Invest Clin 66(1): 49 - 62, 2025 https://doi.org/10.54817/IC.v66n1a05

Health profile of patients subjected to gastric bypass at Clinics Hospital of Acre, Brazil.

Suellem Maria Bezerra de Moura Rocha[1], Alanderson Alves Ramalho[2], Rachel Horta Freire[3], Thiago Montes Fidale[4], Dionatas Ulises de Oliveira Meneguetti[1], Luis Carlos Oliveira Gonçalves[6,7], Anibal Monteiro de Magalhães Neto[5,6], Luiz Carlos de Abreu[1] and Romeu Paulo Martins Silva[1]

[1]Graduate Program in Health Science in the Western Amazon – Federal University of Acre, Brazil.
[2]Health and Sports Science Center - Federal University of Acre, Brazil.
[3] Biochemistry and Immunology Department. Federal University of Minas Gerais, Brazil.
[4]Special Academic Unit of Biotechnology, Federal University of Catalao, Brazil.
[5]Graduate Program in Basic and Applied Immunology and Parasitology – Federal University of Mato Grosso, Brazil.
[6]Graduate Program in Physical Education - Federal University of Mato Grosso, Brazil;
[7]Graduate Program in Genetics and Biochemistry – Federal University of Uberlandia, Brazil.

Keywords: obesity; bariatric surgery; weight recovery; weight loss; public health

Abstract. The study aimed to analyze the health profile of women undergoing Roux-en-Y gastric bypass according to the time elapsed since surgery. Ninety-three women who underwent this procedure at the Clinics Hospital in Acre, Brazil, from 2008-2017, were divided into three groups according to the post-surgery period: G1 (n = 37) up to two years; G2 (n = 20) from two to four years; G3 over four years (n = 36) after surgery. Pre-surgery and post-surgery clinical, anthropometric, and dietary variables were analyzed through a 24-hour recall. The postoperative time was 16.9±7.9 months (G1); 33.9±9.2 months (G2) and 75.3±19.1 months (G3). In the postoperative period, there was a decrease in the number of patients who practiced physical activity (35.5-33.3%). The mean percentage of excess weight loss was 66.1±15.4%. Satisfactory results were achieved by 88.17% (% PEP ≥50%). 67% of the patients presented weight reacquisition, proportional to the postoperative time ($p<0.001$). The dietary survey indicated a daily energy consumption of 1262.75±424.11 kcal. The macronutrient distribution showed 59.25±8.33% for carbohydrates, 24.26±6, 90% for lipids and 17.12±6.68% for proteins. The mean protein intake was lower in group G1 (16.09±6.23), and lipid intake slightly increased over time. Bariatric surgery had a significant impact on the reduction of comorbidities, medication use, and the loss of excess weight. However, the nutrient adequacy and the increasing incidence of weight regain in the post-surgery period demonstrated that bariatric surgery does not end the obesity treatment, but it is only a step that requires periodic monitoring.

Corresponding Author: Luis Carlos Oliveira Gonçalves. Federal University of Uberlandia. Amazonas Avenue. Uberlandia, Minas Gerais, Brazil. E-mails: luis.carlos@ufu.br; luisogoncalves@yahoo.com.br

Perfil de salud de los pacientes sometidos a bypass gástrico en el Hospital de Clínicas de Acre, Brasil.

Invest Clin 2025; 66 (1): 49 – 62

Palabras clave: obesidad; cirugía bariátrica; recuperación de peso; pérdida de peso; salud pública.

Resumen. El objetivo del estudio fue analizar el perfil de salud de mujeres sometidas a bypass gástrico Roux-en-Y según el tiempo transcurrido desde la cirugía. Noventa y tres mujeres que se sometieron a este procedimiento en el Hospital de Clínicas en Acre, Brasil, de 2008 a 2017, se dividieron en tres grupos según el período posoperatorio: G1 (n = 37) hasta dos años; G2 (n = 20) de dos a cuatro años; G3 más de cuatro años (n = 36) desde la cirugía. Se analizaron variables clínicas, antropométricas y dietéticas preoperatorias y posoperatorias a través de un recordatorio de 24 horas. El tiempo posoperatorio fue de 16,9 ± 7,9 meses (G1); 33,9 ± 9,2 meses (G2) y 75,3 ± 19,1 meses (G3). En el posoperatorio, hubo una disminución en el número de pacientes que practicaban actividad física (35,5-33,3%). El porcentaje medio de pérdida de exceso de peso fue de 66,1±15,4%. Se obtuvieron resultados satisfactorios en el 88,17% (% PEP ≥50%). El 67% de los pacientes presentó readquisición de peso, proporcional al tiempo postoperatorio (p<0,001). La encuesta dietética indicó un consumo energético diario de 1262,75±424,11 kcal. La distribución de macronutrientes mostró 59,25±8,33% para carbohidratos, 24,26±6,90% para lípidos y 17,12±6,68% para proteínas. La ingesta media de proteínas fue menor en el grupo G1 (16,09±6,23%), y la ingesta de lípidos aumentó ligeramente con el tiempo. La cirugía bariátrica tuvo un impacto significativo en la reducción de comorbilidades, uso de medicamentos y pérdida de exceso de peso. Sin embargo, la adecuación de nutrientes y la creciente incidencia de recuperación de peso en el período postoperatorio demostraron que la cirugía bariátrica no pone fin al tratamiento de la obesidad, sino que es sólo un paso que requiere seguimiento periódico.

Received: 08-05-2024 *Accepted: 01-02-2025*

INTRODUCTION

Obesity is currently one of the biggest public health problems in the world. Its projection, according to the World Health Organization, is that in 2025, 2.3 billion adults will be overweight, and more than 700 million will be obese. Being a global epidemic of chronic conditions, a multifactorial etiology whose treatment involves different approaches, the main ones are dietary guidelines, physical activity practice, and, in cases where these measures are not enough, the use of medications and surgical intervention [1].

