


Bariatric surgeries performed by the Brazilian National Health System in the period 2010-2016: a descriptive study of hospitalizations*

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Abstract

Objective: to characterize Brazilian National Health System (SUS) hospitalizations for bariatric surgeries in Brazil, in the period 2010-2016. **Methods:** this was a descriptive study of time series using data from the SUS Hospital Information System (SIH/SUS); the target population consisted of patients aged 16 years and older. **Results:** there were 46,035 hospitalizations (6,576/year; 4.3/100,000 inhabitants/year); average age was 39.0 years old (SD:10.4); female sex predominated (85.4%), and the 35-39 age group accounted for 18.0% of cases; 16,923 patients (36.8%) needed to be admitted to the intensive care unit (ICU); there were 99 (0.2%) in-hospital deaths; the median hospital stay was 3 days, and the interquartile range was 2 days; average annual expense was R\$ 39,410,919.37 and the average cost of hospitalization was R\$ 5,992.75 (R\$ 1,464.15/day). **Conclusion:** bariatric surgeries were characterized as procedures involving young female adults, frequent ICU use and low lethality.

Keywords: Obesity; Bariatric Surgery; Hospitalization; Brazilian National Health System; Time Series Studies.

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Introduction

Obesity is a disease that is reaching epidemic proportions globally. In the first two decades of the 20th century this condition has already become one of the leading Public Health problems, given its increased prevalence in several regions of the world.¹

According to the World Health Organization (WHO), globally in 2014 there were 600 million obese people, i.e. 13% of the planet's adult population. Of this percentage, 11% were male and 15% female.¹ Between 2006 and 2016, obesity prevalence in Brazil increased by 7.1 percentage points from 11.8% to 18.9% and affected 18.1% of males and 19.6% of females.²

Obesity is a risk factor for type 2 diabetes *mellitus*, hypertension, cardiovascular diseases and neoplasms, as well as contributing to an increase in the mortality coefficient.³ However, few forms of traditional treatment for Class 3 obesity or severe obesity are effective: most of them produce unsatisfactory results whereby 95% of patients regain their initial weight in two years.⁴

Brazil is the world's second leading country in performing bariatric surgery after the United States.

Owing to the absence of a more effective intervention as part of clinical management of severe obesity, there has been a growth in the indication of bariatric surgery.⁴ This is an alternative for treating severe obesity which is effective for weight control in the long term as well as for improvement in and remission of comorbidities.⁵

According to the Brazilian Bariatric and Metabolic Surgery Society (SBCBM), Brazil is the world's second leading country in performing bariatric surgery after the United States. Bariatric surgery among Brazilians increased from 72,000 operations in 2012 to 100,000 in 2016. The increase in the period from 2006 to 2015 is estimated to have been 300%.⁶

The Brazilian National Health System (SUS) included gastroplasty on the list of procedures it covers in 1999. Currently the criteria for indicating bariatric surgery covered by the public health service are stipulated by Ministerial Ordinance GM/MS No. 424, dated March 19th 2013: (i) individuals with body mass index (BMI) >50kg/m²; (ii) individuals with BMI >40kg/m², with or without comorbidities, with unsuccessful continuous

clinical treatment in Primary Care and/or Specialized Outpatient Care services for at least two years following clinical protocols; and (iii) individuals with BMI >35kg/m² who have comorbidities, with unsuccessful continuous clinical treatment for at least two years following clinical protocols.⁷

Up until the end of 2016, bariatric surgery on the SUS was only performed via laparotomy. However, on January 31st 2017, Ministerial Ordinance GM/MS No. 5 incorporated videolaparoscopic bariatric surgery into SUS procedures.⁸

The objective of this study was to characterize SUS hospitalizations for bariatric surgery in Brazil from 2010 to 2016.

Methods

This was a descriptive epidemiological time series study based on secondary data. We sought to give continuity and chronological sequence to the study conducted by Kelles, Machado and Barreto.⁹ These authors compared access, in-hospital mortality, length of inpatient stay and cost in relation to patients undergoing bariatric surgery on the SUS in Brazil or at a supplementary health service in the city of Belo Horizonte between 2001 and 2010. We found no other similar studies involving national SUS data after 2010.

Our target population comprised people aged 16 or over, given the criteria for indicating surgery in force in the selected study period. These criteria were stipulated by Ministerial Ordinance GM/MS No. 425/2013, which included young people aged 16-18 undergoing specific evaluation and also adults aged over 65 after having been assessed for risk-benefit.¹⁰

We consulted abridged public domain SUS Hospital Information System (SIH/SUS) files corresponding to the period covering January 2010 to December 2016, available for public access via the SUS information portal (www.datasus.saude.gov.br).

Tabulation and analysis of the consistency and completeness of the data retrieved from the source files were performed using two Ministry of Health provided tools: TabNet, which enables cross-checking of pre-defined basic variables on the above mentioned website; and TabWin, which enables greater detailing when cross-checking data. The original data dictionary consisted of the Technical Notes available on the same website.

