Estimating nutrient intake for post bariatric patients and its effectiveness on their performance

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Abstract

Bariatric surgery is effective in producing long-term weight loss, yet it requires adherence to the recommended diet and physical activity. This present study assesses the correlation between the estimated total calorie intake and self-reported physical activity to successful weight loss defined by achieving at least 75% excess weight loss (EWL) after bariatric surgery. The international physical activity-short form questionnaire was used to assess of a subject's activity level over the previous seven days in four separate activity domains vigorous, moderate, walking, and sitting. Secondly, the food frequency questionnaire was used to assess a subject's estimated total calorie intake, and macronutrient percentages. Questionnaires were completed by thirty-nine subjects. The food energy intake and physical activity variables were calculated, then correlated with the %EWL which was based on a loss <75% or 75%EWL, also based on ideal body weight. The groups who lost <75% or ≥75% EWL after the bariatric surgery were significantly different in their age ($p<0.036$), pre-surgery BMI ($p=0.005$) and post-surgery BMI ($p<0.001$). The ≥75% EWL group consumed less energy from fat than the <75 %EWL group (34.8±5.4) vs. (37.8±6.6). Regarding the activity data, patients with ≥75 %EWL reported a total activity in min/week higher median 180(40-670) compare to 143(90-455) for <75% EWL group. This study shows a significant difference between %EWL age, pre- and post-surgery BMI, but did not show any significant correlation between %EWL and food energy nor physical activity. However, it does show a high level of success weigh loss after bariatric surgery.

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Keywords: bariatric surgery, excess weight loss percentage, FFQ, IPAQ-SF, physical activity, total calorie intake

1. Introduction

Obesity is defined as an excess of body fat mass inducing adverse effects on health which currently has become a world epidemic (Arson-Wisnewsky et al., 2016). At this point more than 2.1 billion nearly 30% of the world's population are considered overweight or obese (Jassil et al., 2015). This body weight epidemic is linked to several other chronic disorders including coronary heart disease, Type II diabetes, numerous cancers, sleep apnea, anxiety and depression; thus rendering severe obesity to be a major concern for health care systems (Reid et al., 2015).

Morbid obesity is progressively becoming more common in developed world and poses a great challenge to the medical community. Due to this, different approaches in nutritional, pharmaceutical, psychological, complementary therapies and surgical interventions have been suggested for coping with obesity (Widhalm et al., 2011). However sometimes the non-surgical methods are not sufficient for people who suffer obesity, as a result, these individuals may need to explore alternative approaches, like as undergoing bariatric surgery. (Jimenez-Loaisa et al., 2015). Bariatric surgery can be grouped into three main categories: restrictive, malabsorptive and mixed procedures. According to the 2015 annual report from the American Society for Metabolic and Bariatric Surgery (ASMBS), 196,000 bariatric surgeries were performed in the US and sleeve gastrectomy (SG) was the most frequent bariatric procedure done (Hassannejad et al., 2017).

Currently, bariatric surgery is the most effective and successful type of weight loss intervention for those who suffer from severe obesity, which is defined as having a body mass index (BMI) of >35Kg.m^2 with a comorbid condition that is able to be improved through weight loss or a BMI> 40 Kg. m^2 (Jassil et al., 2015). Compared to traditional lifestyle and pharmacological approaches, bariatric surgery is thought of being the most efficacious treatment strategy for obesity (Dodsworth et al., 2011). Yet it should be noted that bariatric procedures do have both early and late complications. The most dangerous and distressing of early complications are anastomotic leakage, bleeding and pulmonary or venous thromboembolism; although these early postoperative complications are extremely rare and ordinarily occur in less than 1% of patients. On the other hand, the late complications include gallstone formation, anastomotic strictures, mental disorders, dumping syndrome and weight regain (Handzlik-Orlik et al., 2015).

