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Trabajo Original

Obesidad y síndrome metabólico

Good weight loss responders and poor weight loss responders after Roux-en-Y gastric bypass: clinical and nutritional profiles

Buenos y malos respondedores después de bypass *gástrico en Y de Roux: perfiles clínicos y nutricionales*

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Abstract

Background: Bariatric surgery is one of the main treatments for severity obesity, but weight regain after surgery is an important issue.

Objectives: To compare the clinical and nutritional profiles of good and poor weight loss responders in the late postoperative period after bariatric surgery.

Methods: A cross-sectional study with patients undergoing Roux-en-Y gastric bypass in a University Hospital. Patients were divided into good weight loss responders (GWLR) and poor weight loss responders (PWLR) defined as ≥ 50% or < 50% excess weight loss (EWL), respectively, at least 2 years post-surgery.

Results: The sample included 204 individuals (87.7% women; mean age 50.15 ± 11.1 years; mean time after surgery 67.38 ± 30.76 months). Two years post-surgery, 71.1% were considered GWLR and 28.9% PWLR (mean EWL 72.33% ± 13.86%, and 35.06% ± 12.10%, respectively; p = 0.000). Weight regain was < 10% for 36.3% of patients, 10.1-20% for 36.3%, and > 20% for 21.3%, compared with the lowest post-surgery weight. Among PWLR, 49.0% regained > 20% of the lowest post-surgery weight. GWLR lost most weight at all time points analyzed (p < 0.05). GWLR presented improvement or remission of diabetes, dyslipidemia and hypertension more frequently compared to PWLR (p < 0.05). Eating patterns was similar between GWLR and PWLR (p > 0.05, study's power 100%). Quality of life improved in 79.5% of the total study sample, with greater improvements in the GWLR (p < 0.05).

Conclusions: Greater weight loss correlated with improved remission in comorbidities and better quality of life.

Key words:

Gastric bypass. Long-term post-surgery. Weight loss. Nutrition. Co-morbidity.

Resumen

Introducción: la cirugía bariátrica es uno de los principales tratamientos para la obesidad, pero la recuperación de peso después de la cirugía es una cuestión importante.

Objetivo: comparar los perfiles clínicos y nutricionales de los buenos y malos respondedores en postoperatorio (PO) tardío de la cirugía bariátrica.

Método: estudio transversal con pacientes sometidos a *bypass* gástrico en Y de Roux en un hospital universitario. La muestra se divide en buenos respondedores (BR) y respuesta deficiente (MR), teniendo en cuenta el porcentaje de pérdida de exceso de peso (PEP) del 50,0%, después de al menos 2 años de PO.

Resultados: un total de 204 personas (87,7% mujeres, con una edad media de 50,15 ± 11,1 años y 67,38 ± 30,76 meses después de la operación). Después de 2 años de la operación, el 71,1% se consideraron BR y el 28,9% MR (PEP promedio 72,33 ± 13,86% y 35,06 ± 12,10%, respectivamente) (p < 0,05). La recuperación de peso fue < 10% para el 36,3% de los pacientes, 10,1 a 20% a 36,3% y > 20% a 21,3% en comparación con el menor peso después de la cirugía. Entre MR, el 49,0% recuperó más del 20% del peso más bajo después de la cirugía. El BR perdió la mayor parte de sobrepeso en los diferentes tiempos analizados PO (p < 0,05). El BR mostró mejoría o remisión de la diabetes mellitus, dislipidemia e hipertensión con más frecuencia, en comparación con los MR (p < 0,05). El patrón de dieta fue similar entre la BR y MR (p > 0,05; 100% de la potencia del estudio). La calidad de vida mejoró en el 79,5% del total del grupo, con la mejor evolución en los BR (p < 0,05).

Conclusión: la pérdida de peso mayor se correlaciona con la mejora de la remisión de comorbilidades y una mejor calidad de vida.

Palabras clave:

Cirugía bariátrica. Postoperatorio tardío. Pérdida de peso. Nutrición. Comorbilidad.

