19, in both the adult and pediatric populations[23]. Obesity weakens the immune system because adipose cells infiltrate the bone marrow, spleen, and thymus, where immune cells are typically generated and stored, making the individual highly vulnerable to COVID-19. There is also an increased tendency for the blood of obese people to clot, making it an especially serious risk during infection as small vessels of the lungs become peppered with clots https://www.science.org/content/article/why-covid-19-more-deadly-people-obesity-evenif-theyre-young. Kompaniyets *et al.*[24] conducted a large-scale study across 238 hospitals in the United States, involving patients aged 18 years and above, diagnosed with COVID-19 between 1 March and 31 December 2020. Results from the study showed that the risks of inpatient hospitalization, ICU admission, need for invasive mechanical ventilation (IMV), and death resulting from COVID-19 infection increased with increasing BMI. In individuals.

under 65 years of age, the risks of hospitalization and death were particularly pronounced[24]. Kompaniyets *et al.*[25] also performed a similar study in COVID-19 patients aged 18 years and below and found that obese patients were 3.07 times more at risk of being hospitalized and 1.42 times more at risk of ICU admission, need for IMV, or death. In yet another study by O'Hearn *et al.*[26], which captured data from the start of the pandemic until 18 November 2020, it was reported that of the over 900 000 adults in the United States who were hospitalized due to a COVID-19 infection, hospitalizations in 271 700 (30.2%) of cases have been attributed to obesity. In a retrospective cohort study by Simonnet *et al.*[27], the relationship between BMI and the need for IMV was studied in 124 patients who were admitted to the ICU of a single institution in France for COVID-19 between 27 February and 5 April 2020. This study similarly demonstrated a distinct relation between obesity and the severity of COVID-19 infection, with 47.5% of patients admitted into the ICU being obese (BMI $\geq$ 30kg/m^2)[27]. Specifically, class II obesity (BMI 35–39.9kg/m^2) and class III obesity (BMI $\geq$ 40kg/m^2) were observed in 13.7% and 14.5% of patients, respectively[27]. The need for IMV was found to be associated with severe obesity, independent of age, gender, and pre-existing diabetes and hypertension[27].

Relationship between immune function and obesity

Tanaka *et al.*[28], who studied 34 obese and 50 non-obese control patients, suggested that obese individuals are at increased susceptibility to infections due to reduced subsets of T-cell populations and their functionality. Huttunen and colleagues similarly suggest that obesity results in dysregulation of the immune system. Specifically, adipose tissue that releases leptin, adiponectin, and other adipokines alters the secretion of TNF-α, MCP-1, IL-6, and other cytokines[29]. These cytokines then alter T-cell proliferation and macrophage differentiation[29]. A reduction in the CD8 + population of cells, natural killer (NK) cell activity, and

antigen presentation of dendritic cells results[29]. In a study of 1,559 patients, Festa *et al*.[30] also demonstrated BMI to be strongly correlated to circulating levels of C-reactive protein (CRP) and fibrinogen. Tanaka *et al*.[28] further reported that adequate weight reduction was found to reduce T-cell dysregulation.

Relationship between lung function and obesity

In a study by Jones *et al*.[31] who studied the pulmonary function tests (PFT) results of 373 patients, it was reported that an increased BMI was associated with decreased functional residual capacity (FRC) and expiratory reserve volume (ERV), suggesting that obesity reduces lung capacity and reserve, making ventilation tougher in obese patients. Watson *et al*.[32] separately compared the total lung capacity (TLC) and FRC in 14 obese men against 7 non-obese men and reported that obese men had a smaller FRC and FRC: TLC ratio. This led the authors to conclude that obese patients could be experiencing reduced thoracic expansion[32]. Copley *et al*.[33] evaluated the lung parenchymal and tracheal CT morphology before and 6 months following bariatric surgery in 51 obese patients, correlating the results to patient-reported symptoms and functionality. Less tracheal collapse and air-trapping at end-expiration chest CT were observed post-surgery, and patients concurrently reported reduced dyspnea, demonstrating that the restrictive pattern and reduced lung volumes on PFT may be reversed following weight loss[33]. In another study that reviewed over 3000 COVID-19 cases, of which 307 were obese patients below 60 years of age, it was found that patients with a BMI falling between 30 and 34 kg/m^2 were twice as likely to be admitted to acute care and 1.8 times as likely to be admitted to critical care for ARDS as compared to those with a BMI below 30 kg/m^2[34].

