OBES SURG (2012) 22:266–270
DOI 10.1007/s11695-011-0558-z

ECONOMIC ASPECTS

Economic Benefits of Bariatric Surgery

S. P. Sussenbach · A. V. Padoin · E. N. Silva · D. Benzano · M. A. Pufal · A. S. Barhouch · R. Chatkin · R. J. Ramos · A. Balestro · C. C. Mottin

Published online: 6 December 2011

Abstract With the high prevalence of obesity and associated comorbidities, the costs of health services produce a great economic impact. The objective of this work was to evaluate the economic benefits of bariatric surgery and to relate the costs to the impact on the health of the individual. A historic cohort study was conducted, with review of medical charts of 194 patients who fulfilled the inclusion criteria for the study. The costs for medications, professional care, and examinations in the pre- and postoperative periods were analyzed, taking into consideration the comorbidities DM2, SAH, and dyslipidemia. The study demonstrated a reduction in the medical costs in the course of the postoperative period, in relation to expenses for medications, professional care, and examinations in the preoperative period. Comparing the preoperative expenses with different times in the postoperative period, a statistically significant difference was seen at all time evaluated ($p<0.001$). The resolution of comorbidities was higher than 95% at 36 months after surgery. No statistically significant difference was seen with respect to the prevalence of comorbidities between the sexes in the pre- and postoperative periods ($p>0.05$). With regard to age, younger patients showed lower rates of comorbidities in the pre- and postoperative periods ($p<0.001$). The costs of the surgery are high, but the expenditures for medications, professional care, and examinations decrease progressively after the operation, where this is more evident in patients with more associated comorbidities.

Keywords Morbid obesity · Bariatric surgery · Costs · Comorbidities

Introduction

The economic impact of morbid obesity is substantial. It is estimated that 2–8% of the expenses in health care treatments in various countries around the world are for obesity [1]. The costs involved in the management of the morbid obese patient are a challenge for the public and private sectors of medical assistance [1].

After bariatric surgery, comorbidities are significantly reduced [1–5], and patients use less health care options and have fewer hospitalizations and doctor visits. Five years after the surgery, patients reduce their medical expenses by two thirds [3]. In addition, there is evidence that the surgery is a cost-effective alternative [6], providing benefits for the health of the patient and for the health care system on the whole [6–9].

The objective of this study was to evaluate the economic benefits of bariatric surgery and the impact on the health of the individuals, especially related to the reduction of comorbidities and, consequently, of their costs over 3 years.

Material and Methods

A historic cohort study was conducted, with review of the medical charts of 194 patients under the care of a multidisciplinary team at a tertiary care center for the obese. Included in the study were patients submitted to Roux-en-Y gastric bypass

This article was prepared according to the publication guidelines of Obesity Surgery.

S. P. Sussenbach · A. V. Padoin · E. N. Silva · D. Benzano · M. A. Pufal · A. S. Barhouch · R. Chatkin · R. J. Ramos · A. Balestro · C. C. Mottin (✉)
Av. Ipiranga 6690/302,
Porto Alegre, Rio Grande do Sul, Brazil CEP 90610-000
e-mail: samysuss@gmail.com

surgery, who had the operation in the period of March 2006 to July 2007, all treated by the same team. This period was chosen due to the need for the patients to have a minimum postoperative follow-up of 24 months. The size of the sample was defined considering the reasonable time to carry out the study.

This study focused on the comorbidities type 2 diabetes mellitus (DM2), systemic arterial hypertension (SAH), and dyslipidemia, all these being serious public health problems. The costs of medications, professional care, and examinations for the patients were evaluated in the pre- and postoperative periods, from the perspective of costs at a referral hospital for morbid obesity in the south of Brazil. The study concentrated on these costs, as these represented the greatest part of the costs incurred with these comorbidities. Due to the short timeline of this study, i.e., 3 years, we chose not to include the costs of the operation and complications resulting from the bariatric surgery, since a longer period would be necessary to compensate for the higher initial costs.

Considering the possibility of the patients showing comorbidities or not, three groups were established: group I—without comorbidity; group II—with one comorbidity; group III—with two or more comorbidities.

For the purpose of evaluating the benefits of the surgery on health, considering the improvement or resolution of comorbidities, these were compared in the preoperative period and at 12 postoperative months, considering gender and age of the patients. With regard to age, the mean age of the patient sample, i.e., 37.6±11.2 years, was used as the cutoff point, comparing the age groups above and below the mean.