Providing early postoperative nutrition education and behavioral intervention has been shown to enhance weight loss after surgery (Jasil et al., 2015). Poor adherence to postoperative modifications has been shown to lead to the failure of significant weight loss and even weight regain which is typically associated with not limiting calorie intake and not increasing energy expenditure (Josbeno et al., 2011). Also sedentary behavior has been identified as a risk factor of initial obesity and for the return of obesity, weight gain and lower metabolic profiles independent of physical activity. This being noted, increased insight and comprehension of the physical activity behaviours of bariatric patients would improve weight loss outcomes through the development of appropriate and potentially effective post-surgical exercise guidelines and interventions specific for the individual (Josbeno et al., 2011).

Therefore, stressing the areas where a patient is in need of more support is crucial and this would also help the bariatric team with intervention. The present study focuses on examining the data collected from patients 18 years old or above who had bariatric surgery done at least six months prior. The study assesses the correlation between total calorie intake and self-reported physical activity to the successful weight loss defined by achieving at least 75% excess weight loss (EWL) after bariatric surgery. The objective of study was to assess the diet intake of post bariatric patients as to support intervention of bariatric dietitian. Also to calculate physical activity performance in post-bariatric patients with the impact of weight loss percentages and to identify any relation between estimated food intake of post-bariatric patients with their performance of physical activity.

2. Methodology and methods

The study was approved by Research and Ethics Committee of the Royal Medical Services of the Bahrain Defense Force (RMS-BDF). Participation was strictly voluntary and patients were allowed to exit the trial at any point without explanation. All eligible patients were provided with an information for them to make an informed decision about their participation in this study. The participant confidentiality was maintained at all times by not adding personal data on materials and members of ethics committee are obliged to fully respect confidentiality by not revealing any participant's identity or any other personal information.

During February and March 2017, a cross-sectional one-way retrospective review was conducted on forty-three randomly selected post-bariatric patients who underwent bariatric surgery within the six prior months. All patients were operated on by the same surgeon at the Bahrain Defense Hospital in the Kingdom of Bahrain. Of these patients, thirty-nine met initial criteria for bariatric surgery. Thus, this study included patients aged eighteen years and above, with a BMI>35 kg/m^2 who were eligible for BS according to the guidelines for surgery of obesity and metabolic disorders (SMOB). These candidates were suitable for primary bariatric surgery, had minimal complications, were non-lap band patients, and had surgery within six months. The thirty-nine participating subjects of this study were then sub-divided based on the length of the follow-up each had after bariatric surgery. These two groups included those less than (n=12), or more than (n=27), one-year follow-up after the bariatric surgery. All the patients were provided with two questionnaires: The Food Frequency Questionnaire (FFQ), and the short-form International Physical Activity Questionnaire (IPAQ-SF).

2.1. Food frequency Questionnaire

One of the most frequently used means to assess nutritional quality are semi-quantitative food frequency questionnaires(FFQ) as they are brief and inexpensive; present well-defined foods and food categories; and are easy to administer to individuals (Shrestha et al., 2017) (Gibson, 2005). Therefore, a FFQs entails a lesser burden for both interviewers and participants than most of the other dietary assessments methods such as a food diary or the 24-hour food recall assessment (Gibson, 2005). FFQs are designed to measure energy consumption and dietary intake of macronutrients and micronutrients. In large scale epidemiological studies, FFQ are deemed as both more practical and economical for dietary data collection because they are easier to administer, less intrusive, and less time consuming (Moghames et at., 2016).

The FFQ used for this present study comprised sixty-three ordinarily consumed food categories, with six levels for frequency of consumption. These levels were: than twice a day' Every day', '3-5 times a week; 1-2 a week'; '1-3 times a month, and, 'Rarely or never'. Participants were additionally asked concerning about issues concerning their lifestyle. They were also requested to rate their dietary quality on scale of 1 to 6 as follows: '1=Not at all healthy' through '6= extremely healthy' (Greatwood et al., 2013). In this current study, the sample of participants who completed the FFQs will focus on comparing the total calorie intake, and the macronutrient percentages, and then will these findings will be correlated to weight-loss success. 'Success' will be defined as the loss of seventy-five percent of their excess weight following surgery.

