



Preoperative Nutritional Interventions in Morbid Obesity: Impact on Body Weight, Energy Intake, and Eating Quality

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Abstract

Background Although the benefits of preoperative weight loss and adequacy of dietary patterns in bariatric surgery is well-recognized, the nutritional strategies in the preoperative period have been scarcely investigated. We aimed to evaluate the impact of intensive and standard nutritional interventions on body weight, energy intake, and eating quality.

Methods This is a retrospective study in which 32 patients undergoing intensive nutritional intervention, with low-calorie diet (10 kcal/kg) and biweekly visits, were pair-matched by age, sex, and body mass index with 32 patients under a standard nutritional intervention, based on a general dietary counseling. Twenty-four-hour food recall was used to assess energy intake and to derive healthy eating index (HEI). The follow-up preoperative period varied from 8 to 16 weeks.

Results Weight loss was observed in 72 % of the patients from the intensive intervention group and 75 % of the patients from the standard intervention group. According to the mixed model analysis, time effect on weight loss in both groups was significant ($P=0.0002$); however, no difference was found between the intervention groups ($P=0.71$). The time effect was significant in both groups for energy intake reduction as well ($P<0.0001$), but no

difference was found between the intervention groups ($P=0.25$). Improvement of eating quality was expressed by the nutrient score of the HEI that increased significantly over time ($P=0.02$), also without distinction between the groups ($P=0.61$).

Conclusion Both intensive and standard nutritional interventions promoted weight loss, energy intake reduction, and improvement of eating quality in morbidly obese patients during preoperative period.

Keywords Morbid obesity · Nutritional intervention · Preoperative bariatric surgery · Weight loss · Energy intake · Eating quality

Introduction

Obesity is a multifactorial disease encompassing genetic, metabolic, socioeconomic, and environmental factors, and it has reached epidemic proportions around the world [1]. The incidence and prevalence of morbid obesity has increased substantially as well [2]. Bariatric surgery is considered the most effective therapy for morbid obesity by resulting improvement or complete resolution of comorbidities, besides providing quality of life [3, 4].

Weight loss in the preoperative phase has shown to reduce the amount of visceral fat [5–7], the size of the liver [8, 9], cardiovascular risk, inflammation, thromboembolic risk, serum glucose, and frequency of obstructive sleep apnea [10, 11]. In addition, losing weight can diminish the risk of the operation in obese patients, minimizing the operative time and potential perioperative complications [12, 13]. Finally, a number of studies have demonstrated that losing weight and improving dietary patterns previous to surgery may benefit postoperative weight loss [14–17]. Therefore, efficient strategies to accomplish such benefits in

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a preoperative period are of great relevance for the treatment of morbidly obese patients.

In view of the paucity of data on the nutritional protocols for bariatric surgery candidates, we aimed to evaluate the impact of different nutritional interventions, intensive and standard, on body weight, energy intake, and eating quality in morbidly obese patients during the preoperative period.

Methods

Patients and Study Protocol

This is a retrospective study that included morbidly obese patients who underwent laparotomy Roux-en-Y gastric between August 2007 and December 2007, following the criteria established by the National Institute of Health [18]. Thirty-two patients who underwent an intensive nutritional intervention were pair-matched by age, sex, and body mass index (BMI) with 32 patients who underwent a standard nutritional intervention. The intensive nutritional care consisted of providing a low-calorie diet with 10 kcal/kg/day and a pre-scheduling visit biweekly. The standard nutritional intervention was based on general dietary counseling without severe dietary restriction and frequent visits. Patients had visits when they were asked by the dietitian or according to the patients' interest. The preoperative follow-up period varied from 8 to 16 weeks, and patients were followed by the same skilled dietitian.

Nutritional visits included anthropometric evaluation and food consumption assessment. Demographic, laboratory, and medical history (presence of comorbidities, use of anti-obesity drugs, physical activity, and obesity onset) data of the baseline were collected. Eating patterns such as binge, snacker, sweet, or night eater were registered. Operative time, length of hospital stay, and presence of intraoperative and perioperative complications (surgical, gastrointestinal, cardiac, circulatory, or infections) were also recorded.

