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The Impact of Weight Reduction Surgery on Health-Care Costs in Morbidly Obese Patients

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Background: The treatment of obesity and related co-morbidities are significant financial burdens and sources of resource expenditure. This study was conducted in order to assess the impact of weight-reduction surgery on health-related costs.

Methods: This was an observational two-cohort study. The treatment cohort included patients having undergone weight-reduction (bariatric) surgery at the McGill University Health Centre (MUHC) between 1986 and 2002. The control group included age and gender matched obese patients who had not undergone weight-reduction surgery from the Quebec provincial health insurance database (RAMQ). The cohorts were followed for a maximum of 5 years from inception. The primary outcome measure was overall direct health-care costs. Secondary outcomes included cost analysis by diagnostic category for the treatment of new medical conditions following cohort inception.

Results: The cohorts were well-matched for age, gender and duration of follow-up. Patients having undergone bariatric surgery had significant reductions in mean percent initial excess weight loss (67.1%, *P*<0.001) and in percent change in initial body mass index (34.6%, *P*<0.001). Bariatric surgery patients had higher total costs for hospitalizations (per 1,000 patients) in the first year following cohort inception (surgery cohort = CDN $12,461,938; control cohort = CDN $3,609,680). At 5 years after cohort inception, average cumulative costs for operated patients were CDN $19,516,667 versus CDN $25,264,608, for an absolute difference of almost CDN $6,000,000 per 1,000 patients.

Conclusion: Weight-reduction surgery in morbidly obese patients produces effective weight loss and decreases long-term direct health-care costs. The initial costs of surgery can be amortized over 3.5 years.

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Introduction

During recent years, obesity has emerged as a major public health problem and is second to smoking as a leading cause of preventable, premature death in the United States and the Western World.[1] According to the World Health Organization (WHO), there is a growing epidemic of obesity throughout most of the developed and developing world.[2] The prevalence of obesity in Canada has increased from 5.6% in 1985 to 14.8% in 1998.

Morbid obesity is independently associated with an increased risk for mortality[3,4] and increased physical and psychological dysfunction.[5-8] The associations between morbid obesity and increased risk for the development of hypertension, coronary artery disease, diabetes, cancer and respiratory conditions have been well-documented.[9-15] The data in the literature have shown that bariatric surgery is effective in producing short- and long-term weight loss in obese patients[16-20] and is more effective than dieting in producing sustained weight loss.

In addition to the increased risk for mortality and morbidity, obesity consumes a large portion of health-care expenditures through both direct and indirect costs related to the management of obesity and its sequelae.[22-27] Obesity has been shown to be associated with a 36% independent increase in inpatient and outpatient spending and a 77% increase in medication use.[28] In view of the impact of obesity on health status and quality of life, it is anticipated that weight loss in obese patients will be associated with both health and economic benefits.[29] However, to our knowledge there have not been any reports of the economic effects of weight-reduction surgery in morbidly obese patients compared to non-operated individuals.

This study was undertaken with the goal of evaluating the effect of weight-loss (bariatric) surgery on health-care costs. The current study addresses this issue by comparing the direct health-care costs related to hospitalization for two cohorts of obese patients: one cohort that underwent weight-reduction surgery and one that did not.

Methods

Study Design

This was an observational two-cohort study that compared the health-care costs of a cohort of morbidly obese patients treated with bariatric surgery at the Center for Bariatric Surgery, McGill University Health Centre (MUHC) to that of matched morbidly obese controls that had not been treated surgically. The inception time of the bariatric cohort was the time of admission for surgery. The inception time for the control group was the date of surgery of their matched bariatric patients. A maximum of six controls were identified for each bariatric subject. The two cohorts were followed for 5 years.

Assembly of Study Cohorts

A total of 1,118 patients underwent bariatric surgery for the treatment of morbid obesity at the MUHC between January 7, 1986 and June 8, 2002. The unique health insurance numbers of these patients were used to retrieve their information from the provincial health insurance database of the Regie de l'assurance maladie du Quebec (RAMQ). The RAMQ database includes information regarding all health-care utilization claims, including those for hospitalizations, physician visits, prescription medications and other paramedical services. Database linkage was conducted using encrypted provincial health insurance numbers to ensure anonymity of the patient. Data concerning weight loss parameters for these patients were extracted from the MUHC bariatric surgery patient registry.

Of the 1,118 patients in the bariatric surgery cohort, 83 patients were excluded because they were treated for one of the outcome conditions listed in Table 1 prior to their operation. If a patient had a repeat bariatric surgery, the index surgery was used as the point of entry into the cohort and the subsequent surgery was included in the follow-up morbidity assessment.

The RAMQ database was queried to identify a maximum of six control subjects for each bariatric patient. The inclusion criteria for the controls were a diagnosis of morbid obesity according to the ICD9 codes for treatment in a hospital, treatment by a physician or as an indication for a prescription, as well as never having had surgery for the treatment of obesity, and never having been treated for one of the outcome conditions listed in Table 1 prior to the date of surgery for the matched bariatric subject. Each bariatric patient was caliper-matched to controls with respect to the date of the first diagnosis of morbid obesity within 2 years, age within 5 years, and gender. There were a total of 6,210 controls identified, of which 464 were excluded because they had been hospitalized for one of the chronic conditions listed in Table 1 prior to the surgery date of their matched bariatric patient.

The final study sample included 1,035 bariatric

Table 1. Exclusion Criteria – Chronic Conditions

Diseases of the Blood and Blood-Forming Organs
Cancer
Cardiovascular and Circulatory Diseases
Digestive Diseases
Endocrinological Diseases including Diabetes
Genito-urinary Diseases
Infectious Diseases
Musculoskeletal Disorders including Arthritis
Nervous System Diseases
Psychiatric and Mental Diseases
Respiratory Diseases
Skin Diseases

surgery patients and 5,746 matched controls.

Weight loss for the bariatric surgery cohort was estimated using the percent change in body mass index (BMI) and percent excess weight loss. The percent change in BMI was calculated as: 100% $x\{(BMI_0-BMI_i)/BMI_0\}$ where BMI_i=the BMI at the last follow-up and BMI_0 is the BMI at the time of surgery. The percent excess weight loss was calculated as: 100% $x\{(W_0-W_i)/EW_0\}$ where W_0=the weight (kg) at the time of surgery, W_i=the weight (kg) at the last follow-up and EW_0=the excess weight at the time of surgery. Excess weight was estimated according to the formula described by Deitel and Greenstein[30] and are based on the Metropolitan Tables for middle frame individuals.

Surgical Procedures

Roux-en-Y Gastric Bypass (RYGBP)

Patients were given 2 gm sodium cephazolin i.v. and 7,500 units of unfractionated heparin s.c. with induction of anesthesia. Exposure was obtained through an upper midline incision. Blunt finger dissection was used to encircle the cardia of the stomach at the angle of His and the lesser curvature of the stomach approximately 2 cm distal to the gastroesophageal junction. At this point, a 2 cm window was made along the lesser curvature of the stomach. A previously placed 32-Fr bougie was held against the lesser curvature and a 25-mm EEA® (Ethicon Endo-Surgery) was used to create a circular opening into the stomach.

