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Bariatric surgeries in the Brazilian public health system from 2012 to 2022: descriptive study of hospitalizations in the state of Paraná

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HIGHLIGHTS

- Obesity is most prevalent among women, aged between 30 and 49 years old, and of white ethnicity.
- Between 2012 and 2022, the number of bariatric surgeries performed in Paraná increased significantly, with 97.6% of all surgeries utilizing primarily the Roux-Y technique.
- Surgical approaches for the treatment of obesity and its related conditions, such as type II diabetes, yield significantly better rates of remission.

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ABSTRACT – Background – Obesity is a chronic health condition with a multifactorial etiology, resulting from the interplay of genetic, environmental, and behavioral factors leading to an energy imbalance. **Objective –** To characterize hospitalizations for bariatric surgeries through the Brazilian Unified Health System (SUS) in the state of Paraná from 2012 to 2022. **Methods –** This is a descriptive and retrospective study, utilizing a time series design, based on secondary data. Public data from the SUS Hospital Information System for the period from 2012 to 2022 were consulted, focusing on the population of obese patients undergoing bariatric surgery. **Results –** In Paraná, concerning SUS procedures data from 2012 to 2022, 39,793 hospitalizations for bariatric surgeries were observed. Among the five modalities, Roux-en-Y gastric bypass predominated with 38,849 hospitalizations (97.6%), showing a lower mortality rate. **Conclusion –** The research highlights a notable variation in costs, emphasizing the importance of economic evaluation. The correlation between obesity and diabetes underscores the complexity of the situation, justifying the superiority of surgical treatment in comorbidity remission. The study reveals a decline in bariatric surgeries in 2020, coinciding with the pandemic, and alerts to the increased vulnerability of obese patients to SARS-CoV-2.

Keywords – Bariatric surgery; obesity; epidemiology; hospitalizations.

INTRODUCTION

Obesity is a complex health condition that arises from a combination of genetic, environmental, and behavioral factors. When these factors interact, they disrupt energy balance, leading to the accumulation of adipose tissue. This accumulation triggers a range of negative health outcomes, including cardiometabolic consequences that increase morbidity and mortality[1]. Chronic diseases, such as type II diabetes mellitus, cardiovascular diseases, dyslipidemia, sleep apnea, osteoarthritis, dental changes, and various types of neoplasms are all linked to obesity[2].

At first, it is suggested to consider options such as tracking nutrition, engaging in regular physical exercise, and potentially using medications. However, studies indicate that clinical treatments are often unsatisfactory in about 95% of cases where obesity has advanced to stage III (i.e., BMI >40 kg/m²), with individuals typically regaining their initial weight within 2 years[3]. As a solution to effectively combat morbid obesity and its related complications, bariatric surgery is a viable option[4].

In 1991, the Consensus Development Panel of the National Institutes of Health (NIH) established the indications for surgical treatment of severe obesity. Recently, the second Diabetes Surgery Summit (DSS-II) suggested expanding access to bariatric surgery for individuals with lower body mass index (BMI), different ethnic groups, and those with inadequate control of hyperglycemia[5]. This proposal has since been endorsed by 45 international medical and scientific organizations. In 2022, the American Society for Metabolic and Bariatric Surgery (ASMBS) and the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) released updates on the indications for bariatric surgery[6].

Also, in 1999, gastroplasty was added to the list of procedures covered by the Unified Health System (SUS). However, the eligibility criteria for this surgery, which is publicly funded, have changed since then. Today, the criteria are outlined in Ordinance GM/MS no. 424, dated March 19, 2013. These criteria specify that patients must meet at least one of the following conditions: (i) have a BMI greater than 50 kg/m²; (ii) have a BMI greater than 40 kg/m², with or without comorbidities, and have undergone unsuccessful longitudinal clinical treatment for at least two years in Primary Care and/or Specialized Outpatient Care, following clinical protocols; or (iii) have a BMI greater than 35 kg/m² and have comorbidities, and have also undergone unsuccessful longitudinal clinical treatment for at least 2 years, following clinical protocols[7].

Based on current literature, individuals who are eligible for bariatric surgical procedures are adults with a BMI of 35 kg/m² or higher, regardless of the presence or severity of comorbidities. Studies have shown that bariatric surgery is more effective than lifestyle interventions like diet and exercise in achieving substantial and long-term weight loss, while also improving obesity-related comorbidities in cases of obesity class II or higher[8]. Moreover, adults with a BMI between 30 and 34.9 kg/m² and type 2 diabetes may consider bariatric surgery as a treatment option, especially if non-surgical methods fail to result in significant weight loss or improvements in comorbidities. Both retrospective and prospective studies have demonstrated the superior and lasting benefits of bariatric surgery in this group[8].

