Obesity Surgery (2018) 28:3193–3198
https://doi.org/10.1007/s11695-018-3318-5

ORIGINAL CONTRIBUTIONS

Nationwide Macroeconomic Variables and the Growth Rate of Bariatric Surgeries in Brazil

Everton Cazzo[1] · Almino Cardoso Ramos[1] · José Carlos Pareja[1] · Elinton Adami Chaim[1]

Published online: 6 June 2018

Abstract

Background The effect of nationwide economic issues on the necessary expansion in the number of bariatric procedures remains unclear.

Objective This study aims to determine whether there are correlations between the growth rate in the number of bariatric surgeries and the major macroeconomic variables over time in Brazil.

Methods It is a nationwide analysis regarding the number of bariatric surgeries in Brazil and the main national macroeconomic variables from 2003 through 2016: gross domestic product (GDP), inflation rate, and the unemployment rate, as well as the evolution in the number of registered bariatric surgeons.

Results There were significant positive correlations of the growth rate of surgeries with the early variations of the GDP ($R = 0.5558$; $p = 0.04863$) and of the overall health expenditure per capita ($R = 0.78322$; $p = 0.00259$). The growth rate of the number of bariatric surgeries was not correlated with the unemployment and inflation rates, as well as with the growth rate of available bariatric surgeons.

Conclusion There were direct relationships between the growth rate of bariatric surgeries and the evolutions of the GDP and health care expenditure per capita. These variables appear to influence the nationwide offer of bariatric surgery.

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

Introduction

Brazil currently holds the second place in the worldwide ranking of the largest number of bariatric surgeries performed per year, accounting for more than 100,000 yearly procedures [1–4]. Despite the continuous growth of these numbers over recent years, there is a pent-up demand of individuals who could benefit from surgery, but cannot achieve it, since obesity affects almost 20% of the Brazilian adult population, which means almost 25 million people, of which about five million are eligible for bariatric surgery [5, 6].

Over the second decade of the twenty-first century, Brazil has struggled against serious economic issues, which led to a severe crisis that affected the entire health care system, either public or private. Following years of low inflation and steady economic growth, the country went through an economic depression characterized by decreases in the gross domestic product (GDP), increasing inflation levels, and growing unemployment rates. The Brazilian depression is considered to have begun in 2014, following successive decreases in the GDP associated with the bankruptcies of several companies, high unemployment rates, and a decrease of the international and domestic investment rates [7]. The 2014–2017 crisis was a result of a combination of economic policies that reduced Brazil's potential economic growth and a fiscal crisis that led to an unsustainable growth of the public sector debt. Several factors contributed to create and deepen this crisis: an increased governmental interventionism on fiscal and monetary policies, which led to non-coordinated changes in the interest rates allied with a tight control of government-regulated prices (such as petrol-derived products), detached of the international scenery [8]. This led to decreases in the governmental health

✉ Everton Cazzo
cazzo@unicamp.br

[1] Department of Surgery, Faculty of Medical Sciences, State University of Campinas (UNICAMP), Alexander Fleming, s/n, Cidade Universitaria Zeferino Vaz, Campinas, SP CEP 13085-000, Brazil

expenditures and also in the number of people who have access to private health care insurance plans [9].

Bariatric surgery is known to produce significant long-term decreases in direct and indirect health costs [10, 11]. Nonetheless, to perform such proceedings and guarantee the expansion in its numbers, certain expenses are demanded, such as the costs to maintain multidisciplinary teams and afford specific medical devices.

The effect of nationwide economic policies on the necessary expansion in the number of bariatric procedures is unclear and its knowledge may help in planning specific actions to allow it to reach a larger portion of the entire population that may benefit from them.

Objective

This study aims to determine whether there are correlations between the growth rate in the number of bariatric surgeries and the main macroeconomic variables over time in Brazil.

Methods

This is a nationwide analysis of the previous surveys regarding the estimated number of bariatric surgeries in Brazil from 2003 through 2016, the growth rate in these numbers from 2004 through 2016, and the main macroeconomic variables of Brazil during the evaluated period (GDP, inflation rate, and unemployment rate). The growth rates of bariatric surgeries during the study period were correlated with each macroeconomic variable to determine whether there is any significant association between them. The growth rates of bariatric surgeries were also correlated with the growth rate of the number of registered bariatric surgeons in Brazil and with the overall health care costs per capita.