SIH/SUS uses the Hospital Inpatient Admission Authorization (AIH-SUS) form to collect data. There are two models of this document: (i) AIH-1, for 'Initial Admission', containing patient identification data and a record of the set of medical procedures and diagnostic services performed; and (ii) AIH-5, or 'Long Stay' form, for data on chronic or psychiatric patients needing continual treatment.¹¹

In order, to obtain data on the physical dimension of our study, namely 'admissions' or 'hospitalizations', we used paid Initial Admission AIHs (AIH-1). Whereas, to obtain data on the financial dimension we used the Long Stay AIHs (AIH-5), given that patient expenditure calculated on AIH-1 is incorporated into AIH-5.

Data tabulation and analysis were performed using Microsoft Excel®. Our analysis plan took into account all hospitalizations of service users whose main diagnosis at the time of hospital admission on the SUS was 'obesity' – as defined by code E66 of the 10th Edition of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) – and who had at least one of the following procedures (SUS codes): gastroplasty with intestinal bypass (04.07.01.017-3); gastrectomy with or without duodenal switch (04.07.01.012-2); vertical gastrectomy, also known as sleeve gastrectomy (04.07.01.036-0); and vertical banded gastroplasty (04.07.01.018-1).

We calculated indicators by type of surgery, sex, geographic region of hospitalization, use of intensive care unit (ICU), lethality and cost per hospitalization. The data on surgery are available to the public, although they are not systematized or expressed in indicators that facilitate comparison.

Average volume of hospitalizations for the period was calculated by sex and age range. The hospitalization coefficients per population (per 100,000 inhabitants) were calculated based on the averages for hospitalizations occurring between 2010 and 2016, divided by the population projection for the midpoint year (2013).

We also retrieved from the SIH/SUS system data on total cost, use of ICU, number of in-hospital deaths, patient sex and age range.

Monetary amounts were obtained in national currency (BRL); total annual costs were converted into international dollars (Int\$) taking the conversion rate for the year, considering purchasing power parity (PPP).¹²

With regard to ethical aspects, we used only publicly available secondary data where it is impossible to identify the individuals in question, thus respecting the ethical principles provided for by National Health Council (NHC) Resolution No. 466, dated December 12th 2012; and NHC Resolution No. 510, dated April 7th 2016. The study project was approved by the Federal University of Rio Grande do Sul Faculty of Medicine Research Commission (Compesq-Famed/UFRGS): Research Record No. 33.607, dated August 11th 2017.

Results

Between January 2010 and December 2016, we found 46,035 SUS bariatric surgery hospitalizations for the whole of Brazil: 6,576 hospitalizations/year; or 4.3/100,000 inhab./year. Of these hospitalization, 39,307 were female patients (85.4%; 7.2/100,000 inhab./year) and 6,728 were male (14.6%; 1.3/100,000 inhab./year), while average age was 39.0 years (standard deviation: 10.4). Median hospital stay was 3 days and interquartile range was 2 days.

Table 1 shows the distribution of the hospitalizations we analyzed (2010-2016), by region of the country, sex and age range, considering the need or not for ICU. The Southern region had the highest population rates by sex and age range, with or without ICU use.

The most frequent bariatric surgery procedure was gastroplasty with intestinal bypass (94.2%; or 43,370 operations) (Table 2). Of the total bariatric surgery hospitalizations in the period 2010-2016, 41,155 (89.4%) took place in hospitals located in the Southeast and Southern regions (Table 3).

Of the 46,035 de bariatric surgery hospitalizations, 16,923 (36.8%) used an ICU, 13,855 (81.9%) of whom were female (Table 1).

With regard to lethality, there were 99 (0.2%) in-hospital deaths among SUS hospitalizations in the period 2010-2016: 65 (0.2%) in females and 34 (0.5%) in males. In-hospital lethality varied between 0.1% in the Northeast region and 1.1% in the Midwest region (Table 4).

Between 2010 and 2016, total SUS expenditure on bariatric surgery procedures was BRL 275,876,435.56 (Int\$ 162,846,360.22), or BRL 39,410,919.37 (Int\$ 23,263,765.75) per annum. Of the total amount, BRL 40,756,124.76 (14.8%) related to procedures with males and BRL 235,120,310.8 (85.2%) with females.

Table 1 – Number and rate (per 100,000 inhabitants/year) of obesity^a hospitalizations involving bariatric surgery procedures, with and without the need to use ICU^b facilities by sex, age range and country region providing public health care, Brazil, 2010-2016