Individuals with a BMI between 30 and 34.9 kg/m² may find bariatric surgery to be a viable option if traditional non-surgical methods have not yielded satisfactory results. Research has consistently shown that those with class I obesity can achieve significant weight loss and metabolic improvements through this procedure[9]. Furthermore, bariatric surgery has been shown to effectively alleviate comorbidities commonly associated with obesity, such as type 2 diabetes, obstructive sleep apnea, hypertension, and hyperlipidemia[8].

A survey conducted in Brazil between 2008 and 2009 revealed a high incidence of overweight and obesity across various social strata and regions. In 2009, almost half of the population aged 20 and over were found to be overweight. The prevalence of obesity was higher among women, at 16.9%, compared to 12.4% among men[10]. Additionally, the Brazilian Association for the Study of Obesity and Metabolic Syndrome (ABESO) reports that around 8% of public health spending in Brazil is allocated toward managing overweight and obesity. According to studies, as the BMI increases, the risk of developing comorbidities such as systemic arterial hypertension,

coronary artery disease, dyslipidemia, and diabetes also increases exponentially[11].

Brazil is ranked second globally, after the United States, for performing bariatric surgeries according to data from the Brazilian Society of Bariatric and Metabolic Surgery (SBCBM). The number of surgical procedures of this type performed on Brazilians has significantly increased from 72,000 in 2012 to 100,000 in 2016. It is estimated that the growth in the period from 2006 to 2015 reached an impressive 300%[12].

Thus, the aim of this study is to analyze the epidemiological profile of obesity in the state of Paraná, as well as the hospitalization rates, costs, and mortality rates of bariatric surgeries through the Unified Health System (SUS) from 2012 to 2022. Through examining hospitalizations over the years, the study hopes to identify patterns and correlations that can enhance public policies and clinical practices in the health sector.

METHODS

This is a descriptive and retrospective time series study based on secondary data. The study consulted public data from the SUS Hospital Information System (SIH/SUS) for the period from January 2012 to December 2022. The SIH/SUS data is accessible to the public through the DATASUS information portal (https://datasus.saude.gov.br/informacoes-de-saude-tabnet/).

The study involved individuals who were 16 years or older and met the surgical criteria during the period of the study. The criteria were established in Ordinance GM/MS No. 425/2013 and included young people aged 16 to 18 years, after a specific assessment, and adults over 65 years, after a risk-benefit assessment[7]. The data for the study were obtained from two different sources of DATASUS: SUS Hospital Morbidity (SIH/SUS) and Hospital Production (SIH/SUS).

The first source covered all hospitalizations of users whose main diagnosis at the time of admission was "obesity" — provided for in the International Statistical Classification of Diseases and Related Health Problems (ICD-10) with code E66. Thus, the following variables were analyzed: number of hospitalizations, sex, age group, color/race.

Next, we examined hospitalizations related to bariatric surgery. We identified individuals who had undergone at least one of the following procedures (SUS codes): gastroplasty with intestinal diversion (04.07.01.017-3), gastrectomy with or without duodenal diversion (04.07.01.012-2), vertical gastrectomy (or sleeve gastrectomy or gastric sleeve) (04.07.01.036-0), vertical band gastroplasty (04.07.01.018-1), and bariatric surgery via laparoscopy (04.07.01.038-6). Our analysis included the following variables: hospitalizations (AIH), total value, average value per hospitalization, days of stay, average hospital stay, deaths, and mortality rate.

To comprehensively analyze the collected information, we transferred the data from TABNET into CSV files and organized it into spreadsheets using Microsoft Excel® software. Data were analyzed using the chi-square test with a significance level of 0.05. The statistical program R (R Coreteam, 2015) was used for analysis.

In terms of research ethics, given that DATASUS supplies a database that is easily accessible to the public and does not contain any identifying information about patients, there was no need to seek approval from the Research Ethics Committee for this project. As a result, there were no ethical concerns related to privacy or confidentiality that needed to be reviewed.