2.2. International Physical Activity Questionnaire

The International Physical Activity Questionnaire (IPAQ) is a standardized measure for capturing changes in physical activity performed across all circumstances and situations of daily life (Bond et al., 2009). The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across twelve countries at fourteen sites during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity (Booth, 2000).

In this study sum of the physical activity for the group (less or more than one year follow up post-bariatric surgery) who completed the IPAQ-SF will be calculated and correlated to the excess weight loss percentage based on whether they lost less than or more than 75% of their excess weight, which in turn, was based on ideal body weight following the design of the original validation studies (Mundi et al., 2013). The IPAQ-SF has also been tested internationally in patients from very diverse rural and urban backgrounds which further makes it very suitable for this current study at hand.

2.3. Statistical Analyses

Analyses were performed using the Statistical package for the Social Sciences (SPSS) for Windows (version 23.0; SPSS Inc., Chicago, IL). Data was de-identified and stored in a password-protected file. Descriptive statistics were performed for age in years; amount of weight loss in kg; current BMI (kg/m^2); months since BS; and type of BS performed. Categorical variables are presented as frequency (n) and percent (%). Data is presented as mean $\pm$ SD for continuous variables with normal distribution, and as a median (25th (Q1)-75th (Q3) percentile) for non-normally distributed variables. The Shapiro-Wilk test was used to determine if the variable was normally distributed or not (see Table 8). Evaluations and comparisons within groups were accomplished utilizing the student's t test for normally distributed variables, Mann Whitney test for non-normally distributed variables, and chi square test or Fisher's Exact test for non-normally distributed variables, and Chi square test or Fisher's Exact test for categorical variables (see Table 9). The minutes of physical activity was correlated with excess weight loss percentage at both less than and more than one-year post- bariatric surgery (Mundi et al., 2013). In addition, multiple linear regression was used to identify the factors that affect the excess weight loss percent. Spearman's correlation coefficient was computed between two non-normal distributed variables. A P value of<0.05 was considered statistically significant.

3. Results and discussion

All post bariatric patients who met the inclusion criteria were included in this study. There were 39 out of 43 initial participants who did. The baseline characteristics for our present study are shown in Table 1 with 59% of the participants being men, and 41% were women. Furthermore, 50% of respondents had a pre surgery BMI of ≤42, whereas, the mean and SD for BMI post-surgery were 27.9 ± 4.8. Participants had BS as either a gastric sleeve (87.2%) or a mini gastric bypass (12.8%); from this the median (25^{th} – 75^{th} percentile) of the weight loss for participants was 47 (28-54). In addition, 69.2% of the participants had weight loss surgery one year or prior to participating in this study. In regard to excess weight loss, 48.7% of the subjects presented with ≥ 75% of EWL.

Table 2 illustrates statistical description of food and activity data in which the median and SD of the food energy is 1860.1 (1168.5-2301.3) kcal. Furthermore, the mean and SD of the food energy percent from protein, fat and carbohydrate were (17.8± 3.7), (36.3± 6.2) and (50.6 ± 7.5) respectively. In addition, the median for vigorous activity, moderate activity, walking and total activity was 10, 45, 90 and 150 minutes/week respectively.

Table 3 reveals that the groups who lost at least 75 % or < 75% of their excess weight after the bariatric surgery did not differ significantly in terms of their gender, type of surgery, nor the number of months after surgery. In contrast those groups had significant difference in their age (p-0.036). There was a trend in the group with < 75% EWL to have a higher BMI both pre and post bariatric surgery. This was statistically significant independently reported at (p=0.005) and (p<0.001) respectively. Additionally, this group had lost approximately 49kg of their weight compared to 44kg for the weight loss of the ≥ 75% group, yet no significant difference was found between the <75% or ≥ 75% EWL groups (p<0.298).

