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Determinants of Total Body Weight Loss Among Palestinian Adults Post–Bariatric Surgery

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This study aimed to determine total weight loss percent (%TWL) and the contributing factors in 100 patients post-bariatric surgery. Self-reported anthropometric measurement, 13 dietary behaviors, lifestyle, sociodemographic, and bariatric surgery–related data were collected from the participants via telephone. The results revealed a %TWL mean of 29.00% ± 10.30%. %TWL was significantly associated with exercise, preoperative body mass index, locality type, and intake of dairy products ($P < .05$). Significant positive changes in dietary behaviors were reported postsurgically ($P < .001$). This study highlights the role of exercise and diet as part of overall post–bariatric surgical care. **Key words:** *bariatric surgery*, *determinants*, *Palestine*, *weight loss*

OBESITY, DEFINED as an abnormal or excessive accumulation of fat,[1] continues to represent a major cause of public health burden worldwide.[2] Obesity prevalence has been steadily increasing and has now reached global epidemic proportions.[2] According to 2016 data from the World Health Organization, there were approximately 650 million obese adults worldwide.[3] Projections estimate that more than 1 billion adults will be affected by obesity by 2025.[3] As of 1998, obesity was considered to be a "multifactorial chronic disease."[4] Therefore, by considering the chronic and relapsing nature of obesity, a multimodal treatment plan is usually required.[5] Treatment plans usually include lifestyle, pharmacotherapy, and/or surgical interventions. Lifestyle and pharmacotherapy have been generally criticized for their limited results compared with surgical interventions,[2] as they are affected by a multitude of factors that influence their effectiveness. Using traditional lifestyle and pharmacotherapy strategies for weight maintenance often fails.[6]

Bariatric surgery, the gastric and/or intestinal surgery performed for obese people,[7] is considered to be one of the most effective approaches for weight loss.[6] Compared with traditional methods, weight loss using bariatric surgery is generally more

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cost-effective,[8] as it is more rapid, more significant, and more sustained.[2] It is also an effective method for reducing and achieving remission of obesity-related comorbidities.[2] There are various approaches to bariatric surgical procedures. These achieve weight loss through restricting the amount of food, by causing nutrient malabsorption, or by both methods.[7] Despite its documented advantages, there are concerns regarding the complications and mortality rates associated with bariatric surgical procedures. Complications include leaks, bleeding, and intestinal obstructions, among others.[9] A large prospective controlled study concluded that the surgical option can decrease overall mortality.[9] Hazard ratio, adjusted for sex, age, and risk factors, of overall mortality was 0.71 ($P = .01$) in the bariatric surgery group compared with the conventional treatment group.[10] Hazard ratio represents a relative measure of the effect of this surgery on total mortality rates, which in this case means an approximately 29% lower risk of death.

Multiple factors can affect the success of weight loss maintenance, including postoperative diet quality. In one prospective study, patients regained approximately 11.3% ± 8.8% during the first 18 months of follow-up of their weight.[2] Weight maintainers were found to be more adherent to healthy dietary habits than weight regainers ($P < .001$).[2] Behaviors found to be associated with better weight maintenance include regular breakfast intake, reduced carbohydrate and fat intake, and consuming more than 5 small meals per day. Regarding the reduction in total energy consumption, there is a large variation in values between studies. Results show that up to 50% to 68% of energy may be reduced post-bariatric surgery.[5] Energy intake does show an increase over time postsurgery.[2] This is largely the result of improved food tolerance over time and hence the quality of nutrition (adequate consumption of nutrients) and energy intake. Interestingly, Masood et al[2] concluded that weight regain was mainly attributed to food quality, rather than excessive caloric consumption.[2]

A systematic review of 33 studies reported that long-term excess weight loss (EWL, or loss of excess body weight defined as current weight minus ideal weight) with gastric bypass, laparoscopic adjustable gastric band, biliopancreatic diversion with duodenal switch, and sleeve gastrectomy was 56.7% (18 reports), 45.9% (17 reports), 74.1% (9 reports), and 58.3% (2 reports), respectively.[11] The high % weight loss, however, is usually not sustained in the long term. Despite initial weight loss, weight regain can still occur regardless of surgery type.[2,4,10]

Dietary education is critical at this point, as findings from a study with an 18-month follow-up period show that there might be a predominance of unhealthy behaviors among post–bariatric surgical patients,[2] and patients can develop inaccurate perceptions regarding their eating behaviors.[2] These can adversely affect long-term effectiveness of the weight loss process. Failure to maintain the rapid weight loss and weight regain can threaten the success of bariatric surgery. There are a limited number of studies that evaluate the dietary intake post–bariatric surgery, and there have been inconsistent results regarding the long-term effect of multiple dietary behaviors.