Conventional treatment for severe obesity still produces unsatisfactory results since 95% of patients regain their initial weight in up to 2 years. Due to the need for a more effective intervention in the clinical management of severely obese individuals, an indication of surgery is the most effective treatment for obesity control [2].

In Brazil, bariatric surgery is among the procedures of high complexity offered by the Unified Health System (SUS), according to the regulation established on April 21, 2001. Its indication must be according to CFM Resolution No. 1,766/05, which designates the following requirements for its accomplishment: being over 18 years of age, presenting a Body Mass Index (BMI) of 40 kg/m^2 or more or equal to or greater than 35 kg/m^2 and comorbidities such as diabetes, sleep apnea, hypertension, dyslipidemia, coronary disease, osteoarthritis, and others. In addition, the subject must have undergone conventional methods and have psychological conditions to follow the indications suggested after surgery [2].

According to the Brazilian Society of Bariatric and Metabolic Surgery (SBCBM), throughout 2018, 63,969 bariatric surgeries were performed, 49,521 of which for supplementary health (health plans), according to data from the National Supplementary Health Agency (ANS), 11,402 surgeries by the Unified Health System (SUS) and 3,046 private surgeries. The total number of procedures performed in 2018 was 4.38% higher than in 2017, when approximately 61.283 thousand surgeries were performed by SUS and ANS [3].

Although bariatric surgery is an effective clinical strategy for promoting weight loss, reducing comorbidities, and improving quality of life, it is essential to emphasize that it does not promote the cure of obesity but rather its control. Therefore, although the surgical treatment demonstrates satisfactory results, some individuals present postoperative complications related to organic and behavioral problems that damage clinical and nutritional aspects [4,5].

The Brazilian population has extensive demographic, social, and cultural diversity, which is why population studies that assess the health conditions of the Amazonian peoples and their main conditions allow us to broaden the understanding of the magnitude of diseases, analyze their historical trends, and observe risks of morbidity and mortality in these population groups.

From this perspective, the objective of this study was to analyze the clinical, nutritional, and weight requirements of women undergoing Roux-en-Y gastric bypass according to the time elapsed post-surgery.

PATIENTS AND METHODS

Study design and data collection

The research, carried out at the Clinics Hospital of the State of Acre from August to December 2017, was quantitative, qualitative, and retrospectively observational. The project was submitted to the Research Ethics Committee of the Clinics Hospital /HC of the State of Acre and approved through opinion nº 1,979,084.

Patient inclusion criteria were age 18 or older, having a BMI ≥ 35kg/m^2 associated with a disease or BMI ≥ 40kg/m^2, and having undergone bariatric surgery from 2008 to 2017. The collection took place through an outpatient appointment, which was scheduled by the hospital's Obesity and Quality of Life Group and held every Wednesday and Thursday afternoon in the outpatient clinic of the Rio Branco Clinic Hospital—Acre, Brazil. Telephone contact with the patients and during the support group meetings were made. The researcher and two nutritionally trained academics collected the data. At the time of collection, the participants were informed about the study's relevance, and they voluntarily participated by signing the Informed Consent Form (TCLE).

The evaluation consisted of a questionnaire to identify the patient with the following information: personal data, socioeconomic data, schooling, previous clinical history, current clinical history, anthropometric evaluation, and dietary assessment. It was also evaluated whether or not the patient did nutritional monitoring during the postoperative period. All items were self-reported by the patients, except for the anthropometric data of the preoperative

period, which were obtained from the medical records and the current anthropometric data collected during the outpatient care performed by the researchers.

The study included 114 patients who underwent Roux-en-Y gastric bypass from 2008 to 2017 at the Acre State Clinic Hospital. Among these patients, ninety-three (81.57%) were women and twenty-one (18.42%) were men. Among the patients selected, seven refused to participate, and two died before being evaluated.

The patients were divided into three groups, according to the postoperative period, to compare the variables of interest in the study: group (G1) for up to twenty-four months, group (G2) from twenty-four months to forty-eight months, and group 03 (G3) more than forty-eight months.

After analysis, it was decided to exclude males since there was a statistically significant difference between surgery time and sex. 47.6% of males were in the 25 to 48-month group. Thus, the analyses were based only on female patients.

Clinical Evaluation

The clinical evaluation was performed in two parts: clinical history before surgery and current clinical history. The clinical history in the pre-surgical period was based on the presence of associated diseases, medication use, and physical activity practice. The current clinical history was based on the same information, adding only the use of nutritional supplements and the presence or absence of gastrointestinal disorders [4,5] in the postoperative period.

Obesity is a clinical condition with a high risk for developing other chronic diseases [6], and the following comorbidities were analyzed during the clinical evaluation of the patients: arterial hypertension, dyslipidemia, arthritis, hormonal changes, diabetes mellitus type II, apnea obstructive sleep, and edema [7]. For the evaluation of drug use [6], they were categorized into antihypertensive, antidiabetic, anti-lipemic, antidepressants, appetite suppressants, and others [8]. Patients were asked whether or not they performed regular activities to evaluate physical activity, what their activities were, and how often they practiced them: once, twice, three to four times a week, and five or more times a week.

Regarding the presence or absence of gastrointestinal disorders in the postoperative period, patients were questioned if, at any time, they had at least one of these complications: vomiting, nausea, diarrhea, constipation, and abdominal distension. Regarding supplementation in the postoperative period, the consumption of the following supplements was evaluated: polyvinyl alcohol and minerals, vitamin B12, calcium, and ferrous sulphate.