To evaluate the preoperative costs, we followed the recommendations of the main guidelines for each comorbidity. We proceeded in this way because in the majority of the medical charts analyzed, there was no available information for the period before the surgery. For patients with type 2 diabetes mellitus (DM2), the guidelines of the International Diabetes Federation were utilized, and for patients with systemic arterial hypertension (SAH) and dyslipidemia, the guidelines of the Brazilian Society of Cardiology and Framingham risk index were utilized. The costs for necessary professional care, number of doctor visits, examinations/tests, and medications in the 12-month postoperative period were determined based on the charges of a referral hospital.

The criteria for the diagnosis of each comorbidity were:

- DM2—Fasting plasma glucose level equal to or greater than 126 mg/dL (7.0 mmol/l) on two occasions; plasma glucose level equal to or greater than 200 mg/dL or 11.1 mmol/l 2 h after an oral dose of 75 g glucose as in a glucose tolerance test on two occasions; or random plasma glucose level over 200 mg/dL or 11.1 mmol/l, combined with signs and symptoms typical of diabetes [10].
- SAH—systolic pressure ≥130 and diastolic ≥85 mmHg
- Dyslipidemias—cholesterol >200 mg/dL[11]
  - LDL—chol >100 mg/dL
  - HDL—chol <40 for men and <50 for women
  - TG>150 mg/dL

The expenses during the postoperative period were calculated according to the information in the medical charts of the patients at the tertiary care center, where the doctor visits, examinations/tests, and medications prescribed were recorded. These medications included the nutritional supplements necessary in this period.

The financial costs were expressed in US dollars (US $), using an exchange rate of US $1=R$ 1.65 (May 2011).

Statistical Analysis

The categorical variables were described by absolute frequency and percentage of frequency, and compared by the chi-square test or Fisher's exact test. The quantitative variables with asymmetric distribution were described by the median and interquartile interval and compared by the Wilcoxon test, and by Student's *t* test for independent samples. The level of significance was set at 5% ($p \leq 0.05$). The SPSS/PASW v.18.0 program was used for statistical analysis.

Results

The sample consisted of 194 patients: 138 women and 56 men. The mean age of the patients was 37.6±11.2 years. The surgical access route most utilized was the conventional one: 112 patients (58%), with 84 women and 28 men (Table 1).

Among the groups analyzed, group I included 56 (29%) patients, group II 52 (44%), and group III 86 (27%) in the preoperative period. In this study, 107 (56%) patients had a routine follow-up of up to 36 months after surgery.

In the sample studied, in the preoperative as well as postoperative period, no statistically significant difference was observed between men and women with respect to the prevalence of type 2 diabetes mellitus (DM2), systemic arterial hypertension (SAH), and dyslipidemia ($p>0.05$).

Table 1 Characterization of the sample

Characteristic	
Gender—*n*(%)	
Female	138 (71)
Age—mean±SD	37.6±11.2
Operative access—n(%)	
Conventional	112 (58)
Videolaparoscopy	82 (42)

The results are expressed in absolute and relative frequencies, means and standard deviations.

When compared to patients younger than 37.6 years, the older ones had significantly higher rates of dyslipidemia and SAH, respectively $p=0.001$ and $p<0.001$. There was a tendency for the younger patients to show a lower prevalence of DM2 in the preoperative period, but without a statistically significant difference. Comparing the two groups at 12 months after surgery, the younger patients showed a statistically significant reduction in SAH. There was a reverse tendency for dyslipidemia in the patients younger than 37.6 years, but showing no statistically significant difference (Table 2).

In relation to the frequency of comorbidities, there was a large reduction in associated diseases from the preoperative to the postoperative period. Before the surgery, of the 194 patients in the sample, 32 were diabetics (16%), 53 were hypertensives (26.5%), and 128 were dyslipidemics (64%). Just in the first postoperative month, there was a reduction of 56% for DM2, 68% for SAH, and 48% for dyslipidemias. At 36 months after the surgery, the patients showed 97% resolution of DM, 98% for SAH, and 95% for dyslipidemias (Table 3).