Table 4 shows activity and food data for groups that lost <75% or ≥ 75% EWL after bariatric surgery. There was no significant difference found between the determinant groups in the total food energy nor in any macronutrient energy percentage. The ≥ 75% EXL group consumed (17.9±3.4) percent energy from proteins, (34.8±5.4) percent energy from fats, and (51.8±7.0) percent from carbohydrates. Correspondingly, the <75% EWL group consumed (17.7±4.0) energy from proteins, (37.8±6.6) percent from fats, and (49.3±7.9) percent energy from carbohydrates. Concerning the activity data, the group with <75% EWL reported higher median in vigorous and moderate activity compared to ≥75% EWL group at 15 (0-55) vs. 0 (0-100), and 48 (0-110), vs. 20 (0-120) respectively. However, no significant difference was found between the groups in the total physical activity nor at any physical activity level.

Table 5 illustrates the multiple linear regression coefficients in which the excess weight loss percentage was used as the dependent variable. In the multiple linear regression model, only age and BMI prior to the surgery had a significant effect on the %EWL with p-value of 0.023 and 0.012 respectively. These values revealed that if the age increased by one year, the % EWL increased by1.135%. In contrast, if the BMI prior to surgery increased by 1KG/m^2 the %EWL decreased by 1.72%.

Table 6 and 7 describe Spearman's correlation which indicate that there is no significant correlation between total activity and length of time since surgery in months respectively when examined and compared to the data regarding the total food energy, or any food energy percentage from protein, fat and carbohydrate.

This study assesses the estimated total food energy intake and self-reported physical activity level for post-bariatric patients who had BS at the Bahrain Defense Force Hospital. All of these surgeries were done by one specific surgeon. The impact of specific variables on the successful weight loss of patients was compared in this present study by achieving at least 75% excess weight loss (EWL) of each of these individuals after bariatric surgery. It is important to note that initially this study aimed to categorize the participants into two groups who achieved less than 50% or 50% and more of the EWL. This was initial aim was based on the study of Mundi et al. (2013) in which it was defined that success after surgery was considered to be at ≥50 %EWL. However, the baseline analysis of our present study revealed that from 39 participants only two had an EWL below 50%. Thus, success after BS was redefined and raised to ≥75% EWL.

A very noteworthy finding in this present study is that a significant difference found when observing patient age between the groups that lost <75% or ≥75% of the EWL after

BS. Here, the lowest mean age (32 ± 7.3) was found for the group who lost <75% of their EWL compare to the ≥75% EWL group (37.1± 7.3) (Table 3). Multiple linear regression was used to identify the factors that affect the %EWL.

***Table 1**: Descriptive statistics for baseline data*

Sex [n(%)]	Male	23 (59)
	Female	16 (41)
Age (Mean ± SD)		34.5 ± 7.7
BMI pre-surgery [Median (Q1 – Q3)]		42 (41.1 – 45)
BMI post-surgery (Mean ± SD)		27.9 ± 4.8
Weight loss [Median (Q1 – Q3)]		47 (28 – 54)
Type of Surgery [n(%)]	Gastric sleeve	34 (87.2)
	Mini gastric bypass	5 (12.8)
Months since surgery [n(%)]	<12	12 (30.8)
	>=12	27 (69.2)
Excess weight loss percentage [n(%)]	<75%	20 (51.3)
	≥75%	19 (48.7)

Table 2: Descriptive statistics for food and activity data

Food energy [Median (Q1 – Q3)]	1860.1 (1168.5 – 2301.3)
Food energy percent from protein (Mean ± SD)	17.8 ± 3.7
Food energy percent from fat (Mean ± SD)	36.3 ± 6.2
Food energy percent from CHO (Mean ± SD)	50.6 ± 7.5
Vigorous activity in minutes per week [Median (Q1 – Q3)]	10 (0 – 60)
Moderate activity in minutes per week [Median (Q1 – Q3)]	45 (0 – 120)
Walking in minutes per week [Median (Q1 – Q3)]	90 (0 – 210)
Sitting in minutes per week [Median (Q1 – Q3)]	15 (0 – 30)
Total activity in minutes per week [Median (Q1 – Q3)]	150 (60 – 540)