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INTRODUCTION

The prevalence of obesity has increased worldwide in the last two decades, reaching epidemic proportions and becoming a serious public health problem. More than 10% of the global adult population is obese. In Brazil, the prevalence of obesity is 17%. Causes of weight excess include hypercaloric diet, low physical activity, and genetic factors. Nutritional counseling, exercise and/or pharmacological treatments often fail to treat severe obesity (body mass index [BMI] >35 kg/m^2), and more effective interventions are necessary. Bariatric surgery has emerged as the most effective treatment for severe obesity, with Roux-en-Y gastric bypass (RYGB) being the most commonly used surgical technique. It combines gastric restriction with reduction in food intake and bowel surface contact (1,2).

The number of bariatric surgeries is rising each year. In Brazil, the number increased from 16,000 in 2003 to 86,840 in 2013 (3). RYGB results in excess weight loss (EWL) of between 65% and 70%, decreased and/or resolution of obesity-related comorbidities, quality of life (QOL) improvement, and increased life expectancy (1).

However, EWL can diminish over time, and weight regain is frequent in the long-term. Mechanisms that may underlie weight regain include dilatation of the gastric pouch because of consumption of larger amounts of food, hypercaloric food ingestion, physiologic increase in nutrient absorption capacity in bowel, alcohol consumption, sedentarism, and hormonal adaptations (4,5).

Few studies have compared the clinical and nutritional profile of people with adequate EWL with those failing to maintain EWL in the late postoperative period, or compared good and poor weight loss responders after RYGB. Studies performed by the same surgical team, with long-term multidisciplinary follow-up, are of particular value. Therefore, the aim of this study is to compare the clinical and nutritional profile of good weight loss responders (GWLR) with poor weight loss responders (PWLR) after RYGB in the late postoperative period.

METHODS

This cross-sectional study included patients aged >18 years who had received bariatric surgery ≥ 2 years previously (long-term postoperative period). Pregnant women were excluded. All patients underwent RYGB and were monitored by a multidisciplinary team of the Service of Multidisciplinary Care of Surgical Obese Patients in the National Brazilian Health Care System (NBHCS). Retrospective data were collected from medical records of patients who underwent RYGB between 1998 and 2009. Prospective data were collected from October 2011 to March 2013 during the clinical and nutritional consultation. Experienced trained health care providers (physicians and dieticians) collected all data.

The institutional ethics committee approved the study (n. 2572.179/2011-08). The study design conformed to the guidelines of the Declaration of Helsinki. All subjects were informed about the study objectives/procedures and data confidentiality, and provided written informed consent to participate.

All surgeries were supervised by one experienced surgeon. RYGB included a small gastric reservoir to between 20 and 50 mL and secondary dysabsorption with bypass of the duodenum and proximal jejunum, leaving an alimentary limb of 100 cm. The surgery was performed by laparotomy with a silastic ring insertion between the stomach pouch and small bowel.

Data collected from medical records included age, sex, education level, ethnicity, date of surgery, obesity history (years), smoking, alcohol consumption, weight (kg), height (m), and BMI (kg/m^2). Data were also collected on comorbidities in the preoperative period, plateau phase duration (months) and early postoperative complications and mortality (30 days after surgical procedure). Plateau phase corresponds to the time with lower weight achieved or with maximum weight loss. Data collected at the clinical and nutritional consultation included duration of postoperative period (months), physical activity, alcohol consumption, food intake, smoking, weight (kg and %), height (m), BMI (kg/m^2), weight loss (kg and %), excess weight loss (%EWL), weight regain (kg), waist circumference (cm), comorbidities and metabolic control. QOL was assessed using the *Bariatric Analysis and Reporting Outcome System* (6).

Regular physical activity (7) and alcohol consumption (8) were classified according to the World Health Organization. Food consumption was analyzed with one 24-hour dietary recall (R24h), applied at the nutritional consultation by experienced trained dietician. Energy and macronutrient intake were estimated using the software Avanutri® online version 3.0 (Avanutri LTDA., Rio de Janeiro, RJ, Brazil), and carbohydrate, protein and lipid intake was estimated in absolute (g) and proportional values of total energy intake. Smoking was estimated from smoking pack-years.