The study was approved by the Ethical Committee of the Healthy Faculty of the University of Brasília (Brasília, Brazil), and informed consent was obtained from each participant.

Anthropometric and Biochemical Assessment

Body mass index was obtained as weight divided by squared height. Biochemical parameters [glucose, glycosylated hemoglobin, insulin, total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides] were analyzed in order to characterize the baseline metabolic profile.

Twenty-Four-Hour Food Recall

Energy intake and the healthy eating index (HEI) were obtained by using 24-h food recall. We used the HEI adapted for Brazilian population [19], which considers the following components: (1) Serves: food reported in 24-h recall were converted into portions, according to the energy content and food groups of the Adapted Food Pyramid: cereals, fruits, vegetables, legumes, dairy products, meats, sweets and sugars, and fats and oils. (2) Nutrients: nutrients assessed were total and saturated fat, and cholesterol. (3) Variety: different food items were registered. Each component was graded from 0 to 10, resulting in a maximum score of 120, then eating quality was classified into three categories: poor quality (score ≤ 70), needing improvement (score from 71 to 100), and good quality (score >100).

Statistical Analyses

Differences between groups for continuous variables were evaluated by Mann–Whitney test or independent student's *t* test, as appropriate. For qualitative variables, we used the chi-square test. As intervention time varied among patients, we applied a mixed effects model analysis with the time treated as a linear variable in order to investigate potential changes in body weight, energy intake, and HEI during the follow-up. *P* values <0.05 were considered statistically significant. All analyses were performed using a standard statistical package SAS (version 9.2, Cary, NC: SAS Institute Inc, 2008).

Results

This study included 64 patients who met the criteria for bariatric surgery and were followed in our preoperative screening program. Age varied from 19 to 59 years (37.7 ± 11.4 years) and the gender distribution of the study population was predominantly female (66 %). Hypertension and dyslipidemia were the most frequent comorbidities. BMI at baseline ranged from 34.7 to 56.6 kg/m² (42 ± 4.9 kg/m²). Obesity onset of the patients was as follow: childhood (48 %), adolescence (17 %), and others/not determined (35 %). Binge was the most common eating abnormality (77 %). Sixteen percent of the patients were on use of anti-obesity drugs and 80 % were sedentary. Average biochemical parameters were in general within acceptable levels. HEI indicated that only one patient had good quality (score >100), the majority of the patients (73 %) needed improvement (score from 71 to 100), and the remaining had poor quality (score ≤ 70). The baseline characteristics of the patients who underwent intensive nutritional intervention ($n=32$) and those who underwent standard nutritional intervention ($n=32$) during the preoperative period

are depicted in Table 1. No baseline differences were found between the groups with regards to demographic, clinical, and nutritional characteristics.

Table 2 demonstrates the follow-up data of the patients according to the nutritional intervention. As expected, the number of visits was significantly higher in the intensive intervention group. There was a trend towards decreasing the length of hospitalization in the intensive care group when compared to the standard care. We observed that 72 % of the patients from the intensive intervention group and 75 % of the patients of the standard intervention group had weight loss. According to the mixed model analysis, time effect on weight loss in both groups was significant ($P=0.0002$; Fig. 1). Body weight changes for intervention and standard groups were respectively -1.0 (-12.7 to 5)kg and -1.5 (-23.9 to 7.2)kg [median (range)]. However, there was no difference between the groups ($P=0.71$). This multilevel model also revealed that time effect was significant in both groups for energy intake reduction as well ($P<0.0001$), regardless of the nutritional intervention ($P=0.25$; Fig. 2). In addition, the improvement of eating quality was expressed by means of the nutrient score of the HEI that increased significantly overtime ($P=0.02$), without distinction between the groups ($P=0.61$; Fig. 3).

Therefore, the benefits translated as weight loss, energy intake reduction, and improvement of eating quality were evidenced during the preoperative period in morbid obesity undergoing both types of nutritional interventions.