The number of bariatric surgeries performed in Brazil was obtained by means of the periodic reports of the Brazilian Society of Bariatric and Metabolic Surgery (SBCBM) [12]. The main macroeconomic variables evaluated were obtained by means of the official reports 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 that belong to the economically active population [13]. The number of registered bariatric surgeons in Brazil was provided by the SBCBM. The overall health care costs per capita were obtained by means of the World Health Organization (WHO) health expenditures database [14].

Statistical Analysis

To determine the correlation between the analyzed variables, the Spearman correlation tests were used. The Spearman tests generate rank *correlation* coefficients (values of R) that vary from − 1 to 1; the values next to the edges 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.

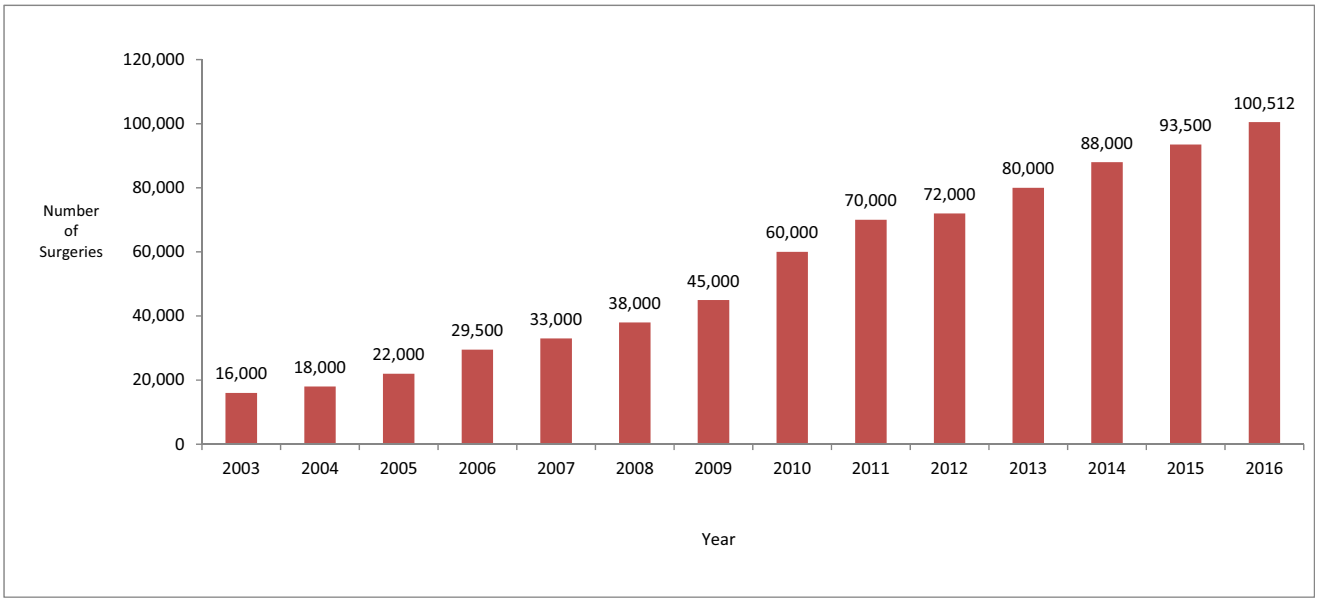
Results

The overall number of surgeries increased from 16000 in 2003 to 100,512 in 2016. The highest yearly growth (34%) rate was observed in 2006. Figure 1 presents the detailed data on the referred number of surgeries performed in Brazil from 2003 through 2016. 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 health care expenditure per capita. These data are presented in Fig. 2.

In regard to the correlations between the growth rate of the number of surgeries and the macroeconomic and health care variables, there were significant positive correlations of the growth rate of surgeries with the yearly variation of the GDP ($R = 0.5558$; $p = 0.04863$) and also with the yearly variation of the overall health expenditure per capita ($R = 0.78322$; $p = 0.00259$). The growth rate of the number of bariatric surgeries did not present significant correlations with the unemployment and inflation rates, respectively, as well as with the growth rate of the number of registered bariatric surgeons. The variation of the GDP was also not significantly correlated with the health care expenditures per capita (Table 1). Figure 3 presents the complete ranks and respective correlation coefficients (R) and values of p by means of dispersion graphs.