Nutritional and Dietetic Assessment

For the anthropometric evaluation, the following data were collected: weight (kg) on the day of surgery; height (m); maximum weight achieved in the preoperative period; current weight; minimum weight achieved in the postoperative period; waist circumference (cm); body composition through electrical bioimpedance; reacquisition of weight and percentage of the loss of excess weight (PEP).

The current body weight was measured on a pre-calibrated digital weighing scale with a Welkin 300 kg capacity, and the patient was instructed [8] to remove the shoes, climb backwards to the equipment and remain still with the feet in the center of the platform.

The vertical stadiometer (coupled to the scale) was used for stature measurement, with a scale of 0.5cm. The patient was instructed to keep the arms extended along the body, the head erect, and the stare fixed in a horizontal plane. The body mass index (BMI) was calculated by the weight ratio (kg) divided by the height (m) squared. This index was calculated using preoperative and current weights to evaluate its classification in both moments. The values found were classified according to the WHO [9].

The patients' body composition was evaluated through electrical bioimpedance (BIA) using a Maltron BioScan [10] 915/916 Analyzer.

The following variables were analyzed: lean mass (kg), fat mass (kg), total body water (L), and basal metabolic rate (Kcal).

The loss of excess weight (PEP) was calculated according to the equation indicated by Deitel[11], and weight reacquisition was evaluated by comparing the current weight with the minimum weight reached in the postoperative period.

The quantitative feeding evaluation was performed through a 24-hour recall (R24h) using the Avanutri 2.0 Nutrition Software based on the food composition table (TACO)[12].

Nutrient intake adequacy was evaluated according to the cut-off points of the DRIs19 (Dietary Reference Intakes), considering adequate intake as 50 to 60% carbohydrates, 25 to 30% lipids, and 10 to 15% protein [12].

The weight reacquisition was evaluated by comparing the current weight collected with the minimum weight reached in the postoperative period and the value in kilograms (kg) when the weight was regained.

Data Analysis

Statistical Package for Social Sciences (SPSS) 10.0 and SigmaPlot 14.5 were used to analyze the data. For the qualitative variables, absolute (n) and relative (%) frequencies were described, and the Pearson chi-square test was used to evaluate the difference in the proportion of the outcomes according to the independent variables. The mean (μ) and standard deviation (SD) describe the quantitative variables. The T/Mann-Whitney test was used to evaluate the difference in means of the outcomes according to the independent variables. ANOVA/Kruskal-Wallis was used for the evaluation between two means and three or more means, ANOVA/Kruskal-Wallis was used, according to the Shapiro-Wilk Normality test (p-value).

RESULTS

Ninety-three women with a mean age of 41.8 ± 7.6 years, divided into three groups were evaluated according to the postoperative time: group one (G1) up to twenty-four months, group two (G2) of twenty-four months to forty-eight months and group three (G3) over forty-eight months. In the first group, the mean postoperative time was 16.9 ± 7.9 months. In the second group, 33.9 ± 9.2 months, and in the third group, a mean of 75.3 ± 19.1 months.

As described in Table 1, 29% of the patients evaluated reported having a complete secondary level, 24.7% an incomplete upper level, and only 22.6% a complete upper level.

The income classification showed that 17.2% up to one minimum wage 58% had a family income of up to four minimum wages, 18.3% up to seven and 6.5% more than seven minimum wages.

Regarding whether or not to perform nutritional follow-up after surgery, 52.7% said to follow up, and 47.3% did not do nutritional monitoring. Among the groups, the G1 group (25 to 48 months) attended most nutritional consultations, with 42.9% of the patients.

When the groups were compared, the lowest percentage of patients (23.3%) using medication was found in group 2 (25 to 48 months). 98.9% of the patients reported using medications in the preoperative period, with antihypertensives (32.3%) and anxiolytics (24.7%) being the most commonly used medications. In the postoperative period, this index decreased to 46.2%.

Only 35.5% of the patients reported doing some physical activity before surgery, which was the most performed: walking (22.6%) and bodybuilding (8.6%). The frequency of physical activity reported by the majority (21.5%) was 3 to 4 times per week. The number of patients who practiced physical activity decreased to 33.3% in the postoperative period. The types of exercise most performed by them were walking (20.4%) and bodybuilding (8.6%). Most patients (19.4%) reported having physical activity 3 to 4 times a week.

Regarding alcohol consumption, 61.3% reported not consuming. However, 27.9% reported consuming eventually, and 10.8% weekly.

Table 1
General characterization of the study population.

Variable	Groups			Total	p
	Group 1	Group 2	Group 3		
	n = 37	n = 20	n = 36		
	n (%)	n (%)	n (%)	n (%)	
Schooling					
Incomplete Elementary School	4 (66.7)	0 (0.0)	2 (33.3)	6 (6.5)	0.11
Complete Elementary School	1 (20.0)	0 (0.0)	4 (80.0)	5 (5.4)	
Incomplete High School	1 (9.10)	5 (45.5)	5 (45.5)	11 (11.8)	
Complete High School	12 (44.4)	4 (14.8)	11 (40.7)	27 (29.0)	
Incomplete Higher Education	5 (21.7)	8 (34.8)	10 (43.5)	23 (24.7)	
Complete Higher Education	14 (66.7)	3 (14.3)	4 (19.0)	21 (22.6)	
Family income					
Up to 1 minimum wage	8 (50,0)	2 (12.5)	6 (37.5)	16 (17.2)	0.495
From 2 to 4 minimum wages	22 (40.7)	10 (18.5)	22 (40.7)	54 (58.0)	
From 5 to 7 minimum wages	5 (29.4)	5 (29.4)	7 (41.2)	17 (18.3)	
More than 7 minimum wages	2 (33.3)	3 (50.0)	1 (16.7)	6 (6.5)	
Nutritional monitoring					
Yes	21 (42.9)	12 (24.5)	16 (32.7)	49 (52.7)	0.437
No	16 (36.4)	8 (18.2)	20 (45.5)	44 (47.3)	
Use of medicines					
Yes	19(42.2)	10(23.3)	14(32.6)	43 (46.2)	0.526
No	18(36.0)	10(20.0)	22(44.0)	50 (53.8)	
Physical activity practice					
Yes	13(41.9)	5(16.1)	13(41.9)	31 (33.3)	0.669
No	24(38.7)	15(24.2)	23(37.1)	62 (66.7)	
Alcohol use					
Never	24 (42.1)	12 (21.1)	21 (36.8)	57 (61.3)	0.229
Eventually	12 (46.2)	6 (23.1)	8 (30.8)	26 (27.9)	
Weekly	1 (10.0)	2 (20.0)	7 (70.0)	10 (10.8)	
Smoking					
Non-smoking	31 (38.3)	17 (21.0)	33 (40,7)	81 (87.0)	0.574
Smoker	6 (50.0)	3 (25.0)	3 (25.0)	12 (13.0)	

