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Review article

Role of bariatric surgery in a COVID-19 era: a review of economic costs

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Abstract

Obesity has rapidly become a significant public health issue. As the prevalence of obesity continues to rise, so does its economic burden as a result of both direct and indirect costs. Likewise, since 2019, the coronavirus disease of 2019 (COVID-19) has become a global pandemic with rising infection rates carrying significant economic costs associated with treatment of the disease and the reduction in economic activity due to government regulations. The COVID-19 pandemic has had a detrimental impact on obesity, not only creating an increasingly obesogenic environment but also reducing access to bariatric care and treatment of obesity-related diseases. In this article, we form a compelling argument for the resumption of bariatric services as soon as it is safe to do so because bariatric surgery brings significant additional medical and economic benefits. Medically, obesity is a risk factor for increased severity of COVID-19 infections, and therefore, treatment of obesity should be a priority in the current pandemic. Additionally, bariatric surgery has been shown to be a cost-saving procedure in the long term and thus has significant economic benefit in reducing the costs of obesity in the future as we recover from the economic collapse following the global pandemic. (*Surg Obes Relat Dis* 2021;17:2091–2096.) © 2021 American Society for Bariatric Surgery. Published by Elsevier Inc. All rights reserved.

Key words: Obesity; COVID-19; Bariatric surgery; Economic cost; Cost-saving procedure

Obesity has rapidly become a global health concern, reaching pandemic proportions, with worldwide obesity tripling over the last two decades [1]. A continued growth trend will result in an estimate of 50% of the worldwide population being overweight or obese by 2030 [2]. Obesity is associated with a number of co-morbidities and chronic diseases, including type 2 diabetes, cardiovascular diseases, and cancer [3], as well as more frequent patient visits to general practitioners or hospitals [4]. Since the coronavirus disease (COVID-19) first emerged in late 2019, the virus has

infected 144 million people worldwide with a current mortality of 3 million people [5]. The economic impacts of obesity and COVID-19 are and will continue to be substantial if uncurbed. This paper aims to discuss the economic burden of COVID-19 and obesity while exploring the financial and health implications of bariatric surgery within this current climate.

Search strategy

We performed a thorough search of the literature for the purpose of this review. Our search criteria were directed to address the following topics: (1) the economic impact of obesity, (2) the economic impact of COVID-19, (3) the financial implications of bariatric surgery, and (4) the

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impact of COVID-19 on obesity. These issues were explored by examining empirical articles located through a computerized search of biomedical and life sciences databases (PubMed and Medline) and references located within the articles themselves. Articles were included based on relevance to the intended topic, and date of publication was limited to the last 10 years. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were used to aid in evaluating the articles.

Our search terms included:

1. ((economic impact[Title]) OR (economic cost[Title])) AND ((COVID[Title]) OR (coronavirus[Title]))
2. ((economic impact[Title]) OR (economic cost[Title])) AND (obesity[Title])
3. (bariatric surgery[Title]) AND ((economic[Title]) OR (cost[Title]))
4. (obesity[Title]) AND ((COVID[Title]) OR (coronavirus [Title]))

Economic impact of obesity

Obesity poses a large economic burden for individuals themselves, as well as for the government and healthcare systems. These costs may be direct or indirect, with direct causes involving costs associated with the treatment of obesity and its related chronic diseases/co-morbidities and indirect costs relating to the loss of productivity, workdays, and disability secondary to obesity-related sequelae. At a personal level, obesity can lead to physical, psychological, and social problems that have a significant impact on an individual's well-being and productivity [6].

The current literature contains several analyses of the cost of obesity to the global economy, as summarized in [Table 1](#). A comprehensive systematic review by Specchia et al. in 2015 concluded that obesity accounts for a large proportion of healthcare spending in the global economy, with high levels of both direct and indirect costs [7]. Furthermore, a report by the McKinsey Global Institute in 2014 indicated that the estimated economic impact imposed by obesity on the world economy is equivalent to US\$2 trillion—2.8% of the world gross domestic product (GDP) [2]. Assessing individual countries such as the United Kingdom, the estimated direct obesity and obesity-related costs to their National Health Service amounted to US\$7.1 billion in 2007, accounting for .3% of their total GDP [8]. In the United States, estimates of the medical cost of adult obesity range from US\$147 billion to US\$185.7 billion per year, including spending on obesity-related diseases such as diabetes [9–11].

In 2005, the cost of overweight and obesity was US\$14.2 billion in Australia, with an additional US\$24.3 billion being spent on government subsidies for people who were overweight or obese, accounting for 4% of total GDP [12]. The global obesity pandemic extends beyond

developed nations, with epidemiologic evidence from Brazil in 2011 estimating that annual costs of obesity and related diseases amounts to US\$269.6 billion, representing 10.3% of their GDP [13]. As evident from a German study that showed a 70% increase in obesity-related economic costs over a 6-year period [14], the obesity problem and its associated economic impact will only continue to rise unless it is adequately addressed. A key application of economics involves decision making in order to ensure the efficient allocation of finite resources to maximize productivity. These choices involve minimizing opportunity costs and ensuring optimal cost effectiveness [15].

