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ORIGINAL CONTRIBUTIONS

# Bariatric Surgery Offer in Brazil: a Macroeconomic Analysis of the Health system's Inequalities

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## Abstract

**Background** Brazil currently holds the second place in the worldwide ranking of the largest number of bariatric surgical procedures performed. The offer of bariatric surgery in the public health system is not sufficient for its demand; it remains to be determined whether the recent economic downturn affected this offer.

**Objective** To analyze the proportion of bariatric surgeries performed by the public system in Brazil and assess the influence of macroeconomic variables over time.

**Methods** This is a nationwide analysis which correlated the estimated number of bariatric surgeries in Brazil in both public and private health-providing systems from 2003 through 2017 with the main macroeconomic variables of Brazil during the evaluated period (gross domestic product [GDP], inflation rate, and unemployment rate), and both overall and public healthcare expenditures.

**Results** The proportion of surgeries performed in the public system varied from 7.1% in 2014 to 10.4% in 2004. There was a significant positive correlation between the public proportion of surgeries with the unemployment rate ($R = 0.55666$; $P = 0.03868$). There were significant negative correlations between the proportion of public surgeries with the public health expenditure per capita ($R = -0.88811$; $P = 0.00011$) and with the public percentage of healthcare expenditure per capita ($R = -0.67133$; $P = 0.01683$).

**Conclusion** There were direct correlations between the number of public bariatric procedures and the unemployment rate, as well as with the public healthcare expenditure per capita. Despite the increase in the number of public procedures, its proportion reveals an insufficiency of the current offer of bariatric surgery provided by the public system.

**Keywords** Bariatric surgery · Obesity · Economics · Socioeconomic factors · Economic indexes

## Introduction

The demand for bariatric surgery has steadily grown over the last decades. The prevalences of obesity and related comorbidities have risen to epidemic proportions and, at the same time, bariatric surgery, especially based on minimally invasive approaches and performed at multidisciplinary centers of excellence, has become a safe and effective method to treat refractory cases [1–4]. However, the offer of bariatric surgery is subjected to various factors, of which economic issues remain a significant variable [5].

In Brazil, the health-providing system's financing is organized through a mixed way. There is a public system endorsed and funded by several stances of the government, which is supposed to universally offer health services for the entire population; on the other hand, there are private health-providing services which may be directly funded by the users, but are mostly associated with private insurance plans, which are funded by the part of the population who can afford them or by employers which offer them as benefits for their employees. Roughly about one fourth of the population has access to the private health-providing system and the remaining are completely dependent on the public system [6, 7].

Accounting for more than 100,000 annual proceedings, Brazil currently holds the second place in the worldwide ranking of the largest number of bariatric surgical procedures performed [8–11]. Although a continuous growth of these

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number of procedures has occurred in the recent years, there is a pent-up demand of individuals who would achieve benefits from bariatric surgery, but cannot reach an access for surgical treatment; almost 20% of the Brazilian adult population is obese, which means nearly 25 million people, of which approximately 5 million are eligible for bariatric surgery [12, 13]. The majority of this population relies upon the public system for their entire healthcare services; hence, it is relevant to evaluate to which degree this system is currently fulfilling their needs in regard to the offer of bariatric surgery and to what extent the recent economic downturn in Brazil affected the public availability of this essential treatment modality.

This study aims to analyze the proportion of bariatric surgeries performed by the public system in Brazil and assess how it was affected by macroeconomic issues over time.

## Methods

This is a nationwide analysis of previous surveys which correlated the estimated number of bariatric surgeries in Brazil in both public and private health-providing systems from 2003 through 2017 with the main macroeconomic variables of Brazil during the evaluated period (gross domestic product [GDP], inflation rate, and unemployment rate), and both overall and public healthcare expenditures. The proportion of bariatric surgeries performed by the public service during the study period was then correlated with each macroeconomic variable to determine whether there is any significant association between them. The proportion of public bariatric surgeries was also correlated with the overall and public healthcare expenditures per capita.

The number of bariatric surgeries performed in Brazil was obtained by means of the periodical reports of the Brazilian Society of Bariatric and Metabolic Surgery (SBCBM) [14] and the number of bariatric surgeries performed by public health-providing services by means of the Federal Department of Health reports [15]. The main macroeconomic variables evaluated were obtained by means of the official publications of the Brazilian government organization Applied Research Institute (IPEA); the data considered were the yearly rates of nominal GDP, inflation determined by the broad consumer price index (IPCA), and unemployment determined by the proportion of unemployed individuals who are part of the economically active population [16]. The overall, public, and private healthcare expenditures per capita were obtained by means of the World Health Organization (WHO) health expenditures database [17].