Discussion

Bariatric surgery is becoming increasingly more common in the treatment of morbid obesity in the clinical practice. Considering there are no universal recommendations for carrying out benefits in the preoperative period for morbidly obese individuals, the issue under investigation in the present study is of great relevance. Herein, we demonstrated that the intensive nutritional intervention, with very restrictive diet and frequent visit, as well as the standard nutritional intervention based on a general dietary counseling promoted weight loss, energy intake reduction, and improvement of eating quality in morbidly obese patients during preoperative period.

Surgery generates substantial weight loss, but 20 to 30 % fails to achieve successful weight loss. In a recent meta-analysis, Livhits et al. [20] investigated the preoperative

Table 1 Baseline characteristics of the patients according to the interventions

Variables	Intervention		P value
	Intensive (n=32)	Standard (n=32)	
Age (years)	39±10.6	37±12.2	0.16
Comorbidities			
Type 2 diabetes [n (%)]	7 (22)	12 (38)	0.17
Hypertension [n (%)]	18 (56)	16 (50)	0.62
Dyslipidemia [n (%)]	15 (47)	21 (66)	0.13
Hepatic steatosis [n (%)]	10 (31)	17 (53)	0.08
Obstructive sleep apnea [n (%)]	11 (34)	15 (47)	0.31
Anthropometry			
Weight (kg)	112.6±20.6	114.4±19.3	0.53
BMI (kg/m ²)	41.9±5.2	42.2±4.6	0.56
Biochemical parameters			
Glucose (mg/dl)	94.6±11.3	92.4±11.5	0.56
Glycosylated hemoglobin (%)	6.0±0.6	6.2±2.6	0.12
Insulin (μU/ml)	20.8±14	18.6±9.8	0.94
Total cholesterol (mg/dl)	190.8±34.9	204.2±56.3	0.21
LDL cholesterol (mg/dl)	114.9±37.1	123.1±37.4	0.39
HDL cholesterol (mg/dl)	44.1±9.5	50.1±18.5	0.09
Triglycerides (mg/dl)	138.1±56.3	168.1±77.8	0.10
Food consumption			
Energy intake (kcal/day)	2,163±1,250	1,847±875	0.60
Healthy eating index	77±14	80±11	0.45
≤70 (poor quality) [n (%)]	8 (25)	8 (25)	
71–100 (needing improvement) [n (%)]	23 (72)	24 (75)	0.60
>101 (good quality) [n (%)]	1 (3)	0 (0)	

BMI body mass index, LDL low-density lipoprotein, HDL high-density lipoprotein, HEI healthy eating index