Economic impact of COVID-19

In addition to the overwhelming health and social impacts, COVID-19 has led to great losses for the global economy. These costs include direct costs such as the cost of healthcare associated with treating patients affected by COVID-19 as well as numerous indirect costs such as unemployment, loss of productivity and income due to isolation measures, long-term complications such as cardiac or respiratory diseases, and mental health issues [16,17]. In the first half of 2020, most countries began enforcing stringent lockdown measures to reduce the spread of COVID-19. These lockdown measures were associated with sharper economic contractions owing to reduced consumption and production and higher unemployment rates [17].

Additionally, social distancing from both government regulation and voluntary distancing due to fear of contracting the virus further reduced the level of economic activity globally. This led to a dramatic contraction in the global economy, with global GDP falling by 3.3% in 2020.

Advanced economies including the United States and Europe experienced an average fall of 4.7% in their GDP, whereas emerging markets and developing economies also were affected, with an average decrease in GDP of 2.2% [17]. An out-of-equilibrium analysis of both the direct costs of the COVID-19 lockdowns and the follow-up effects of this through the global economy estimated that the total impact of COVID-19 amounts to 9% of global GDP [18].

Global output also was affected by intercountry interactions, with world trade volumes, industrial production, and the manufacturing purchasing managers' index falling steeply. This has been exacerbated by falling commodity prices, particularly petroleum, where weak aggregate demand has driven prices down [17]. Inversely coupling the reduction of economic growth and output was the astronomical rise in COVID-19–related health costs [19]. [Table 2](#) summarizes the several articles that have attempted to estimate the current costs of the COVID-19 pandemic despite the lack of reliable and unequivocal data. One paper estimated losses of COVID-19 in the United States to be approximately US\$16 trillion, representing 90% of the U.S. GDP. Approximately half this cost is attributable to

Table 1
Comparison and main features of articles that have estimated costs of obesity around the world

Study	Country	Type of analysis	Population	Time	Costs considered	Main findings
Dobbs et al., 2014 [2]	Global	Retrospective	Overweight and obese	2014	Direct and indirect costs	The estimated cost of obesity to the world economy was US\$2 trillion—2.8% of world GDP
Scarborough et al., 2011 [8]	United Kingdom	Retrospective	Overweight and obese	2006–2007	Direct medical costs	Overweight- and obesity-related costs amounted to US\$7.1 billion in 2007
Wang et al., 2011 [9]	United States	Prospective	Obese	2010–2030	Direct medical costs	The medical costs associated with treatment of obesity-related diseases are estimated to increase by US\$48 billion to US\$66 billion per yr
Finkelstein et al., 2009 [10]	United States	Retrospective	Adults with obesity (body mass index >30 kg/m ²) aged >18 yr	1998–2006	Direct medical costs	The medical cost of obesity was projected to rise to US\$147 billion/yr in 2008. The increase in obesity rates in 2006 increased healthcare costs by US\$40 billion
Cawley et al., 2012 [11]	United States	Retrospective	Adults with obesity aged >18 yr	2008	Direct medical costs	It was estimated that the medical costs of obesity amounted to US\$185.7 billion in 2008
Colagiuri et al., 2010 [12]	Australia	Retrospective	Persons overweight or with obesity ≥ 25 yr	2005	Direct medical and nonmedical costs and government subsidies	The cost of overweight/obesity was US\$14.2 billion. An additional US\$24.3 billion was spent on subsidies for people who were overweight/obese.
de Oliveira et al., 2015 [13]	Brazil	Retrospective	Persons with obesity aged >20 yr	2011	Direct medical costs	Annual costs of obesity and their related diseases amounted to US\$269.6 billion
Lehnert et al., 2015 [14]	Germany	Retrospective	Adults overweight or with obesity (body mass index ≥ 25 kg/m ²)	2008	Direct and indirect costs	Excess weight caused US\$19.92 billion in total costs in 2008 (+70%), of which US\$1.03 billion were direct costs

GDP = gross domestic product.

income lost from the COVID-19–induced recession, and the remainder is from the economic losses associated with COVID-19–related health complications [20].

In China for the period January to March 2020, the total estimated healthcare and societal costs associated with COVID-19 were US\$.47 billion and US\$383.02 billion, respectively. Societal costs were primarily due to lost workdays because of lockdown regulations [21]. One simulated model of the COVID-19 economic impact in the United States estimated that a single symptomatic COVID-19 infection would cost a median of US\$3045 in direct healthcare costs at the time of infection [22]. In Australia, the Treasury reported spending US\$101 billion on direct fiscal support in response to COVID-19 [23].