* p values (Pearson chi-square test).

Eighty-seven percent of the patients said they were not smokers, and 13% said they were former smokers.

Regarding using nutritional supplements in the postoperative period, 59.13% of the patients reported taking supplementation, and 40.86% reported not using any supplement. Comparing the groups, the G1 group (25 to 48 months) used the most supplementation (52.7%).

Table 2 shows the participants' anthropometric variables (weight, height, percentage of fat mass, fat mass, and lean mass).

Table 2
Anthropometric data of the study population.

Variable	Groups			Total	p
	Group 1	Group 2	Group 3		
	n = 37	n = 20	n = 36		
	μ ± SD	μ ± SD	μ ± SD	μ ± SD	
Pre-surgery					
Weight surgery (kg)	117.71 ± 12.08	125.81* ± 15.24	124.94* ± 14.33	122.25 ± 14.04	0.037
BMI surgery (kg/m²)	46.10 ± 4.40	47.60 ± 6.12	48.17 ± 4.62	47.22 ± 4.93	0.188
Maximum weight (kg)	124.42 ± 12.76	129.86 ± 14.55	130.54 ± 13.14	128.00 ± 13.48	0.122
Overweight (kg)	20.85 ± 10.83	22.58 ± 7.55	21.68 ± 8.15	21.54 ± 9.13	0.792
Post-surgery					
Current weight (kg)	78.47 ± 11.24	81.83 ± 8.27	80.40 ± 7.81	79.92 ± 9.42	0.421
Current BMI (kg/m²)	31.09 ± 4.87	31.07 ± 3.13	31.17 ± 3.62	31.12 ± 4.03	0.995
Minimum weight (kg)	76.15 ± 11.97	76.64 ± 8.89	72.66 ± 9.71	74.88 ± 10.58	0.269
Fat mass (%)	30.60 ± 5.49	31.52 ± 5.15	32.17 ± 3.64	31.40 ± 4.77	0.373
PEP**(%)	65.64 ± 18.18	67.22 ± 11.64	66.19 ± 14.61	66.19 ± 15.46	0.936

PEP** Percentage of excess weight loss. μ ± SD: average ± Standard Deviation.

The p values are determined by the ANOVA/Kruskal-Wallis test between groups according to the Shapiro-Wilk Normality test. *Different from group 1.

Regarding the anthropometric evaluation, the mean preoperative BMI was 47.2±4.9 kg/m². Ninety-eight percent of the patients were classified as grade III (IMC>40kg/m²), and 2% were classified as grade II obesity. In the postoperative period, the mean BMI was 31.1±4.0 kg/m², the mean of group one being 31.10±4.8 kg/m², group two 31.1±3.1 kg/m², and group three of 31.1±3.6 kg/m².

The mean percentage of excess weight loss was 66.1±15.4%, and the following means were found in the groups: G1 65.64±18.1%, G2 67.22±11.6 and G3 66,19±14.6%. Satisfactory results were achieved by 88.1% of the patients who presented PEP≥50%. There was no significant difference between groups (p=0.05).

Table 3 contains the results obtained in the 24-hour recall for mean daily caloric intake, macronutrients, and micronutrients.

Concerning nutrient intake, the dietary survey (R24hs) pointed to the average daily energy consumption of 1262.75±424.11 kcal. There was no difference in energy consumption between the groups evaluated (p>0.05).

The distribution of the macronutrient percentage indicated a mean intake of 59.25±8.33% for carbohydrates, 24.26±6.90% for lipids, and 17.12±6.68% for proteins. There was no significant difference between the groups regarding the intake of macro and micronutrients (p>0.05).

Although the macronutrient intake was not significant between the groups, the mean protein intake was lower in group 01 (16.09±6.23), and that of lipid showed a slight increase over time.

Regarding the regularity of meal times, 69.89% of the patients reported not eating regularly. Only 30.10% stated that they had regular meals. Regarding the number of meals performed daily, most participants had a proper fractionation of their meals; 63.4% stated they had 3 to 4 meals/day, while only 18.3% reported doing 1 to 2 meals/day.

Table 3
Daily nutrient intake.