The PI-90® instrument (US Surgical Corp) was passed through this opening (with the help of a No. 28 chest tube), positioned in a vertical orientation against the bougie, and fired. A second firing of the PI-90 created a quadruple row of staples, and the stomach was completely divided between the staple-lines. A Roux limb of jejunum (50-300 cm long depending on the BMI and the date of the surgery) was brought up in a retrocolic, retrogastric fashion, and an end-to-side gastrojejunostomy was fashioned using a 3-0 PDS® (Ethicon Endo-Surgery) single continuous suture around an 18-gauge nasogastric tube. The end result was a gastric pouch 1.2 cm in diameter and 4-5 cm long with a calculated volume (πr^2 x height) of ~4.5-6 cc (approximately the size of a thumb). The jejunojejunostomy was completed, and the mesenteric defects were closed. The nasogastric tube was removed after a satisfactory methylene blue and air bubble leak test. A small suction drain was placed next the gastrojejunostomy and brought out through a separate stab-wound incision up to 1998. No drains were used afterwards. The fascia was closed with a No. 2 Maxon® double suture in a continuous fashion. The subcutaneous tissue was irrigated and carefully dried with clean sterile sponges that had not touched skin.

Clips were used to close the skin, and an occlusive dressing was applied. Two more doses of cephazolin were given after surgery and 7,500 units of s.c. heparin was continued until patient discharge. Patients were placed on a cardiac monitor after surgery and ambulated later on the day of surgery. Ice chips and water were given orally the night of the operation, initially limited to no more than 60 mL per hour. The following morning, if there was no tachycardia >120 bpm, tachypnia or fever, the patients were given a clear fluid diet and advanced to full fluid diet as tolerated. Discharge followed on the 3rd-4th postoperative day. The first appointment to the bariatric clinic was scheduled for 2 weeks after surgery.

Since February 2002, we have been performing RYGBP laparoscopically using 5 ports. We perform a hand-sewn gastrojejunostomy using a modification of Higa's technique.[31] This ensures that the operation is very similar to the open RYGBP, especially the creation of the very small vertically oriented gastric pouch. The time-frame of this study captured the first 21 laparoscopic RYGBP patients for this analysis.

Vertical Banded Gastroplasty (VBG)

Exposure was obtained through an upper midline incision. Blunt finger dissection was used to encircle the cardia of the stomach at the angle of His and the lesser curvature of the stomach approximately 2 cm distal to the gastroesophageal junction. At this point, a 2 cm window was made along the lesser curvature of the stomach. A 28-Fr Maloney bougie was placed along the lesser curvature of the stomach as a guide for the placement of the EEA stapler and for the placement of the vertical staple-lines. The EEA device used was either Auto-Suture (United States Surgical Corp) or the Ethicon Proximate intraluminal stapler. Pouch size was measured in the first 20 patients and intermittently thereafter with a 70-cm water head of pressure and was never larger than 30 ml.

The vertical staple-lines were made with a TA 90 instrument (United States Surgical Corp, Norwalk, CT) with 4.8-mm staples. In all patients, at least two applications of the stapler were made with close approximation of the staple-lines in most. In a few patients, a third set of staple-lines was added and in some patients there was a separation of the staple-lines by 1 cm of stomach wall. The staple-lines were not reinforced with sutures. The VBG was made with an outlet of 40 to 45 mm external circumference. Either a single or double layer of polypropylene mesh 60 mm in length and 15 mm in width was used to construct the band. The mesh was sutured in place with four 3-0 polypropylene sutures at a premeasured length to correspond to the above circumferences. A gastrostomy with a 14-Fr catheter was routinely placed in the stomach below the gastroplasty and removed after 6 weeks if the patient tolerated oral feeds. An 18-Fr nasogastric tube was also placed into the gastroplasty pouch for 24 hours.

Estimation of Health-Care Costs

The RAMQ database was searched for all claims for health-care services utilized by subjects in both cohorts for the 5-year period following the date of entry into the study. The ICD9 codes were used to classify the primary conditions leading to the utilization of health-care services.[32] Direct health-care costs were presented in 1996 Canadian dollars. For each subject, the total direct health-care cost was estimated on the basis of the information in the RAMQ database. Hospital costs included the costs for hospital bed use, intensive care unit stay, nursing, medications, food, operating-room costs, diagnostic procedures including all radiology and laboratory tests, disposable equipment, physician's fees, surgeon's fees, anesthesiologist's fee, preoperative evaluation fees, dietetics consultation fees, psychiatric evaluation fees and all paramedical services including physiotherapy. The costs for the bariatric surgery and subsequent related care including the management of complications were included in the total cost estimates of the bariatric surgery cohort. The RAMQ costs reflect the value of the claim and are not necessarily equivalent to the costs for the services in the private sector.

The statistical significance of weight loss in the bariatric surgery cohort was assessed using the paired Student's t-test and was described using the mean change and 95% confidence intervals for the cohort. Differences between the bariatric surgery and control cohorts with respect to health-care costs were assessed for statistical significance with the Student's t-test.

The study was submitted and approved by the McGill University Health Centre Ethics Review Board.

Results

Seven different surgeons affiliated with the MUHC treated the 1,035 bariatric patients in two hospitals over 16.4 years. One surgeon carried out half these procedures. Table 2 describes the patient demographics of the two cohorts. There were no differences with respect to age and gender of the two cohorts. The majority of the procedures were open Roux-en-Y isolated gastric bypasses: 820 (79.2%), followed by VBG: 194 (18.7%), and laparoscopic Roux-en-Y isolated gastric bypass: 21 (2.2%). Fifty-six per cent were in the BMI range 38-49, 32% in the BMI range 50-59, 8% in the BMI range 60-69, and the rest had a BMI >70 (highest 98). Thirty-five per cent of the VBG patients were subsequently converted to open RYGBP because of complications which included outlet obstruction (58%), failure to lose weight (33%) and miscellaneous reasons (9%). There were no significant differences in age, gender or follow-up.

The data in Table 3 describe the weight loss

Table 2. Patient Demographics

		Bariatric Surgery	Controls
Number of Subjects		1,035	5,746
Age (years)	Mean (SD)	45.1 (11.6)	46.7 (13.1)
	Median	44.8	47.0
Gender N (%)	Male	356 (34.4)	2,068 (36.0)
	Female	679 (65.6)	3,678 (64.0)

Table 3. Weight Loss - Bariatric Surgery Cohort

Parameter	Mean	SD	Min-Max
Initial Weight (kg)	136.4	28.4	77 - 284
Initial BMI (kg/m²)	50.0	8.2	36 - 90
Ideal Body Weight (kg)	64.1	8.4	45 - 114
Initial Excess Weight (kg)	72.4	23.8	29 - 205
Excess BMI (kg/m²)	26.5	7.8	12 - 66
Final Weight (kg)	88.8	22.9	42 - 199
Final BMI (kg/m²)	32.6	7.3	16 - 62
% Initial Excess Weight Loss	67.1	23.7	1 - 130
% Initial BMI Reduction	34.6	12.1	1 - 65
Overall Follow-up (years)	5.3	3.8	1 - 16

achieved in the bariatric surgery cohort. There were significant reductions in mean percent excess weight loss (67.1%, $P<0.001$) and in the percent change in BMI (34.6%, $P<0.001$).