Healthcare and the COVID-19 impact on obesity

Despite the rise in healthcare need during the COVID-19 pandemic, some early trends on health spending have demonstrated a greater emphasis in budget allocation on supporting and boosting economic activity rather than funding healthcare. In high-income countries, the budget allocated to the health response for COVID-19

represents only 8% of pre–COVID-19 public health spending, which equates to approximately US\$205 per capita [19]. Furthermore, the redistribution of health resources and personnel to running COVID-19 clinics and COVID-19–related investigations/treatments has inadvertently had an impact on the delivery of other medical services, including elective surgery [24,25].

In the context of obesity and bariatric surgery in particular, the International Federation for the Surgery of Obesity and Metabolic Disorders issued a series of recommendations at the start of the COVID-19 pandemic. These recommendations state that all elective surgeries should be postponed during the pandemic and rescheduled for when the pandemic is over [26]. The American Society for Metabolic and Bariatric Surgery declared that bariatric surgery is not elective because it is the best lifesaving treatment for obesity—a contradiction of the definition of elective that refers to a surgery that is not essential to the survival of the patient. Instead, the American Society for Metabolic and Bariatric Surgery advocates for use of the term *medically necessary time-sensitive surgery* or *medically necessary nonemergent surgery* over the term *elective* when describing bariatric surgery and therefore advocates for bariatric/

Table 2
Comparison and main features of articles that have estimated costs of COVID-19 around the world

Study	Country	Type of analysis	Costs considered	Main findings
Cutler et al., 2020 [20]	United States	Retrospective	Lost GDP and healthcare costs	The estimated financial costs of COVID-19 related to the lost output and health reduction are more than US\$16 trillion, or approximately 90% of the gross domestic product of the United States
Bartsch et al., 2020 [22]	United States	Prospective analysis	Cost of resources and direct medical costs in treating COVID-19 infections	The simulated model estimated that a single COVID-19 infection would cost a median of US\$3045 in direct healthcare costs at the time of infection
Australian Treasury 2020 [23]	Australia	Retrospective	Cost of direct fiscal support for the COVID-19 pandemic	The Australian Treasury reported spending AU\$134 (US\$101) billion on direct fiscal support in response to COVID-19
International Monetary Fund 2020 [17]	Global	Retrospective	Lost GDP	Global GDP fell by 3.3% in 2020. Advanced economies experienced an average fall in GDP of 4.7%, whereas emerging/developing economies had an average decrease of 2.2%.
Mandel et al., 2020 [18]	Global	Prospective analysis	Direct costs of lockdown regulations and its propagation through the global supply chain	Both direct costs of the COVID-19 lockdowns and its follow-on effects through the global economy amounts to 9% of global GDP
Jin et al., 2021 [21]	China	Retrospective	Direct costs of COVID-19 and societal costs	From January to March 2020, the estimated healthcare and societal costs of COVID-19 were US\$4.7 billion and US\$383.02 billion, respectively. Societal costs were primarily lost workdays due to lockdown regulations.

GDP = gross domestic product.

metabolic surgery to be restarted as soon as it is safe to do so [27].

The reduction of face-to-face clinical care also has impacted the care of chronic diseases such as hypertension and diabetes, which likely will have associated long-term costs, especially in patients with obesity. A worldwide survey among bariatric surgeons found that 84.6% of surgeons had postponed primary or redo bariatric procedures in light of the COVID-19 pandemic [28]. A similar survey in the United Kingdom found that 97% of bariatric surgeons ceased their outpatient clinics for both new and follow-up patients, and almost 60% of bariatric surgeons stopped placing new patients on their waiting lists [29]. In Argentina, a survey found that 99% of bariatric surgeons ceased all their elective bariatric surgeries with a mean of 7.7 days prior to the first regional COVID-19 case [30].

In addition, social distancing regulations and lockdown laws combined with socioeconomic stressors and deterioration of mental well-being may place long-term consequences on obesity. This is a result of social isolation exacerbating socioeconomic stressors and reducing mental well-being, which may lead to altered eating patterns and an increase in sedentary lifestyles [31–34]—the perfect milieu for obesity.

With added financial stress, patients who were planning to seek obesity surgery may now choose to delay treatment in the view of diverting their own personal resources to more urgent needs. Thus, although the COVID-19 regulations are effective at reducing the spread of the virus, they may serve as a risk factor for obesity and other associated metabolic diseases [35].

Economic benefits of obesity surgery

Bariatric surgery remains the criterion standard treatment for obesity and has been consistently proven to be efficacious and safe [36,37] while also reducing the incidence of obesity-related co-morbidities [38]. However, bariatric procedures are not inexpensive, with the median cost for a sleeve gastrectomy, a popular bariatric procedure, being US\$10,531 in 2013 [39]. Despite these costs, a 2019 meta-analysis found that bariatric surgery when compared with conventional methods of weight loss is more cost saving over the life course, even when indirect costs are not considered [40].