### Statistical Analysis

The Spearman correlation tests were used to determine the correlation between the analyzed variables. The Spearman tests generate rank *correlation* coefficients (values of $R$) that vary from − 1 to 1; values close to the edge signal negative or positive correlations, respectively. *The level of significance adopted was 5%* ($p < 0.05$). The software SSPS v. 16.0 (Chicago, IL, USA) was used for the analysis.

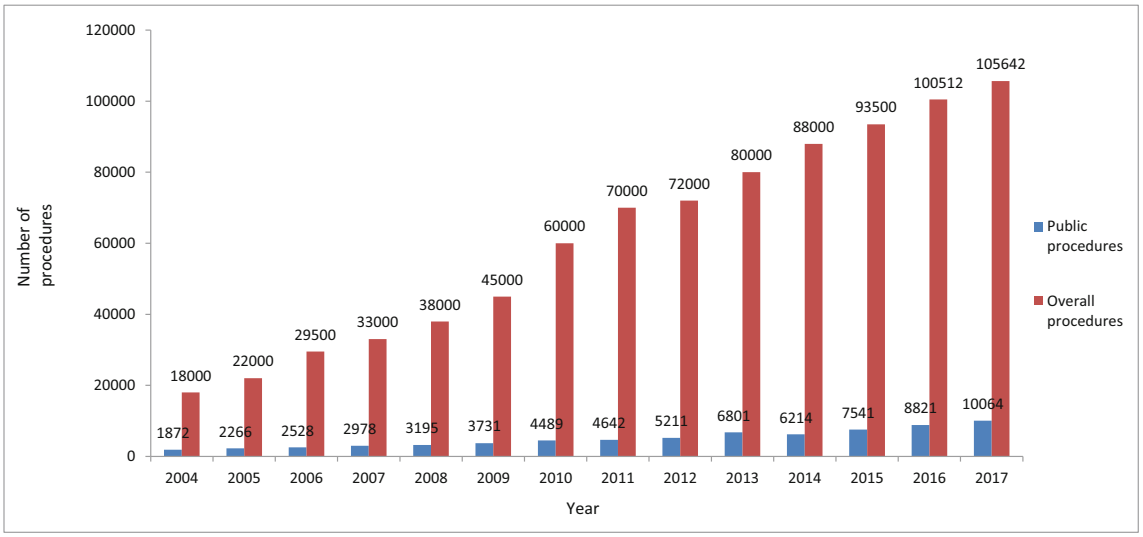
## Results

The overall number of surgeries increased from 18,000 in 2004 to 105,642 in 2017; the number of surgeries performed in the public system increased from 1872 in 2004 to 10,064 in 2017. The proportion of surgeries performed in the public system varied from 7.1% in 2014 to 10.4% in 2004. Figure 1 presents the detailed data on the overall and public number of surgeries performed in Brazil from 2004 through 2017. There was a tendency towards positive or mildly negative macroeconomic parameters in the first half of the evaluated period, followed by a rapid worsening of such statistics, leading to higher inflation and unemployment rates, as well as decreases in the GDP and healthcare expenditure per capita. These data are presented in Fig. 2.

In regard to the correlations between the proportion of surgeries performed in the public system, macroeconomic and healthcare variables, there was a significantly positive correlation between the public proportion of surgeries with the annual unemployment rate ($R = 0.55666$; $P = 0.03868$), i.e., the higher the proportion of surgeries performed in the public system, the higher the unemployment rate. On the other hand, there were significantly negative correlations between the proportion of public surgeries with the public health expenditure per capita ($R = -0.88811$; $P = 0.00011$) and with the public percentage of healthcare expenditure per capita ($R = -0.67133$; $P = 0.01683$), i.e., the higher the absolute and proportional public healthcare expenditures, the lower the proportion of public bariatric surgeries**.** The proportion of public bariatric surgeries did not present significant correlations with the GDP variation and inflation rates, respectively (Table 1).