Region	Males						Females						Total
	16-29	Rate	30-49	Rate	50+	Rate	16-29	Rate	30-49	Rate	50+	Rate	
Without ICU													
North	12	0.1	41	0.3	6	0.1	52	0.3	171	1.1	35	0.4	317
Northeast	95	0.2	267	0.5	69	0.2	347	0.7	1,240	2.2	300	0.8	2,318
Midwest	35	0.2	56	0.4	11	0.1	123	0.9	367	2.3	74	0.7	666
Southeast	381	0.5	1,159	1.3	322	0.5	1,825	2.6	7,524	8.4	2,113	2.8	13,324
South	303	1.2	692	2.4	211	0.9	2,477	10.1	7,042	23.8	1,762	6.7	12,487
Total	826	0.5	2,215	1.1	619	0.5	4,824	2.7	16,344	7.9	4,284	2.7	29,112
With ICU													
North	7	–	23	0.1	7	0.1	31	0.2	124	0.8	25	0.3	217
Northeast	55	0.1	177	0.3	35	0.1	191	0.4	638	1.1	181	0.5	1,277
Midwest	12	0.1	16	0.1	10	0.1	16	0.1	46	0.3	14	0.1	114
Southeast	137	0.2	419	0.5	171	0.3	415	0.6	1,701	1.9	751	1.0	3,594
South	506	2.0	1,156	3.9	337	1.5	2,067	8.4	5,812	19.6	1,843	7.0	11,721
Total	717	0.4	1,791	0.9	560	0.4	2,720	1.5	8,321	4.0	2,814	1.8	16,923

a) International Statistical Classification of Diseases and Related Health Problems – 10th Revision (ICD-10): code E66.
 Note: target population comprised of individuals aged 16 or over.

Average cost per hospitalization was BRL 5,992.75 (BRL 1,464.15/day), with a difference of just 1.3% between the sexes: BRL 6,057.69 for males and BRL 5,981.64 for females (Table 5). Average cost of hospitalizations without ICU varied between BRL 5,536.05 in the Northeast region to BRL 5,740.46 in the Southeast region (national average: BRL 5,719.77), while the cost of hospitalizations with ICU oscillated between BRL 6,215.27 in the Northern region and BRL 6,525.67 in the Northeast region (national average: BRL 6,462.36) (data not shown in the Tables).

Discussion

In the period studied, bariatric surgery was characterized by the predominance of female patients, adults aged around 40 years old, gastroplasty with intestinal bypass, concentrated in the most developed regions of Brazil, with low lethality, frequent ICU use and similar cost between the sexes – despite the greater volume of expenditure on female patients.

Over the seven years analyzed (2010-2016), the hospitalization rate of 4.3/100,000 inhab./year

represented a sevenfold increase in relation to the rate found by Kelles, Machado and Barreto for the year 2001 (0.6/100,000 inhab.).⁹

Between 2010 and 2016, there was a 96.0% increase in the number of SUS hospitalizations for obesity followed by bariatric surgery procedures. When comparing the period 2010-2016 with the seven immediately preceding years (2003-2009), the number of bariatric surgery procedures performed by SUS increased 2.5 times (Kelles, Machado and Barreto).⁹ Over 14 years, average increase in this type of surgery was 12.7% per annum. This increase is 4.9 times greater than the increase in total surgical procedures performed by the public health system and is in line with the considerable increase in the prevalence of obesity in the Brazilian states.

Notwithstanding, the availability of bariatric surgery on the SUS still falls below demand: the length of time spent on the waiting list for this type of operation can vary between 1 and 4 years.¹³ Whereas more than 100,000 procedures per annum are performed by private and supplementary health services, SUS does not achieve so much as 10% of this total.

Table 2 – Obesity^a hospitalizations involving bariatric surgery procedures, by year and by procedure performed by the public health network, Brazil, 2010-2016

Period	Gastroplasty with intestinal bypass		Gastrectomy with or without duodenal switch		Vertical gastrectomy (sleeve gastrectomy)		Vertical banded gastroplasty		Total
	n	%	n	%	n	%	n	%	N
2010	4,251	94.7	47	1.0	–	–	189	4.2	4,487
2011	5,026	93.6	143	2.7	–	–	201	3.7	5,370
2012	5,749	95.4	25	0.4	–	–	253	4.2	6,027
2013	6,470	95.1	31	0.5	148	2.2	151	2.2	6,800
2014	6,591	93.8	22	0.3	340	4.8	71	1	7,024
2015	6,880	91.4	34	0.5	549	7.3	68	0.9	7,531
2016	8,403	95.5	16	0.2	314	3.6	63	0.7	8,796
Total	43,370	94.2	318	0.7	1,351	2.9	996	2.2	46,035

a) International Statistical Classification of Diseases and Related Health Problems – 10th Revision (ICD-10): code E66.
 Note: target population comprised of individuals aged 16 or over.

Table 3 – Obesity^a hospitalizations involving bariatric surgery procedures, by year and by country region providing public health care, Brazil, 2003-2009^b and 2010-2016