Table 2 Follow-up data of the patients according to the interventions

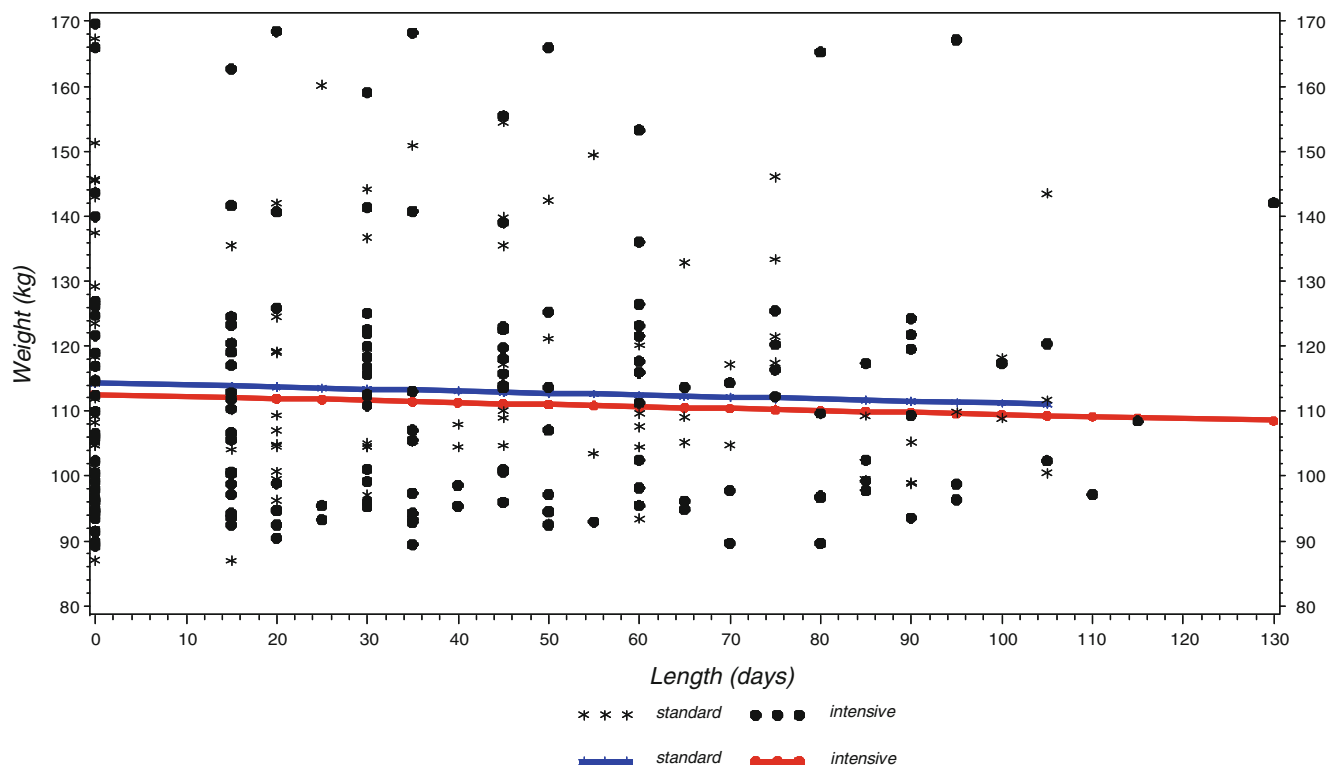
Variables	Intervention		P value
	Intensive (n=32)	Standard (n=32)	
Follow-up			
Number of visits	4.8±1.4	3.2±0.9	<0.001
Length of follow-up (days)	81.2±22.8	85.3±15.7	0.56
Intra- and peri-operative evolution			
Operative time (hours)	2.7±0.4	2.9±0.5	0.17
Length of hospitalization (days)	3.2±0.5	3.4±0.7	0.06
Perioperative complications [n (%)]	5 (16)	2 (6)	0.43

predictors of weight loss following bariatric surgery and pointed out preoperative weight loss as mandatory [20]. The benefits of weight loss in the preoperative phase extend to the reduction of visceral fat [21–23] and size of the liver [24], which improves the surgical field and intra-operative view, and may in turn help during the surgical act, both in open as well as laparoscopic surgery [25]. In addition, cardiovascular risk, inflammation, thromboembolic risk, serum glucose, frequency of obstructive sleep apnea [10, 11] as well as complications associated to operation [12, 13] may be mitigated by reduction in body weight.

The preoperative clinical treatment for most patients in the present study was not based on the use of medications

for weight loss, but on behavioral changes related to diet. In fact, the potential benefit of improving dietary patterns before surgery on both pre- and postoperative weight loss has been previously suggested [14, 15, 26]. Thus, dietary approach is a very important ingredient in the management of bariatric surgery candidates.

In the current study, in accordance with the previous findings [27], binge was the most common eating abnormality, accounting for 77 % of the patients. The prevalence of binge, however, differs according to the studies probably due to the differences in population and classification instruments as well. Powers et al., in a sample of 116 morbid obese patients, found presence of binge in 52 % of the