Table 4 summarizes the average total costs per 1,000 patients for the 5 years following cohort inception. In the first year, total costs for hospitalizations in the surgery cohort were higher by over 8 million Canadian dollars per 1,000 patients, when compared to the controls. This difference is reversed for the subsequent years, reaching a maximum during the fifth year when the costs for the control cohort were more than 4 million dollars higher on the average for the control cohort when compared to the bariatric cohort. After 5 years, the total cost per 1,000 patients for hospitalizations in the control cohort was 29% higher when compared to the bariatric patients (Absolute Difference = 5.7 million 1996 CDN dollars in favor of weight-reduction surgery).

Table 5 and Figures 1 and 2 demonstrate the annual cumulative costs over the 5-year study period. For the first 3½, the cumulative average cost is higher for the bariatric cohort. However, in the next 1½, the difference in costs was in favor of the patients who underwent surgery. After 3.5 years, the initial investment for the weight-reduction surgery and related hospital care was compensated by a reduction in total costs. This corresponds to an expected amortization period of 3.5 years of the initial investment for bariatric surgery.

Table 6 outlines the annual costs per hospitalization per 1,000 patients by primary diagnosis of hospitalization. The costs of the bariatric surgery are included in the first year. The cost for the surgery and admissions due to digestive system problems were higher in the first year in the surgery cohort when compared to controls. For all subsequent years, these costs were higher in the controls when compared to the surgery cohort. For all other diagnoses, the costs in the bariatric cohort were less than the controls for the 5-year follow-up period.

Discussion

This was an observational study utilizing a combination of hospital and provincial insurance administrative databases to assess the direct health-care costs in morbidly obese patients treated with bariatric surgery and matched controls that were not treated surgically.

The direct cost of obesity is between 2 and 5% of most developed countries' health-care expenditures.[33] In 1995, the total cost of obesity in the USA was estimated to be 99 billion US dollars with 52 billion dollars representing direct health costs. This is equivalent to 5.7% of the total health costs.[34] If the direct cost of physical inactivity is combined with that of obesity, the estimated cost in the USA is 9.4% of the national health budget.[35] The direct

Table 4. Average total cost per 1,000 patients for hospitalization by group, year of follow-up

Year of Follow Up	Bariatric	Control	Absolute Difference	Cost Ratio; Control/Bariatric
1	$12,461,938	$3,609,680	$-8,852,258	0.29
2	$3,398,835	$4,846,794	$1,447,959	1.43
3	$1,362,408	$5,831,456	$4,469,048	4.28
4	$1,318,323	$5,895,988	$4,577,666	4.47
5	$975,163	$5,080,690	$4,105,526	5.21
Total:	$19,516,667	$25,264,608	$5,747,941	1.29

Table 5. Average cumulative costs per 1,000 patients for hospitalization by group and year of follow-up

Year of Follow-Up	Bariatric	Control	Absolute Difference	Cost Ratio; Control/Bariatric
1	$12,461,938	$3,609,680	$-8,852,258	0.29
2	$15,860,773	$8,456,474	$-7,404,299	0.53
3	$17,223,181	$14,287,930	$-2,935,251	0.83
4	$18,541,503	$20,183,918	$1,642,415	1.09
5	$19,516,667	$25,264,608	$5,747,941	1.29

medical costs attributable to adult obesity in Canada are estimated to have been $1.8 billion in 1997 or 2.4% of total direct medical costs.[36] The highest cost drivers are those of managing the co-morbidities associated with obesity.[37,38] It is estimated that obesity accounts for 85% of the total cost of treating type II diabetes and 45% of the cost of treating hypertension.[39]

Medical interventions for weight loss in severely obese patients are ineffective.[40-44] In 1991, an NIH consensus conference reviewed the long-term data on safety and efficacy of medical and surgical weight loss therapies and concluded that surgical therapy should be offered to morbidly or severely obese patients who are unresponsive to non-surgical therapy.[45] In 2000, the NIH published evidence-based guidelines stating that surgical therapy should be offered to obese patients (BMI >35) who have experienced obesity-related co-morbidities.[46]

Narbro et al[47] compared the pharmaceutical costs in a group of 510 obese individuals who underwent weight-reduction surgery to a group of 455 randomly selected obese individuals who did not undergo weight-reduction surgery for 6 years following surgery. She found that surgery lowered the usage and costs of diabetes and cardiovascular medications, but was associated with increased costs for other medications including gastrointestinal, anemia and vitamin deficiency medications. This resulted in similar total overall medication costs for both groups. Potteiger et al[48] found a 77.3% reduction in total cost of diabetic and antihypertensive medications with surgically induced weight loss (RYGBP).

We found that when compared to a cohort of matched controls, the patients having undergone bariatric surgery had significantly reduced total direct health-care costs. This finding is significant from a societal and health-economic point of view, because the health-care services and costs associated with surgery were included in the total costs for the bariatric surgery patients. These results have shown that on the average, the total direct health-care costs for managing a morbidly obese patient may be reduced by 29% within 5 years following surgery. In absolute terms, this is equivalent to a total reduction of approximately CDN $5,700 in direct health-care costs per patient. The total benefit would be greater if indirect costs were considered.

The strengths of the current study are related to the design and the selection of the cohorts. The

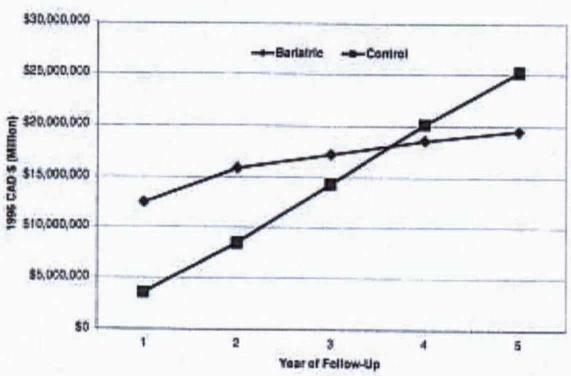

Figure 1. Average cumulative costs per 1,000 patients for hospitalization by group and year of follow-up.

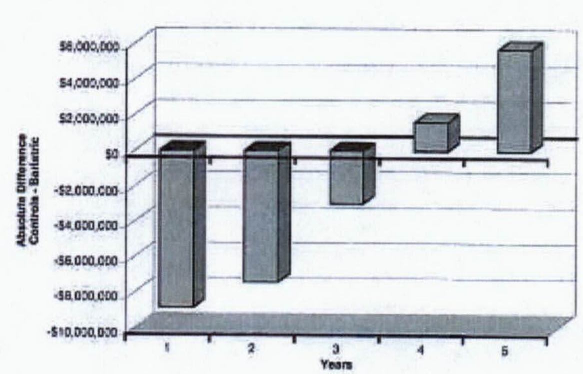

Figure 2. Average cumulative costs per 1,000 patients for years of follow-up: Controls minus surgery patients.