Period	North		Northeast		Midwest		Southeast		South		Brazil	
	n	%	n	%	n	%	n	%	n	%	N	Rate (per 100,000 inhab.)
2003	58	3.3	208	11.7	158	8.9	812	45.7	542	30.5	1,778	1.0
2004	50	2.7	182	9.7	112	6.0	940	50.2	588	31.4	1,872	1.0
2005	66	2.9	285	12.6	131	5.8	944	41.7	840	37.1	2,266	1.2
2006	81	3.2	260	10.3	167	6.6	1,200	47.5	820	32.4	2,528	1.3
2007	105	3.5	253	8.5	146	4.9	1,379	46.3	1,095	36.8	2,978	1.6
2008	50	1.6	375	11.7	132	4.1	1,245	39.0	1,393	43.6	3,195	1.7
2009	62	1.7	437	11.7	176	4.7	1,284	34.4	1,772	47.5	3,731	1.9
Total^c	472	2.6	2,000	10.9	1,022	5.6	7,804	42.5	7,050	38.4	18,348	
2010	40	0.9	413	9.2	161	3.6	1,496	33.3	2,377	53.0	4,487	2.3
2011	62	1.2	487	9.1	109	2.0	1,848	34.4	2,864	53.3	5,370	2.7
2012	91	1.5	583	9.7	82	1.4	2,111	35.0	3,160	52.4	6,027	3.0
2013	98	1.4	542	8.0	100	1.5	2,412	35.5	3,648	53.6	6,800	3.4
2014	63	0.9	487	6.9	122	1.7	2,639	37.6	3,713	52.9	7,024	3.5
2015	106	1.4	490	6.5	152	2.0	2,771	36.8	4,012	53.3	7,531	3.7
2016	65	0.7	585	6.7	42	0.5	3,192	36.3	4,912	55.8	8,796	4.3
Total^d	525	1.1	3,587	7.8	768	1.7	16,469	35.8	24,686	53.6	46,035	
Total^e	997	1.5	5,587	8.7	1,790	2.8	24,273	37.7	31,736	49.3	64,383	

a) International Statistical Classification of Diseases and Related Health Problems – 10th Revision (ICD-10): code E66.

b) Period analyzed by Kelles, Machado and Barreto.⁹

c) Total number of operations in the period 2003-2009 (7 years).

d) Total number of operations in the period 2010-2016 (7 years).

e) Total number of operations in the period 2003-2016 (14 years).

Table 4 – Death and lethality of patients hospitalized for obesity^a involving bariatric surgery procedures, by year and by country region providing public health care, Brazil, 2003-2009^b and 2010-2016

Period	Region											
	North		Northeast		Midwest		Southeast		South		Total	
	Deaths (n)	Lethality (%)	Deaths (n)	Lethality (%)	Deaths (n)	Lethality (%)	Deaths (n)	Lethality (%)	Deaths (n)	Lethality (%)	Deaths (n)	Lethality (%)
2003	1	1.7	–	–	4	2.5	3	0.4	3	0.6	11	0.6
2004	–	–	–	–	3	2.7	7	0.7	7	1.2	17	0.9
2005	1	1.5	1	0.4	1	0.8	4	0.4	5	0.6	12	0.5
2006	–	–	1	0.4	–	–	5	0.4	11	1.3	17	0.7
2007	–	–	–	–	3	2.1	9	0.7	11	1.0	23	0.8
2008	1	2.0	2	0.5	–	–	2	0.2	10	0.7	15	0.5
2009	–	–	–	–	1	0.6	3	0.2	7	0.4	11	0.3
Total^c	3	0.6	4	0.2	12	1.2	33	0.4	54	0.8	106	0.6
2010	1	2.5	–	–	2	1.2	6	0.4	8	0.3	17	0.4
2011	–	–	–	–	–	–	5	0.3	6	0.2	11	0.2
2012	–	–	–	–	–	–	6	0.3	5	0.2	11	0.2
2013	1	1.0	–	–	2	2.0	7	0.3	4	0.1	14	0.2
2014	–	–	–	–	–	–	6	0.2	9	0.2	15	0.2
2015	1	0.9	–	–	2	1.3	3	0.1	5	0.1	11	0.1
2016	–	–	1	0.2	1	2.4	9	0.3	9	0.2	20	0.2
Total^d	3	4.5	1	0	7	6.9	42	0.3	46	0.2	99	0.2
Total^e	6	0.6	5	0.1	19	1.1	75	0.3	100	0.3	205	0.3

a) International Statistical Classification of Diseases and Related Health Problems – 10th Revision (ICD-10); code E66.

b) Period analyzed by Kelles, Machado and Barreto.⁹

c) Total number of operations in the period 2003-2009 (7 years).

d) Total number of operations in the period 2010-2016 (7 years).

e) Total number of operations in the period 2003-2016 (14 years).

Increased frequency of bariatric surgery has been noted in various countries: in the United States they increased 41.7% in 4 years;¹⁴ in France, 400% in 10 years;¹⁵ and in England they increased more than 300% between 2006 and 2011.¹⁶

Despite there not being significant differences in obesity prevalence between males and females in Brazil – 18.1% *versus* 19.6% respectively –, the predominance we found for female bariatric surgery hospitalizations (85.4%) is compatible with other studies.^{9,17-21}

A possible explanation for higher frequencies of bariatric surgery among females may be related to the fact of women being more concerned than men about their physical appearance. Esthetic motivation favors the quest for this form of surgery as a way for women to fit in with the standards of beauty imposed by the media and society.²²

With regard to median hospital stay and interquartile range, the fact of this issue not usually being approached in the literature made it impossible to make comparisons with other studies.

The most common bariatric procedure performed was gastroplasty with intestinal bypass (94.2%; or 43,370 operations), this also being the conclusion reached by other studies.^{20,21,23} These findings corroborate data publicized by SBCBM.²⁴ According to that Society, this technique stands out as being the most used in Brazil, accounting for 75% of operations performed, and is considered by surgeons to be the gold standard. It must be pointed out that the code for laparoscopic surgical procedures, rather than via laparotomy, was only introduced in SUS after the period analyzed in our study.