**Fig. 1** Changes in body weight in the groups under intensive and standard nutritional interventions

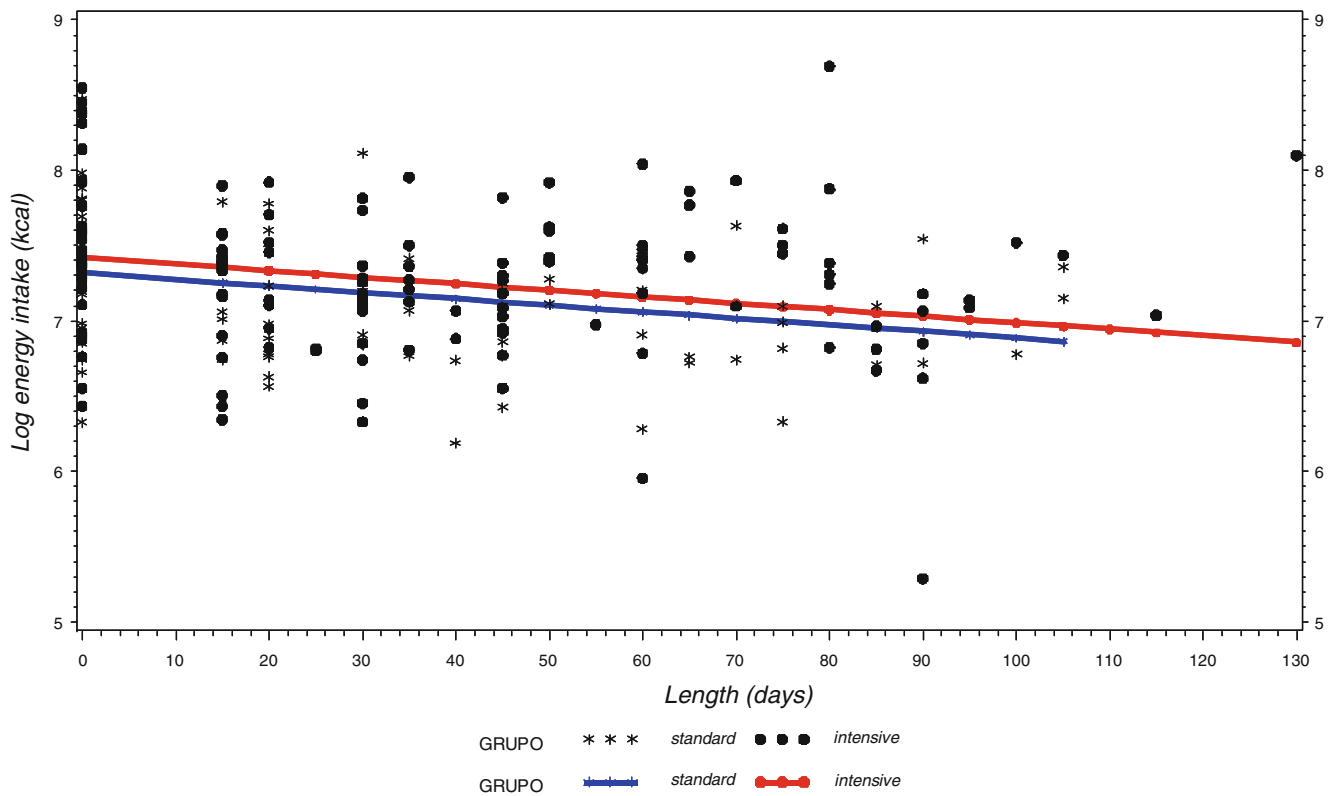


Fig. 2 Changes in energy intake in the groups under intensive and standard nutritional interventions