However, this confirmed the same findings as the T-test and Mann-Whitney test. Furthermore, significant differences were found in groups based on age, and BMI pre-surgery, being (p-value 0.023) and (p-value 0.012) respectively (Table 5). In 1991, the National Institutes of Health Consensus Conferences (NIH) recommended to broaden the age of eligibility for patients to have BS to include elderly patients. This change from limiting it to just those between 18 and 50 was done so those over 50 could potentially improve in obesity-related comorbidities, and also have an overall reduction in medication requirements (Musella et al., 2014). The findings of our present study support the recommendation because as age increased by one year, the %EWL was elevated by 1.135%. In contrast Luppi et al. (2015) concluded in their study that younger patients show greater weight loss than patients over 60 years old. According to Liebl et al. (2016), adult patients have a greater ability to identify and thus, eliminate or modify negative attitudes, environments and behaviors, which is so crucial when trying to make the long-term behavioral changes required to maintain weight loss after BS. It was found that the mean age difference was greater for the group who had a higher %EWL. This could be related more to other factors not assessed in the current study, such as pregnancy, or other factors which affect a participant's ability to change. Quyen-Pham et al. (2015) aimed to study the effect of pregnancy on long-term outcomes of BS and found that pregnancy after BS slows down post-operative weight loss which results in the %EWL being lower in the pregnant group after two years (pregnant group = 45.9 ± 24.6%; non-pregnant group = 56.9 ± 28.6%, P = .002).

Table 3: Baseline data for groups that lost at least 75% or less than 75% of their excess weight after surgery

		EWL <75%	EWL ≥75%	P-value
Sex [n(%)]	Male	12 (60)	11 (57.9)	0.894
	Female	8 (40)	8 (42.1)	
Age (Mean ± SD)		32 ± 7.3	37.1 ± 7.3	0.036
BMI pre-surgery [Median (Q1 – Q3)]		44.2 (41.7 – 48.7)	41.7 (39.7 – 44.1)	0.005
BMI post-surgery (Mean ± SD)		31.4 ± 3.8	24.3 ± 2.3	<0.001
Weight loss [Median (Q1 – Q3)]		48.5 (37 – 56.5)	44 (24 – 53)	0.298
Type of Surgery [n(%)]	Gastric sleeve	17 (85)	17 (89.5)	1.000
	Mini gastric bypass	3 (15)	2 (10.5)	
Months since surgery [n(%)]	<12	6 (30)	6 (31.6)	0.915
	>=12	14 (70)	13 (68.4)	

Table 4: Food and activity data for groups that lost at least 75% or less than 75% of their excess weight after surgery

	EWL <75%	EWL ≥75%	P-value
Food energy [Median (Q1 – Q3)]	1491.4 (1064.1–2325.6)	2034.1 (1259.9–2301.3)	0.216
Food energy percent from protein (Mean ± SD)	17.7 ± 4.0	17.9 ± 3.4	0.817
Food energy percent from fat (Mean ± SD)	37.8 ± 6.6	34.8 ± 5.4	0.131
Food energy percent from CHO (Mean ± SD)	49.3 ± 7.9	51.8 ± 7.0	0.304
Vigorous activity in minutes [Median (Q1 – Q3)]	15 (0 – 55)	0 (0 – 100)	0.331
Moderate activity in minutes [Median (Q1 – Q3)]	48 (0 – 110)	20 (0 – 120)	0.954
Walking in minutes [Median (Q1 – Q3)]	80 (35 – 180)	90 (0 – 270)	0.910
Sitting in minutes [Median (Q1 – Q3)]	8 (0 – 30)	15 (0 – 30)	0.821
Total activity in minutes [Median (Q1 – Q3)]	143 (90 – 455)	180 (40 – 670)	0.966

Table 5: Multiple Linear Regression Coefficients[a]