Table 6. Average costs per 1,000 patients for hospitalization by primary diagnosis, group and year of follow-up

	Bariatric	Control	Bariatric	Control	Bariatric	Control	Bariatric	Control	Bariatric	Control
Bariatric Surgery	$8,718,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Hematological	$2,126	$1,532	$4,251	$2,297	$0	$5,743	$0	$5,360	$2,126	$4,595
Cancer	$128,357	$226,580	$148,895	$312,588	$46,209	$707,485	$56,477	$677,891	$46,209	$457,785
Digestive	$1,340,033	$251,525	$1,321,247	$289,874	$513,471	$625,993	$444,590	$664,342	$394,496	$431,991
Cardiovascular	$885,872	$1,767,764	$477,676	$2,797,134	$442,936	$1,148,264	$425,566	$1,104,461	$251,866	$1,756,813
Endocrinological	$302,458	$129,032	$270,620	$107,527	$71,635	$288,172	$55,716	$263,800	$63,675	$197,850
Genito-urinary	$216,155	$361,183	$262,145	$407,574	$87,382	$917,870	$55,188	$954,320	$59,787	$685,089
Infections	$347,589	$274,675	$437,290	$349,402	$67,275	$694,765	$123,338	$745,257	$22,425	$506,936
Musculoskeletal	$130,788	$130,641	$101,064	$132,783	$59,449	$340,525	$41,614	$320,179	$47,559	$240,937
Nervous System	$164,754	$273,022	$164,754	$281,925	$16,475	$658,814	$65,901	$718,166	$49,426	$510,432
Psychiatric	$107,374	$58,022	$130,383	$44,207	$53,687	$120,189	$30,678	$120,189	$23,009	$85,652
Respiratory	$102,099	$127,858	$68,066	$115,598	$0	$307,385	$14,586	$302,130	$14,586	$196,166
Skin	$16,333	$7,845	$12,444	$5,884	$3,889	$16,251	$4,667	$19,894	$0	$6,444
Total:	$12,461,938	$3,609,680	$3,398,835	$4,846,794	$1,362,408	$5,831,456	$1,318,323	$5,895,988	$975,163	$5,080,690

exclusion of patients with a history of the ascertained outcomes allows the estimation of the true incidence and removes potential selection bias and confounding. Matching the cases and controls with respect to age, gender and duration of disease, further reduces the possibility of confounding from these factors, because both are potentially associated with increased health-care utilization and costs. The random selection of controls from an administrative database reduces selection bias and bias by indication that would have been introduced if hospital-based controls were used.

In conclusion, weight reduction surgery in this cohort of Canadian patients is associated with a net reduction of more than 5.7 million Canadian dollars for health-related hospitalizations per 1,000 patients treated, within 5 years after surgery. Weight-reduction surgery appears to be cost minimizing over the long-term, and further reductions in costs over longer periods of follow-up could be expected. Although more extensive risk-benefit assessments may be useful in providing more detailed data regarding the impact of bariatric surgery, the current study has produced evidence supporting the implementation of weight-reduction surgery in the management of the morbidly obese patient from a health-economic perspective.

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STUDY ON ECONOMIC IMPACT OF BARIATRIC SURGERY

A Study on the Economic Impact of Bariatric Surgery

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Objective: To evaluate the private third-party payer return on investment for bariatric surgery in the United States.

Study Design: Morbidly obese patients aged 18 years or older were identified in an employer claims database of more than 5 million beneficiaries (1999-2005) using *International Classification of Diseases, Ninth Revision, Clinical Modification* code 278.01. Each of 3651 patients who underwent bariatric surgery during this period was matched to a control subject who was morbidly obese and never underwent bariatric surgery. Bariatric surgery patients and controls were matched based on patient demographics, selected comorbidities, and costs.

Methods: Total healthcare costs for bariatric surgery patients and their controls were recorded for 6 months before surgery through the end of their continuous enrollment. To account for potential differences in patient characteristics, we calculated the cost differential by estimating a Tobit model. A return on investment was estimated from the resulting coefficients. Costs were inflation adjusted to 2005 US dollars using the Consumer Price Index for Medical Care, and the cost savings were discounted by 3.07%, the 3-month Treasury bill rate during the same period.

Results: The mean bariatric surgery investment ranged from approximately $17,000 to $26,000. After controlling for observable patient characteristics, we estimated all costs to have been recouped within 2 years for laparoscopic surgery patients and within 4 years for open surgery patients.

Conclusions: Downstream savings associated with bariatric surgery are estimated to offset the initial costs in 2 to 4 years. Randomized or quasiexperimental studies would be useful to confirm this conclusion, as unobserved characteristics may influence the decision to undergo surgery and cannot be controlled for in this analysis.

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For author information and disclosures, see end of text.

The prevalence of obesity among the US adult population has increased steadily to reach one third of the US adult population.[1] More alarming yet, the trend in morbid obesity outpaces that of nonmorbid obesity. From 2000 through 2005, the US obesity rate increased by 24%, while the rate of morbid obesity (body mass index [BMI], calculated as weight in kilograms divided by height in meters squared ≥40) grew by 50%, and the rate of patients with a BMI exceeding 50 grew by 75%.[2,3] This trend in morbid obesity results in increased healthcare utilization and costs, as healthcare costs for the morbidly obese are 81% above those for the nonobese population and 47% above costs for the non–morbidly obese population.[4,5]

Morbid obesity is associated with a myriad of serious comorbid conditions, including hypertension, type 2 diabetes mellitus, dyslipidemia, osteoarthritis, and gallbladder disease.[6,7] Bariatric surgery has been demonstrated to be an effective weight-loss alternative for the morbidly obese[8-10] and is associated with marked resolution of comorbidities.[9] Other studies[11-13] have found similar results, with reductions in morbidity, cardiovascular risk, healthcare utilization, and costs in bariatric surgery patients compared with control subjects. Although most of the current literature examines health benefits associated with bariatric surgery,[14] studies have also documented quality-of-life improvements,[15,16] length-of-life increases,[17-19] and reduced work loss[20] associated with bariatric surgery.

Despite the extensive literature on the clinical effects of bariatric surgery, little research has been published on the economic impact of the procedure. This represents a growing gap in the literature as the clinical outcomes become better known and the procedure becomes more commonplace (>170,000 surgical procedures in 2005), while its economic costs or benefits remain unclear.[21] The present analysis is unique in its use of actual patient-level cost data for 3651 patients who underwent the procedure. The resulting return on investment is calculated based on up to 5 years of postoperative cost data.

This study quantifies the effect of bariatric surgery on direct medical costs. We focus on the time required for third-party payers to recover the initial investment associated with bariatric surgery (ie, the return on investment).[8] Using the Ingenix private insurer claims database and a matched cohort method and focusing only on costs incurred and saved by the private insurer, we build on findings of a

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previous study[20] that suggested a 9-year period to recoup the cost of bariatric surgery. We further examine changes in return on investment over time as bariatric surgery techniques have improved and focus on laparoscopic surgery outcomes.[22] This analysis should help evaluate the cost-benefit implications of bariatric surgery.

METHODS

Data

We used a privately insured administrative claims database containing medical and drug claims from 1999 through 2005 covering more than 5 million lives from 31 large companies that provided extensive health insurance coverage, including mental health. These companies have operations nationwide in a broad array of industries and job classifications (eg, financial services, manufacturing, telecommunications, energy, and food and beverage). The data contain deidentified information on patients' demographics (eg, age and sex) and monthly enrollment history, as well as medical and pharmacy claims. Specifically, patients' utilization of medical services is recorded with the date of service, place of service, associated diagnoses, performed procedures, billed charges, and actual amount of payments. Patients' pharmacy claims contain prescribed medications identified by National Drug Code, the date a prescription was filled, days of supply, quantity, and actual payment amount. The study sample for this analysis included claimants having a diagnosis of morbid obesity (*International Classification of Diseases, Ninth Revision, Clinical Modification* code 278.01). Patients 18 years or older who underwent bariatric surgery were identified using Health Care Financing Administration Common Procedural Coding System and *Current Procedural Terminology* codes 43644, 43645, 43842, 43843, 43845, 43846, 43847, S2085, S2082, and S2083. Of these procedures, 73% were gastric restrictions with bypass (codes 43845, 43846, and 43847), 11% were gastric restrictions without bypass (codes 43842 and 43843), 12% were laparoscopic surgical procedures with bypass (codes 43644, 43645, and S2085), and 4% were laparoscopic surgical procedures without bypass (codes S2082 and S2083).