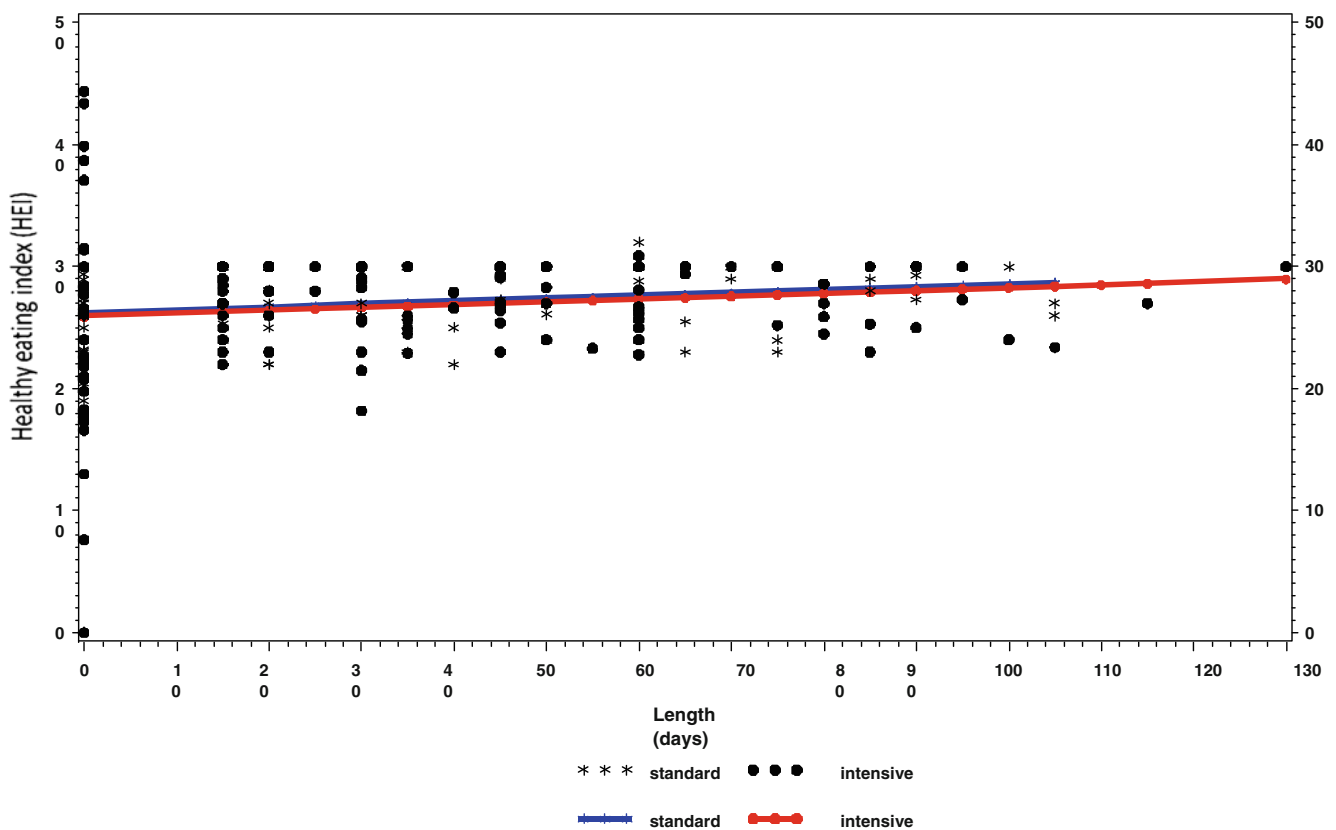


Fig. 3 Changes in the healthy eating index in the groups under intensive and standard nutritional interventions

patients before surgery [28]. In a larger sample, Busetto et al. [27] found that 34 % of their morbidly obese patients had binge eating disorder. The authors showed that the presence of binge did not affect weight loss as well as weight regain during 5 years of follow-up. As far as we are concerned, there is no data regarding the relationship between binge eating disorder and clinical endpoints in preoperative phase. In the present study, we found no association between binge and body weight changes, dietary intake as well as other eating disturbances, possibly due to the adequate support and monitoring with psychological therapy.

There are no national studies that have applied the adapted HEI in obese patients, and our study is the first to use this tool for the assessment of eating quality before obesity surgery. Although the criteria used to derive the HEI in the current study differ from the original [29], the final categorization in both is similar, i.e., poor diet, needing improvements, or good quality. Our results pointed out the majority of patients (73 %) needed eating quality improvement according to the HEI. This is in line with the previous findings by Guo et al. [30], who assessed the quality of the diet of obese Americans and demonstrated that approximately 70 % needed improvement. Such observations call attention to the definite need of encouraging obese patients to improve the quality of food before surgical intervention. Accordingly, the improvement of eating quality expressed as nutrient score of the HEI was evidenced in the present study after nutritional intervention.