	Unstandardized Coefficients		Stand ardized Coefficients		
	B	Std. Error	Beta	t	P -value
(Constant)	1 41.709	178.351		. 795	. 434
Sex	- .446	7.645	-.011	-. 058	. 954
Type of Surgery	- 11.200	11.091	-.180	- 1.010	. 322
Length of surgery by months	- 1.048	6.968	-.023	-. 150	. 882
Age	1 .135	.469	.415	2 .419	. 023
BMI pre-surgery	- 1.720	.634	-.462	- 2.712	. 012
Food energy	. 002	.003	.101	. 563	. 578
Food energy percent from protein	. 485	1.539	.084	. 315	. 755
Food energy percent from fat	- .844	1.455	-.247	-. 580	. 567
Food energy percent from CHO	- .203	1.517	-.073	-. 134	. 894
Vigorous activity in minutes	. 016	.024	.139	. 672	. 508
Moderate activity in minutes	- .011	.033	-.078	-. 334	. 741
Walking in minutes	. 004	.022	.033	. 168	. 868
Sitting in minutes	. 065	.080	.120	. 816	. 422

a. Dependent Variable: Excess weight loss percentage

Table 6: Spearman's Correlation Coefficients (between total activity and food data)

	Total activity in minutes	
	Correlation Coefficient	P-value
Food energy	0.067	0.685
Food energy percent from protein	-0.055	0.741
Food energy percent from fat	0.167	0.310
Food energy percent from CHO	-0.197	0.230

Table 7: Spearman's Correlation Coefficients (between length of surgery by months and food data)

	Months since surgery	
	Correlation Coefficient	P-value
Food energy	0.262	0.107
Food energy percent from protein	-0.248	0.129
Food energy percent from fat	-0.124	0.451
Food energy percent from CHO	0.074	0.652

Table-8 :Tables of Shapiro-Wilk test which determine the normality of variables

	Shapiro-Wilk P-value
Age	0.753
BMI pre-surgery	<0.001
BMI post-surgery	0.098
Weight loss	<0.001
Food energy	<0.001
Food energy percent from protein	0.081
Food energy percent from fat	0.993
Food energy percent from CHO	0.889
Vigorous activity in minutes	<0.001
Moderate activity in minutes	<0.001
Walking in minutes	<0.001
Sitting in minutes	<0.001
Total activity in minutes	<0.001

Another important finding in the current study was that the BMI prior to BS had a significant effect on patients' %EWL ($p<0.005$) indicating that a higher median presurgery BMI 44.2 (41.7-48.7) lead to a lower percent loss of the excess weight <75% compared to the other group whose EWL was ≥75% when the pre-surgery BMI was 41.7 (39.7- 44.1) (Table 3). Supporting this finding was Peterson et al. (2017) in a study which showed that individuals with super obesity (BMI ≥ 50 kg/m2) are more likely to have more complex health issues such as diabetes, congestive heart failure, hypertension, and chronic obstructive pulmonary disease that might increase surgical risk and challenges to the health care system. Additionally, a significant difference appears in the post-bariatric BMI 52 ($p<0.001$), where the group with EWL <75% had a higher post-bariatric BMI compared with the EWL ≥75% group (31.4± 3.8), vs. (24.3± 2.3) respectively. In contrast, Christou et al. (2006) revealed significant findings related to the initial pre-bariatric BMI and weight regain after long-term follow-up. This study found that 18% of patients may regain weight at five years following post-surgery (P <0.0001). Weight regain was even more in patients with an initial BMI >50 kg/m2, reaching to a 43% weight regain. Furthermore, Novais et al. (2012) showed a statistical difference among groups regarding highest and lowest weights achieved and post-surgery BMI. These value were inversely proportional to the EWL%; the highest mean post-surgery weights (92.0±10.1) and post-surgery BMI (35.4±3.2) were found in the EWL% <50% group.