The aim of this study was to determine the weight loss and describe the change in dietary habits in patients who have undergone bariatric surgery and to identify which factors influence long-term total weight loss following bariatric surgery.

MATERIALS AND METHOD

Study design

This study used a cross-sectional design to evaluate the dietary behaviors of 100 patients post-bariatric surgery. Data collection, which took place from February 2020 through April 2020, was done through a pretested structured questionnaire. The questionnaire was validated for content validity by 8 experts (5 dietitians, 2 surgeons, and 1 expert in assessment and measurement). The questionnaire

was later piloted by 12 participants. The Cronbach α coefficient was 0.88 for changes in dietary behaviors, 0.69 for complications related to bariatric surgery, and 0.72 for surgery-related data. Overall, for all sections, it was 0.801, signifying relatively high internal consistency.

The participants were invited to join the study through several methods including phone calls, e-mails, social media account postings, and advertisements in nutrition clinics and bariatric surgery centers. The participants who agreed to join the study were called by trained nutrition students and were asked to report the required data by phone. The collected data included sociodemographic data, medical history, lifestyle (smoking and physical activity), bariatric surgery–related data including surgery type, indication for surgery, postsurgical complications, weight change, and dietary habits before and after bariatric surgery. The research team asked the participants to send the available self-reported results of the biochemical tests, anthropometric measurements, and body composition by smartphone application to ensure accuracy of the report.

The sample size was calculated using the formula for sample size calculation for mean difference minus dependent mean. The mean and standard deviation were taken from a similar previous study.[12] The level of confidence was set at 95%, and the power of the study was set at 80%. The recommended sample size was 94 patients. Because of consideration of dropout and missing data, the sample size was set at 100 participants.

Inclusion criteria included Palestinian males and females, older than 18 years, who underwent bariatric surgery either in Palestine or abroad. There were no restrictions regarding the type of bariatric surgical procedures or the duration since surgery. Patients who suffered from serious complications (including but not limited to leaks, hemorrhage, or obstructions) were excluded from the sample.

Study instruments and tools

Weight and weight changes

The participants were asked to report their height and weight to the nearest 1 cm and 1 kg, respectively. They were asked to report the last body weight measurement before the surgery for the presurgical weight and their last body weight measurement since the surgery for their postsurgical weight. Different expressions of weight are usually used to report weight loss in bariatric surgery patients. Total weight loss percent (%TWL) is recommended as the best suited measure for bariatric weight loss expression, as it does not present the same limitations of using excess body mass index (BMI) loss percentage and EWL.[13,14] The latter two were reported to be not suitable for comparing patients with different initial BMI values or study designs with nonrandomized groups[13] as is the case with our study. %TWL was adopted in this study to express weight loss and was calculated as follows:

$$\text{Total weight loss percent} = \left[\left(\frac{\text{Starting weight} - \text{Current weight}}{\text{Starting weight}}\right)\right] \times 100$$

Dietary behaviors

In addition to the number of meals and snacks consumed per day, participants were asked to report the frequency of the following 13 dietary behaviors both presurgery and postsurgery: drinking 8 or more cups of water per day, consistent meal times throughout the day, fruit intake daily (whole or juice), vegetable intake daily (raw or cooked), weekly nuts intake, fish intake twice a week, white bread consumption, whole grain bread consumption, daily dairy product intake, daily processed meat intake, daily fast food intake, daily desserts/sweets intake, and daily sweetened juice intake. These items were scored on a 5-point frequency scale ranging from "always" to "rarely."

Ethical considerations and informed consent

The study proposal was reviewed and approved by the ethical committee at the Palestine Polytechnic University. Participants who agreed to join the study were briefed about the study's objectives and the required data, and they were informed that the participation was completely voluntary and confidential and that they were able to drop out at any point.