Weight regain was defined as the final weight at the single nutritional consultation in October 2011 to March 2013 compared with the lowest weight achieved after surgery (recovery). Cut-off points of 10% and 20% were established to indicate important and very important weight regain, respectively.

The %EWL was obtained as follows: [(operative weight – follow-up weight)/initial excess weight] × 100. Initial excess weight was obtained subtracting operative weight and ideal body weight, where ideal body weight was estimated as BMI 25 kg/m^2. %EWL was estimated from four different timepoints after surgery: 6 months, at the postoperative time with lowest weight, at 2 years, and at the clinical consultation. The sample was divided into two groups: patients with %EWL < 50% at the clinical consultation were considered PWLR, and patients with %EWL of ≥ 50% at the clinical consultation were considered GWLRs (9).

Metabolic control was assessed by the criteria of Mechanick et al. (10), measured by improvement or resolution of the following comorbidities: type 2 diabetes mellitus (T2DM) (fasting glucose ≤ 126 mg/dL); dyslipidemia (total cholesterol ≤ 200 mg/dL, LDL cholesterol ≤ 130 mg/dL and triglycerides ≤ 150 mg/dL); and hypertension (systolic blood pressure [BP] ≤ 140 mmHg, diastolic BP ≤ 90 mmHg). Waist circumference was measured in the standing position at the end of expiration midway between the lowest rib and the iliac crest. Hip circumference was measured at the greater trochanters. Absolute values were used for analysis.

Statistical analyses were performed using Statistical Package for the Social Science for Windows version 22.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics are presented as mean ± standard deviation, and minimum and maximum values for data with normal distribution. Median, standard error of the mean, minimum and maximum values were used or variables without symmetrical distribution. Normal distribution of continuous variables was determined using the Shapiro-Wilk test. Variables without symmetrical distributions were corrected with Z scores, and means from two different samples were compared with Student's t-test. Categorical variables were shown as percentages. Chi-square test was used for categorical variables. Fisher's exact test was used where there were less than five observations in a variable. When we identified important variables that lacked statistical difference, the study's power analisys to detect such difference was performed using G*Power version 3.0.10 (Departament of Psychology, University Dusseldorf, Dusseldorf, Germany). Statistical significance was set at the 95% confidence interval, considered to be significant when $p < 0.05$.

RESULTS

From 1998 and 2009, 569 patients underwent RYGB at the public hospital. The early mortality rate was 2.3% (n = 13). Six patients (1%) died after surgical complications, and seven because of nonsurgical reasons. The final sample comprised 204 subjects (87.7% female, mean age 50.1 ± 11.1 years, 22.1% ≥ 60 years old). Overall, 28.9% (n = 59) were classified as PWLR (Table I).

Table I. Preoperatory patient's characteristics

	TS n = 204	n	GWLR n = 145	n	PWLR n = 59	n	p value	χ^2
Age (years)*€α	50.1 ± 11.1	204	50.8 ± 11.4	145	48.6 ± 10.1	59	0.193	-
Minimum to maximum	19.0 – 75.0		19.0 – 75.0		29.0 – 70.0			
Gender (%)£								
Female	87.7	179	88.3	128	86.4	51	0.814	0.131
Male	12.3	25	11.7	17	13.6	8		
Scholarity (%)β								
Unlettered/ semi-literate	2.9	6	3.4	5	1.7	1	0.777	1.099
Less than high school	48.1	98	47.6	69	49.1	29		
High school	33.3	68	34.5	50	30.6	18		
College degree	15.7	32	14.5	21	18.6	11		
Ethnicity (%)£								
Caucasian	84.8	173	84.1	122	86.4	51	0.830	0.137
Non caucasian	15.2	31	15.9	23	13.6	8		
Smoking (%)£	15.7	32	15.2	22	16.9	10	0.917	0.011
Alcoholic beverage (%)β								
Never	78.4	160	79.3	115	76.3	45	0.726	0.123
Social drinking	21.6	44	20.7	30	23.7	14		
Alcohol addiction	0.0	0	0.0	0	0.0	0		
*Obesity history (years)**€α*	19.0 ± 0.7	204	19.0 ± 0.9	145	20.0 ± 1.3	59	0.477	-
Minimum to maximum	4.0 – 50.0		4.0 – 50.0		4.0 – 41.0			
Preoperatory weight (kg)**€α	122.5 ± 1.6	204	120.0 ± 1.9	145	125.8 ± 3.0	59	0.147	-
Minimum to maximum	83.7 – 200.2		83.7 – 200.2		89.8 – 190.0			
Preoperatory BMI (kg/m^2)**€α	47.9 ± 0.5	204	47.7 ± 0.6	145	49.1 ± 0.9	59	0.184	-
Minimum to maximum	36.7 – 77.1		36.7 – 74.4		39.4 – 77.1			
Comorbities (%)£								
SAH	80.4	164	80.7	117	79.7	47	0.848	0.028
T2DM	33.8	69	33.8	49	33.9	20	1.000	0.000
Dyslipidemia	48.5	99	47.6	69	50.8	30	0.758	0.159