Table-9 : Tests of Normality of the data among <75% or ≥75% EWL

	EWL Percent	Shapiro-Wilk P-value
Age	<75%	.916
	>=75%	.441
BMI pre-surgery	<75%	.001
	>=75%	.063
BMI post-surgery	<75%	.117
	>=75%	.508
Weight loss	<75%	.001
	>=75%	.496
Food energy	<75%	.009
	>=75%	.000
Food energy percent from protein	<75%	.128
	>=75%	.502
Food energy percent from fat	<75%	.828
	>=75%	.590
Food energy percent from CHO	<75%	.616
	>=75%	.941
Vigorous activity in minutes	<75%	.000
	>=75%	.000
Moderate activity in minutes	<75%	.005
	>=75%	.000
Walking in minutes	<75%	.000
	>=75%	.003
Sitting in minutes	<75%	.000
	>=75%	.000
Total activity in minutes	<75%	.001
	>=75%	.001

The findings of the total food calories and the macronutrient energy percent were notable. Our current study showed higher total calories for the median (25th-75th percentile) of EWL ≥75% group compared to the EWL <75% group in which it was 2034.1 (1259.9 -2301.3) vs. 1491.4 (1064.1 - 2325.6) (Table 4). However, the mean food energy percent from fat was lower in the EWL ≥75% group compared to the EWL <75% group (34.8 ± 5.4) vs. (37.8 ± 6.6). Although the group with higher %EWL also had higher total calories, however, this group also had a higher amount of minutes of total activity compare to the second group. This may be because exercise has been postulated to improve weight loss after bariatric surgery by increasing energy expenditure (Livhits et al., 2010). Another reason this supports our study's findings is that dietary fat contributes more than twice as many calories (9 calories/g) as equal amounts of either protein or carbohydrates (each 4 calories/g). The reduction in the level of fats in the post-operative diet is related to greater caloric value of fats compared with other macronutrients. However, food volume reduction is not enough to compensate for the increased energy provided by a high-fat diet (Furtado, 2010).

Furthermore, Furtado, (2010) stated that weight reduction after gastric bypass surgery is related to decreased caloric intake, predominantly of fats. Novais et al. (2012) did not find differences among the groups regarding the acceptable macronutrient distribution ranges (AMDR). However, in the present study those that lost the least amount of weight (%EWL <75) presented a percentage of fat intake of 37.8 ± 6.6, while the AMDR recommends a maximum fat intake of 35% in relation to the total energy intake (20%-35%). Regarding carbohydrate intake and protein intake, the mean for both groups, < 75% and ≥75% EWL, were slightly closer (49.3± 7.9) vs. (51.8± 7.0) and (17.7± 4.0) vs. (17.9± 3.4) respectively. Similar findings from Novais et al. (2012) where the study population was divided into three groups (<50% EWL, 50-75% EWL and, >75% EWL) and their mean for carbohydrate percentage of intake was (47.2±7.1) vs. (49.6±8.9) vs. (49.8±9.4) respectively. In contrast, our current study had a higher mean for the protein percentage compare to Novais et al. (2012) which were (15.0±4.8) vs. (15.8±4.9) vs. (16.0±5.8).

However, in our current study, patients with ≥75% EWL reported a median (25th-75th percentile) of 180 (40 - 670) for the total activity (walking, moderate PA and vigorous PA) in minutes/week compare to 143 (90 - 455) for the < 75% EWL group (Table 4). This findings correlated quite well with established guidelines recommending at least 150 minutes of total activity for the maintenance of cardiorespiratory fitness (Gust, 2016). Mundi et al.(2013) revealed that there was a relationship between reported minutes of moderately vigorous physical activity and %EWL one year following bariatric surgery in a large groupof subjects (n=118). Mundi et al. (2013) also found that being successful with bariatric surgery (>50 % EWL) required 150 minutes of moderately vigorous activity per week. It is important to highlight the benefits of exercise for patients which includes increasing energy expenditure and lean body mass while contributing to fat loss, reducing obesity related complications, and improving self-esteem and rate of depression (Livhits et al., 2010).

Conversely, our current study conflicts these former findings from Reid et al.(2015) and rather supports Bond et al. (2009) that found that it was important for bariatric patients to be physically active and spend a longer duration of time exercising rather than solely engaging in high intensity exercises. However, it was also mentioned that lesser amounts of more vigorous activity may be sufficient to achieve successful weight maintenance (Bond et al., 2009).