Statistical analyses

Statistical analysis was carried out using SPSS version 22.0 (Armonk, New York). Means ± standard deviations (SD) were used for presenting continuous variables and frequencies for categorical variables. The differences of mean in continuous data (anthropometrics, number of meals, and snacks consumed per day) before and after the surgical intervention were compared using the paired-samples *t* test. Wilcoxon signed rank test, a nonparametric equivalent of the paired-samples *t* test, was used to compare the differences in categorical variables before and after surgery, which include the 13-item diet behavior scale. *P* value of less than .05 was considered significant.

The significance of the difference between the different groups in %TWL was assessed using the independent-samples *t* test and one-way analysis of variance (ANOVA) where appropriate. *P* value of less than .05 was considered significant.

RESULTS

Subjects characteristics

A total of 115 participants were invited to join the study; 100 participants completed the study questionnaire (87% response rate). Participants' characteristics are presented in Table 1. The patients reported a history of the following medical conditions: diabetes (n = 30), hypertension (n = 11), other cardiovascular diseases (n = 3), gastroesophageal reflux disease (n = 24), joint pain (n = 24), respiratory conditions (n = 9), liver diseases (n = 3), renal diseases (n = 3), and gastrointestinal diseases (n = 12). Most participants also reported a family history of diabetes (n = 69), hypertension (n = 42), and heart disease (n = 22). The majority of the patients (n = 79) did not have a surgical history. The mean age of the participants was 35.5 ± 8.5 years.

Table 1. Characteristics of the Study Sample

Characteristics	n	%
Gender		
Male	31	31
Female	69	69
Age, mean ± SD, y	35.5 ± 8.5	
Average monthly family income		
<1500 NIS	2	2
1500-3000 NIS	16	16
3000-5000 NIS	46	46
>5000 NIS	36	36
Marital status		
Single	20	20
Married	77	77
Divorced	2	2
Widowed	1	1
Locality type		
Urban	87	87
Rural	12	12
Camp	1	1
Housing type		
Owns a house	89	89
Rents a house	11	11
Smoker		
Yes	27	27
No	73	73
Physical activity		
Regular (2-3 times weekly)	15	15
Irregular (<1 time weekly)	35	35
No physical activity	50	50

Abbreviation: NIS, New Israeli Shekel.

Among the smokers, 15 were regular smokers (on a daily basis) and 12 were irregular (occasionally), for an average period of 7.40 ± 4.183 years.

Half of the participants engaged in a form of exercise. Regular exercisers (minimum 3

scheduled days per week) worked out an average of 1.31 ± 0.93 hours per day. Irregular exercisers (workout days vary from week to week) worked out an average of 2.61 ± 0.88 days per week for 1.10 ± 0.69 hours per day. All participants were asked whether they walk for at least 30 minutes per day, and 16%, 62%, and 22% responded as "no," "sometimes," and "yes," respectively.

Bariatric surgery–related data

Before undergoing bariatric surgery, most of the patients had tried losing weight (81%), using methods such as dietitian supervision (n = 53), individual efforts (n = 38), or using Internet sources (n = 10), word of mouth (via family and friends) (n = 23), and others (n = 25). Table 2 presents results regarding the type, indications, and complications of bariatric surgery.

The majority of the participants reported that they have returned to consuming solid foods (91%) postsurgery. On average, this change took the participants 2.57 ± 1.44 months to complete (minimum: 1 month; maximum: 8 months). Transition may differ depending on the patient's tolerance, but it is estimated that after 4 weeks (1 month), patients may be able to transfer to semisolid (soft) foods.[15] There was a significant difference in the scores for the number of meals presurgery (4.08 ± 1.14 meals) and postsurgery (3.09 ± 0.77 meals); $t_{98} = -8.27$, $P = .000$. The number of snacks was also significantly reduced from 3.67 ± 1.477 snacks per day presurgery to 2.31 ± 1.07 snacks per day postsurgery; $t_{97} = -9.86$, $P = .000$.

Changes in the behavior related to their food choices are presented in Table 3. Participants showed a significant change in their choices, resulting in more positive behaviors regarding their intake of water, fruit, vegetable, fish, whole grains, dairy, processed meats, fast food, desserts, and sweetened juices. Changes in the nut intake were not statistically significant.