*TS: total sample; GWLR: good weight loss responders; PWLR: poor weight loss responders; kg: kilogram; BMI: Body Mass Index; *mean ± SD; m: meters; **median ± SEM; £Chi-square test; €Student´s t Test; βFisher´s exact test; α Coefficient of variation ≤25%.*

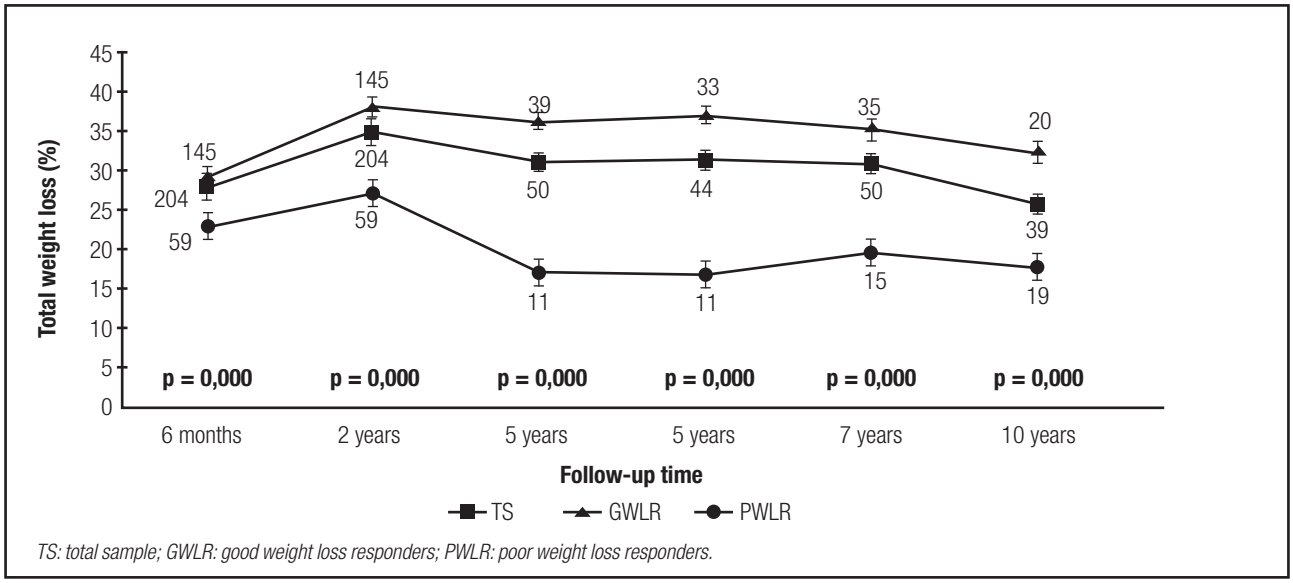
Table I shows the similarity between GWLR and PWLR characteristics ($p > 0.05$). Most patients had preoperative BMI > 40 kg/m^2 (mean preoperative BMI 47.9 ± 0.5 kg/m^2). There were 46% (n = 67) postmenopausal women in the GWLR and 44% (n = 26) in the PWLR ($p = 0.902$). The postoperative period was lower in the GWLR compared with PWLR ($p < 0.05$). PWLR reached plateau earlier than GWLR ($p < 0.05$), and had higher total weight, weight regain, waist circumference and BMI assessed at the last nutritional consultation ($p < 0.05$) (Table II).