These results are consistent with a separate systematic review in 2018 [41] supporting the fact that bariatric surgery is highly cost-effective. The long-term financial benefits of bariatric surgery with regard to improvements or resolution of obesity and its associated metabolic diseases cannot be underestimated. At an individual level, metabolic surgery has been proven to significantly reduce daily medication-related healthcare costs for patients previously requiring multidrug therapy [40]. At a national healthcare level, the reversal of obesity-associated chronic medical diseases such as diabetes, hypercholesterolemia, and hypertension will significantly reduce the long-term healthcare burden that would continue to be present if untreated. A cost-utility analysis conducted in the United Kingdom substantiated the fact that bariatric surgery produced annual savings per patient of US\$2689 while providing an additional .8 life-years and 4.0 quality-adjusted life-years [42]. This supports the conclusion that bariatric surgery can save the healthcare system significant funds in the long term.

Medical benefits of reducing obesity in the COVID-19 era

Obesity remains a disease that must be treated in order to optimize health outcomes for patients. This is especially true in light of the COVID-19 pandemic, where obesity serves as a risk factor for increased severity of symptoms from COVID-19 infections. Obesity was associated with increased need for hospitalization, mechanical ventilation, and increased mortality rates [43]. This may be explained by the decreased respiratory system compliance and functional capacity, as well as the increased incidence of comorbidities such as cardiac disease [44]. In fact, one report on COVID-19 found that obesity was a more significant risk factor for hospital admission than cardiovascular disease [45].

In a recent systematic review of obesity and COVID-19, obesity was shown to have a significant association with higher COVID-19 infection rates (odds ratio [OR] 1.50, $P < .001$), more severe COVID-19 disease (OR 3.13, 95% $P = .005$), and higher mortality (OR 1.36, 95% $P = .006$) [43]. Bariatric surgery again has an important role in managing obesity-related COVID-19 complications, with one multicenter study finding that patients who had undergone bariatric surgery 12 months or earlier developed less severe COVID-19–related symptoms than subjects who were currently obese [46]. Therefore, although the COVID-19 pandemic justly halted elective bariatric surgeries, efforts must be made to prioritize bariatric surgeries once it is practical to do so [47].

How we should view bariatric surgery in the COVID-19 era and beyond

The era of COVID-19 has had a broad impact on all aspects of society, the economy, health infrastructure, and politics. Similarly, the growing global trend and negative impact of obesity cannot be ignored. By objectively inspecting population trends [1], it is clear that the obesity pandemic remains an existing significant healthcare problem while further compounding the effects of COVID-19. The global economic impact of both, when considered individually or as a collective, is enormous, and both diseases must be tackled simultaneously. Even prior to COVID-19, bariatric surgery was underutilized secondary to misconceptions and stigma associated with obesity and bariatric surgery [48]. Such perceptions may further delay suitable candidates for bariatric surgery with the diversion of health resources in managing COVID-19. As discussed earlier, the financial impact of obesity surgery as a secondary prevention of obesity-related metabolic disease cannot and should not be ignored because it has long-standing benefits when it comes to healthcare not only in the COVID era but beyond.

As we come to terms with COVID-19 and the recommendation of elective surgery, adequate financial resources should be allocated to dealing with the backlog of patients currently awaiting bariatric surgery worldwide. The

prioritization of case loads needs to be considered carefully so as to ensure that available resources are allocated to patients who will benefit most from bariatric surgery in addition to their body mass index. In so doing, we also help to minimize future the healthcare burden relating to their obesity disease. Fundamentally, this will include bariatric patients with significant morbidity and mortality from their associated obesity-related diseases (i.e., cardiovascular, respiratory, and metabolic diseases). In addition to metabolic disease, bariatric surgery also should be preferentially offered to patients who have had their quality of life and mobility affected by organ-specific disease (e.g., chronic kidney disease, chronic liver disease, and obstructive sleep apnea) and symptoms relating to high body mass index (e.g., musculoskeletal and joint problems).

Conclusion

It is clear that COVID-19 has had a significant impact on global economic output and has severely reduced economic growth. Although the exact costs cannot yet be quantified, the economic and social costs from the disease are profound and will take many years to recover from. COVID-19 also has become a significant risk factor in potentiating the obesity pandemic, whereas obesity is in itself a risk factor in exacerbating the severity of COVID-19 infection. Thus, although COVID-19 has currently limited the practice of bariatric surgery, adequate focus and attention need to be allocated to prioritizing bariatric surgery once it is safe to do so because it serves not only to reduce obesity-related complications but also to scale down economic and social costs going into the future.

Disclosures

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