Discussion

Obesity has reached epidemic proportions over the last decades, and this phenomenon has not spared underdeveloped countries. In fact, obesity is actually responsible for more deaths than malnutrition worldwide [15]. Brazil, despite significant social advances over since the late twentieth century, still presents concerning rates of poverty and economic inequality among its population, as well as a deficient access to health-providing services [16]. Recently, a significant deterioration of the economic parameters associated with a convoluted political situation even led to riots and the destitution of the then Brazilian Head of State. The influence of such turmoil on the already insufficient health system is hard to determine;

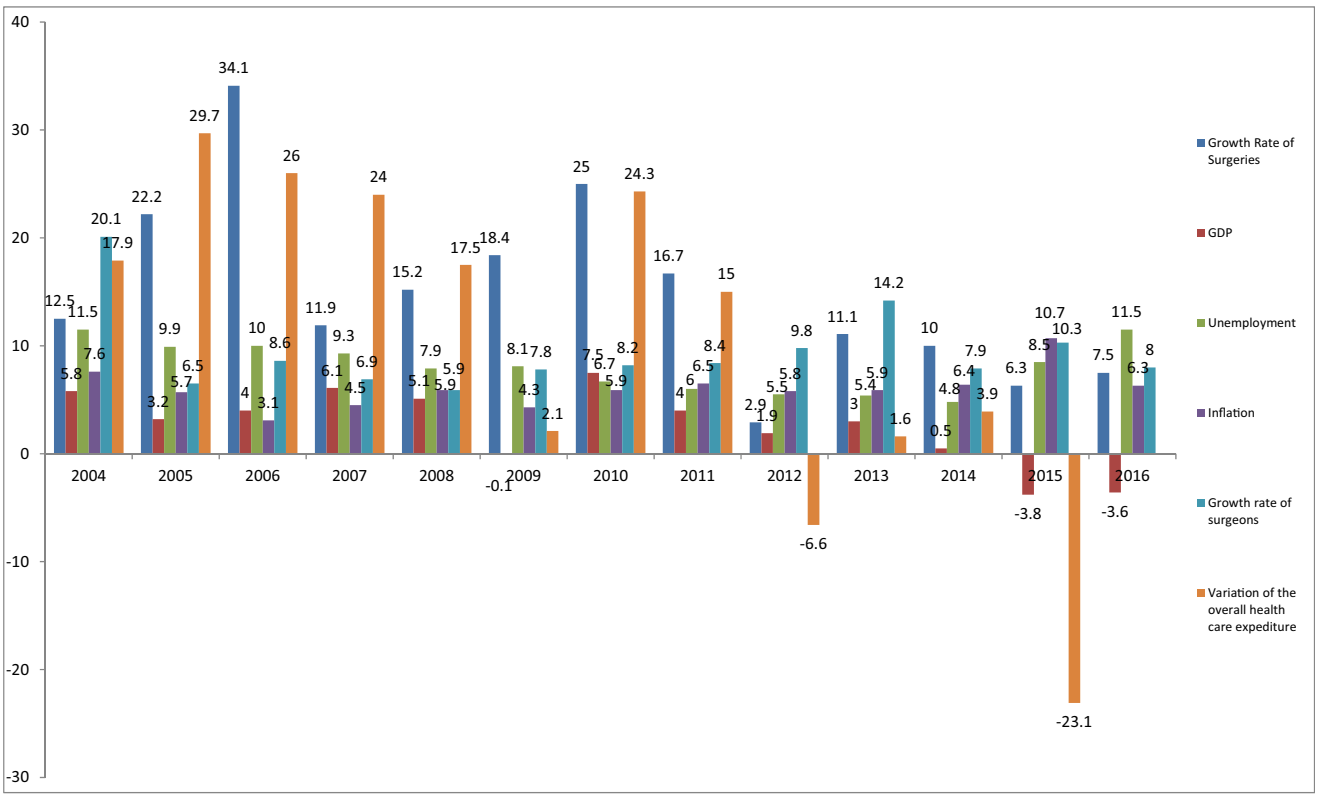


Source: Brazilian Society of Bariatric and Metabolic Surgery (SBCBM)

Fig. 1 The number of bariatric surgeries performed over time in Brazil. Source: Brazilian Society of Bariatric and Metabolic Surgery (SBCBM)

however, its effects can be indirectly measured through methods such as the model proposed by this study [7].