There was better total weight loss among the GWLR ($p < 0,05$) (Fig. 1), and PWLR had higher weight regain than GWLR ($p < 0.05$). Current %EWL was estimated with the lowest post-surgical weight

Table II. Clinical and nutritional profile compararison between good and poor weight loss responders post roux-en-Y gastric bypass

	TS	GWLR	PWLR	p-value£
PO period (months) †*	67.38 ± 30.76	63.05 ± 29.96	78.01 ± 30.34	0.001
Minimum to maximum	24.00 – 151.00	24.00 – 151.00	25.00 – 130.00	
Plateau phase (months) †*	21.92 ± 12.85	23.10 ± 13.68	18.96 ± 10.00	0.039
Minimum to maximum	6.00 – 60.00	6.00 – 60.00	5.00 – 60.00	
*Weight (kg)** α*	86.95 ± 1.32	81.00 ± 1.16	101.00 ± 2.33	0.000
Minimum to maximum	54.50 – 157.00	54.50 – 132.00	75.00 – 157.00	
*EWL (%)**	61.55 ± 21.56	72.33 ± 13.86	35.06 ± 12.10	0.000
Minimum to maximum	1.56 – 106.15	50.06 – 106.15	1.56 – 49.75	
*Waist circumference (cm)** α*	105.00 ± 1.01	101.00 ± 0.99	120.00 ± 1.44	0.000
Minimum to maximum	77.00 – 150.00	77.00 – 141.00	92.00 – 150.00	
*BMI (kg/m^2)** α*	33.93 ± 0.44	32.04 ± 0.35	41.04 ± 0.72	0.000
Minimum to maximum	22.98 – 54.32	22.98 – 48.78	32.24 – 54.32	
*Weight regain (kg)** α*	8.85 ± 0.62	7.55 ± 0.49	15.45 ± 1.43	0.000
Minimum to maximum	0.00 – 51.50	0.00 – 31.10	1.50 – 51.50	

*TS: total sample; GWLR: good weight loss responders; PWLR: poor weight loss responders; PO: postoperative period; kg: kilogram; cm: centimeters; EWL: excess weight loss; BMI: Body Mass Index; *mean ± SD; **median ± SEM; £Student´s t test; αCoefficient of variation ≤ 25%; †Coefficient of variation > 25%.*



TS: total sample; GWLR: good weight loss responders; PWLR: poor weight loss responders.

Figure 1.

Total weight loss of good and poor weight loss responders in follow-up time.

for 6.1% (n = 11) of the patients, and was higher in GWLR. To classify weight loss, results were stratified according to postoperative time: 2, 3, 5, 7, and 10 years after surgery. Weight loss was 35%, 31.3%, 33.7%, 29.6% and 25.9% in these groups, respectively. For 36.3% (n = 74) of patients, weight regain was < 10%, 36.3% (n = 74) had weight regain of 10.1%-20%, and 21.3% (n = 45) had weight regain > 20%, compared with the lowest post-surgical weight. Among the PWLR, 49.0% (n = 29) regained > 20% of the lowest weight after surgery.

Before surgery, 80.4% (n = 164) of the patients had hypertension, 33.8% (n = 69) had T2DM, and 48.5% (n = 99) had dyslipidemia (Table I). After RYGB, metabolic control improvement or T2DM, dyslipidemia and hypertension resolution was higher in the GWLR group than the PWLR group ($p < 0.05$) (Fig. 2).

After surgery, there were 23% (n = 34) and 34% (n = 20) of GWLR and PWLR, respectively, using antidepressants ($p = 0.174$).