Evaluation

A retrospective cohort study conducted in IRCCS Policlinico San Donato, Italy, from 9 March to 27 April 2020, identified a notable association in chest X-ray (CXR) severity scores of COVID-19 patients with the increase in abdominal obesity (waist-to-height ratio and waist circumference; adiposity indexes) rather than an overall BMI score[35]. Out of 221 hospitalized patients, 215 patients were found to have similar findings. The abdominal obesity phenotype is associated with a higher chest radiographic grade than BMI-based obesity in hospitalized patients with COVID-19. Therefore, patients with abdominal obesity should be closely monitored by the measurement of waist circumference. Multivariate analysis revealed bronchial asthma and abdominal obesity at admission as independent elements linked to increased chest X-ray severity scores.

The financial implications of obesity in COVID-19 patients

Current literature broadly agrees that obesity generally poses a large economic burden, considering the direct and indirect costs on the government and healthcare systems[34]. In November 2014, the McKinsey Global Institute estimated the economic impact of obesity on the world economy to be approximately US $2 trillion, which accounts for 2.8% of the world's GDP[35]. A study by Czernichow *et al*.[36], which sought to estimate total secondary care costs specifically in COVID-19 patients in Europe who were hospitalized between January and June 2020, reported that the costs for secondary care amounted to €13.9 billion, with 76% of that cost attributed to treatment for overweight and obese individuals. The average cost per hospitalized patient was also found to increase with increasing BMI, from an average of €15 831 in patients with BMI under 25 kg/m^2, to an average of €30 982 or almost double in patients with BMI greater than or equal to 40 kg/m^2[36]. The estimated average cost of each COVID-19 hospital admission in 31 European countries and the UK (Table 1), while the estimated total direct cost of secondary care for COVID-19 is separated by type of admission from the same countries (Table 2).

Indirect costs associated with COVID-19 must also be considered, and these include long-term health complications following recovery from COVID-19, unemployment, and mental health issues. Data published by various countries demonstrates a 3.3% drop in global GDP in 2020, with advanced and developing economies reporting an average drop of 4.7% and 2.2%, respectively[37]. Cutlet *et al*.[38] estimate the loss from COVID-19 to be US$16 trillion in the United States, with half of this attributed to losses due to Covid-19-related health complications. Liu and colleagues provide a summary of articles that have provided estimates of the cost of the COVID-19 pandemic (Table 3). 1. No epidemic in the last 2-3 decades was on the scale of COVID, so any comparison made can broadly be summarized by the statement "the financial impact of COVID was greater because the scale of COVID was greater"

Also, because of the issue of scale (in terms of countries affected and number of deaths and extent and duration of closures), fewer studies were performed on and by fewer countries, which limits what I can find. We cannot compare different things—for example revenue lost in absolute dollars for COVID vs GDP growth for SARS. Papers specifically looking at the same type of financial impact do not exist.

Treatment and management of obesity during the COVID-19 pandemic

Management of obesity is varied, ranging from lifestyle changes such as dietary changes and increasing physical activity to medical interventions such as weight loss medications, endoscopic procedures, and surgery[42]. Commonly prescribed FDA-approved medications include bupropion-naltrexone, phentermine-topiramate, liraglutide, and orlistat[42]. Endoscopic procedures commonly involve a sleeve gastroplasty or placement of an intragastric balloon, while bariatric surgery could include gastric banding, a gastric sleeve, or a gastric bypass[42].

Table 1

Average cost of each COVID-19 hospital admission in the 31 European countries and the UK by BMI category[36]

	BMI categories (Kg/m^2)				
	BMI < 25	BMI (25–29)	BMI (30–34.9)	BMI (35–39.9)	BMI ≥ 40
Average cost (€)	15,831	17,021	23,809	24,871	30,982

Table 2

Total direct cost of secondary care for COVID-19 and total cost segregated by type of admission in the 31 European countries and the UK by BMI category[36]

	BMI categories (Kg/m^2)				
	BMI < 25	BMI (25–29)	BMI (30–34.9)	BMI (35–39.9)	BMI ≥ 40
Total direct cost of secondary COVID-19 care (million €)	3,379	4,397	4,117	1,366	650
Total cost of general hospitalization (million €)	1,905	2,300	2,309	733	280
Total cost of ICU admission (million €)	577	699	519	165	97
Total cost of ICU admission requiring IMV (million €)	897	1,399	1,289	467	273

IMV, invasive mechanical ventilation.