Variable	Groups			Total	p
	Group 1	Group 2	Group 3		
	n = 37	n = 20	n = 36		
	$\mu \pm$ SD	$\mu \pm$ SD	$\mu \pm$ SD	$\mu \pm$ SD	
Heat Transfer (kcal)	1201.5 ± 460.81	1395.4 ± 523.93	1252.0 ± 302.06	1262.7 ± 424.11	0.255
Carbohydrates (%)	58.68 ± 9.69	59.41 ± 8.58	59.74 ± 6.74	59.25 ± 8.33	0.860
Protein (%)	16.09 ± 6.23	17.30 ± 6.53	18.03 ± 7.19	17.12 ± 6.68	0.466
Lipids (%)	23.91 ± 7.42	23.78 ± 6.88	24.88 ± 6.49	24.26 ± 6.90	0.788
Calcium (mg)	480.70 ± 369.71	488.91 ± 360.42	522.51 ± 413.07	498.65 ± 381.57	0.891
Iron (mg)	9.86 ± 8.62	14.82 ± 10.10	12.98 ± 8.14	12.14 ± 8.90	0.102
Thiamine (mg)	1.43 ± 2.59	2.25 ± 5.64	1.10 ± 0.78	1.48 ± 3.10	0.414
Vitamin B_{12} (mcg)	2.22 ± 3.84	2.64 ± 6.59	0.72 ± 0.77	1.73 ± 3.96	0.135
Folate (mcg)	182.30 ± 311.47	203.37 ± 290.38	229.65 ± 282.99	205.16 ± 293.75	0.792
Zinc (mg)	5.48 ± 4.42	6.91 ± 5,17	8.59 ± 17.42	6.99 ± 11.43	0.512

$\mu \pm$ SD: average ± Standard Deviation. The p values were determined by the ANOVA/Kruskal-Wallis test between groups according to the Shapiro-Wilk Normality test.

The evaluation of water consumption showed that 74.2% of the patients consumed 1 to 2 liters of water/per day, 19.4% above 2 liters, and 6.5% up to 1 liter of water/per day.

73.3% of the patients reported food intolerances. The most mentioned foods were tapioca (59.1%), açaí (49.5%), rice (43%), fried foods (37.6%), and milk. Food intolerances were not reduced according to the postoperative time ($p>0.05$).

Sixty-seven percent of the patients presented weight reacquisition, with a mean reacquisition of 14.6±10.8 kg. Among the patients who presented weight reacquisition, 27.4% were from G1 (2 to 24 months), 21% from G2 (25 to 48 months), and 51.6% from G3 (above 48 months). It was observed that the reacquisition of weight was proportional to the postoperative time ($p<0.001$).

Of the several factors analyzed that could influence weight reactivity (age, preoperative BMI, percentage of excess weight loss, basal metabolic rate, and caloric intake), none had a significant influence on postoperative weight reactivity ($p>0.05$) (Table 4).

Ninety-nine percent of the patients presented at least one obesity-related disease in the preoperative period. After the surgical procedure, this index decreased to 36.7%, showing a significant reduction in the presence of all comorbidities ($p=0.01$), as shown in Fig. 1.

DISCUSSION

Currently, bariatric surgery is considered the most effective strategy for managing and treating severe obesity. However, several studies show that the surgical procedure does not end treatment, necessitating auxiliary therapies associated with continuously monitoring risk factors by a multiprofessional team [13].

In Brazil, the highest prevalence of severe obesity is concentrated in women. The higher prevalence of women undergoing bariatric surgery may be justified by a social issue that involves the beauty pattern,

Table 4
Analysis of factors associated with weight re-acquisition.

Variable	Total (n = 93)	weight re-acquisition		p
		Yes	No	
		n = 62	n = 31	
	$\mu \pm SD$	$\mu \pm SD$	$\mu \pm SD$	
Surgery time	43.19 ± 29.68	52.32 ± 29.07	24.94 ± 21.60	0.001
Age	41.86 ± 7.68	42.84 ± 7.40	39.90 ± 7.98	0.82
Preoperative BMI	47.22 ± 4.93	47.33 ± 4.75	47.00 ± 5.36	0.759
Percentage of Excessive Weight Loss	4.17 ± 0.65	4.21 ± 0.58	4.10 ± 0.79	0.435
Basal Metabolic Rate	1463.56 ± 166.27	1456.45 ± 148.60	1477.76 ± 198.92	0.563
Fat Mass (Percentage)	31.40 ± 4.77	31.55 ± 4.10	30.50 ± 5.86	0.199
Caloric intake	1262.75 ± 424.12	1302.46 ± 410.52	1183.33 ± 446.28	0.203

$\mu \pm SD$: average ± Standard Deviation. The p values are determined by the T/Mann-Whitney test between groups according to the Shapiro-Wilk Normality test.

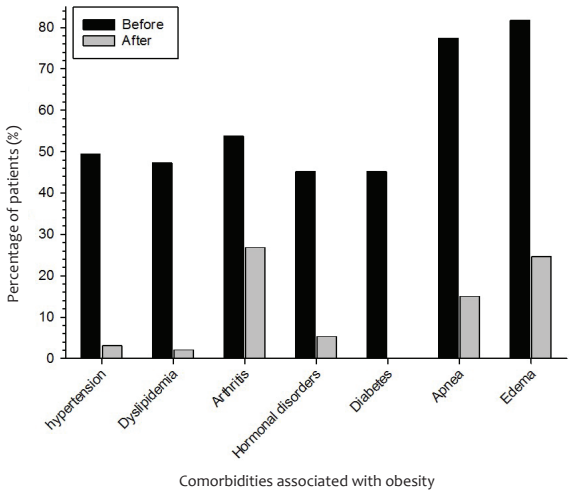

Fig. 1. Comorbidities associated with obesity before and after operation.

the appreciation of leanness, and the social pressure for weight loss to be greater in this public. In addition, women seek more health services than men [14-16].

According to information published by the Brazil Agency website, 70% of bariatric surgeries are performed by women[17]. Research carried out in different sociocultural contexts has shown that women are the majority of patients who seek a surgical procedure to treat obesity[18,19].