The nutritional intervention also contributed to the reduction in energy consumption regardless of the type of intervention, intensive, or standard. A number of reports have suggested that adherence to the recommended diet is poor. This seems to be a serious problem particularly in the long-term postoperative period, in which the caloric intake often increases drastically. Brolin et al. [31] demonstrated that before surgery patients consumed 2,604 kcal/day, 6 months after Roux-en-Y gastric bypass patients consumed 890 kcal/day, and during the next 2.5 years the total caloric intake increased to 1,386 kcal/day. Similar patterns of caloric consumption were found by other investigators [32]. Although we could suppose such caloric amount might not be sufficient to promote weight regain, it is important to note that obese individuals typically underestimate their caloric consumption in approximately 40 % of the dietary intake assessment [33].

The limitation of this study relies on the relatively small sample size and the retrospective nature of the study. In addition, the time interval between the preoperative measurements was not standardized, since assessments were based on the patient visits to clinicians. A short follow-up time could not provide a sufficient weight loss and a long period could increase the possibilities of weight regain, even before surgery. However, there is no consensus so far on the

most appropriate follow-up time for preoperative nutritional intervention. In the present study, body weight, energy intake, and food quality changes overtime were all time-adjusted in the multilevel analysis. Finally, the current investigation is important in view of the growing scientific evidence evaluating the potential benefits of nutritional interventions for bariatric surgery candidates. The findings of the present study can contribute to the development of guidelines for this particular group of patients.

In conclusion, both intensive and standard nutritional interventions promoted weight loss, energy intake reduction, and improvement of eating quality in morbidly obese patients during preoperative period. Considering the experienced benefits were similar between the intervention groups, it is reasonable to suggest that implementation of standard nutritional counseling might be easier and should be encouraged for the surgery candidates. Finally, further studies are necessary to investigate the impact of the preoperative nutritional interventions on future clinical and hard outcomes during and after surgery.

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Conflict of Interest The authors have no conflict of interest.

References

1. National Heart, Lung and Blood Institute, National Institutes of Health. The Practical Guide: Identification, Evaluation and Treatment of Overweight and Obesity in Adults., U.S. Department of Health and Human Services. October 2000, NIH Pub. No 00-4084.
2. Santos LMP, Oliveira IV, Peters LRP, et al. Trends in morbid obesity and in bariatric surgeries covered by the Brazilian Public Health System. *Obes Surg*. 2010;20:943–8.
3. Faintuch J, Matsuda M, Cruz ME, et al. Severe protein–calorie malnutrition after bariatric procedures. *Obes Surg*. 2004;14(2):175–81.
4. Consensus BH, Panel C. Consensus conference statement bariatric surgery for morbid obesity: health implications for patients, health professionals, and third-party payers. *Surg Obes Relat Dis*. 2005;1(3):371–81.
5. Phillips ML, Lewis MC, Chew V, et al. The early effects of weight loss surgery on regional adiposity. *Obes Surg*. 2005;15:1449–55.
6. Colles SL, Dixon JB, Marks P, et al. Preoperative weight loss with a very-low-energy diet: quantitation of changes in liver and abdominal fat by serial imaging. *Am J Clin Nutr*. 2006;84:304–11.
7. Korner J, Punyanitya M, Taveras C, et al. Sex differences in visceral adipose tissue post-bariatric surgery compared to matched non-surgical controls. *Int J Body Compos Res*. 2008;6(3):93–9.
8. Fris R. Preoperative low energy diet diminishes liver size. *Obes Surg*. 2004;14:1165–70.
9. Lewis MC, Phillips ML, Slavotinek JP, et al. Change in liver size and fat content after treatment with Optifast very low calorie diet. *Obes Surg*. 2006;16:697–701.