RESULTS

According to hospitalization data in Paraná, there were a total of 43,516 cases of hospitalization with the main diagnosis of "obesity" (code E66 by ICD-10) between 2012 and 2022. The majority of those hospitalized were women (n=37,595; 86.4%; X-squared= 23055, df = 1, *P*-value <0.0001), individuals between the ages of 30 and 49 years (n=26,188; 60.2%; X-squared = 33486, df = 3, *P*-value <0.0001), and of white ethnicity (n=33,672; 77.4%; X-squared = 91090, df = 4, *P*-value <0.0001). You can find the base demographic data in TABLE 1.

TABLE 2 provides a breakdown of the number of hospitalizations for each type of surgery. Between 2012 and 2022, there were 39,793 hospitalizations in the SUS for bariatric surgeries. Among the five types of surgeries, Roux-en-Y gastroplasty was the most common, accounting for 97.6% (38,849) of all hospitalizations (X-squared = 149880, df = 4, *P*-value <0.0001).

TABLE 1. Baseline demographic data of hospitalized patients (ICD-10 code E66).

Variable	Subvariable	(n)	(%)
Sex	Male	5,921	13.6%
	Female	37,595	86.4%
	Total	43,516	100.0%
Age range	15 to 29 years old	9,765	22.4%
	30 to 49 years old	26,188	60.2%
	50 to 69 years old	7,515	17.3%
	70 years and older	46	0.1%
Color/ race	White	33,672	77.4%
	Medium brown	4,819	11.1%
	Black	1,313	3.0%
	Yellow	152	0.3%
	Not included	3,558	8.2%

DATASUS, TABNET - SINAN (BRASIL, 2023).

TABLE 2. Number of surgeries performed from 2012 to 2022.

Procedure	(n)	(%)
Gastrectomy with or without duodenal diversion	41	0.1%
Roux-en-Y gastroplasty	38,849	97.6%
Vertical banded gastroplasty	137	0.3%
Vertical sleeve gastrectomy	431	1.1%
Laparoscopic bariatric surgery	335	0.8%
Total	39,793	100%

DATASUS, TABNET - SINAN (BRASIL, 2023).

Following Roux-en-Y gastroplasty, sleeve gastrectomy (n=431; 1.1%), videolaparoscopic surgery (n=335; 0.8%), and vertical banded gastroplasty (n=137; 0.3%) were less commonly performed (TABLE 2).

TABLE 3 displays the total expenditures incurred by the SUS for each procedure during the analyzed period. Roux-en-Y gastroplasty had the highest total expenditure, amounting to R$ 248,228,837.29 (X-squared = 958980000, df = 4, *P*-value <0.0001), with an average cost per hospitalization of R$ 6,389.58 (X-squared = 376.4, df = 4, *P*-value <0.0001). On the other hand, vertical banded gastroplasty had the lowest total cost, reaching only R$ 675,118.10, with an average value of R$ 4,927.87 per hospitalization.

TABLE 3. Total and average expenses for hospitalizations by surgical modality.

Procedure	Total cost	Average cost per AIH
Gastrectomy with or without duodenal diversion	R$ 277,803.09	R$ 6,775.69
Roux-en-Y gastroplasty	R$ 248,228,837.29	R$ 6,389.58
Vertical banded gastroplasty	R$ 675,118.10	R$ 4,927.87
Vertical sleeve gastrectomy	R$ 2,592,207.01	R$ 6,014.40
Laparoscopic bariatric surgery	R$ 2,262,608.22	R$ 6,754.05
Total	R$ 254,036,573.71	R$ 6,383.95

DATASUS, TABNET - SINAN (BRASIL, 2023).

The data presented in TABLE 4 illustrates the average duration of hospital stays for various medical procedures. While gastrectomy with or without duodenal diversion had the longest average stay of 4.4 days, there was no significant statistical difference observed when compared to the other procedures (X-squared = 0.85732, df = 4, *P*-value = 0.9306). Upon analysis of the length of stay, Roux-en-Y gastric bypass showed a significant increase compared to other procedures (X-squared = 396500, df = 4, *P*-value <0.0001).

TABLE 4. Total days of hospital stay and average length of hospital stay by surgical modality.

Procedure	Length of stay	Average length of stay (days)
Gastrectomy with or without duodenal diversion	181	4.4
Roux-en-Y gastroplasty	103,160	2.7
Vertical banded gastroplasty	419	3.1
Vertical sleeve gastrectomy	1,421	3.3
Laparoscopic bariatric surgery	752	2.2
Total	105,933	2.7

Source: DATASUS, TABNET - SINAN (BRASIL, 2023).