With regard to the costs, the obese patients who had a nutritional and laboratory follow-up, according to the recommendations of the guidelines, had an annual expenditure of about US $848. However, the patients with one comorbidity had annual expenses of approximately US $1,417, and those with two or more comorbidities, annual costs were around US $2,300 (Table 4). After the operation, we could determine from the medical charts the actual expenditures. In the first 12 postoperative months, the patients in group I showed an annual expenditure of US $1,153. In the period from 13 to 24 months, these expenses decreased to US $560 annually, and from 25 to 36 months to US $256 annually. However, the patients in group II showed annual expenses of US $1,165 in the first 12 months. From 13 to 24 months, these expenses decreased to US $588 annually, and from 25 to 36 months to US $264 annually. The patients in group III had annual expenditures of approximately US $1,770 in the first 12 months. From 13 to 24 months, the annual expenses were US $1,500, and from 25 to 36 months, these expenditures were reduced to US $744 annually (Fig. 1).

In our study, the annual median expenses for medications, professional care, and examinations in the preoperative period were US $1,706. In the postoperative period, these expenses were US $1,174 in the first 12 months, US $713 for 13 to 24 months, and US $431 for 25 to 36 months. Comparing the preoperative expenses to those at the different time in the postoperative period, a statistically significant difference was seen for all the times evaluated ($p<0.001$) (Fig. 2).

Discussion

There is a clear tendency for an increase in the number of bariatric surgeries performed in all the world. The improvement or resolution of comorbidities is directly related to this. It is known that comorbidities such as DM2, SAH, and dyslipidemias improve, with some being completely resolved, after bariatric surgery [2–5, 11]

According to cardiology directives, the prevalence of SAH is over 30%, in accordance with population surveys conducted in Brazilian cities in the last 20 years. SAH has a high prevalence and low rates of control, where it is considered one of the most important public health problems. In Brazil, cardiovascular disease (CVD) has been the principal cause of death and, due to its high frequency of hospitalization, is also responsible for generating high medical and socioeconomic costs [12].

According to the Ministry of Health of Brazil [13], the prevalence of DM2 in the Brazilian population over 40 years is 11%. At the end of the 1980s, the prevalence was 7.6%. In the USA, according to ADA, the prevalence is 8.3% of the population, which results in US $116 billion in direct costs and US $58 billion in indirect costs [10].

It is worth pointing out that bariatric surgery not only leads to weight loss but also a gain in health. It is a treatment

Table 2 Comorbidities in the preoperative and 12-month postoperative periods in relation to sex and age

	Preoperative			12 months postoperative		
	DM	DIS	SAH	DM	DIS	SAH
Females ($n=138$)	18 (13)	40 (29)	87 (63)	6 (4.3)	3 (2.2)	29 (21)
Males ($n=56$)	13 (23.2)	12 (21.4)	35 (62.5)	0	0	8 (14.3)
p value	0.125[a]	0.369[a]	1.000[a]	0.184[b]	0.558[b]	0.379[a]
↓37.6 (n=96)	11 (11.5)	16 (16.7)	49 (51)	1 (1.0)	0	8 (8.3)
↑37.6 (n=77)	17 (22.1)	32 (41.6)	61 (79.2)	4 (5.2)	3 (3.9)	23 (29.9)
p value	0.094[a]	0.001[a]	<0.001[a]	0.173[b]	0.086[b]	0.001[a]

According to conditions of application, association between categorical variables was determined by Chi-squared and Fisher's exact test

[a] Chi-squared test

[b] Fisher's exact test

Table 3 Prevalence of comorbidities in pre- and postoperative periods

Comorbidities			
Months	DM2 *n* (%)	SAH *n* (%)	Dyslipidemia *n* (%)
Pre	32 (16)	53 (26.5)	128 (64)
1	14 (7)	17 (8.5)	66 (33)
6	7 (3.5)	6 (3)	48 (24)
12	7 (3.5)	3 (1.5)	40 (20)
24	1 (0.5)	4 (2)	24 (12)
36	1 (0.5)	1 (0.5)	7 (3.5)

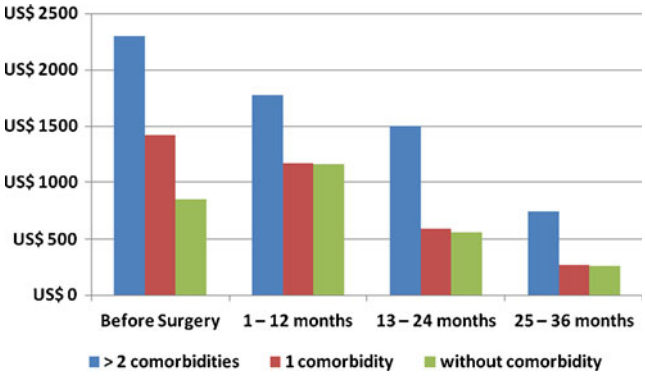

Fig. 1 Annual costs based on the number of comorbidities

modality that saves lives and that should be readily available in all countries of the world, in order to complement the fight against obesity [14]. It is essential that in the preoperative period, the patients be made aware of the changes necessary in their lifestyle, such as dietary modifications, in order to optimize weight loss and to reduce comorbidities [15].