Analysis

The initial date of bariatric surgery was defined as the index date for the relevant patient, as well as his or her control. All claimants in the study sample were required to have at least 6 months of continuous enrollment before the index date and 1 month following the index date.

Because patients with a morbid obesity claim may be sicker, on average, than patients with no such claim recorded, surgery-eligible controls (morbidly obese patients with no bariatric surgery procedure code) were matched to bariatric surgery patients based on age group, sex, state of residence, comorbidities, and 5-month presurgery direct costs (months −6 to −2, excluding month −1 immediately before surgery, which is often characterized by increased costs associated with preparation for surgery). Each bariatric surgery patient was matched to a specific control drawn from the morbidly obese control population that never underwent bariatric surgery.

For each bariatric surgery patient, a control was considered a match if (1) the control's age was within the same 10-year age range as that of the bariatric surgery patient, (2) the control was of the same sex, (3) the control resided in the same state as the bariatric surgery patient, (4) the control had the same 10 comorbidities as the bariatric surgery patient (Table 1), and (5) the control's healthcare costs fell within 1 SD of the cumulative costs (during months −6 to −2) incurred by the bariatric surgery patient. The matching of bariatric surgery patients with their controls is performed based on 10 comorbidities, although findings in a review of the existing literature[23] and the guidelines of the American Society for Bariatric Surgery[24] suggest that 18 comorbidities could cause imbalance between the 2 samples. However, not every patient could be matched on the demographics and on all 18 comorbidities because patients with the corresponding combination of comorbidities may not be observed in the control group. Hence, patients were matched to controls using a subset of the following 10 comorbidities: asthma, coronary artery disease, diabetes mellitus, dyslipidemia, gallstones, gastroesophageal reflux, hypertension, nonalcoholic steatohepatitis or nonalcoholic fatty liver disease, sleep apnea, and urinary incontinence. Multivariate analysis was used to account for the remaining 8 comorbidities, thereby addressing any remaining imbalance across matched samples. These 8 comorbidities are breast cancer, congestive heart failure, lymphedema, major depression, osteoarthritis, polycystic ovary syndrome, pseudotumor cerebri, and venous stasis or leg ulcers.

Because calculating a return on investment requires a comparison of costs for the bariatric surgery and control patients during multiple years, 2 adjustments were made. First, costs were inflation adjusted to 2005 US dollars using the Consumer Price Index for Medical Care because a dollar spent today would purchase more goods and services than a dollar spent in 2 years (as long as inflation is positive). Second, cost savings were discounted by a 3.07% interest rate, the mean return on a 3-month Treasury bill, because a dollar saved today would, if invested in a risk-free Treasury bill, be worth more than a dollar in 2 years (roughly $1.06 at the stated rate). However, the shorter the time horizon to recoup costs, the less effect discounting will have on the estimated return on investment. The multivariate analysis modeled normalized monthly costs as a function of bariatric surgery interacting with discrete indicators of time from surgery. A positive coefficient indicates that costs incurred by the bariatric surgery patients are higher; a negative coefficient indicates that costs are lower relative to their controls. Therefore, positive coefficients indicate incremental third-party payer costs associated with bariatric surgery (the "investment"), and negative coefficients indicate savings from bariatric surgery (the "return"). The return on investment calculations combine these estimates to determine the number of months necessary for cumulative savings associated with improved comorbidity outcomes following surgery to cover the initial investments. The point estimates are reported with 95% confidence intervals (CIs). Indicator variables in 6-month increments are included to allow for nonlinear savings. In addition to the indicator variables, the multivariate model controlled for age and the 8 comorbidities already mentioned. The comorbidities were tracked at 3-month intervals to record changes in prevalence.

Healthcare costs cannot be negative, rendering ordinary least squares analysis biased and inefficient.[25] Therefore, we estimated a maximum likelihood Tobit model with a cluster option to account for panel-level heterogeneity[26] to reflect the truncated normal distribution. A sensitivity analysis was conducted using an interval model, which yielded similar results. We calculated the cost differential by estimating the model on the pooled population (patients and controls) and using the coefficient on the variable interacting bariatric surgery with the relevant time period. Based on this coeffi-

Table 1. Baseline Characteristics of Bariatric Surgery Patients and Matched Surgery-eligible Control Subjects

Baseline Characteristic[a]	Bariatric Surgery Patients (n = 3651)	Surgery-eligible Control Subjects (n = 3651)
Demographics		
Age at index date, mean, y	43.8	44.1
Female sex, %	86.0	86.0
Age group, y, %		
18-30	11.1	11.1
31-40	27.0	27.0
41-50	32.2	32.2
51-64	29.7	29.7
Year of index date, %		
1999	0.5	0.5
2000	2.4	2.4
2001	8.2	8.2
2002	18.3	18.3
2003	29.1	29.1
2004	21.2	21.2
2005	20.3	20.3
Comorbidity profile, %		
Matched comorbidity		
Asthma	3.9	3.9
Coronary artery disease	1.9	1.9
Diabetes mellitus	18.4	18.4
Dyslipidemia	19.0	19.0
Gallstones	0.9	0.9
Gastroesophageal reflux	9.7	9.7
Hypertension	37.0	37.0
Nonalcoholic steatohepatitis or nonalcoholic fatty liver disease	0.4	0.4
Sleep apnea	13.5	13.5
Urinary incontinence	0.1	0.1
Nonmatched comorbidity		
Breast cancer	0.5	0.8
Congestive heart failure	1.0	1.3
Lymphedema	0.3	0.3
Major depression	6.5	5.5[b]
Osteoarthritis	9.7	7.3[c]
Polycystic ovary syndrome	1.0	0.9
Pseudotumor cerebri	0.3	0.2
Venous stasis or leg ulcers	0.1	0.1

(Continued)

Table 1. Baseline Characteristics of Bariatric Surgery Patients and Matched Surgery-eligible Control Subjects *(Continued)*

Baseline Characteristic[a]	Bariatric Surgery Patients (n = 3651)	Surgery-eligible Control Subjects (n = 3651)
Healthcare service utilization, %		
Inpatient visit	4.5	4.9
Emergency department visit	10.8	12.4[b]
Outpatient hospital visit	58.0	45.8[c]
Office visit	93.5	84.0[c]
Healthcare costs, mean (SD), $		
Prescription drug	668 (1019)	663 (988)
Medical service	1775 (2555)	1480 (2510)[c]
Total	**2443** (2864)	**2143** (2797)[c]

[a]Baseline characteristics are measured during the 6-month preindex period except for healthcare costs and utilization, which do not include the month before surgery and cover 5 months of care. For bariatric surgery patients, the index date is the first date recorded for bariatric surgery; for surgery-eligible control subjects, the index date is the same as that of the matched patient. Bariatric surgery patients and surgery-eligible controls were matched on the following 10 comorbidities: asthma, coronary artery disease, diabetes mellitus, dyslipidemia, gallstones, gastroesophageal reflux, hypertension, nonalcoholic steatohepatitis or nonalcoholic fatty liver disease, sleep apnea, and urinary incontinence.
[b]$P < .05$.
[c]$P < .01$.

cient, a return on investment is calculated by offsetting the initial bariatric investment against incremental cost savings for bariatric surgery patients following surgery.