Regarding deaths and mortality rate, Roux-en-Y gastroplasty had the highest number of death (X-squared = 226.94, df = 4, *P*-value <0.0001) but lowest mortality rate (not significant; X-squared = 5.4638, df = 4, *P*-value = 0.2429). Laparoscopic bariatric surgery had a mortality rate of 0.30, while vertical banded gastroplasty presented an intermediate value with a rate of 0.73. Finally, gastrectomy with or without duodenal diversion had the highest, but not significant, mortality rate at 2.44 (TABLE 5).

Finally, FIGURE 1 displays the number of Roux-en-Y gastroplasties performed each year between 2012 and 2022. We can see a significant increase in the number of procedures until 2019. However, in 2020, there was a sudden decline in the number of bariatric surgeries performed in the SUS. Only 491 surgeries were recorded in 2021 (t=5.159, df=10, *P*-value = 0.0004).

TABLE 5. Total deaths and mortality rate by surgical modality.

Procedure	Deaths	Mortality race
Gastrectomy with or without duodenal diversion	1	2.44
Roux-en-Y gastroplasty	61	0.16
Vertical banded gastroplasty	1	0.73
Vertical sleeve gastrectomy	-	-
Laparoscopic bariatric surgery	1	0.3
Total	64	0.16

DATASUS, TABNET - SINAN (BRASIL, 2023).

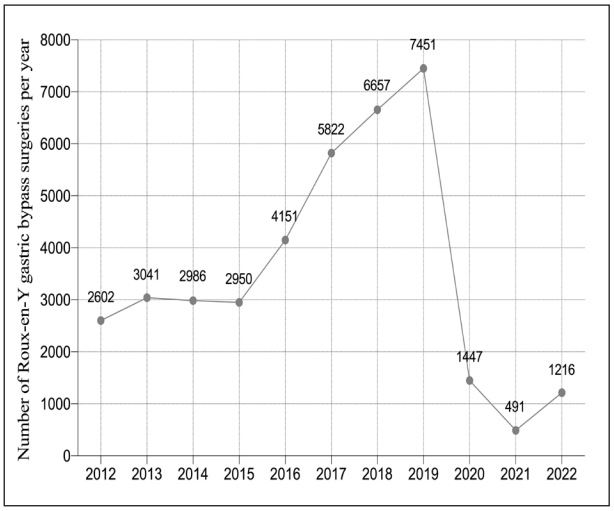

FIGURE 1. Number of Roux-en-Y gastric bypass surgeries per year (2012 to 2022).

DISCUSSION

According to a study conducted in 2017, data was gathered from 2010 to 2014 that consisted of a total of 29,717 bariatric surgical procedures performed by the Brazilian Unified Health System (SUS). The volume of surgeries increased over the years, starting from 3,877 in 2010 and reaching 6,210 surgeries in 2014. The study also found that 85% of surgeries were performed on women, with 32% of these operations occurring in women between the ages of 35 and 44[13]. The data presented in TABLE 1 confirms this, with 86.4% of hospitalized patients being female, which supports previous research. Furthermore, the age analysis shows that individuals between 30 and 49 years old represented 60.2% of the patient population.

During the analyzed time interval, a total of 39,793 surgical procedures were performed, as shown in TABLE 2. The Roux-Y technique was predominantly used, accounting for 97.6% of all surgeries performed, with a total of 38,849 procedures. Interestingly, this surgical approach had the lowest mortality rate of all techniques, with only a 0.16% mortality rate as depicted in TABLE 5. When compared to the period between 2010 and 2014, the Roux-en-Y technique remained the most frequently used, representing 93.7% of all surgeries performed. The second most commonly used procedure during the period between 2013 and 2014 was sleeve gastrectomy, contributing to 4% of the total number of surgical interventions[13].

An analysis conducted in 2012 showed the direct costs of outpatient and hospital care for conditions related to excess weight and obesity in the Brazilian Unified Health System (SUS). The study found that the annual costs amounted to a staggering US$ 2.1 billion. Hospital admissions accounted for US$ 1.4 billion (68.4% of the total amount), while US$ 679 million was attributed to outpatient procedures[14]. Based on the data presented in TABLE 3, the total value of hospitalizations for surgeries in Paraná amounts to R$ 254 million. This represents 18.1% of Brazil's total spending in 2012. It's worth noting that a study conducted in the same year revealed that patients who underwent bariatric surgery experienced a significant reduction in medical costs during the postoperative period compared to the preoperative period. This reduction included expenses for medication, professional assistance, and exams[15].