Average weight before surgery was 114.07 ± 17.38 kg. The participants' current

Table 2. Bariatric Surgery–Related Variables

Variable	n	%
Type of bariatric surgery		
Gastric sleeve	80	80
Gastric bypass	9	9
Adjustable gastric band	7	7
Intragastric balloon	4	4
Follow-up period after surgery		
<6 mo	9	9
6 mo-1 y	10	10
1-3 y	47	47
>3 y	34	34
Indications for the surgery		
Weight loss	42	42
Preventing obesity-related conditions	26	26
Treating obesity-related conditions	26	26
Improve psychological wellbeing	1	1
Increasing chances of a successful pregnancy	5	5
Postsurgical complications (no, yes)		
Hernia	17	17
Nausea	56	56
Weakness	49	49
GERD	27	27
Indigestions	26	26
Dumping syndrome	38	38
Satisfaction (weight loss)		
Yes	7	7
To some extent	34	34
No	59	59
Weight loss trend		
Decline and then increase gradually	35	35
Decline and then stabilized	32	32
Continuous decline	33	33
Expectations		
Less than expected	13	13
As expected	61	61
More than expected	26	26

Abbreviation: GERD, gastroesophageal reflux disease.

Table 3. Changes in Diet-Related Behavior Post–Bariatric Surgery

Variables	Values	Before Surgery		After Surgery		% Change	*P* for Change[a]
		n	%	n	%		
Drink at least 8 cups of water	Always	15	15	69	69	+54	.000
	Often	42	42	16	16	−26	
	Sometimes	33	33	10	10	−23	
	Rarely	8	8	5	5	−3	
	Never	2	2	0	0	−2	
Eat meals at constant time	Always	13	13	46	46	+33	.000
	Often	44	44	38	38	−6	
	Sometimes	25	25	13	13	−12	
	Rarely	14	14	2	2	−12	
	Never	4	4	1	1	−3	
Eat fresh fruits or drink fruit juices daily	Always	21	21	53	53	+32	.000
	Often	37	37	33	33	−4	
	Sometimes	32	32	9	9	−23	
	Rarely	7	7	5	5	−2	
	Never	3	3	0	0	−3	
Eat fresh or cooked vegetables daily	Always	21	21	46	46	+25	.000
	Often	35	35	34	34	−1	
	Sometimes	34	34	16	16	−18	
	Rarely	9	9	3	3	−6	
	Never	1	1	1	1	0	
Eat nuts at least twice a week	Always	29	29	24	24	−5	.453
	Often	23	23	36	36	+13	
	Sometimes	32	32	31	31	−1	
	Rarely	15	15	8	8	−7	
	Never	1	1	1	1	0	
Eat fish twice a week regularly	Always	15	15	23	23	+8	.000
	Often	24	24	40	40	+16	
	Sometimes	33	33	26	26	−7	
	Rarely	19	19	8	8	−11	
	Never	9	9	3	3	−6	
Eat white bread	Always	53	53	23	23	−30	.000
	Often	22	22	21	21	−1	
	Sometimes	17	17	29	29	+12	
	Rarely	7	7	18	18	+11	
	Never	1	1	9	9	+8	
Eat whole grain bread	Always	16	16	37	37	+21	.000
	Often	25	25	25	25	0	
	Sometimes	28	28	16	16	−12	
	Rarely	25	25	18	18	−7	
	Never	6	6	4	4	−2	
Eat dairy products daily	Always	25	25	42	42	+17	.019
	Often	42	42	36	36	−6	
	Some times	29	29	16	16	−13	
	Rarely	3	3	5	5	2	
	Never	1	1	1	1	0	

(*continues*)

Table 3. Changes in Diet-Related Behavior Post–Bariatric Surgery (*Continued*)

Variables	Values	Before Surgery n	Before Surgery %	After Surgery n	After Surgery %	% Change	*P* for Change[a]
Eat processed meat	Always	34	34	4	4	−30	.000
	Often	27	27	18	18	−9	
	Sometimes	24	24	41	41	+17	
	Rarely	10	10	24	24	+14	
	Never	5	5	13	13	+8	
Eat fast food daily	Always	41	41	3	3	−38	.000
	Often	25	25	12	12	−13	
	Some times	20	20	44	44	+24	
	Rarely	13	13	30	30	+17	
	Never	1	1	11	11	+10	
Eat desserts daily	Always	44	44	12	12	−32	.000
	Often	33	33	17	17	−16	
	Some times	20	20	49	49	+29	
	Rarely	2	2	16	16	+14	
	Never	1	1	6	6	+5	
Drink sweetened juices daily	Always	25	25	3	3	−22	.000
	Often	22	22	10	10	−12	
	Some times	25	25	37	37	+12	
	Rarely	24	24	37	37	+13	
	Never	4	4	13	13	+9	