Table 3

Estimates of the cost of the COVID-19 pandemic in countries around the world[34]

Study	Country studied	Costs considered estimated losses
Liu et al, 2020[34]	Australia	Direct fiscal support for Covid-19 pandemic AU$134 (US$101) billion
Jin *et al.*, 2021[39]	China	Healthcare and societal costs (due to lost workdays) of Covid-19 (US$0.47 billion and US$383.02 billion respectively)
Mandel *et al.*, 2020[40]	Global	Cost of lockdown regulations (9% of global GDP)
Bartsch *et al.*, 2020[41]	United States	Cost of resources in treating Covid-19 (median of US$3045)

Table 4

Percentage change in the average healthcare and medication costs at various time points before and after bariatric surgery[49]

	Pre-surgery vs longest follow-up period post-surgery	1-year pre-surgery vs. longest follow-up period post-surgery	Pre-surgery vs. post-surgery
Percentage change in healthcare cost (%)	– 1.41	– 6.36	7.85
Percentage change in medication cost (%)	– 39.22	NA	7.10

NA, not applicable.

Two meta-analyses published by Buchwald and colleagues and Chang and colleagues reported bariatric surgery to be efficacious and safe, making it the gold standard treatment for obesity[43,44]. A clinical trial conducted by Mingrone *et al.*[45], which compared the 5-year outcomes in obese patients with Type 2 diabetes who received medical treatment against those who underwent bariatric surgery also found bariatric surgery to be superior and further reported the incidence of obesity-related comorbidities to be reduced.

The American Society for Metabolic and Bariatric Surgery advocates for medically necessary bariatric surgery as a treatment for obesity. However, the International Federation for the Surgery of Obesity and Metabolic Disorders issued recommendations at the start of the COVID-19 pandemic stating that elective surgeries, such as bariatric surgery, should be postponed until after the pandemic is over[34]. Lazaridis *et al.*[46] conducted a global survey on 169 bariatric surgeons and found that 84.6% of surgeons had postponed bariatric procedures due to the Covid-19 pandemic. A survey performed by Beskow *et al.*[47] in Argentina also reported that all bariatric surgeons except for one had ceased elective bariatric surgeries before the first regional case. Ghanem *et al.*[48] also performed a survey in the UK and found that 97% of bariatric surgeons had ceased outpatient clinic consultations, with almost 60% no longer accepting new patients due to the Covid-19 pandemic.

Xia *et al.*[49] performed a meta-analysis of studies published between September 1995 and September 2018, which looked at bariatric surgery as a cost-saving treatment for obesity. The percentage change in the average healthcare costs at various time points in 17 studies and medication costs across the same period in 20 studies (Table 4). A sensitivity analysis was further performed and the percentage change in average healthcare and medication costs in 3 different sub-groups (Table 5).

Xia *et al.*[49] thus concluded that bariatric surgery is more cost-saving than conventional or medical treatment methods when indirect costs were not considered, with a significant reduction in medication costs post-surgical treatment. Alsumali *et al.*[50] also support the finding that bariatric surgery is highly cost-effective, while Borisenko *et al.*[51], who analyzed in the UK, reported that bariatric surgery resulted in a yearly savings of US $2689 per patient while also providing an additional 0.8 life-years to patients, https://www.science.org/content/article/why-covid-19-more-deadly-people-obesity-evenif-theyre-young.

Enhancing healthcare team outcomes

Obesity is an intricate disease with many contributing elements. Community administrators are working to ensure that their societies and systems promote health and wellness. They also support a healthy, active lifestyle amidst the COVID-19 pandemic. This includes ensuring obesity management and prevention starting early and providing everyone access to a healthy diet and places for physical activity. Promoting nutrition standards and healthy beverage options in education settings, workplaces, and public venues is encouraged. Consuming healthy food with plenty of vegetables and fruits, whole grains, and lean protein, as

Table 5

Percentage change in the average healthcare and medication costs at various time points before and after bariatric surgery in 3 different sub-groups[49]

	Pre-surgery vs. longest follow-up period post-surgery	1-year pre-surgery vs. longest follow-up period post-surgery	Pre-surgery vs. post-Surgery
Percentage change in healthcare cost (%), sub-group A[a]	– 1.65	– 6.60	7.10
Percentage change in healthcare cost (%), sub-group B[a]	– 10.15	– 15.10	8.08
Percentage change in healthcare cost (%), sub-group C[a]	– 2.33	– 7.53	– 0.94
Percentage change in medication cost (%), sub-group A[a]	– 38.11	NA	7.1

NA, not applicable.

[a]Sub-group A excludes the study with the largest sample size, sub-group B excludes the study with the largest cost variation, and sub-group C includes indirect costs.

well as a reasonable number of calories, is significant to one's health and can encourage weight loss. It can help boost immune performance and it can help prevent cardiovascular diseases and type 2 diabetes, which also intensifies the risk of severe infection.