Overall results across all bariatric surgical procedures are reported using the complete time series available from 1999 through 2005. For open surgical procedures, results are further reported separately for patients who received their surgical procedure from 1999 through 2002 and for patients who received their surgical procedure from 2003 through 2005. This tests our clinical experience of shorter lengths of stay and improved outcomes associated in part with the development of centers of excellence in the later years, which may in turn shorten the estimated return on investment relative to the earlier period. This approach cannot be used for laparoscopic surgery because a code specific to that type of surgery did not exist until 2004. Hence, we report results for patients who underwent laparoscopic surgery from 2004 through 2005 separately. All estimations were performed using statistical software (Intercooled STATA 9.2 [StataCorp LP, College Station, Texas] and SAS 9.1 [SAS Institute, Cary, North Carolina]).

RESULTS

Table 1 compares bariatric surgery patients and their controls at baseline after matching on age group, sex, costs, state of residence, and 10 comorbidities. The sample is predominantly female (86%), with a mean age of 44 years. More than one third of the sample had hypertension, and close to 20% had dyslipidemia or diabetes mellitus. Major depression and osteoarthritis are the only 2 comorbidities with statistically different prevalences across groups. Both comorbidities are included as control variables in the multivariate analysis. Both study groups have similar prescription drug costs. Bariatric surgery patients have somewhat higher baseline medical service costs (20%) and total healthcare costs (14%). The absence of any statistically significant difference in weight-loss medication use or in visits to nutritionists suggests that these differences are not driven by differences in presurgery reimbursable weight-loss efforts. Patients were observed for 6 months before surgery and for a mean of 17 months and 18 months following the index date for the bariatric surgery group and the control group, respectively.

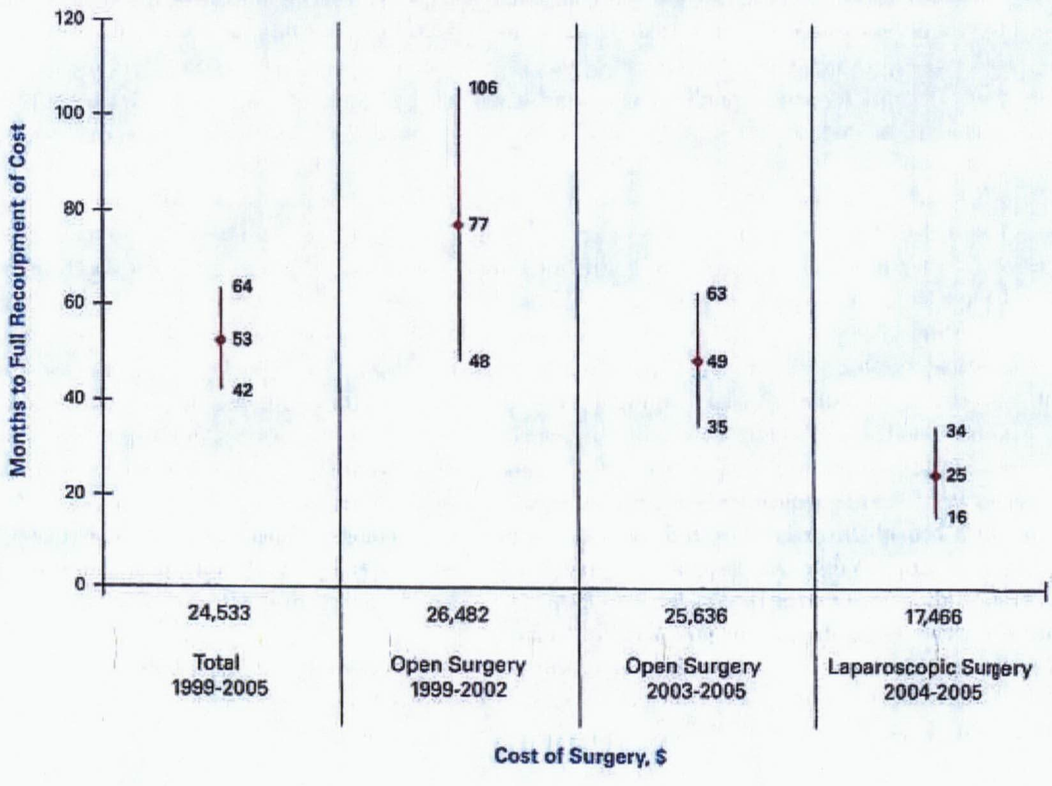
Multivariate regression analysis results summarized in Table 2 demonstrate total incremental costs of approximately $24,500 for all types of bariatric surgery combined, $26,000 for open surgery, and $17,000 for laparoscopic surgery during the period from 1 month before surgery to 2 months following surgery. The total incremental cost is the sum of costs incurred in the month before the surgery, costs incurred in surgery, and costs incurred in the first 2 months following surgery. Starting at month 3, cost savings associated with the bariatric surgery patients start accruing. One and a half years after surgery, monthly savings associated with bariatric surgery reach more than $500 for the whole sample and $400 (1999-2002) to $600 (2003-2005) for open surgery depending on the period ($P < .01$). Monthly savings associated with laparoscopic bariatric surgery reach more than $900 as early as 13 months following surgery ($P < .01$). The Figure shows the estimated return on investment for the 4 models given in Table 2. Based on the data available and on an assumption of constant savings after 19 months, we find that (for the combined sample) total surgery costs are fully recovered after 53 months (95% CI, –42 to 64 months). Costs of open surgery performed between 1999 and 2002 are fully recovered after 77 months (95% CI, –48 to 106 months), and, as expected, costs

Table 2. Multivariate Regression Analysis of Total Monthly Costs of Bariatric Surgery (Dependent Variable Minus Total Monthly Costs) Estimated Using a Tobit Model[a]

	Total	Open Surgery		Laparoscopic Surgery
Variable	1999-2005 (n = 7302)	1999-2002 (n = 2346)	2003-2005 (n = 3914)	2004-2005 (n = 1042)
Presurgery, $				
Months −6 to −2	148.04[b]	−84.99	274.51[c]	312.87[b]
Month before surgery	1815.04[b]	1814.84[b]	1971.79[b]	1278.99[b]
Time of surgery	19,118.01[b]	20,325.78[b]	19,900.61[b]	14,468.50[b]
Postsurgery, $				
Months 1 to 2	1799.78[b]	2170.51[b]	1881.62[b]	859.40[b]
Months 3 to 6	−49.4[b]	176.50	−145.16	−161.27
Months 7 to 12	−272.85[b]	13.75	−402.77[b]	−496.55[b]
Months 13 to 18	−436.67[b]	−207.14[b]	−537.07[b]	−926.23[b]
Months 19 and longer	−544.69[b]	−399.86[b]	−590.68[b]	—
No. of observations	221,483	96,963	106,638	17,882

[a]The model controls for age, breast cancer, congestive heart failure, lymphedema, major depression, osteoarthritis, polycystic ovary syndrome, pseudotumor cerebri, and venous stasis or leg ulcers. For laparoscopic surgery, a likelihood ratio test showed that the coefficients for 13 to 18 months and for 19 months and longer are statistically similar, so a single coefficient is reported. For all other models, a likelihood ratio test was performed to see if grouping the data past 19 months was significantly different from continuing with 6-month increments. All *P* values were statistically nonsignificant.
[b]$P < .01$.
[c]$P < .05$.