Comparing data from the pre-and postoperative periods of the population evaluated in this study showed improvement in all obesity-related comorbidities. Several studies [20-22] described the reduction of the presence of comorbidities.

In this study, most patients reported the use of drugs in the preoperative period, and in the postoperative period, there was a significant reduction. Possibly, this result is directly related to the reduction of comorbidities diagnosed before surgery. According to Ceneviva *et al.* [23], the reduction of comorbidities and the use of medications is proportional to weight reduction in the postoperative period of bariatric surgery. A meta-analysis investigated the impact of surgery on weight and reduction of significant comorbidities in more than 136 studies, totalling 22,094 patients (72.6% women) with a mean age of 39. The results found that the reduction of comorbidities was proportional to the loss of excess weight, similar to that found in this research [24].

A study of 342 patients (261 women and 81 men) who underwent Roux-en-Y gastric bypass showed that, as the mean BMI decreased in a postoperative period of 1,2,5 and 10 years, the associated comorbidities

were also reduced in the short, medium, and long term [25].

Regarding the practice of physical activity, we observed in this study that there was a reduction in the postoperative period, which may contribute to the reacquisition of weight. Bariatric surgery, combined with guided physical exercise, potentiates the reduction of comorbidities and contributes to a better quality of life for the patient [26]. Although no significant result was found between the association of physical activity practice and weight reactivity in this study, it is known that those who become more active present better weight control postoperatively compared to people who do not exercise physically [27]. Weich *et al.* identified that 30% of the patients who adhered to regular physical activity had better weight control in the postoperative period of bariatric surgery [28].

Regarding using nutritional supplements in the postoperative period, most patients evaluated in this study did not use any supplementation. When comparing the groups, it was observed that group 02 was the least medication user. This result may be related to the non-attendance of these patients in the health unit for nutritional follow-up since it was the group that less frequently attended consultations with nutritionists. Regarding whether or not to attend the nutritional consultation, 49% of the patients stated that they did not attend the consultations. Similar results were described by Magro et al. and Souza JMB [27,29], evidencing that periodic nutritional monitoring greatly influences dietary habits and adherence to supplementation.

Regarding the anthropometric evaluation, this study did not observe a significant difference in BMI values between the groups evaluated in the postoperative period. This study confirmed that satisfactory results were achieved by 88.17% of the patients (% PEP ≥50%), with similar results [24].

The dietary survey (R24h) indicated an average daily energy consumption of 1262.7 ± 424.1 kcal. There was no significant difference between groups in terms of nutrient intake. A similar result was described by Brolin RE *et al.* [30].

Carbohydrate intake was 57±6.4%, the only macronutrient that presented intakes compatible with current nutritional recommendations. In this study, we found similar results since the percentage of carbohydrate intake was also the only one that showed adequacy of the current daily recommendations [31].

Although the macronutrient intake was not significant between the groups, the mean protein intake was lower in group 01 (16.09 ± 6.23), and that of lipids showed a discrete increase over time. The average protein intake in grams was shown to be inadequate since the minimum recommendation is 60 to 70 grams per day. A study showed similar results when citing the average protein intake performed by most patients in the postoperative period [13].

Compared to the DRIs-recommended Daily Intake Means, inadequacy was observed in all micronutrients analyzed: calcium, iron, thiamine, vitamin B_{12}, folate, and zinc. Other studies [30-32] also reported low vitamin B12, iron, zinc, iron, calcium, and folate intake.

In patients over 18 years of both genders submitted to Roux-en-Y gastric bypass gastroplasty, it was evidenced that 30.83% of subjects had vitamin B_{12} deficiency, 29.1% had iron deficiency, and 14.1% had calcium deficiency [30-32].

The majority of patients adequately fractionated their meals. Thirty-five reported similar results, identifying that 62.1% of the individuals evaluated consumed four or five meals daily.

Food intolerances were reported by 73.3% of the patients, similar to that found by other authors [30-35,] who also identified that the foods that caused the most discomfort were rice, sweets, and meat. In this study, the most mentioned foods were tapioca (59.1%), açaí (49.5%), rice (43%), fried foods (37.6%), milk (32.3%), and sweet (31,2%).

Foods such as tapioca and açaí have not yet been cited in other studies because they are regional foods.

Regarding weight reacquisition, 67% of the patients regained weight, with a mean reacquisition of 14.6 ± 10.8 kg. [27], finding that 46% of the patients regained weight in two years postoperatively and 63.6% in four years.

In this study, most patients who presented reacquisition were in G3 (above 48 months). Thus, reacquisition was significantly proportional to postoperative time, although no significant relationship was found with income, daily caloric intake, basal metabolic rate, body composition, physical exercise, and nutritional monitoring.

As observed in this study, the literature [30-35] points out a greater incidence of weight reacquisition after two years of surgery, which is attributed to the longer time elapsed after surgery.

The occurrence of weight relapse, especially in patients with a more extended postoperative period, is associated with worsening comorbidities. There is little data on patients with more than 10 years of postoperative, which increases the concern and the need for more research in the area [31].

In the last five years, the scientific literature has pointed out that so far, bariatric surgery is the most effective method to treat obesity and can play an essential role in reducing the direct and indirect costs of obesity treatment [36]. The procedure increases fertility rates and improves breastfeeding, providing benefits to infant and maternal health[37] However, it pointed out that issues associated with bone mineralization [38], digestive motility [39], and nutritional deficiencies should be carefully observed [40].

The results found in this study evidenced that the public that most demanded bariatric surgery in the Western Amazon is the female population.

Among the individuals evaluated, there was a significant reduction in comorbidities associated with obesity and, consequently, a decrease in medication use. The loss of excess weight was satisfactory concerning the surgical procedure adopted (Roux-en-Y gastric bypass), and daily caloric intake, as well as protein, vitamin, and mineral intake, especially in the first two postoperative years, presented inadequacies compared to the current recommended nutrient recommendations.