## Discussion

Brazil, despite undeniable social and economic advances since the end of the twentieth century, still presents worrying rates of poverty and social inequality, as well as an insufficient offer of essential health-providing services [18]. Over recent years, a relevant deterioration of economic indices associated with a convoluted political situation led to riots in the streets and even to the impeachment of the then Brazilian president. Following years of low inflation and an almost steady economic growth, the country entered a period of economic depression characterized by decreases in the GDP, increasing inflation levels, and high unemployment rates. The Brazilian




Sources: Source: Brazilian Society of Bariatric and Metabolic Surgery (SBCBM) and Datasus (Department of Health - Brazil).

**Fig. 1** Number of overall and public bariatric surgeries performed over time in Brazil, 2004–2017. Sources: Brazilian Society of Bariatric and Metabolic Surgery (SBCBM) and Datasus (Department of Health - Brazil)

depression began in 2014, following successive decreases in the GDP linked to the bankruptcies of several companies, trades, and industries, along with high unemployment rates and a severe decrease of both international and domestic investment rates. The 2014–2017 downturn was caused by a combination of economic policies that reduced Brazil's potential economic growth and a fiscal crisis that led to an unsustainable increase in the public sector debt. Many factors contributed to create and worsen this crisis: an increase of the governmental interventionism in fiscal and monetary policies that led to non-coordinated changes in the interest rates associated with a tight control of government-regulated prices (such as petrol-derived products), detached of the international economic scenery and prices. The consequences of these disastrous policies on the healthcare system were significant decreases in the government health expenditures and also in the number of people who could afford private healthcare insurance plans [19–21]. The influence of such economic downturn and political turmoil on an already insufficient health system is difficult to be directly determined; nevertheless, its effects can be indirectly assessed through statistical methods such as the model proposed by this study.

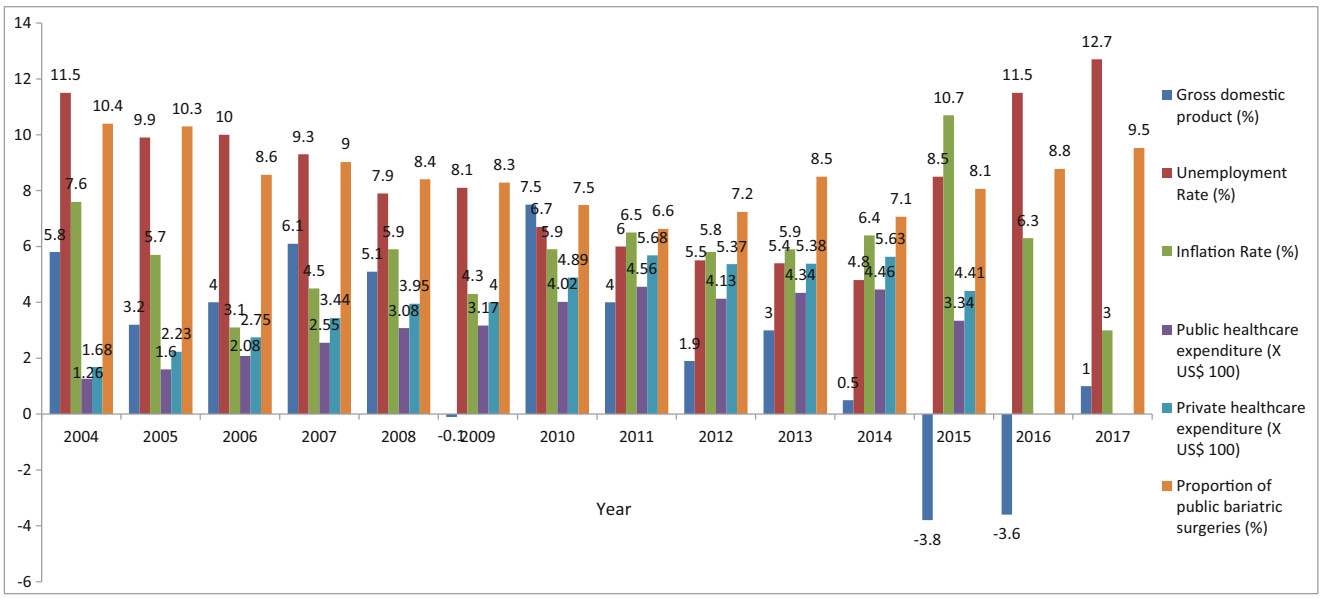



**Fig. 2** Macroeconomic data (gross domestic product, unemployment, and inflation rates), public and private healthcare expenditures per capita and proportion of bariatric surgeries in Brazil, 2004–2017. 2016 and 2017 healthcare expenditures' data not yet available