There were significant associations of both the evolutions of the GDP and health care expenditure per capita with the



GDP: gross domestic product. 2016 data for the overall health-care expenditure not yet available.

Fig. 2 The annual percent variation of the number of surgeries, macroeconomic variables, number of surgeons, and overall health care expenditure. GDP gross domestic product. 2016 data for the overall health care expenditure not yet available

Table 1 Correlations between the growth rate of bariatric surgeries and macroeconomic variables over time

Macroeconomic variable	Correlation coefficient	Value of *p*
Gross domestic product	0.5558	*0.04863*
Unemployment rate	0.2318	0.44749
Inflation rate	− 0.475145	0.10082
Overall health care expenditure per capita	0.78322	*0.00259*

Correlation coefficients determined by means of the Spearman correlation ranks' analysis

Italic indicates statistical significance

growth rate in the number of bariatric surgeries; interestingly, the evolutions of the GDP and health expenditure per capita did not present a significant association between themselves. These findings indicate that the major macroeconomic variable and its direct consequences on health expenditure are somewhat correlated with the offer of a specific procedure to a population which is likely to directly benefit from it. To our knowledge, such finding is unprecedented, since there are no studies specifically analyzing the net impact of the overall economic situation on the bariatric surgery field. Since the number of procedures performed is far from reaching the actual necessities, this decrease in its expansion points out that the potential benefits of a better control of obesity and comorbidities are impaired, either individually or systemically. For example, the reimbursement provided by the Health Department for public hospitals to provide bariatric surgeries was approximately US$ 2000 per procedure, considering the then current exchange rate of US dollars when those values were determined [17]; the overall public health costs of an individual with type 2 diabetes in Brazil was estimated by Borges et al. [18] at about US$ 1844 per year. This means that a single individual with diabetes almost requires the cost of an entire bariatric procedure each year. In Brazil, more than 90% of the bariatric procedures are performed by private health-providing services; the vast majority of these services are reimbursed by third-party payers (health insurance plans); during the crisis, the number of individuals whose main health care was provided by such insurance companies also decreased by about three million people which could not afford their costs [9]. The