Figure. Return on Investment for Bariatric Surgery by Types of Surgery and Different Periods



Take-away Points

The rate of bariatric surgery use has increased in the past decade to more than 170,000 surgical procedures per year in the United States.

- The initial investment for bariatric surgery is approximately $26,000 for open surgery and $17,000 for laparoscopic surgery.
- After taking into account age, sex, and comorbidities, the initial investment is returned within 4 years for patients who undergo open surgery and within 2 years for patients who undergo laparoscopic surgery.
- Even ignoring potential quality-of-life and length-of-life benefits, as well as disability and work loss, third-party payers can rely on bariatric surgery paying for itself through decreased comorbidities within 2 to 4 years.

of open surgery performed between 2003 and 2005 are recovered after 49 months (95% CI, –35 to 63 months). Costs associated with laparoscopic surgery are fully recovered after 25 months (95% CI, –16 to 34 months). These returns on investment result from reductions in prescription drug costs, physician visit costs, and hospital costs (including emergency department visits and inpatient and outpatient visits). The reduced costs are associated with multiple major diagnosis categories, including diabetes mellitus, coronary artery disease, hypertension, and sleep apnea.

DISCUSSION

Bariatric surgery is an effective treatment for morbid obesity. However, payer coverage for these procedures has lagged because of cost concerns. This analysis demonstrates that payers can expect significant cost savings to start accruing after 25 months for patients undergoing laparoscopic bariatric surgery. The study also shows that, while bariatric surgery costs took more than 6 years to be fully recovered as recently as 2002, this interval has been reduced to just over 2 years in 2005 for laparoscopic bariatric surgery. These improvements in return on investment can be attributed to surgical experience, improved technology, and dedicated facilities.[27] Although striking, the short return on investment associated with bariatric surgery is consistent with the well-demonstrated immediate and long-lasting decrease in a myriad of comorbid conditions, including, for example, diabetes mellitus, coronary artery disease, hypertension, and sleep apnea.[11-19,23] The cost reductions observed in this analysis mirror the comorbidity reductions in these disease areas in terms of prescription drug use, hospital visits, and physician visits. Although no systematic data have yet been published to our knowledge, the growing prevalence of "centers of excellence" may also have contributed to this downward trend in costs through improved outcomes and follow-up.[28] We have not examined the cause of the cost advantage associated with laparoscopic bariatric surgery. Our experiences as laparoscopic (SAS) and open (HB) surgeons suggest that it may result from open procedures' being disproportionately performed in the earlier years. At centers performing open and laparoscopic bariatric surgery, patients with higher BMIs and higher comorbidity rates may also be more likely to undergo open surgery.[29] Alternatively, at centers performing laparoscopic bariatric surgery on all morbidly obese patients irrespective of BMI, the lower cost associated with laparoscopic surgery may be the result of reduced trauma, shorter length of stay, or lower levels of wound complications.[8]

Any increases in copayment beyond those incurred by patients in our data (75% of patients had no copayment) would further shorten the period necessary for payers to fully recover their costs. For example, a 25% patient copayment on claims reimbursed would reduce the estimated return on investment period for full recovery from 49 months to approximately 32 months for open surgery and from 25 months to approximately 18 months for laparoscopic surgery. These recovery periods ignore the quality-of-life benefits and reduced work loss associated with weight loss resulting from bariatric surgery.[15,16]

To our knowledge, only 1 other study has assessed the economic benefits of bariatric surgery. In a simulation study, Finkelstein and Brown[30] reported that a 5- to 10-year period was necessary to fully recover costs associated with bariatric surgery. Using real data, our study documents improvement in results relative to the simulation conducted by Finkelstein and Brown. They relied on survey data (2000-2001 Medical Expenditure Panel Survey) to estimate savings; our analysis relies on actual claims records during a 6-year period. Our analysis omits absenteeism costs, while Finkelstein and Brown assumed reduced absenteeism for bariatric surgery patients. Furthermore, the costs of bariatric surgery were assumed by Finkelstein and Brown based on prior literature, whereas we estimated these costs directly from recorded claims. Similarly, reduced costs associated with surgery are calculated directly from claims rather than estimated from various assumptions about surgery-associated weight loss. Despite these significant methodological differences, our estimate of 4 to 9 years for full cost recovery in the early period between 1999 and 2002 is consistent with the 9 years estimated by Finkelstein and Brown.

This study is based on a large insurance claims database that includes detailed information on costs and comorbidities. However, BMI (a potentially useful measure of bariatric surgery eligibility and outcomes) is unavailable. Although this is a limitation of our analysis, surgery-eligible controls were matched to bariatric surgery patients along multiple demographic factors and 18 comorbidities that are likely to be correlated with BMI. Most important, the bariatric surgery patients and the surgery-eligible controls were diagnosed as having morbid obesity, which requires the patient to have a BMI of 40 or higher. The reliability of the cost-savings estimates in our analyses depends in part on the accuracy of our matching process. We matched the bariatric surgery patients with their respective controls on multiple baseline characteristics, including age, sex, total presurgery medical costs, and up to 10 comorbid conditions. We imposed the strict criterion of an exact match on the comorbidities but also confirmed our findings using propensity score matching. We find that the exact match results in a more balanced sample of patients and controls, although it is limited to 10 comorbidities rather than 18 comorbidities selected. Controlling for the 8 nonmatched comorbidities through regression analysis yields similar results, suggesting that few imbalances remain in the sample. Nevertheless, unobserved characteristics unrelated to baseline costs, age, sex, and the selected comorbidities may influence the decision for surgery, introducing a potential bias in the analysis.

Another limitation of our analysis is that the sample of patients observed shrinks as the period elapsed since the index date increases. In particular, the breakeven point estimated for open surgery is dependent on the assumption of constant cost savings from month 19 onward, while the average patient is observed for 17 months. As a result, the CIs estimated around the point estimates widen as the sample size of observed patients decreases over time. Further research based on data during longer periods would be useful to assess the longer-term bariatric surgery return on investment and to confirm the cost savings. Nevertheless, this analysis presents new evidence about the return on investment associated with bariatric surgery during a postsurgery period of 2 to 5 years depending on the date and type of bariatric surgery. Further research on the return on investment for the subgroup of patients with diabetes mellitus might be a useful avenue of research given recent clinical findings for that subset of the population.[17-19,30]

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BARIATRIC MISCONCEPTIONS

Bariatric Surgery Misconceptions

ASMBS

Misconception: Most people who have metabolic and bariatric surgery regain their weight.

Truth:

As many as 50 percent of patients may regain a small amount of weight (approximately 5 percent) two years or more following their surgery. However, longitudinal studies find that most bariatric surgery patients maintain successful weight-loss long-term. 'Successful' weight-loss is arbitrarily defined as weight-loss equal to or greater than 50 percent of excess body weight. Often, successful results are determined by the patient, by their perceived improvement in quality of life. In such cases, the total retained weight-loss may be more, or less, than this arbitrary definition. Such massive and sustained weight reduction with surgery is in sharp contrast to the experience most patients have previously had with non-surgical therapies.