In 2018, an investigation was conducted to compare the long-term weight reduction outcomes between laparoscopic sleeve gastrectomy and Roux-en-Y gastroplasty. The study found that Roux-en-Y gastroplasty was significantly superior in achieving weight loss, with a higher percentage rate of excess weight loss and a more substantial rate of cessation of antihypertensive medication use compared to laparoscopic sleeve gastrectomy. However, it was noted that there was no statistically significant difference in quality of life between the two groups[16]. Given the results outlined in TABLE 2, which show a 97.6% rate of surgical interventions performed through Roux-en-Y gastroplasty over a decade, it can be inferred that this approach is the pre-eminent option. A systematic review conducted in 2014 analyzed economic evaluation studies

comparing the cost-effectiveness of laparoscopic and laparotomic routes in Roux-en-Y gastric bypass surgery. The review concluded that laparoscopy was considered the dominant strategy in terms of clinical benefit and total cost[17].

An analysis of mortality associated with bariatric procedures was conducted from January 1996 to January 2006. The sample size consisted of 13,871 patients. It was concluded that the mortality rate after bariatric surgeries was 0.25%. Pulmonary embolism was identified as the most common cause of death[18]. TABLE 5 presents data covering the period from 2012 to 2022. During this time, a total of 39,793 procedures were performed. Only 64 cases resulted in death, indicating a mortality rate of 0.16%. This decrease in the mortality rate may be due to technological advancements in surgical procedures and the continuous improvement of professional surgeons.

Graph 1 depicts the trend of Roux-en-Y procedures over the span of ten years. The graph shows a gradual increase in the number of procedures over time, followed by a sudden decline in 2020 due to the outbreak of COVID-19. Studies suggest that individuals who suffer from obesity and contract SARS-CoV-2 have a higher likelihood of being hospitalized, requiring intensive care, and facing a higher risk of death, in comparison to individuals with a BMI of less than 30 kg/m^2[19].

CONCLUSION

According to a study conducted in Paraná, obesity has significantly impacted hospitalizations, leading to a total of 43,516 hospitalizations from 2012 to 2022, with a majority of cases being women (86.4%), aged between 30 to 49 years (60.2%), and of white ethnicity (77.4%). The study reveals that bariatric procedures in the SUS during the same period totaled 39,793. The Roux-en-Y gastroplasty was the predominant procedure (97.6%), with the lowest mortality rate (0.16%), but also led to the highest expenses and days of stay. Thus, economic evaluation becomes crucial in this regard. The study also warns of the greater vulnerability of obese patients to SARS-CoV-2, as seen from the drop in bariatric surgeries in 2020 during the pandemic.

Authors' contribution

Fahs HA and Oliveira MSM conducted data collection and wrote the manuscript. Gomes ECZ supervised the research, performed statistical analysis, and reviewed the text.

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RESUMO – Contexto – A obesidade é uma condição crônica de saúde que apresenta etiologia multifatorial. Resulta da combinação de fatores genéticos, ambientais e comportamentais, os quais, quando interagem, levam a um desbalanço energético. **Objetivo –** Caracterizar as hospitalizações pelo Sistema Único de Saúde (SUS) para realização de cirurgias bariátricas no estado do Paraná, no período de 2012 a 2022. **Métodos –** Trata-se de um estudo descritivo e retrospectivo, do tipo série temporal, baseado em dados secundários. Foram consultados os dados públicos contidos no sistema de informações hospitalares do SUS, no período de 2012 a 2022. A população analisada foram pacientes obesos submetidos à cirurgia bariátrica. **Resultados –** No Paraná, com relação aos dados de procedimentos realizados no SUS, no período de 2012 a 2022, foram observadas 39.793 hospitalizações para a realização de cirurgias bariátricas. Dentre as cinco modalidades, houve predomínio da gastroplastia em Y de Roux, com 38.849 hospitalizações (97,6%), com menor taxa de mortalidade. **Conclusão –** A pesquisa ressalta uma notável variação nos custos, enfatizando a importância da avaliação econômica. A correlação entre obesidade e diabetes evidencia a complexidade da situação, justificando a superioridade do tratamento cirúrgico na remissão de comorbidades. O estudo mostra uma queda nas cirurgias bariátricas em 2020, coincidindo com a pandemia, e alerta para a maior vulnerabilidade de pacientes obesos ao SARS-CoV-2.

Palavras-chave – Cirurgia bariátrica; obesidade; epidemiologia; hospitalizações.

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