Clegg [15] classified the benefits of the surgery for morbid obesity in three main groups. In the first place, the rapid loss of weight results in reduction in diabetes and high blood pressure, beginning soon after the first weeks following surgery. In the second place, after weight loss, there is improvement in quality of life and reduction in the use of medications. Finally, diseases such as DM2, SAH, and dyslipidemias, lessen in severity or disappear.

However, it is also important to consider the costs involved in the treatment of an obese patient. According to Christou [14], obese patients without surgery require more health care services, which make them more burdensome, because obesity can lead to various associated diseases, and these complications result in high costs [10, 11]. However, operated individuals show a high need for health care services up to the end of the first year after bariatric surgery [2].

It is known that the cost of bariatric surgery is high. However, if we take into consideration that positive clinical effects of the surgery can be seen in the long-term, such as improvement in or resolution of comorbidities, less incidence of complications of DM2, and reduction in the costs of treatment, the operation can be justified.

According to a study in Canada carried out to evaluate the course of DM2 in a time interval of 10 years, where the operative procedure was compared to the gold standard treatment, greater stability of the disease could be visualized in those patients submitted to bariatric surgery. Besides, various studies concluded that the cost-effectiveness associated with bariatric surgery is attractive, because the groups with DM2 show reductions in costs and improvement in health when compared to the standard treatment [16].

In the sample studied, there was a resolution of comorbidities. In the preoperative period, a large majority of the patients had one or more associated comorbidities, and during the postoperative period, the resolution of these diseases was more than 95%. With the improvement of these comorbidities, there was a reduction in spending on medications, examinations/tests and office visits, which demonstrates the economic benefits of bariatric surgery.

There was no statistically significant difference in prevalence of comorbidities between the sexes in the pre- and postoperative periods. With regard to age range, younger patients showed lower rates of comorbidities in the pre- and postoperative periods.

Table 4 Costs of preoperative care

Comorbidity	Cost
Obese	848
DM2	654
SAH	1,525
Dyslipidemia	2,072
DM2+SAH	2,041
DM2+SAH+dyslipidemia	2,670
SAH+dyslipidemia	2,237
DM2+dyslipidemia	2,254

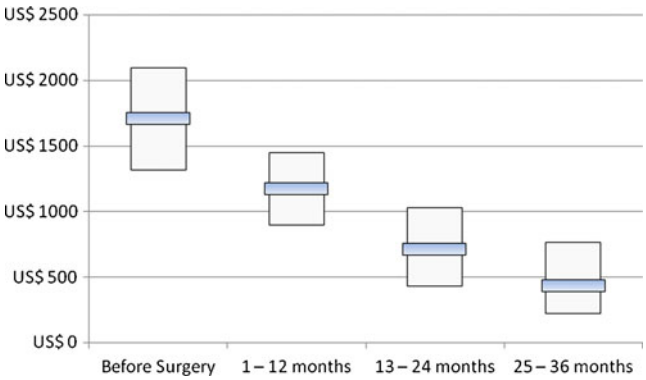

Fig. 2 Annual costs for different time intervals in the postoperative period

A decrease in the costs for medications, examinations/test, and professional was already detectable in the first 12 postoperative months. The patients in group I showed an increase in expenses of 36% in the first postoperative year in relation to the preoperative period. This can be explained by the large majority of obese patients in this group without comorbidities who have no extra expenses for doctor visits, medications, and examinations. It is after surgery that they need frequent regular checkups and tests and special medications and supplements. However, in the period of 13 to 24 months, a considerable reduction in expenditures occurred. The patients in group II showed a reduction of 18% their medical expenses in the first 12 postoperative months, 58% between 13 and 24 months, and 82% between 25 and 36 months. The patients in group III reduced their health care cost by 23% in first 12 months, 35% from 13 to 24 months, and 68% from 25 to 36 months in the postoperative period.

After having bariatric surgery, the patient has lower expenses for medications, professional care, and examinations/tests, reaching a reduction of about 32% in the first 12 postoperative months, even though this is a period that requires greater professional follow-up, use of specific medications, and examinations. In the course of 24 months, we saw a reduction of around 58%, and at 36 months, an approximate reduction of 74%.