Table 5 – Average expenditure (BRL) and total expenditure (in BRL and Int\$) on obesity^a hospitalizations involving bariatric surgery procedures in public health services, Brazil, 2003-2009^b and 2010-2016

Period	n	Average cost per hospitalization (BRL)	Total cost (BRL)	Total cost (Int\$)
2003	1,778	3,211.30	5,709,691.40	5,876,915.27
2004	1,872	3,229.16	6,044,987.52	5,933,425.99
2005	2,266	3,272.35	7,415,145.10	6,992,449.10
2006	2,528	3,220.60	8,141,676.80	7,411,039.24
2007	2,978	3,448.65	10,270,079.70	9,015,837.53
2008	3,195	4,925.31	15,736,365.45	12,948,406.31
2009	3,731	5,446.52	20,320,966.12	15,699,572.73
Total^c	18,348	4,241.24	77,818,248.23	63,877,646.17
2010	4,487	5,468.28	24,536,171.50	17,699,232.84
2011	5,370	5,450.78	29,270,675.02	19,897,474.92
2012	6,027	5,431.91	32,738,091.85	20,999,143.20
2013	6,800	6,028.74	40,995,428.31	24,856,369.98
2014	7,024	6,340.68	44,536,960.52	25,489,387.10
2015	7,531	6,321.10	47,604,227.05	25,602,056.98
2016	8,796	6,388.69	56,194,881.41	28,302,695.20
Total^d	46,035	5,992.75	275,876,435.56	162,846,360.22
Total^e	64,383	5,493.60	353,694,683.79	226,724,006.39

a) International Statistical Classification of Diseases and Related Health Problems –10th Revision (ICD-10); code E66.

b) Period analyzed by Kelles, Machado and Barreto.⁹

c) Total number of operations, average hospitalization cost and total cost (BRL and Int\$) for the period 2003-2009(7 years).

d) Total number of operations, average hospitalization cost and total cost (BRL and Int\$) for the period 2010-2016 (7 years).

e) Total number of operations, average hospitalization cost and total cost (BRL and Int\$) for the period 2003-2016 (14 years).

The percentage of ICU hospitalizations we found was similar to that reported by a study conducted in a private hospital in the city of Rio de Janeiro.²⁵ On the other hand, more recent studies conducted in the state of Santa Catarina¹⁸ and in municipalities in the metropolitan region of Porto Alegre,²⁰ capital of the state of Rio Grande do Sul, revealed proportions of 1.5% and 18.2% of ICU use, respectively.

There are indications that being admitted to ICUs was in accordance with protocol recommendations in the majority of cases involving this type of surgery. However, consensus does not exist among surgeons as to the benefits of having postoperative care in an ICU following bariatric surgery. It is known that being admitted to an ICU prolongs recovery and hospital stay time and, consequently, increases SUS expenditure.^{26,27}

The study cited in the preceding paragraph,²⁵ in which the proportion of ICU use (38.5%) in bariatric surgery was similar to our findings, did not find

significant difference in the rate of postoperative complications between patients admitted or not admitted to the intensive care unit, despite the sample being small and despite only representing bariatric procedures performed in just one hospital in the city of Rio de Janeiro.

The proportion of bariatric surgery patients admitted to an ICU in our study was 6 times greater than the percentage limit (4.8% to 6.2%) recommended by the Ministry of Health,²⁸ by type of surgery bed, among patients aged 15-59.

In view of the lack of evidence of the benefits of routine post-bariatric admission to ICUs and in view of the insufficient amount of ICU beds in Brazil, more judicious analysis needs to be made, with the aim of reassessing the real need for intensive care among bariatric patients.

We found 0.2% in-hospital lethality among patients admitted for bariatric surgery over the period analyzed

(2010-2016) and this was similar to the rates found by several other studies.^{9,14,15,17,18,20} When comparing in-hospital lethality (0.2%) for the period 2010-2016 found in our study with that found for the period 2003-2009 (0.6%) and reported by Kelles, Machado and Barreto,⁹ it can be stated that a considerable reduction occurred.

With regard to hospitalization distribution between the Brazilian regions when comparing the period 2010-2016 with the period 2003-2009, bariatric procedures performed in SUS services increased 3.5 times in hospital establishments in the Southern region (250.2%), whereas procedures in the Midwest region fell by 24.9% between one period and the other.

The Southern and Southeast regions concentrated 89.4% of all operations performed in Brazil in the period analyzed; but more than half (53.6%) the procedures took place in Southern region hospitals. This result is similar to that found by a study involving all the country's regions:²³ 58.0% of operations were concentrated in the Southern region.

According to the above mentioned study of the years 2001-2010, which was the period immediately prior to that covered by our study,⁹ the highest concentration of bariatric procedures occurred in the Southeast region, demonstrating that the increase in hospitalizations in the Southern region probably began in 2010.