[a]*P* value as reported by the Wilcoxon signed rank test.

weight postsurgery was 80.2 ± 12.34 kg. In terms of %TWL, this corresponds to an average loss of 29.00 ± 10.30%. Thirty-five percent of the patients reported that their weight had increased following the postsurgical weight loss, 32% of the sample reported that they had reached a plateau, and 33% were still losing weight. The difference of %TWL in various subgroups following bariatric surgery is presented in Table 4.

Regarding participant satisfaction and expectation, most patients were satisfied with the weight loss they had achieved (59%), 34% were satisfied to some extent, and 7% were not satisfied. There was a significant difference in %TWL between groups that were satisfied (M = 35.52, SD = 8.60), partially satisfied (M = 25.43, SD = 9.65), and not satisfied (M = 16.63, SD = 12.45) ($F_{2,97}$ = 13.10, P = .000). In total, 61% of the sample reported that the average weight loss met their expectations, 26% of the sample reported that it had exceeded their expectation, and 13% reported that it was less than expected. %TWL was significantly different between groups that considered it to be less than expected, as expected, and more than expected (M = 22.44, SD = 10.09; M = 28.69, SD = 9.72; and M = 33.00, SD = 10.29, respectively) ($F_{2,97}$ = 4.99, P = .009).

Table 4 presents the significance of relationships between various variables and %TWL.

The degree of change in dietary behavior was calculated by the difference in the scale used for assessing behavior frequency before and after surgery. The scale ranged from 1 to 5, with 1-point difference between the following responses: always, often, sometimes, rarely, and never. Therefore, a response that changed from "always" to "never" would be a 4-point difference in the negative direction (decrease). The degree of change scale had a maximum score of 4 and a minimum

Table 4. Difference of %TWL Between Population Subgroups

Variable	Value	%TWL	*P*
Bariatric surgery and diet-related variables	Period post–bariatric surgery		
	<6 mo	23.74 ± 7.68	.254
	6 mo-1 y	29.39 ± 11.15	
	1-2 y	29.19 ± 5.92	
	2-3 y	32.18 ± 8.25	
	>3 y	27.72 ± 13.44	
	Type of bariatric surgery		
	Gastric sleeve	28.93 ± 10.31	.702
	Gastric bypass	31.42 ± 6.24	
	Adjustable gastric band	29.51 ± 15.89	
	Intragastric balloon	24.04 ± 6.81	
	Surgery indication		
	Weight loss	28.65 ± 11.93	.752
	Prevent obesity-related conditions	29.74 ± 6.47	
	Treat obesity-related conditions	28.77 ± 11.23	
	Psychological well-being	41.67	
	Increase pregnancy chances	26.70 ± 8.42	
	Previous adherence to diet		
	Yes	29.50 ± 10.00	.315
	No	26.85 ± 11.58	
	Preoperative BMI		
	30.00-34.99	16.64 ± 4.89	.000
	35.00-39.99	26.37 ± 8.95	
	>40.00	32.52 ± 9.80	
Other variables	Gender		
	Male	29.00 ± 9.62	.999
	Female	29.00 ± 10.67	
	Average income		
	<1500 NIS	26.63 ± 6.54	.254
	1500-3000 NIS	32.60 ± 11.16	
	3000-5000 NIS	27.03 ± 11.30	
	>5000 NIS	30.04 ± 8.33	
	Marital status		
	Single	34.15 ± 11.67	.098
	Married	27.71 ± 9.53	
	Divorced	28.15 ± 19.11	
	Widowed	26.92	
	Locality type		
	Urban	29.92 ± 9.58	.024
	Rural	21.66 ± 12.98	
	Camp	36.51	
	Physical activity		
	Regular	28.16 ± 9.07	.015
	Irregular	32.95 ± 9.81	
	No activity	26.48 ± 10.32	
	Smoking		
	Yes	31.73 ± 10.05	.108
	No	27.99 ± 10.29	

Abbreviations: BMI, body mass index; NIS, New Israeli Shekel; %TWL, total weight loss percent.