In future, test- retest data is recommended to provide additional validity of the data gathered. It should be noted that there are inherent limitations with IPAQ-SF thus Mundi et. Al. (2013) required additional research be done to assess different modalities. For example, using accelerometers which can accurately and cost effectively capture the level of physical activity in post bariatric patients along with exploring behavior modification models which supports the implementation and sustainment of lifestyle behaviours that subsequently lead to adequate and long term weight loss after BS.

BS successfully promotes weight loss and improves quality of life and obesity associated comorbidities (Novais et al., 2012). Consequently, the number of surgical procedures performed worldwide has grown; thus, bariatric surgeons work under the difficult demands from their increasing workload coupled with the intricate procedures undertaken. Thus, they continue to explore additional efficient, inexpensive and less complicated treatment modalities for obesity (Soto et al., 2013). Clinicians also have a vital role in providing therapeutic education and counselling for patients and their families including pre- and post-operative optimization of macronutrients and micronutrients (Liebl et al., 2016) (Rickers and McSherry 2012). Although, in the present study there was no significant correlation between %EWL compared to the food and physical activity variables, yet, it is important to highlight that 94.9% of the participants had %EWL ≥50, and 17.9% (7 out of 39 participants) had their %EWL above 100%. Furthermore, 10 out of 39 participants had a normal BMI after the bariatric surgery with 20.5 being the lowest BMI of the participants. The %EWL provides a better estimate of the amount of weight loss that has been accomplished relative to a defined goal level. Additionally, it is ordinarily used to express weight change following bariatric surgery (Bray et al., 2009).

According to Liebl et al. (2016), positive support can give an opportunity to a patient to make personal health needs priority. These positive weight loss results may be related to doctor-patient interaction coupled with the objective monitoring by healthcare providers of patient habits for better lifelong adherence to the post-bariatric program. Patient compliance is a major concern following malabsorption procedures chiefly because it is a mechanism that surgeons have virtually no control over (Slater et al., 2004). However, a clinician's communication skills may enable and inspire clients to cope with and address negative comments and influences with a healthy constructive approach (Liebl et al., 2016).

4. Conclusion

The main objective of this study was to assess whether activity and estimated food energy correlated with success after BS (>75% EWL). It is important to note that initial aim was to categorize the patient into two groups who achieved less than 50% or 50% and more EWL but the baseline analysis of our present study revealed that from 39 participants only two had an EWL below 50%. Thus, success after BS was refined and raised to >75% EWL. With use of the IPAQ-SF, and FFQ, we found that patients who were successful with surgery engaged in at least 150 minutes of total activity per week and had fat energy percent in relation to their total energy intake within the AMDR recommended range of 20-35%. BS for weight management remains an important tool to treat moderately to severely obese patients who have failed non-surgical approaches. In order to maximize the outcome of the bariatric surgery, patients ought to be encouraged and supported to follow and remain steadfast in keeping proper dietary habits. They should maintain recommended physical activity levels and refrain from smoking (Cena et al., 2016). Although our study showed a significant difference between %EWL when looking at age, pre surgery BMI, and post-surgery BMI, it did not show any significant difference between %EWL and food energy nor physical activity. However, it did not show a high level of success weigh loss after BS where 49% of patients had at least 75% EWL and only 5% of patients had below 50% EWL.

Bariatric patients always need to improve their food frequency, dietary habits, and physical activity in order to attain the highest probability of success. Patients should work with a multidisciplinary team comprised of a physician, registered dietitian, mental health care professional, and exercise physiologist both before and after bariatric surgery (Cena et al., 2016). Highly structured or informal support groups are integral to the success of post-bariatric surgery weight loss, weight loss maintenance, and the management of post-operative problems regardless of whether these support groups are provider or patient-led (Sarvey, 2009). Stewart et al. (2010) hypothesized that support after bariatric surgery can improve weight loss and weight maintenance. This maintenance of the early success of BS should part of the long-term obesity treatment as is done with other chronic diseases such as hypertension or diabetes (Sarvey, 2009).

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