When comparing total expenditure (BRL 275,876,435.56) on operations performed in the period 2010-2016 with expenditure corresponding to the period 2003-2009 (BRL 77,818,248.23) reported in the study conducted by Kelles, Machado and Barreto,⁹ expenditure in BRL increased 3.5 times (254.5%) and 2.5 times (155.0%) in Int\$.

Average cost of bariatric surgery hospitalization in the period 2010-2016 was BRL 5,992.75, representing a 41.3% increase in relation to the average cost of hospitalization in the period 2003-2009 (BRL 4,241.24).⁹ Taking the fourteen-year period as a whole, there was an average increase of 6.0% per annum and a twofold increase in BRL, from BRL 3,211.3 (2003) to BRL 6,388.68 (2016) in the average cost of hospitalization.

In the year 2000, WHO²⁹ stated in its technical report that obesity was already accounting for 2.0% to 7.0% of total health expenditure at that time, depending on the country: in France percentage expenditure was lower (2.0%), while in the United States (7.8%) and Australia (10.0%) it was higher.

Apart from resulting in great weight loss, bariatric surgery is known to be effective in treating type 2 diabetes *mellitus* and dyslipidemias, in addition to metabolic syndrome remission.⁵

These changes alone account for savings, both in expenditure on medication for diabetes and dyslipidemias and also in terms of the reduction in appointments with health professionals and tests performed. Despite its high cost, bariatric surgery is an excellent option, given its positive clinical effects and the reduction it implies in expenditure on treatment in the long term.³⁰

Standing out among the limitations of this study are those arising from the use of SUS Hospital Information System (SIH/SUS) databases which were created for administrative purposes. Given the administrative and accounting objective of the system, hospital readmissions and/or data alteration are possible, as are coding or diagnosis errors.

A great step forward was made in treating obesity by including bariatric surgery as part of the procedures covered by the Brazilian National Health System (SUS) with effect from 1999, as well as the changes brought about with the publication of Ministerial Ordinances No. 424 and No. 425 in 2013,^{7,10} and the incorporation of videolaparoscopic bariatric surgery by SUS in 2017.⁸ Notwithstanding the progress achieved in health care for obesity, the need exists to scale up both access to specialized treatment services and also coverage of bariatric surgery in Brazil.

Finally, it must be emphasized that surgical treatment is part of the comprehensive approach to obesity which prioritizes health promotion and continuity of clinical care.¹⁰ As such, planning of and investment in public policies on severe obesity prevention, promotion, treatment and recovery are essential.

Authors' contributions

Carvalho AS and Rosa RS took part in conceiving and designing the study, data analysis and interpretation, writing and critically revising the intellectual content of the manuscript. Both authors have approved the final version of the manuscript and declare that they are responsible for all aspects of this study, ensuring its accuracy and integrity.