Energy and macronutrient intake (absolute values) were similar between the GWLR and PWLR groups ($p > 0.05$). Macronutrient distribution in total energy also was similar between groups ($p > 0.05$, study's power 100%) (Table III).

QOL was examined in 76.5% (n = 156) of the total sample. It was insufficient for 5.8% (n = 9) of patients, acceptable or good for 50.6% (n = 79), and very good or excellent for 43.6% (n = 68). None of the PWLR group were classified as having excellent QOL, and all insufficient results were found in the PWLR (18.8%; n = 9), demonstrating better QOL in the GWLR group ($p = 0.000$; χ^2=44.966).

After surgery 8.3% (n = 17) of the participants are smokers. Regarding to alcoholic beverage, 78.4% (n = 160) did not use alcohol, 20.1% (n = 41) are social drinkers and 1.5% (n = 3) were classified as alcohol addiction.

Only 14.7% (n = 30) of patients reported practicing some type of physical activity of more than 150 minutes per week, 17.1% (n = 35) practice less than 150 minutes per week and 139 (68.2%) of patients are sedentary.

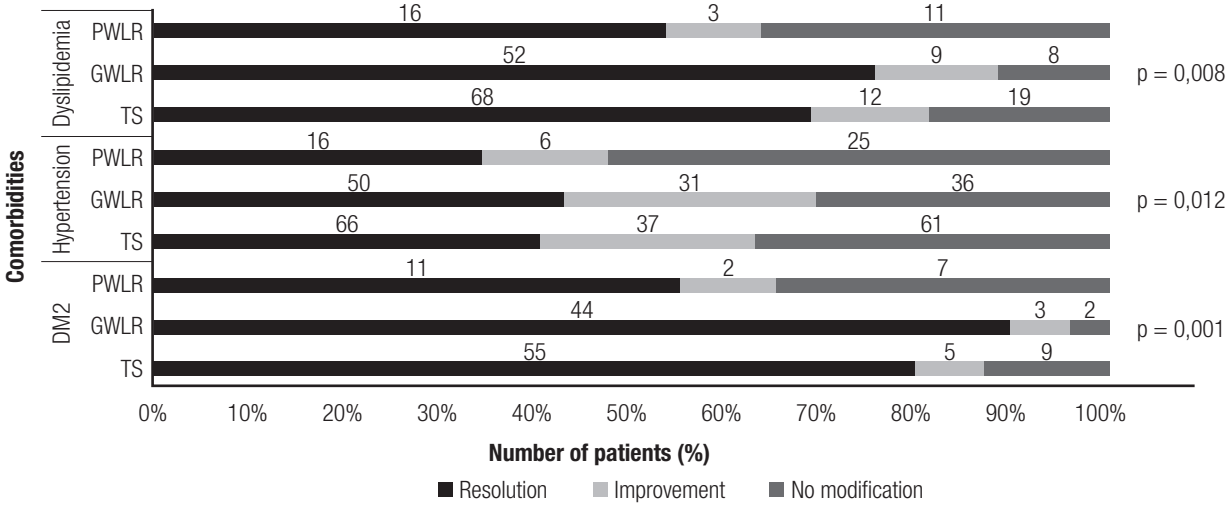
There was no difference between the GWLR and PWLR groups in frequency of smoking, alcohol comsuption and in physical activity ($p > 0.05$).

DISCUSSION

The results of the study demonstrate similar characteristics between the GWLR and PWLR groups in the preoperative period. PWLR achieved the plateau phase before GWLR, and had higher weight regain. However, GWLRs had better %EWL, QOL, and improvement or resolution of comorbidities, compared with PWLRs. Energy and macronutrient intake, alcohol consumption and physical activity were similar between groups following surgery.

There is no consensus definition of success or failure after bariatric surgery. The classification of GWLR and PWLR must include weight loss and weight recovery, alongside improvement or resolution preoperative comorbidities, prevention of nutrient deficiency, and better QOL.

We found that the minimum weight was reached between 18 and 24 months after surgery, and that the weight loss proportion decreases through the postoperative period, as observed in other studies (2,4,11-15). As demonstrated by our results and in other studies, rates of weight loss are higher during the first year after surgery, primarily in the first 6 months, followed by slower progressive weight loss two years after surgery, brief stabilization, then weight regain (2,5,12). Therefore, the %EWL at six months is a potentially valid index of surgical success.