In this study, the costs for hospitalization, complications, and interventions were not included, but we know that these would raise the expenses regarding the comorbities analyzed in this study. According to information from Health Ministry (Hiperdia) [17], 85% of the persons registered as having DM and SAH receive drug treatment, 8% show complications such as diabetic foot, amputation, renal disease and diabetic retinopathy, and 10% have angina, acute myocardial infarct, and cerebrovascular accident. The number of heart surgeries and stent placements is also high. We know that a large number of persons show these diseases, and consequently, we assume that the expenses associated with the treatment of these diseases are extremely high for health care services.

The ideal would be to have a preoperative follow-up of at least 12 months, because in this way, we would have the conditions to compare the pre- and postoperative periods in the real world. However, in practice, the patients only make last-minute preoperative doctor's appointments. Due to this reality, it was necessary to compare the ideal world through guidelines for the preoperative period, with the real world of medial chart for the postoperative period.

We can also consider that a follow-up of 36 months in the postoperative period is short for the evaluation of all the potentiality and significance of bariatric surgery. Studies with longer follow-up can contribute even more to the determination of the economic benefits of bariatric surgery.

Therefore, it is worth pointing out that after bariatric surgery, patients show loss of weight, improvement in or resolution of comorbidities and decreased use of medications, and have fewer visits to see health care professionals and have fewer examinations done. Even though the cost of the surgery is high, in the long run, the positive clinical effects of the surgery and the reduction in the costs of treatment demonstrate that bariatric surgery is an excellent option.

Acknowledgments The authors would like to thank Dr. A. Leyva for his help with the translation and editing of the final draft of the manuscript.

Disclosure There are no external sources of funds supporting this work. There is no financial interest by any of the authors.

References

1. Livingston EH, Ko CY. Socioeconomic characteristics of the population eligible for obesity surgery. Surgery. 2003;135(3):288–96.
2. Crémieux P-Y, Buchwald H, Shikora AS, et al. A study on the economic impact of bariatric surgery. Am J Manag Care. 2008;14(9):589–96.
3. Maggard MA, Shugarman LR, Suttorp M, et al. Meta-analysis: surgical treatment of obesity. Ann Intern Med. 2005;142:547–59.
4. Elder KA, Wolfe BM. Bariatric surgery: a review of procedures and outcomes. Gastroenterology. 2007;132:2253–71.
5. Buchwald H, et al. Bariatric surgery a systematic review and meta-analysis. JAMA. 2004;292(n 14):1725–37.
6. Craig BM, Tseng DS. Cost-effectiveness of gastric bypass for severe obesity. Am J Med. 2002; 113:(6)491–498
7. Sjöström L, Lindroos A-K, Peltonen M, et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med. 2004;351:2683–93.
8. Padwal RS, Sharma AM. Treating severe obesity: morbid weights and morbid waits. CMAJ. 2009;181(11):777–8.
9. Arcila D, Velásquez D, Gamino R, et al. Quality of life in bariatric surgery. Obesity Surgery 2002;12
10. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care 2011;34(supplement 1):January 2011
11. Frezza EE, Wachtel MS. The economic impact of morbid obesity. Surg Endosc. 2009;23:677–9.
12. Sociedade Brasileira de Cardiologia/Sociedade Brasileira de Hipertensão/Sociedade Brasileira de Nefrologia. VI Diretrizes Brasileiras de Hipertensão. Arq Bras Cardiol 2010;95(1 supl.1):1–51.
13. Ministério da Saúde. http://w3.datasus.gov.br/datasus/datasus.php. Accessed on May 11, 2009.
14. Christou NV. Impact of obesity and bariatric surgery on survival. World J Surg. 2009;33:2022–7.
15. Balduf LM, Kohn GP, Galanko JA, et al. The impact os socioeconomic factors on patient preparation for Bariatric Surgery. Obes Surg. 2009;19:1089–95.
16. Klarenbach S, Padwal R, Wiebe N, et al. Bariatric surgery for severe obesity: systematic review and economic evaluation [Internet]. Ottawa: Canadian Agency for Drugs and Technologies in Health; 2010 (Technology report; no. 129). [cited 2010-09-20]. Available at: http://www.cadth.ca/index.php/en/hta/reportspublications/search?&type=16
17. SISHIPERDIA—Ministério da Saúde. http://hiperdia.datasus.gov.br. Accessed on December 13, 2010.