References

- World Health Organization. Obesity and overweight. Factsheet n.311 [Internet]. Geneva: World Health Organization; 2016 [cited 2017 Mar 28]. Available from: <http://www.who.int/mediacentre/factsheets/fs311/en/index.html>
- Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância de Doenças e Agravos não Transmissíveis e Promoção da Saúde. Vigitel Brasil 2016: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico [Internet]. Brasília: Ministério da Saúde; 2017 [citado 2017 mar 28]. 162 p. Disponível em: <http://portalarquivos2.saude.gov.br/images/pdf/2018/marco/02/vigitel-brasil-2016.pdf>
- Francischi RPP, Pereira LO, Freitas CS, Klopfer M, Santos RC, Vieira P, et al. Obesidade: etiologia, morbidade e tratamento. *Rev Nutr* [Internet]. 2000 jan-abr [citado 2019 fev 20];13(1):17-28. Disponível em: <http://www.scielo.br/pdf/rn/v13n1/7919.pdf>. Doi: 10.1590/S1415-5273200000100003
- Segal A, Fandiño J. Indicações e contraindicações para realização das operações bariátricas. *Rev Bras Psiquiatr* [Internet]. 2002 dez [citado 2019 fev 20];24(Supl 3):68-72. Disponível em: <http://www.scielo.br/pdf/rbp/v24s3/13976.pdf>. Doi: 10.1590/S1516-44462002000700015
- Carvalho PS, Moreira CLCB, Barelli MC, Oliveira FH, Guzzo ME, Miguel GPS, et al. Cirurgia bariátrica cura síndrome metabólica? *Arq Bras Endocrinol Metab* [Internet]. 2007 fev [citado 2019 fev 20];51(1):79-85. Disponível em: <http://www.scielo.br/pdf/abem/v51n1/09.pdf>. Doi: 10.1590/S0004-27302007000100013
- Sociedade Brasileira de Cirurgia Bariátrica e Metabólica (SBCBM). História da cirurgia bariátrica no Brasil [Internet]. 2016 [citado 2016 dez 23]. Disponível em: <http://www.sbcm.org.br/wordpress/pagina-exemplo/historia-da-cirurgia-bariatrica>
- Brasil. Ministério da Saúde. Portaria MS/GM nº 424, de 19 de março de 2013. Redefine as diretrizes para a organização da prevenção e do tratamento do sobrepeso e obesidade como linha de cuidado prioritária da rede de atenção à saúde das pessoas com doenças crônicas [Internet]. Diário Oficial da União, Brasília (DF), 2013 mar 20 [citado 2019 fev 20]; Seção 1:23. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/gm/2013/prt0424_19_03_2013.html
- Brasil. Ministério da Saúde. Portaria MS/SCTIE nº 5, de 31 de janeiro de 2017. Incorpora o procedimento de cirurgia bariátrica por videolaparoscopia no âmbito do Sistema Único de Saúde – SUS [Internet]. Diário Oficial da União, Brasília (DF), 2017 fev 01 [citado 2019 fev 20]; Seção 1:84. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/sctie/2017/prt0005_31_01_2017.html
- Kelles SMB, Machado CJ, Barreto, SM. Dez anos de cirurgia bariátrica no Brasil: mortalidade intra-hospitalar em pacientes atendidos pelo Sistema Único de Saúde ou por Operadora da Saúde Suplementar. *ABCD, Arq Bras Cir Dig* [Internet]. 2014 nov-dez [citado 2019 fev 20];27(4):261-7. Disponível em: http://www.scielo.br/pdf/abcd/v27n4/pt_0102-6720-abcd-27-04-00261.pdf. Doi: 10.1590/S0102-67202014000400008
- Brasil. Ministério da Saúde. Portaria MS/GM nº 425, de 19 de março de 2013. Estabelece regulamento técnico, normas e critérios para o serviço de assistência de alta complexidade ao indivíduo com obesidade [Internet]. Diário Oficial da União, Brasília (DF), 2013 mar 20 [citado 2019 fev 20]; Seção 1:25. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/gm/2013/prt0425_19_03_2013.html
- Lessa FJD, Mendes ACG, Farias SE, Sá DA, Duarte PO, Melo Filho DA. Novas metodologias para vigilância epidemiológica: uso do SIH/SUS. *Inf Epidemiol SUS* [Internet]. 2000 [citado 2019 fev 20];9(Supl I):3-27. Disponível em: <http://scielo.iec.gov.br/pdf/iesus/v9s1/v9s1a01.pdf>
- World Bank. PPP conversion factor, LCU per international \$ [Internet]. 2018. [cited 2018 Out 28]. Available from: <https://data.worldbank.org/indicator/PA.NUS.PPP>
- Khawali C, Ferraz MB, Zanella MT, Ferreira SRG. Evaluation of quality of life in severely obese patients after bariatric surgery carried out in the public health care system. *Arq Bras Endocrinol Metabol* [Internet]. 2012 Feb [cited 2019 Feb 20];56(1):33-8. Available from: <http://www.scielo.br/pdf/abem/v56n1/v56n1a06.pdf>. Doi: 10.1590/S0004-27302012000100006
- Nguyen NT, Vu S, Kim E, Bodunova N, Phelan MJ. Trends in utilization of bariatric surgery, 2009–2012. *Surg Endosc* [Internet]. 2016 Jul [cited 2019 Feb 20];30(7):2723-27. Available from: <https://link.springer.com/article/10.1007%2Fs00464-015-4535-9>. Doi: 10.1007/s00464-015-4535-9