Misconception: The chance of dying from metabolic and bariatric surgery is more than the chance of dying from obesity.

Truth:

As your body size increases, longevity decreases. Individuals with severe obesity have a number of life-threatening conditions that greatly increase their risk of dying, such as type 2 diabetes, hypertension and more. Data involving nearly 60,000 bariatric patients from ASMBS Bariatric Centers of Excellence database show that the risk of death within the 30 days following bariatric surgery averages 0.13 percent, or approximately one out of 1,000 patients. This rate is considerably less than most other operations, including gallbladder and hip replacement surgery. Therefore, in spite of the poor health status of bariatric patients prior to surgery, the chance of dying from the operation is exceptionally low. Large studies find that the risk of death from any cause is considerably less for bariatric patients throughout time than for individuals affected by severe obesity who have never had the surgery. In fact, the data show up to an 89 percent reduction in mortality, as well as highly significant decreases in mortality rates due to specific diseases. Cancer mortality, for instance, is reduced by 60 percent for bariatric patients. Death in association with diabetes is reduced by more than 90 percent and that from heart disease by more than 50 percent. Also, there are numerous studies that have found improvement or resolution of life-threatening obesity-related diseases following bariatric surgery. The benefits of bariatric surgery, with regard to mortality, far outweigh the risks. It is important to note that as with any serious surgical operation, the decision to have bariatric surgery should be discussed with your surgeon, family members and loved ones.

Misconception: Surgery is a 'cop-out'. To lose and maintain weight, individuals affected by severe obesity just need to go on a diet and exercise program.

Truth:

Individuals affected by severe obesity are resistant to long-term weight-loss by diet and exercise. The National Institutes of Health Experts Panel recognize that 'long-term' weight-loss, or in other words, the ability to 'maintain' weight-loss, is nearly impossible for those affected by severe obesity by any means other than metabolic and bariatric surgery. Bariatric surgeries are effective in maintaining long-term weight-loss, in part, because these procedures offset certain conditions caused by dieting that are responsible for rapid and efficient weight regain following dieting. When a person loses weight, energy expenditure (the amount of calories the body burns) is reduced. With diet, energy expenditure at rest and with activity is reduced to a greater extent than can be explained by changes in body size or composition (amount of lean and fat tissue). At the same time, appetite regulation is altered following a diet increasing hunger and the desire to eat. Therefore, there are significant biological differences between someone who has lost weight by diet and someone of the same size and body composition to that of an individual who has never lost weight. For example, the body of the individual who reduces their weight from 200 to 170 pounds burns fewer calories than the body of someone weighing 170 pounds and has never been on a diet. This means that, in order to maintain weight-loss, the person who has been on a diet will have to eat fewer calories than someone who naturally weighs the same. In contrast to diet, weight-loss following bariatric surgery does not reduce energy expenditure or the amount of calories the body burns to levels greater than predicted by changes in body weight and composition. In fact, some studies even find that certain operations even may increase energy expenditure. In addition, some bariatric procedures, unlike diet, also causes biological changes that help reduce energy intake (food, beverage). A decrease in energy intake with surgery results, in part, from anatomical changes to the stomach or gut that restrict food intake or cause malabsorption of nutrients. In addition, bariatric surgery increases the production of certain gut hormones that interact with the brain to reduce hunger, decrease appetite, and enhance satiety (feelings of fullness). In these ways, bariatric and metabolic surgery, unlike dieting, produces long-term weight-loss.

Misconception: Many bariatric patients become alcoholics after their surgery.

Truth:

Actually, only a small percentage of bariatric patients claim to have problems with alcohol after surgery. Most (but not all) who abuse alcohol after surgery had problems with alcohol abuse at some period of time prior to surgery. Alcohol sensitivity, (particularly if alcohol is consumed during the rapid weight-loss period), is increased after bariatric surgery so that the effects of alcohol are felt with fewer drinks than before surgery. Studies also find with certain bariatric procedures (such as the gastric bypass or sleeve gastrectomy) that drinking an alcoholic beverage increases blood alcohol to levels that are considerably higher than before surgery or in comparison to the alcohol levels of individuals who have not had a bariatric procedure. For all of these reasons, bariatric patients are advised to take certain precautions regarding alcohol:

- Avoid alcoholic beverages during the rapid weight-loss period
- Be aware that even small amounts of alcohol can cause intoxication
- Avoid driving or operating heavy equipment after drinking any alcohol
- Seek help if drinking becomes a problem

If you feel the consumption of alcohol may be an issue for you after surgery, please contact your primary care physician or bariatric surgeon and discuss this further. They will be able to help you identify resources available to address any alcohol-related issues.

Misconception: Surgery increases the risk for suicide.

Truth:

Individuals affected by severe obesity who are seeking bariatric and metabolic surgery are more likely to suffer from depression or anxiety and to have lower self-esteem and overall quality of life than someone who is normal weight. Bariatric surgery results in highly significant improvement in psychosocial well-being for the majority of patients. However, there remain a few patients with undiagnosed preexisting psychological disorders and still others with overwhelming life stressors who commit suicide after bariatric surgery. Two large studies have found a small but significant increase in suicide occurrence following bariatric surgery. For this reason, comprehensive bariatric programs require psychological evaluations prior to surgery and many have behavioral therapists available for patient consultations after surgery.

Misconception: Bariatric patients have serious health problems caused by vitamin and mineral deficiencies.

Truth:

Bariatric operations can lead to deficiencies in vitamins and minerals by reducing nutrient intake or by causing reduced absorption from the intestine. Bariatric operations vary in the extent of malabsorption they may cause, and vary in which nutrients may be affected. The more malabsorptive bariatric procedures also increase the risk for protein deficiency. Deficiencies in micronutrients (vitamin and minerals) and protein can adversely affect health, causing fatigue, anemia, bone and muscle loss, impaired night vision, low immunity, loss of appropriate nerve function and even cognitive defects. Fortunately, nutrient deficiencies following surgery can be avoided with appropriate diet and the use of dietary supplements, i.e. vitamins, minerals, and, in some cases, protein supplements. Nutrient guidelines for different types of bariatric surgery procedures have been established by the ASMBS Nutritional Experts Committee and published in the journal, Surgery for Obesity and Other Related Disorders. Before and after surgery, patients are advised of their dietary and supplement needs and followed by a nutritionist with bariatric expertise. Most bariatric programs also require patients to have their vitamins and minerals checked on a regular basis following surgery. Nutrient deficiencies and any associated health issues are preventable with patient monitoring and patient compliance in following dietary and supplement (vitamin and mineral) recommendations. Health problems due to deficiencies usually occur in patients who do not regularly follow-up with their surgeon to establish healthy nutrient levels.

Misconception: Obesity is only an addiction, similar to alcoholism or drug dependency.

Truth:

Although there is a very small percentage of individuals affected by obesity who have eating disorders, such as binge eating disorder syndrome, that may result in the intake of excess food (calories), for the vast majority of individuals affected by obesity, obesity is a complex disease caused by many factors. When treating addiction, such as alcohol and drugs, one of the first steps is abstaining from the drugs or alcohol. This approach does not work with obesity as we need to eat to live. Additionally, there may be other issues affecting an individual's weight, such as psychological issues. Weight gain generally occurs when there is an energy imbalance or, in other words, the amount of food