10. The Look AHEAD Research Group. Long-term effects of a lifestyle intervention on weight and cardiovascular risk factors in individuals with type 2 diabetes mellitus: four-year results of the Look AHEAD trial. *Arch Intern Med*. 2010;170:1566–75.
11. Anandam A, Ainnusi M, Kufel T et al. Effects of dietary weight loss on obstructive sleep apnea: a meta-analysis. *Sleep Breath* 2012 Feb 29. [Epub ahead of print]. doi:10.1007/s11325-012-0677-3.
12. Schwartz ML, Drew RL, Chazin-Caldie M. Laparoscopic Roux-en-Y: preoperative determinants of prolonged operative times, conversion to open gastric bypasses, and postoperative complications. *Obes Surg*. 2003;12:734–8.
13. Cassie S, Menezes C, Birch DW, et al. Effect of preoperative weight loss in bariatric surgical patients: a systematic review. *Surg Obes Relat Dis*. 2011;7:760–8.
14. Alvarado R, Alami RS, Hsu G, et al. The impact of preoperative weight loss in patients undergoing laparoscopic Roux-en-Y gastric bypass. *Obes Surg*. 2005;15(9):1282–6.
15. Still CD, Benotti P, Wood GC, et al. Outcomes of preoperative weight loss in high-risk patients undergoing gastric bypass surgery. *Arch Surg*. 2007;142(10):994–8. discussion 999.
16. Alger-Mayer S, Polimeni JM, Malone M. Preoperative weight loss as a predictor of long-term success following Roux-en-Y gastric bypass. *Obes Surg*. 2008;18:772–5.
17. Mrad BA, Stoklossa CJ, Birch DW. Does preoperative weight loss predict success following surgery for morbid obesity? *Am J Surg*. 2008;195:570–4.
18. NIH Conference. Gastrointestinal Surgery for Severe Obesity. Proceedings of an NIH Consensus Development Conference, 1991.
19. Mota JF, Rinaldi AEM, Pereira AF, et al. Adaptação do índice de alimentação saudável ao guia alimentar da população brasileira”. *Rev Nutr Campinas*. 2008;21(5):545–52.
20. Livhits M, Mercado C, Yermilov I, et al. Preoperative predictors of weight loss following bariatric surgery: systematic review. *Obes Surg*. 2012;22(1):70–89.
21. Doucet E, St-Pierre S, Almeras N, et al. Reduction of visceral adipose tissue during weight loss. *Eur J Clin Nutr*. 2002;56:297–304.
22. Phillips ML, Lewis MC, Chew V, et al. The early effects of weight loss surgery on regional adiposity. *Obes Surg*. 2005;15:1449–55.
23. Komer J, Punyanitya M, Taveras C, et al. Sex differences in visceral adipose tissue post-bariatric surgery compared to matched non-surgical controls. *Int J Body Compos Res*. 2008;6(3):93–9.
24. Fris R. Preoperative low energy diet diminishes liver size. *Obes Surg*. 2004;14:1165–70.
25. Martinez DR, Salvador-Sanchis JL, Escrig-Sos J. Pérdida de peso preoperatoria en pacientes candidatos a cirugía bariátrica. *Cirugía Española: Recomendaciones basadas en la evidencia*; 2011 [Epub ahead of print].
26. Alami RS, Morton JM, Schuster R, et al. Is there any benefit to preoperative weight loss in gastric bypass patients? A retrospective randomized trial. *Surg Obes Relat Dis*. 2007;3(2):141–5. discussion 145–6.
27. Busetto L, Segato G, De Luca M, et al. Weight loss and postoperative complications in morbidly obese patients with binge eating disorder treated by laparoscopic adjustable gastric banding. *Obes Surg*. 2005;15(2):195–201.
28. Powers PS, Perez A, Boyd F, et al. Eating pathology before and after bariatric surgery: a prospective study. *Int J Eat Disord*. 1999;25:293–300.
29. Kennedy ET, Ohls J, Carlson S, et al. The Healthy Eating Index: design and applications. *J Am Diet Assoc*. 1995;95(10):1103–9.
30. Guo X, Warden BA, Paeratakul S, et al. Healthy Eating Index and obesity. *Eur J Clin Nutr*. 2004;58(12):1580–6.
31. Brolin RE, Robertson LB, Kenler HA, et al. Weight loss and dietary intake after vertical banded gastroplasty and Roux-en-Y gastric bypass. *Ann Surg*. 1994;220:782–90.
32. Sarwer DB, Dilks RJ, West-Smith L. Dietary intake and eating behavior after bariatric surgery: threats to weight loss maintenance and strategies for success. *Surg Obes Relat Dis*. 2011;7:644–51.
33. Litchman SW, Pisarska K, Berman ER, et al. Discrepancy between self-reported and actual caloric intake and exercise in obese subjects. *N Engl J Med*. 1992;327:1893–8.