Table 5. %TWL According to Changes in the Dietary Habits (Individuals Are Divided on the Basis of Behavior Frequency to 3 Groups: Decreased Frequency of Behavior, no Change in Behavior Frequency, or Increased Frequency of Behavior Postsurgery)

Variables	Behavior Frequency	n	%TWL, Mean ± SD	*P*
Drink at least 8 cups of water	Decreased	5	36.76 ± 11.46	.165
	No change	27	27.26 ± 12.09	
	Increased	68	29.12 ± 9.32	
Eat meals at constant time	Decreased	8	28.67 ± 11.68	.781
	No change	39	28.15 ± 8.18	
	Increased	53	29.68 ± 11.58	
Eat fresh fruits or drink fruit juices daily	Decreased	9	26.49 ± 6.04	.628
	No change	37	30.03 ± 12.45	
	Increased	54	28.71 ± 9.27	
Eat fresh or cooked vegetables daily	Decreased	11	26.30 ± 15.37	.464
	No change	44	28.40 ± 9.47	
	Increased	45	30.24 ± 9.70	
Eat nuts at least twice a week	Decreased	32	28.13 ± 7.57	.233
	No change	32	27.27 ± 10.54	
	Increased	36	31.31 ± 11.94	
Eat fish twice a week regularly	Decreased	17	27.78 ± 6.44	.549
	No change	40	30.38 ± 8.95	
	Increased	43	28.19 ± 12.54	
Eat white bread	Decreased	52	30.67 ± 9.51	.096
	No change	38	28.23 ± 10.71	
	Increased	10	23.26 ± 11.43	
Eat whole grain bread	Decreased	12	23.3 ± 12.55	.117
	No change	48	29.44 ± 10.77	
	Increased	40	30.18 ± 8.60	
Eat dairy products daily	Decreased	19	26.03 ± 9.27	.033[a]
	No change	46	27.5 ± 9.98	
	Increased	35	32.57 ± 10.54	
Eat processed meat	Decreased	61	30.26 ± 9.33	.279
	No change	32	27.39 ± 12.47	
	Increased	7	25.36 ± 5.89	
Eat fast food daily	Decreased	71	29.73 ± 10.90	.501
	No change	26	27.48 ± 8.97	
	Increased	3	24.86 ± 5.01	
Eat desserts daily	Decreased	67	28.99 ± 8.87	.943
	No change	22	29.46 ± 11.71	
	Increased	11	28.15 ± 15.62	
Drink sweetened juices daily	Decreased	53	31.00 ± 9.53	.111
	No change	39	26.97 ± 11.73	
	Increased	8	25.60 ± 3.84	

[a]Significant $P < .05$ using one-way analysis of variance.

score of −4; 0 indicates no change in behavior. Based on these subgroups, one-way ANOVA was used to evaluate the difference between %TWL and behavior change. Results are presented in Table 5.

The majority of the patients (78%) regularly followed up by completing blood laboratory tests every 3 months or semiannually. Patients performed on average 1.84 ± 1.26 laboratory tests per year (maximum 5.0). The type and

Table 6. Blood Laboratory Test Results

Type	Yes, n (%)	Result			Reference Range
		High, n (%)	Normal, n (%)	Low, n (%)	
Hemoglobin	94 (93)	12 (13)	75 (79)	7 (8)	M: 14.0-18.0 g/dL F: 12.0-16.0 g/dL
Vitamin B_{12}	89 (88)	7 (8)	64 (72)	18 (20)	160-950 pg/mL
Vitamin D	80 (77)	4 (5)	55 (69)	21 (26)	30-50 ng/mL
Calcium	82 (77)	9 (11)	58 (71)	15 (18)	8.4-10.6 mg/dL
Triglycerides	92 (85)	20 (22)	64 (69)	8 (9)	40-150 mg/dL
Total cholesterol	94 (88)	20 (21)	68 (72)	6 (7)	100-200 mg/dL

Abbreviations: F, female; M, male.

results are presented in Table 6. There were no significant differences in %TWL based on biochemical data results.