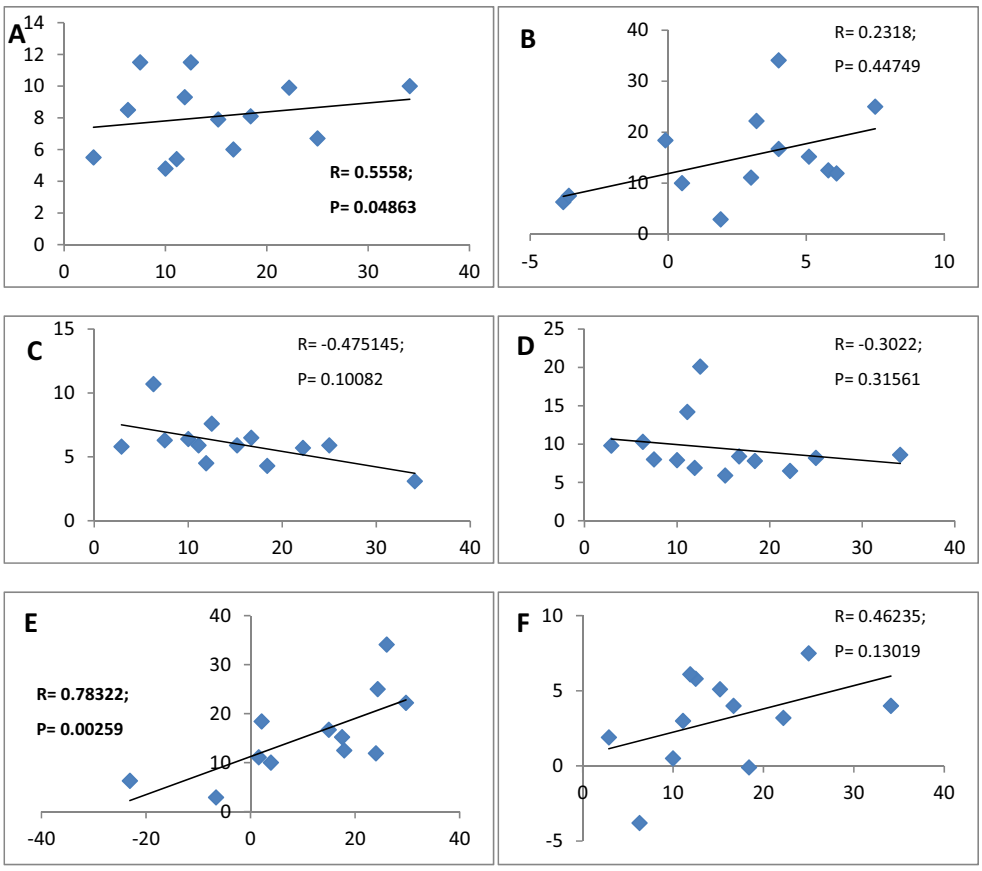


Fig. 3 Correlations between the yearly growth rate of bariatric surgeries, macroeconomic variables, growth rate of the number of surgeons, and variation of the overall health care expenditure. **a** Growth rate of bariatric surgery versus gross domestic product; **b** growth rate of bariatric surgery versus unemployment rate; **c** growth rate of bariatric surgery versus inflation rate; **d** growth rate of bariatric surgery versus growth rate of bariatric surgeons; **e** growth rate of bariatric surgeries versus overall health care expenditure per capita; **f** gross domestic product versus overall health care expenditure per capita. *R* correlation coefficient

overall costs of a bariatric surgery provided by private supplemental health-providing services were estimated by Kelles et al. around US$ 4000 [19].

The possibility of downturns is inherent to modern economic systems worldwide, and their effects may be devastating in countries with relevant socioeconomic issues. However, since health-providing systems should be planned and organized on a long-term basis and aim at systemic net gains over the population health, the impairment in the growth of the bariatric field is likely to produce even worse results in a further analysis. Given the importance of obesity to the overall burden of health costs, countercyclical policies are mandatory to ensure a continued growth in the face of an expanding pent-up demand, even during crises. Although a decrease or deceleration in the number of bariatric operations can provide some early saving of resources, it will ultimately lead to higher long-term health costs [20]. There are some measures that health systems, insurance plans, and hospitals could implement which are likely to soften the effects of such crises, such as switching to minimally invasive procedures and developing enhanced recovery postoperative protocols, which may be a way to decrease overall costs of the postoperative care, disseminating information for professionals and health care planners on the overall net effects of bariatric surgery on decreasing long-term costs directed for obesity-related diseases, stimulating the expansion of coverage for surgery offer in the public health system, which is universal and could attenuate the crisis' effect for people who lost their access to private health insurance plans, and managing the procedures to be preferably performed at high-volume excellence centers, a factor which is recognized to lead to a lower expenditure and better outcomes [21–24].

During the evaluated period, there were three major events that should positively influence the access to bariatric surgery in Brazil: the inclusion of laparoscopic bariatric surgery in the list of procedures which should be mandatorily offered by the health insurance companies; the regulation of the public offer of surgery, by means of an official ordinance published by the Department of Health in March 2013, which aimed to further the access and regulate the reimbursements for public hospitals; and a new policy for indication of bariatric surgeries published by the Federal Council of Medicine (CFM) in January 2016, which considered 21 comorbidities (Table 2) besides the classic five of the older policy (hypertension, diabetes, arthropathies, sleep apnea, and dyslipidemias) for individuals with BMI ≥ 35 kg/m^2 [17, 25]. However, these three significant policy changes did not lead to the expected rise in the growth rate in the following years [17, 25]. More recently, a new determination of the CFM included a possible surgical indication of bariatric surgery for individuals with poorly controlled diabetes and BMI ≥ 30 kg/m^2, but this new policy was published after the period of this study [26]. Interestingly, the absolute number of surgeries increased during the entire evaluated period; nonetheless, the growth rate was significantly lower during the majority of the recession years. It is reasonable to hypothesize that the pent-up demand for bariatric surgery is so large that it is able to maintain a certain growth in the number of surgeries, despite the economic downturn. Moreover, the increase in the number of registered bariatric surgeons and accredited services over time might have helped to alleviate these effects. However, the expansion would be expectedly higher over time whether there was not such economic retraction.