**Table1** Correlations between the proportion of bariatric surgeries in the public health system and macroeconomic variables in Brazil, 2004–2017

| Macroeconomic variable | Correlation coefficient | Value of P |
|---|---|---|
| Gross domestic product | 0.17822 | 0.54215 |
| Unemployment rate | *0.80748* | *0.00048* |
| Inflation rate | − 0.32892 | 0.25085 |
| Proportion of public healthcare expenditure per capita | *− 0.67133* | *0.01683* |
| Public healthcare expenditure per capita | *− 0.88811* | *0.00011* |

Correlation coefficients determined by means of the Spearman correlation ranks' analysis. 2016 and 2017 healthcare expenditures' data not yet available. Italic means statistical significance

The influence of economic downturns on healthcare has been previously reported in different situations and varied healthcare areas. Alkire et al. [22] demonstrated that recession may lead to an inadequate access to high-quality healthcare that results in significant mortality and imposes a macroeconomic burden that is inequitably distributed, with the largest relative burden falling on low-income countries, whereas Norte et al. [23] specifically observed that negative economic changes are able to modify the diet quality and nutritional status, increasing the risk of the poorest and most vulnerable individuals to have a poor diet or to be obese, results which were similar to the findings of Oddo et al. among children [24]. Ribera et al. [25] showed that budgetary issues led to an increase in the waiting time for transcatheter aortic valve replacement for the treatment of severe aortic stenosis at the expense of a lower survival and loss of quality of life. Weiner et al. [26] revealed that a nationwide economic hardship was associated with decreased diagnosis rates of nonpalpable prostate cancer and increased conservative management. A systematic review by Fujihara et al. [27] demonstrated that the surgical volume generally decreased when economic indicators declined, which was observed for both elective and non-elective operations.

The cost-effectiveness of bariatric surgery as a way to reduce overall obesity- and metabolic-related expenditures has been previously demonstrated. It has been shown that the yearly overall cost of a diabetic patient is sufficient to afford a single bariatric surgery, which presents a lasting effect and thus prevents the worsening of diabetes [5, 28, 29].

Despite its significant growth, the number of bariatric surgeries performed by means of public health providers in Brazil is very far from the ideal, reaching near 10% or less of the total during the entire period. In 2016, it was estimated that only 75 public hospitals were accredited for the performance of bariatric surgeries in Brazil [30]. Taking into consideration that grossly less than 75% of the population have an access or could afford private health-providing services, the situation remains critical. It is also noteworthy that, during the period evaluated, there were major changes which expectedly should positively influence the offer of bariatric surgery in Brazil: a new regulation of the public offer of surgery, through an official ordinance published by the Department of Health in March 2013, which sought to increase the access and regulate the reimbursements for public hospitals, and a new policy for indication of bariatric surgeries formulated by the Federal Council of Medicine (CFM) in January 2016, which determined that 21 other comorbidities (Table 2) besides the usual five of the older policy (hypertension, diabetes, arthropathy, sleep apnea, and dyslipidemia) would be considered for surgical indication. Nonetheless, these two relevant policy changes did not lead to an expected rise in the proportion of public bariatric surgery offer in the forthcoming years [31, 32].

Since this study presented data that confirm that the unemployment is a major macroeconomic variable associated with the proportion of bariatric surgeries performed by public health-providing services, a number of reasons should be considered. Firstly, unemployment leads to an increase in the number of people who cannot afford a private health insurance plan, since the vast majority of these plans is directly or partly provided by the employers. Comparing public and private expenditures per capita in healthcare, the inefficiency of the current public bariatric surgery offer policy is even more clearly evident. Even in the years when there were absolute or proportional increases in the public healthcare expenditures, there was not an expected increase in the public proportion of surgeries; on the contrary, the public expenditure was even inversely correlated, pointing a cruel distortion and signaling how operations are not performed to the extent that they should for an appropriate health management and planning in the Brazilian public health system. Considering that public costs per capita are equivalent to about 70–80% of private expenditure and that only less than one fourth of the population have any access to private health insurance plans, the fact that only 10% of bariatric surgeries are performed in the public system demonstrates in an undeniable way how this treatment modality is neglected in this system.