DISCUSSION

As obesity rates continue to be on the rise, bariatric surgical procedures will serve as an important tool for the prevention and treatment of obesity and obesity-related complications. Weight regain has become more frequent and can be associated with the return of obesity-related comorbidities[16] and therefore is a constant threat to the long-term effectiveness of bariatric surgery. Evaluating the behaviors of 100 Palestinians post–bariatric surgery provided an insight into the role of long-term dietary and lifestyle behaviors on its success.

Following a period of follow-up that ranged from 6 months to 3 years, only 2 patients showed that they have returned to their presurgical weight, while the remaining 98 participants showed a %TWL that ranged from 10.53% up to 54.55%. One of the limitations with weight loss reporting is that it is inconsistent in different reports. %TWL is often recommended to report weight loss as it is not affected by preoperative BMI. However, most reports chose %EWL to report findings. Furthermore, %EWL is calculated differently among the various studies based on their definition of the cutoff point. For example, this could be defined as excess weight over BMI of 25 kg/m^2[17] or excess weight over the ideal body weight.[15] References for ideal body weight calculations can differ as well.

Similar to what has been previously described by Seo et al,[18] the findings of our study show that the highest %TWL was found in individuals with higher preoperative BMIs ($P < .001$). Our findings also show that gastric bypass weight losses were higher than all other types as was expected from the literature.[18] This result was not statistically significant ($P = .702$). There was, however, an incomparable sample in our survey as 80 participants underwent gastric sleeve surgery while only 9 underwent gastric bypass. Regarding the pattern of weight loss, there were no significant differences when comparing patients at different periods postsurgery. While collecting anthropometric measurements at different data collection points for the same patient would provide a more robust comparison, the cross-sectional design and different protocols followed at different centers did not allow for this comparison.

The majority of the participants were females (69%), married (77%), and residing in urban areas (87%). Demographic factors did not affect %TWL, with the exception of locality type, where individuals residing in urban areas had a higher %TWL than those in rural areas. Although "camp" category showed the highest %TWL, only one individual fell into that category and therefore the comparison may not be valid. Previous literature reported no significant associations with rural versus

urban residence[19,20]; however, the difference observed may be related to other lifestyle factors that differ between urban and rural areas. These were not included in our study.

Findings of this study generally reflect the predominance of healthy dietary behaviors among bariatric surgery patients postsurgery, as there was a significant positive change in dietary habits following bariatric surgery. On average, 12 of the 13 studied behaviors appeared to change positively. Only one behavior, which was nut consumption, did not significantly change. Nuts are often encouraged because of their nutritional value; however, most postbariatric guidelines suggest that nuts can be poorly tolerated and/or suggest to limit high-fat foods, under which nuts can be categorized.[21] Patients may have received conflicting messages from different sources. Overall, these dietary changes may not be very difficult to establish, as most are cornerstones of the Mediterranean diet, which is commonly followed in the Palestinian society. A recent study in Palestine found that 46.2% of 106 Palestinian adults were highly adherent to the Mediterranean diet guidelines,[22] which recommend an increased intake of fruits, vegetables, fish, and whole grains while limiting refined carbohydrates, processed foods, and processed and fatty meats.[23] Therefore, the transition to the Mediterranean diet may not be very challenging.

We studied the difference in %TWL in 3 groups: those who increased, decreased, or had no change in the frequency of following this dietary behavior. Only one variable showed a significant difference between these 3 groups: dairy product intake. Participants who increased their intake showed a greater %TWL than those who had no change or decreased their intake (%TWL = 32.57% ± 10.54%, 27.5% ± 9.98%, and 26.03% ± 9.27%, respectively). Dairy products have been suggested to be an enhancer of weight loss as a part of restrictive diets, more specifically associated with reductions in body fat mass and waist circumference.[24] The postbariatric period resembles a restrictive diet due to the reduced energy intake.[5] There were no other significant differences, although a few patterns were observed. Participants who decreased their intake of white bread and increased their intake of whole grain bread showed a greater %TWL ($P = .096$ and $P = .117$, respectively). Increased fiber intake has been previously reported to stand out as a behavior of weight maintainers postbariatric surgery.[2] A similar pattern was found with participants who increased their vegetable intake ($P = .464$), but no pattern was found with fruit intake. This may be due to the question format, which combined whole fruits and fruit juices into one category, and the latter is a low-fiber choice. Three other dietary behaviors stood out, as the exclusion of these items resulted in higher %TWL; these were processed meat, fast food, and sweetened beverages intake ($P = .279$, $P = .501$, and $P = .111$, respectively). Freire et al[16] attributed weight regain postoperatively partly to excessive intake of sweets and fatty foods. These data suggest that dietary counseling and educations may play an important role in attempting to promote and achieve higher levels of weight loss.