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

Body mass index (BMI)	Association of comorbidities
≥ 40 kg/m^2	No comorbidity is mandatory
≥ 35 kg/m^2	Type 2 diabetes
	Sleep apnea
	Hypertension
	Dyslipidemias
	Cardiovascular diseases
	Severe non-controlled asthma
	Degenerative osteoarthropathies
	Herniated disc
	Gastroesophageal reflux (with indication for surgical treatment)
	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
≥ 30 kg/m^2	Uncontrolled type 2 diabetes

The current study presents some limitations that should be considered. It is an analysis of nationwide data from a large country which presents significant regional disparities; hence, some of the overall findings may be misleading. Moreover, since economic crises tend to be cyclical, analyses of longer periods are necessary to fully address these tendencies. Despite our attempt to limit the economic and health care variables for establishing their correlations, there are also several other variables that are difficult to evaluate, but also could interfere on the present results, 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, the real number of active bariatric surgeons (the number of members of the SBCBM is an estimate of the total amount of surgeons, since it does not include each surgeon because it is not mandatory to be registered to perform these procedures in Brazil), and changes in economic variables may be influenced more by

political decisions than by free trade principles. The Spearman analysis does not provide linear correlations, since it is a non-parametric method. Although it was appropriate for this study, since it included data that are usually not normally distributed, it also may present a difficult interpretation; for instance, there were years when GDP decreased and the number of procedures still rose. This occurs because the Spearman method is apt to detect overall tendencies within a given time interval and showed that the decrease of the GDP was correlated with the deceleration of the growth in the number of bariatric surgeries in the majority of the time points evaluated. Nonetheless, the significance of the observed results is clear and underlines the necessity of similar studies on other regions and to take into account these findings for an appropriate long-term planning for obesity management.

Conclusion

There were direct relationships between the growth rate of bariatric surgeries and the evolutions of the GDP and health care expenditure per capita. These variables appear to influence the nationwide offer of bariatric surgery.

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.

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.