TS: Total sample; GWLR: good weight loss responders; PWLR: poor weight loss responders; Chi-square test.

Figure 2.

Comorbities resolution and improvement of good and poor weight loss responders.

Table III. Daily intake of energy, carbohydrate, protein and lipid by good and poor weight loss responders post roux-en-Y gastric bypass

	TS	GWLR	PWLR	p-value£
*Energy (kcal)*α*	1151.25 ± 31.45	1114.60 ± 38.18€	1173.13 ± 52.85€	0.321
Minimum to maximum	184.49 – 3047.88	184.49 – 3047.88	565.48 – 2522.73	
*Energy (kcal/ Kg IBW)*α*	18.13 ± 0.53	17.14 ± 0.66€	18.60 ± 0.88€	0.619
Minimum to maximum	3.15 – 51.41	3.15 – 51.41	7.30 – 37.98	
*Carbohydrate (g)*α*	135.11 ± 4.21	135.76 ± 4.98€	135.11 ± 7.93€	0.411
Minimum to maximum	35.90 – 395.88	35.90 – 395.88	75.17 – 317.15	
*Carbohydrate (%kcal)*α*	50.08 ± 0.87	49.95 ± 1.02	50.62 ± 1.68	0.922
Minimum to maximum	22.33 – 83.02	24.26 – 83.02	22.33 – 77.31	
*Protein (g)*α*	49.50 ± 1.84	48.95 ± 2.17	56.98 ± 3.47	0.399
Minimum to maximum	5.48 – 151.69	5.48 – 151.69	22.89 – 129.02	
*Protein (g/kg IBW)*α*	0.77 ± 0.03	0.76 ± 0.04	0.83 ± 0.07	0.309
Minimum to maximum	0.09 – 2.56	0.09 – 2.56	0.31 – 1.94	
*Protein (%kcal)*α*	17.72 ± 0.47	17.81 ± 0.51	16.78 ± 1.03	0.499
Minimum to maximum	6.43 – 43.05	6.43 – 43.05	7.59 – 30.71	
*Lipid (g)*α*	41.25 ± 1.59	41.11 ± 1.92	42.43 ± 2.87	0.680
Minimum to maximum	1.41 – 157.96	1.41 – 157.96	12.58 – 118.25	
*Lipid (%kcal)*α*	31.55 ± 0.65	31.50 ± 0.78	31.89 ± 1.19	0.829
Minimum to maximum	4.04 – 51.26	4.04 – 51.26	15.11 – 50.95	

*TS: total sample; GWLR: good weight loss responders; PWLR: poor weight loss responders; kcal: kilocalories; kg: kilogram; IBW: ideal body weight; g: grams; *median ± SEM; £Student´s t test; €Study's power 100%; α Coefficient of variation ≤ 25%.*

In the late postoperative period, we observed 93.9% of the patients with weight regain in the final nutritional consultation, and 57.6% of the total sample had important or very important weight regain, mainly among the PWLR. This weight regain is dramatic compared with the ≥15% weight regain in 15% of the patients after surgery reported by Odom et al. (2010) on avarage 28 months after surgery (4). However, our results are more similar to other studies that suggest that the longer the postoperative period after surgery, the higher the weight regain (4,12,14).

Weight regain usually starts at 24 months after surgery and is similar at 2, 5, 6 and 10 years after surgery, varying between 7% and 8.7% (2,12,13,16). Lowest values are demonstrated 3 years after surgery, showing 3% proportional weight regain (17).

Socioeconomic factors may also play a role in the long-term success of bariatric surgery. In Brazil, despite of the universal availability of the NBHCS, low-income patients attend public health services more often. Studies suggest that lower socioeconomic status contributes to weight regain after bariatric surgery (11,14,18,19).