Most patients did not perform periodic nutritional monitoring, which can demonstrate non-attendance to consultations with other health professionals since the answering service is integrated. In addition, most of the patients did not adequately use nutritional supplementation. The foods with the most significant potential for food intolerances in the region were tapioca, açaí, sweets, and milk.

Regarding weight reacquisition, the higher the postoperative period of the patients, the greater the weight reacquisition was found. This fact did not present significant relevance when compared to variables such as income, physical activity practice, nutritional monitoring, basal metabolic rate and daily energy intake. This result is worrisome and must be investigated in other research, seeking to describe the determining factors for the reality found.

Bariatric surgery significantly reduced comorbidities, medication use, and excess weight loss. However, the adequacy of nutrients and the increasing incidence of weight reactivity in the postoperative period demonstrated that bariatric surgery does not end the treatment of obesity; on the contrary, it is only a step that requires periodic monitoring by health professionals.

ACKNOWLEDGMENTS

We thank the Clinics Hospital of the State of Acre, Brazil, for allowing and supporting the study, all the professionals for their support, and the patients for agreeing to participate in the experiment.

Funding

No funds, grants, or other support was received.

Conflicts of interest

Authors declare that they have no conflicts of interest.

Ethical approval

The project was submitted to the Research Ethics Committee of the Clinics Hospital /HC of the State of Acre and approved through opinion nº 1,979,084.

Author's ORCID numbers

- Suellem M. Bezerra de Moura Rocha: 0000-0001-8060-2746
- Alanderson Alves Ramalho: 0000-0002-7503-1376
- Rachel Horta Freire: 0000-0001-7020-4402
- Thiago Montes Fidale: 0000-0002-6137-1687
- Dionatas U. de Oliveira Meneguetti: 0000-0002-1417-7275
- Luis Carlos Oliveira Gonçalves: 0000-0001-5368-1194
- Anibal Monteiro de Magalhães Neto: 0000-0002-4887-5936
- Luiz Carlos de Abreu: 0000-0002-7618-2109
- Romeu Paulo Martins Silva: 0000-0002-8368-158X

Participation in the development and Writing of the paper

SMBMR, AAR, and RPMS Conceptualization; SMBMR, AAR, RHF, TMF, DUOM, and RPMS Data curation; SMBMR, AAR, LCOG, AMMN, LCA and RPMS Formal analysis; SMBMR, AAR, RHF, TMF, DUOM and RPMS Investigation; SMBMR, AAR, and RPMS Methodology; RPMS Project administration; All authors Resources; Software; Supervision; Validation; Visualization; Writing - original draft; and Writing - review & editing.

REFERENCES

1. **Thibault R, Huber O, Azagury D, Pichard C.** Twelve key nutritional issues in bariatric surgery. Clin Nutr 2016; 35(1):12-17.
2. **Novais PFS, Júnior IR, Leite CVS, Oliveira MRM.** Evolução e classificação do peso corporal em relação aos resultados da cirurgia bariátrica - derivação gástrica em Y de Roux. Arq Bras Endocronol Metabol 2010; 54(3):303-310.
3. **Boscatto EC, Duarte MFS, Gomes MA, Gomes GMB.** Aspectos físicos, psicossociais e comportamentais de obesos mórbidos submetidos à cirurgia bariátrica. J Health Sci 2010; 28(2):195-198.
4. **Marcus DA.** Obesity and the impact of chronic pain. Clin J Pain 2004; 3(20):186-191.
5. **Fruhbeck G**. Bariatric and metabolic surgery: a shift in eligibility and success criteria. Nat Rev Endocrinol 2015; 11(8):465-477.
6. **Moizé V. Andreu A, Flores L, Torres F, Ibarzabal A.** Long-term intake and nutritional deficiencies following sleeve gastrectomy os Roux-em-Y gastric bypass in a Mediterranean population. J Acad Nutr Diet 2013; 113(3):400-10.
7. **Gletsu-Miller N, Wright BN.** Mineral malnutrition following bariatric surgery. Adv Nutri 2013; 4(5):506-517
8. **Ministério da saúde.** Antropometria: Como pesar e medir. Coordenação geral de política de alimentação e nutrição e centro colaborador em alimentação e nutrição - região sudeste - ENSP - Fiocruz, Departamento de atenção básica. Secretaria de atenção à saúde, 2004. http://www.redesans.com.br/redesans/wpcontent/uploads/2012/10/antopometria_como_pesar_medir_album_biblioteca.pdf.
9. **Ministério da Saúde.** Obesidade. Secretaria de Atenção à Saúde. Departamento

de Atenção Básica. Cadernos de Atenção Básica 2016; 12(A):1-110.