Regular follow-up, both medical and nutritional, is usually a part of postsurgical care for patients. The majority of the patients (78%) regularly follow up with biomedical examinations. Most patients reported normal ranges for hemoglobin, vitamin B_{12}, vitamin D, calcium, cholesterol, and triglycerides. Nutritional deficiencies are common and expected postoperatively; however, for vitamin B_{12}, vitamin D, and calcium tests, only 18%, 21%, and 15% demonstrated low levels, respectively. Freire et al[16] also reported no important nutritional deficiencies regardless of low intake and weight loss, which could possibly be due to supplementation intake. There was not a statistical difference in %TWL and whether patients reported follow-up practices.

We found a significant association between %TWL and other healthy lifestyle factors: exercise, smoking, and routine follow-up. Regarding physical activity, exercisers had a

higher %TWL than nonexercisers. This is similar to what has been previously reported, which showed a strong association between physical activity and weight loss maintenance in the long term.[2,16,25] Livhits et al,[26] in a meta-analysis of 3 studies, reported a significant increase in weight loss postoperatively in patients who exercise, which supports the recommendation of encouraging exercise postoperatively. It was unexpected that participants who identified as irregular exercisers had a higher %TWL than regular exercises and nonexercisers ($P = .015$).

We also inquired specifically about walking for 30 minutes. A previous systematic review found no relationship between walking and weight loss; however, walking does improve as a result of weight loss and patients seemed to engage more in walking postoperatively.[27] Although participants who responded as "yes" had a higher %TWL than responders with "sometimes" and "no," this difference was not statistically significant ($P = .340$).

Finally, smoking has been previously evaluated for its association with weight gain. Although smoking can present its own complications and patients should be encouraged to quit prior to surgery,[28] previous research concluded that there was no significant difference between smokers and nonsmokers in weight loss and regain following bariatric surgery.[28,29] Of the 27 smokers in our population, only 15 were regular smokers. %TWL was higher in smokers; however, this result was not statistically significant, which is similar to what has been reported previously.[28,29]

To our knowledge, this is the first study to explore dietary and lifestyle behaviors and weight loss patterns in Palestinian adults who underwent bariatric surgery. Therefore, we aimed to fill this research gap in order to help achieve a higher rate of success following bariatric surgery as part a multidisciplinary team effort by influencing behaviors about dietary habits in patients post-bariatric surgery. The study design presents its own limitations, including recall bias and errors in anthropometric reporting, as participants were asked to weigh themselves and report their presurgical weight. Another limitation was grouping both fruits and fruit juices into one category, as fiber and especially soluble fiber found in fruits are recommended postsurgery[30] while foods high in simple carbohydrates, such as fruit juices, are avoided because increased risk of dumping syndrome, a common cause of postprandial discomfort.[31] Furthermore, it is recommended that all diet-related data should be collected using the 24-hour recall or the food diary methods as this will allow for the categorization of food items in each food group into other subgroups (eg, low-fat dairy and high-fat dairy).

As we have highlighted the essential role dietary behaviors play as a part in the postsurgical care, the next step following this research is to confirm our findings through a prospective study design. In addition, more dietary factors can be explored for their potential role in %TWL, as well as other factors, which are serving a part in the postsurgical care process, such as adjunct pharmacotherapy.[32]

CONCLUSION

Our study highlights the role of exercise and dietary behavior as part of the overall postsurgical care for bariatric surgery patients. Our results indicated a significant change in dietary behavior before and after bariatric surgery. Of these behaviors, dairy product intake was significantly associated with a higher %TWL. Other factors that showed a higher %TWL were increased whole grain bread and vegetable intake and decreased white bread, processed meat, fast food, and sweetened beverages intake, all of which were statistically insignificant. Taking these factors into consideration and implementing nutritional follow-up practices may have an impact on the significance of weight loss.

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