**Table 2** Indication criteria for bariatric surgery according to the Brazilian Federal Council of Medicine (CFM) (2016)

| Body mass index (BMI) | Association of comorbidities |
|---|---|
| ≥ 40 kg/m$^2$ | No comorbidity is mandatory |
| ≥ 35 kg/m$^2$ | Gallstone disease |
| | Recurrent acute pancreatitis |
| | Nonalcoholic fatty liver disease |
| | Stress urinary incontinence in women |
| | Male and female infertility |
| | Erectile dysfunction |
| | Polycystic ovary syndrome |
| | Varicose veins disease |
| | Hemorrhoidal disease |
| | Idiopathic intracranial hypertension |
| | Social stigmatization |
| | Depression |

There is not a specific recommendation in regard to an optimal number of bariatric surgeries to be performed in a country. Given that 75% of the Brazilian population solely depends on the public health system, which accounts for only 10% of the overall bariatric surgeries, an ideal estimation leads to the necessity to increase this number to 75% of the procedures. However, this is very far from the current landscape. Considering that there are about 5 million Brazilians eligible for bariatric surgery, of which about 3.75 million depend solely on the public system, the rationale proposed by Welbourn and Le Roux in a previous article might be adopted. This study suggested that the United Kingdom public system (National Health Service-NHS) should perform 50,000 surgeries per year to achieve an optimal cost/benefit ratio. According to Ahmad et al., 5.4% of the NHS-attended population was eligible for bariatric surgery (about 3.5 million people); considering the obvious social, economic, and even historical differences between the countries, 50,000 surgeries per year performed by the Brazilian public system might be considered a reasonable and fair goal [33, 34].

The influence of the number of surgeons in each health-providing system is difficult to assess in Brazil. Bariatric surgery was acknowledged as a medical specialty in Brazil only in 2015; the vast majority of surgeons that perform bariatric surgery are registered as general or digestive surgeons. Moreover, to perform these surgeries, it is not mandatory to be assigned to the Brazilian Society of Bariatric and Metabolic Surgery (SBCBM). And to make matters even more complicated, the majority of the surgeons in Brazil work for both the public and private systems, according to variable degrees of dedication to each one of them. However, the number of surgeons that act in the public system should not be considered a problem in this regard, since more than 50% of all general and digestive surgeons work the public system [35]. Moreover, the number of available hospital beds in each system even emphasize how bariatric surgery is not prioritized in Brazil; there are more public than private beds in Brazil, although there were significant reductions in both over time. From 2010 through 2018, the overall number of public beds decreased from 336,842 to 302,524 and the private beds decreased from 295,463 to 264,009 [36].

This study presents some limitations that should be considered. It is an analysis of nationwide data from a continental country that is characterized by significant regional disparities; hence, some of the overall results may be misleading. Moreover, since economic downturns tend to be cyclical, analyses of longer periods are necessary to fully address these tendencies. Although this study tried to limit the economic and healthcare variables for assessing their correlations, there are also several other variables that are very difficult to evaluate, but also could influence the present findings, such as specific changes in coverage or policies in regard to the availability and even indications of bariatric surgery, variations in the educational level of the population studied, and the number of active bariatric surgeons. The Spearman method does not provide linear correlations, given that it is a non-parametric method. Nevertheless, the significance of the findings is clear and reinforces the need for similar studies on other regions and taking into consideration these findings for an appropriate long-term planning for obesity management and bariatric surgery offer.

Some measures may be proposed to alleviate the effects of economic downturns on the offer of bariatric surgery. A more sustained increase in the number of public services that offer these procedures, allied with programs that stimulate a reduction of overall costs associated with the procedures, such as

the implementation of less invasive methods and protocols of enhanced recovery, thus reducing hospital length and complications. A clear definition of obesity as a public health problem coupled with a specific program of prioritizing the access to treatment should be considered as essential state policies, taking into account the impact of their complications on healthcare costs.

## Conclusion

Brazil currently holds the second place in the worldwide ranking of the largest number of bariatric surgical procedures performed. Its healthcare system is based on a three-way access to surgery: private, insurance health plans, and public; however, about 75% of its population solely depends on the public system. There were direct correlations between the number of public bariatric procedures and the unemployment rate, as well as with the public healthcare expenditure per capita. Despite the increase in the number of public procedures, its proportion reveals an insufficiency of the current offer of bariatric surgery provided by the public system in comparison with the population that exclusively depends on this system.

### Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Statement of Human and Animal Rights** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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