10. **Maltron BS.** Manual de operação Bio Scan 916-917. Cardiomed medicine, sports & fitness. Curitiba, 2009.
11. **Deitel M.** Overwheight and obesity worldwide now estimated to involve 1.7 billion people. Obes surg 2003; 13(3):329-330.
12. **Tabela Brasileira de composição de alimentos/NEPA.** Unicamp, 4ª ed.rev. e amp. Campinas, 2011.
13. **Clarisse M, Di vetta V, Siegrist C, Giust V.** How to facilite protein concumption after gastric bypass? Rev Med Suisse 2013; 9(379):670-3.
14. **Silva R, Kelly E.** Prevalência e fatores interferentes no reganho de peso em mulheres que se submeteram ao bypass gástrico em y de roux após 2 anos de cirurgia barátrica. Rev Bras Obes, Nutr Emagrecimento 2014; 8(47):134-141.
15. **Nishiyama MF, Carvalho MDB, Pelloso SM, Nakamura RKC, Peralta RM, Marujo FMPS.** Avaliação do nível de conhecimento e aderência da consulta nutricional em pacientes submetidos e candidatos à cirurgia bariátrica. Arch Health Sci 2007; 11(2):88-98.
16. **Mota D C L, Costa T M B, Almeida S S.** Imagem corporal, ansiedade e depressão em mulheres submetidas à cirurgia bariátrica. Psicologia: teoria e prática 2014; 16.
17. **Pimentel C. Agência Brasil. Artigo:** mulheres são a maioria entre os pacientes de cirurgia bariátrica. Published in: 19/03/2013. Acessed in: 28 de fevereiro de 2018.
18. **Harbottle L.** Audit of nutritional and dietary outcomes of bariatric surgery patients. Obes Rev 2011; 12(3):198-204.
19. **Siqueira A, Zanotti S.** Programa de cirurgia bariátrica e reganho de peso. Ver. Psicologia, saúde e doenças 2017; 18:157-169.
20. **Bruce M, Elizaveta K, Robert E.** Treatment of Obesity weight loss and bariatric surgery. Circ Res 2016; 118(11):1844-1855.
21. **Pajeck D, Dalcanalle L, Oliveira C P M S, Zilberstein B, Halpern A, Garrido J A, Cecconello I.** Follow -up of Roux-en-y gastric bypass patientes at 5 or more years postoperatively. Obes Surg 2007; 17(5):601-607.
22. **Perry, C D; Hutter M M, Smith D B, New house J P, Mcneil B J.** Survival and changes in comobidities after bariatric surgery. Ann Surg 2008; 247(1):21-27.
23. **Ceneviva R, Silva G A, Viegas M M, Sankarankutty A K, Chuere F B.** Cirurgia bariatrica e apnéia do sono. Medicina (Ribeirão Preto) 2006; 39(2): 235-245.
24. **Buchwald H, Avidor Y, Branwald E, Jensen M D, Pories W, Fahrbach K, Schoelles K A.** Bariatric surgery: systematic review and metanalysis. JAMA 2004; 292(14):1724-1737.
25. **White S, Brooks E, Jurikova L, Stubbs R S.** Long-term outcomes after gastric bypass. Obes Surg 2005; 15(2):155-163.
26. **Silva A A, Araújo R P, Gurgel L A, Aguiar J B.** Influência do exercício físico sobre a composição corporal após gastroplastia. Braz J Health Sci 2013; 11(38):25-31.
27. **Magro D O, Geloneze B, Delfini R, Pareja BC, Callejas F, Parejas J C.** Long-term weight regain after gastric bypass: a 5-year prospective study. Obes Surg 2008; 18(6):565-579.
28. **Welch G, Wesolowski C, Piepul B, Kuhn J, Romanelli J, Garb J.** Physical Activity predicts weight loss following gastric surgery: findings from a support group survey. Obes Surg 2008; 18(5):517-524.
29. **Souza J M B, Castro M M, Maria E M C, Ribeiro N A, Almondes K M, Silva N G.** Obesidade e tratamento: desafio comportamental e social. Rev bras ter cogn 2005; 1(1):57-59.
30. **Brolin R E, Leung M.** Survey os vitamin and mineral supplementation ater gastric bypass and biliopancreatic diversion for morbid obesity. Obes Surg 1999; 9(2):150-154.
31. **Rubio M A, Moreno C.** Implicaciones nutricionales de la cirugía bariátrica sobre el tracto gastrointestinal. Nutr hosp 2007; 22(2):124-134.
32. **Dias M C G, Ribeiro A G, Scabim V M, Faintuch J, Zilbertein B, Gama-Rodrigues J.** Dietary intake of female bariatric patients after anti-obesity gastroplasty. Clinics 2006; 61(2):93-98.

33. **Wardé-kamar J, Rogers M, Flancbaum L, Laferrere B.** Calorie intake and meal patterns up to 4 years after roux-em-y gastric bypass surgery. Obes Surg 2004; 17(8):1070-1079.
34. **Segura D C A, Wozniak S D, Andrade L A, Marreto T M, Ponte E D.** Deficiências nutricionais e suplementação em indivíduos submetidos a gastroplastia redutora do tipo Y de Roux. Rev Bras Obes, Nutr Emagrecimento 2017; 11:338-347
35. **Valezi A C, Brito S J, Mali J R, Brito E M.** Estudo do padrão alimentar tardio em obesos submetidos à derivação gástrica com bandagem em y de roux: comparação entre homens e mulheres. Rev Col Bras Cir 2008; 35(6):387-391.
36. **Tabesh MR, Eghtesadi M, Abolhasani M, Maleklou F, Ejtehadi F, Alizadeh Z.** Nutrition, physical activity, and prescription of supplements in pre- and post-bariatric surgery patients: an updated comprehensive practical guideline. Obes Surg. 2023 Aug;33(8):2557-2572.
37. **Adsit J, Hewlings SJ.** Impact of bariatric surgery on breastfeeding: a systematic review. Surg Obes Relat Dis. 2022 Jan;18(1):117-122.
38. **Link TM, Schafer AL.** Bariatric surgery negatively impacts bone health in adolescents. Radiology. 2023 Jun;307(5):e231260.
39. **Montana L, Colas PA, Valverde A, Carandina S.** Alterations of digestive motility after bariatric surgery. J Visc Surg. 2022 Mar;159(1S):S28-S34.
40. **Steenackers N, Van der Schueren B, Augustijns P, Vanuytsel T, Matthys C.** Development and complications of nutritional deficiencies after bariatric surgery. Nutr Res Rev. 2023 Dec;36(2):512-525.