Regular physical activity enables good sleep hygiene and also helps in reducing anxiety. It can also assist with preventing weight gain, and calorie reduction, and helps with weight loss. It prevents illnesses such as cardiac disease and diabetes that make a person vulnerable to

having a severe infection from COVID-19[52–54]. Emerging studies propose it may boost immune function[55,56]. Several different associations have arranged online videos and broadcast daily exercises. During the pandemic, many doctors started telemedicine to assist patients while maintaining social distancing. Pharmaceutical organizations are working on an efficient COVID-19 vaccine[57]. Hence, these efforts can help individuals with obesity enhance their general health.

Recommendations

The WHO and the World Obesity Federation have put forward various recommendations to ensure that national policies are set up to protect the health of the community[58]. Social media is a good way to educate the world on the importance of exercise and physical activity[58]. Obese individuals should also be motivated to take care of their psychological health. Similarly, contemplating COVID-19 coagulopathy, prophylactic anticoagulants may be recommended for obese patients who may need hospitalization. Vitamin D supplementation should also be recommended, especially following the containment strategies to stay at home.

Limitations

Adherence to self-isolation and social distancing are vital during a pandemic. However, the combination of lockdowns, lack of socialization, and anxiety can result in increased consumption of processed foods full of salt, sugar, and fat, which, along with minimal to no physical activity, inherently results in weight gain. Another grave concern for the World Obesity Federation is the risk of excess weight gain in a normal-weight population[58]. Due to a direct correlation between weight gain and the lockdown, we can assess that physical activity is a major contributor to weight loss and immune system health as physical activity was limited to residential living quarters during self-isolation[59]. Moreover, the human antioxidant defense system is strengthened by exercising; this proves to be a loss on all fronts if physical activity is omitted[60]. Obese individuals could be even more susceptible to mental health problems due to the combined effects mentioned in this article, especially with mental illness on the rise. Deteriorating mental health is worsened by the lack of access to therapy and limited care for the bariatric community as these may be deemed as elective procedures. Henceforth, it is recommended that the health administration recognize the impact of pandemic isolation in its role in growing obesity and declining mental health. It is necessary to allocate supportive assistance via virtual and telegraphic measures[58].

Conclusion

Obese individuals are a more susceptible type to COVID-19 infection. The sensitivity to severe infections is heightened due to the impairment of both the innate and adaptive immune systems, usually necessitating invasive ventilation in critical care units. Furthermore, the presence of other comorbidities, primarily cardiovascular illnesses and type 2 diabetes, dramatically exacerbates the severity of the COVID-19 infection. The obesity epidemic is dramatically increasing the intensity and impact of the COVID-19 pandemic. Prophylactic therapies should include supporting optimum nutritional intake and promoting regular physical activity. Screening for obesity and implementing preventive strategies should be addressed. Healthcare practitioners and governments must promote ideas for healthy lifestyle improvements and ensure they are accessible to all sectors of the population.

To tackle these challenges effectively, several specific solutions may be provided. Early intervention and training on appropriate eating habits and the requirement of physical activity should be offered from an early age, utilizing schools and community activities. Ensuring that obese individuals have access to proper healthcare services, including regular diagnostics, dietary counseling, and aid for weight management, is crucial. Policymakers should establish rules that support healthy environments, such as limits on food marketing to youngsters, taxes on sugary drinks, and incentives for physical exercise programs. It is also critical to establish support networks that include counseling and mental health services to manage the psychological component of obesity, which is compounded by the pandemic. Additionally,

adopting and supporting community-based initiatives that promote healthy living, including accessible recreational facilities and municipal activities that encourage active lifestyles, can further lessen the influence of obesity on COVID-19 outcomes and boost overall public health. Providing proper help, patient education, and access to excellent healthcare from an early age is critical to reducing the burden of obesity and strengthening resilience against future health difficulties.

Ethics approval and consent to participate

Not applicable.

Consent

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Author contribution

S.S.H.: conceptualization, as mentor and reviewer for this article and data interpretation. H.L., T.P., T.P.: contributed to conceptualization, writing, and data interpretation. T.N.-K.: contributed to performing literature review and editing. S.B.: contributed to writing, performing a literature review, and editing. H.K., A.K.: contributed to writing the paper and reviewer for this article. C.M., G.S., G.F.F.: contributed to writing the paper and reviewing. S.K.: contributed to data interpretation, reviewing, and editing. All authors have read and approved the manuscript.

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