In addition to changes in the anatomy of the digestive tract after RYGB, some researchs have demonstrated that there are physiological changes involved in complex gut-brain nutrient and neural signaling after surgery, such as the influence of some gastrointestinal hormones involved in the control of hunger and satiety, for example, increased secretion of Glucagon-like peptide-1 (GLP-1) and peptide YY, and decrease ghrelin, with their central and peripheral effects on glycaemia and food intake, affecting glucose homeostasis and weight control (20-22).

Also the genetic factors and epigenetic mechanisms have been associated with variability in weight loss in response to surgical intervention (23). Polymorphisms in genes related to RYGB response after 1 year post-surgery were identified (24). Several common genetic variants may influence weight loss results after RYGB as shown by Rinella et al. (25) when compared genetic polymorphisms between patients with lower and higher %EWL.

Regarding metabolic parameters, T2DM, dyslipidemia and hypertension improvement or resolution was higher after RYGB in GWLR compared with PWLR. In spite of the weight regain, we observed improvement or resolution of comorbidities in late the postoperative period. However, earlier assessment, 2–3 years after surgery, demonstrates better results in T2DM, hypertension and dyslipidemia resolution than found in the present study and in other studies with longer postoperative time, because higher weight loss is associated with better improvement of comorbidities (13-15,18,26-28). After one year the remission of type 2 diabetes can be up to 90% as shown by Pinhel et al. (29). Weight regain after 24 months of surgery is related to less remission and increased recurrence of comorbidities (13-15,18,26,27).

Our results show similar energy and macronutrient intake between the GWLR and PWLR groups. Energy intake and macronutrient distribution observed in our study were similar to a food quality, physical activity and nutritional follow-up study of 100 patients after RYGB (14). In our study, protein intake was lower than daily recommendations for both GWLR and PWLR. This may be important, as a protein rich diet contributes to satiety, and stimulates weight loss and lean mass maintenance (30,31).

Available methods to assess food intake are not precise and the need of individual report is a limitation (18). It is known that energy intake is underreported on the first R24h and three R24h appear ideal for assessing food intake (32). Usually, obese people underestimate energy intake between 20% and 30%, and they reduce their energy intake near to nutritional consultations (14,18). In our study, we compared energy and nutrient intake between groups, and one R24h is enough because all subjects, of both groups, were submitted at the same condition, despite to be a limitation.

We found a better QOL in GWLR compared with PWLR. A study in which bariatric surgery patients were followed-up for 10 years showed a very good or excellent QOL in 84% of patients, similar to our results (33). Positive effects on QOL are reached with 10% of weight loss. Hence, QOL is associated with the magnitude of weight loss, since better results were obtained after one year of surgery, with gradual decline after 6 years, coinciding with weight regain (34).

We found no difference between GWLR and PWLR in smoking frequency, alcohol consumption and physical activity. Regular physical activity was lower than demonstrated in other studies, suggesting regular physical activity as a predictive factor of weight loss maintenance after surgery (14,35). As described in other studies (36,37), we did not find a relationship between alcohol consumption and weight loss.

Limitations of our study include the dropout rate (64.1%), that may affect the study results because the all 569 patients heterogeneity at pre- and post-surgery and that the Service of Multidisciplinary Care of Surgical Obese Patients, providing assistance to pre- and postoperative patients, was started approximately seven years ago, and therefore did not support 60.8% (n = 124) of the patients of the sample before surgery. Other limitations were that precise instruments were not used before surgery to assess alcohol consumption, smoking and comorbidities, and that the food intake investigation only included one R24h.

CONCLUSION

GWLRs have better %EWL, QOL, and improvement or resolution of comorbidities, compared with PWLRs. Alcohol consumption and physical activity are similar between groups following surgery. There are no difference in nutritional GWLR with PWLR after RYGB in the late postoperative period. However, obesity treatment does not end with the bariatric procedure. Further studies are necessary to elucidate factors that assure good response to surgery, to guide the multidisciplinary team, and to elucidate metabolic and hormonal mechanisms underlying weight regain.

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STATEMENT OF INFORMED CONSENT

The authors declare that informed consent was obtained from all individual participants included in the study.

STATEMENT FOR HUMAN RIGHTS

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments.

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