References

1. Angrisani L, Santonicola A, Iovino P, et al. Bariatric surgery worldwide 2013. Obes Surg. 2015;25(10):1822–32.
2. Angrisani L, Santonicola A, Iovino P, et al. Bariatric surgery and endoluminal procedures: IFSO Worldwide Survey 2014. Obes Surg. 2017;27(9):2279–89.
3. Ponce J, Nguyen NT, Hutter M, et al. American Society for Metabolic and Bariatric Surgery estimation of bariatric surgery procedures in the United States, 2011–2014. Surg Obes Relat Dis. 2015;11(6):1199–200.
4. Ponce J, DeMaria EJ, Nguyen NT, et al. American Society for Metabolic and Bariatric Surgery estimation of bariatric surgery procedures in 2015 and surgeon workforce in the United States. Surg Obes Relat Dis. 2016;12(9):1637–9.
5. Ramos AC. Brazil looking for completing his space in bariatric surgery. Arq Bras Cir Dig. 2014;27(Suppl 1):1.
6. Malta DC, Bernal RTI, Andrade SSCA, et al. Prevalence of and factors associated with self-reported high blood pressure in Brazilian adults. Rev Saude Publica. 2017;51(suppl 1):11s.
7. Watts J. Brazil's health system woes worsen in economic crisis. Lancet. 2016;387(10028):1603–4.
8. Barbosa-Filho FH. A crise econômica de 2014/2017 [the economic crisis of 2014/2017]. Estud Av. 2017;31(89):51–60.
9. Agência Nacional de Saúde Suplementar, Brasil [National Agency for Supplementary Health, Brazil]. Dados gerais: Beneficiários de planos privados de saúde, por cobertura assistencial (Brasil—2007–2017) [General data: beneficiaries of private health plans, by assistance coverage (Brazil, 2007–2017)]. http://www.ans.gov.br/perfil-do-setor/dados-gerais. Accessed 12 Mar 2018.
10. Borisenko O, Adam D, Funch-Jensen P, et al. Bariatric surgery can lead to net cost savings to health care systems: results from a comprehensive European decision analytic model. Obes Surg. 2015;25(9):1559–68.
11. Klein S, Ghosh A, Cremieux PY, et al. Economic impact of the clinical benefits of bariatric surgery in diabetes patients with BMI ≥35 kg/m^2. Obesity (Silver Spring). 2011;19(3):581–7.
12. Sociedade Brasileira de Cirurgia Bariátrica e Metabólica. Volume cirurgias bariátricas (por ano). Available from: http://www.sbcb.org.br/wordpress/imprensa-2/releases/evolucao-das-cirurgias-bariatricas-no-brasil/. Accessed 10 Dec 2017.
13. Brasil. Instituto de Pesquisa Econômica Aplicada (Ipea). Ipeadata. Macroeconomic. Most request series. Available from: http://www.ipeadata.gov.br/. Accessed 10 Dec 2017.
14. World Health Organization. Global health expenditure database. http://apps.who.int/nha/database/ViewData/Indicators/en. Accessed 25 Feb 2018.
15. World Health Organization. Global status report on noncommunicable diseases 2014. Geneva: WHO; 2014. p. 1–298.
16. Chaim EA, Pareja JC, Gestic MA, et al. Preoperative multidisciplinary program for bariatric surgery: a proposal for the Brazilian Public Health System. Arq Gastroenterol. 2017;54(1):70–4.
17. Ministério da Saúde, Brasil [Department of Health, Brazil]. Portaria 425 [Ordinance 425]. http://bvsms.saude.gov.br/bvs/saudelegis/gm/2013/prt0425_19_03_2013.html. Accessed 20 Mar 2018.
18. Borges NB, Ferraz MB, Chacra AR. The cost of type 2 diabetes in Brazil: evaluation of a diabetes care center in the city of São Paulo, Brazil. Diabetol Metab Syndr. 2014;6(1):122.
19. Kelles SM, Machado CJ, Barreto SM. Ten-years of bariatric surgery in Brazil: in-hospital mortality rates for patients assisted by universal health system or a health maintenance organization. Arq Bras Cir Dig. 2014;27(4):261–7.
20. Palli S, Heidrich N. The short- and long-term economic impact of bariatric surgery coverage for a payer. Surg Obes Relat Dis. 2017;10(Suppl 1):S105.
21. Fujihara N, Lark ME, Fujihara Y, et al. The effect of economic downturn on the volume of surgical procedures: a systematic review. Int J Surg. 2017;44:56–63. https://doi.org/10.1016/j.ijsu.2017.06.036.
22. Bernstein DN, Brodell D, Li Y, et al. Impact of the economic downturn on elective lumbar spine surgery in the United States: a national trend analysis, 2003 to 2013. Global Spine J. 2017;7(3):213–9. https://doi.org/10.1177/2192568217694151.
23. Nguyen NT, Paya M, Stevens CM, et al. The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. Ann Surg. 2004;240(4):586–93.
24. Jacobsen HJ, Bergland A, Raeder J, et al. High-volume bariatric surgery in a single center: safety, quality, cost-efficacy and teaching aspects in 2,000 consecutive cases. Obes Surg. 2012;22(1):158–66.
25. Conselho Federal de Medicina, Brasil [Federal Council of Medicine, Brazil]. Resolução 2131/2015 [Resolution 2131/2015]. http://www.portalmedico.org.br/resolucoes/cfm/2015/2131_2015.pdf. Accessed 15 Mar 2018.
26. Conselho Federal de Medicina, Brasil [Federal Council of Medicine, Brazil]. Resolução 2172/2017 [Resolution 2172/2017]. https://www.poderesaude.com.br/novosite/images/Publica%C3%A7%C3%A3o_3_-_27.12.2017.pdf. Accessed 03 May 2018.