15. Debes T, Petrucciani N, Kassir R, Ianelli A, Amor IB, Gugenheim J. Trends of bariatric surgery in France during the last 10 years: analysis of 267,466 procedures from 2005–2014. *Surg Obes Relat Dis* [Internet]. 2016 Sep-Oct [cited 2019 Feb 20];12(8):1602-09. Available from: [https://www.soard.org/article/S1550-7289\(16\)30094-6/fulltext](https://www.soard.org/article/S1550-7289(16)30094-6/fulltext). Doi: 10.1016/j.soard.2016.05.010
16. Owen-Smith A, Kipping R, Donova J, Hine C, Maslen C, Coast J. A NICE example? Variation in provision of bariatric surgery in England. *BMJ* [Internet]. 2013 May [cited 2019 Feb 20];346:2453. Available from: <https://www.bmj.com/content/346/bmj.f2453>. Doi: 10.1136/bmj.f2453
17. Ramos AC, Silva ACS, Ramos MG, Canseco EGC, Galvão-Neto MP, Menezes MA, et al. Bypass gástrico simplificado: 13 anos de experiência e 12.000 pacientes operados. *ABCD, Arq Bras Cir Dig* [Internet]. 2014 dez [citado 2019 fev 20];27(Supl I):2-8. Disponível em: http://www.scielo.br/pdf/abcd/v27s1/pt_0102-6720-abcd-27-s1-00002.pdf. Doi: 10.1590/S0102-6720201400S100002
18. Stoll A, Rosin L, Dias MF, Marquiotti B, Gugelmin G, Stoll GE. Complicações pós-operatórias precoces no bypass gástrico em Y-de-Roux. *ABCD, Arq Bras Cir Dig* [Internet]. 2016;29(Supl I):72-4. Disponível em: http://www.scielo.br/pdf/abcd/v29s1/pt_0102-6720-abcd-29-s1-00072.pdf. Doi: 10.1590/0102-6720201600S10018
19. Kelles SMB, Diniz MFHS, Machado CJ, Barreto SM. Perfil de pacientes submetidos à cirurgia bariátrica, assistidos pelo Sistema Único de Saúde do Brasil: revisão sistemática. *Cad Saúde Pública* [Internet]. 2015 ago [citado 2019 fev 20];31(8):1587-1601. Disponível em: <http://www.scielo.br/pdf/csp/v31n8/0102-311X-csp-31-8-1587.pdf>. Doi: 10.1590/0102-311X00022714
20. Carvalho AS, Rosa RS. Cirurgias bariátricas realizadas pelo Sistema Único de Saúde em residentes da Região Metropolitana de Porto Alegre, Rio Grande do Sul, 2010-2016. *Epidemiol Serv Saúde* [Internet]. 2018 [citado 2019 fev 20];27(2):e2017010. Disponível em: <http://www.scielo.br/pdf/ress/v27n2/2237-9622-ress-27-02-e2017010.pdf>. Doi: 10.5123/s1679-49742018000200008
21. Sun S, Borisenko O, Spelman T, Ahmed AR. Patient characteristics, procedural and safety outcomes of bariatric surgery in England: a retrospective cohort study – 2006-2012. *Obes Surg* [Internet]. 2018 Apr [cited 2019 Feb 20];28(4):1098-108. Available from: <https://link.springer.com/article/10.1007%2Fs11695-017-2978-x>. Doi: 10.1007/s11695-017-2978-x
22. Bastos ECL, Barbosa EMWG, Soriano GMS, Santos EA, Vasconcelos SML. Fatores determinantes do ganho ponderal no pós-operatório de cirurgia bariátrica. *ABCD, Arq Bras Cir Dig* [Internet]. 2013 [citado 2019 fev 20];26(Supl I):26-32. Disponível em: <http://www.scielo.br/pdf/abcd/v26s1/a07v26s1.pdf>. Doi: 10.1590/S0102-67202013000600007
23. Xavier DB, Ramalho WM, Silva EN. Spending on bariatric surgery in the Unified Health System from 2010 to 2014: a study based on the specialist hospitals authorized by the Ministry of Health. *Obes Surg* [Internet]. 2017 Mar [cited 2019 Feb 20];27(3):641-8. Available from: <https://link.springer.com/article/10.1007%2Fs11695-016-2327-5>. Doi: 10.1007/s11695-016-2327-5
24. Sociedade Brasileira de Cirurgia Bariátrica e Metabólica (SBCBM). Técnicas cirúrgicas [Internet]. 2017 [citado 2017 abr 28]. Disponível em: <https://www.sbcbm.org.br/tecnicas-cirurgicas/>
25. Penna GLA, Vaz IP, Fonseca EC, Kalichshtein M, Nobre GF. Pós-operatório imediato de cirurgia bariátrica em unidade intensiva versus unidade de internação. Estudo retrospectivo com 828 pacientes. *Rev Bras Ter Intensiva* [Internet]. 2017 set [citado 2019 fev 20];29(3):325-30. Disponível em: <http://www.scielo.br/pdf/rbti/v29n3/0103-507X-rbti-29-03-0325.pdf>. Doi: 10.5935/0103-507x.20170050
26. Cendán JC, Abu-aouf D, Gabrielli A, Caruso LJ, Rout WR, Hocking MP, et al. Utilization of intensive care resources in bariatric surgery. *Obes Surg* [Internet]. 2005 Oct [cited 2019 Feb 20];15(9):1247-51. Available from: <https://link.springer.com/article/10.1381%2F096089205774512681>. Doi: 10.1381/096089205774512681
27. Melo SMD, Vasconcelos FAR, Melo VA, Santos FA, Menezes Filho RS, Melo BSD. Cirurgia bariátrica: existe necessidade de internação em unidade de terapia intensiva? *Rev Bras Ter Intensiva* [Internet]. 2009 jun [citado 2019 fev 20];21(2):162-8. Disponível em: <http://www.scielo.br/pdf/rbti/v21n2/08.pdf>. Doi: 10.1590/S0103-507X2009000200008
28. Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Departamento de Regulação, Avaliação e Controle de Sistemas. Critérios e parâmetros para o planejamento e programação de ações e serviços de saúde no âmbito do Sistema Único de Saúde. [Internet]. Brasília: Ministério da Saúde; 2015 [citado 2017 mar 28]. 136 p. Disponível em: <http://portal.arquivos2.saude.gov.br/images/pdf/2018/abril/06/ParametrosSUS.pdf>

29. World Health Organization. Obesity: preventing and managing the global epidemic. WHO Technical Report Series n. 894 [Internet]. Geneva: World Health Organization; 2000 [cited 2017 Mar 28]. Available from: http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/
30. Süssenbach SP, PaDoin AV, Silva EN, Benzano D, Pufal MA, Barhouch AS, et al. Economic benefits of bariatric surgery. *Obes Surg* [Internet]. 2012 Feb [cited 2019 Feb 20];22(2):266-70. Available from: <https://link.springer.com/article/10.1007%2Fs11695-011-0558-z>. Doi: 10.1007/s11695-011-0558-z

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