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Determining the relationship of diet quality with weight change, body mass index, and depression in women who had undergone sleeve gastrectomy: A cross-sectional descriptive study

Determinar la relación de la calidad de la dieta con el cambio de peso, el índice de masa corporal y la depresión en mujeres sometidas a una gastrectomía en manga: Un estudio descriptivo transversal

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ABSTRACT

Introduction: This study aims to determine the relationship of diet quality in women with weight change, body mass index (BMI), and depression one year after undergoing sleeve gastrectomy.

Material and methods: This is a cross-sectional descriptive study with 62 women aged 18–65 years who underwent sleeve gastrectomy in a private hospital and completed their first postoperative year. The participants were asked to fill a questionnaire on 3-day food consumption record, sociodemographic characteristics, and nutritional status; Beck depression inventory (BDI) was applied. Mean adequacy ratio (MAR) was used to evaluate diet quality.

Results: The mean age was 33.6 ± 9.5 years. The mean MAR score was 76.0 ± 31.8, and the mean BDI score was 8.2 ± 6.4. The excess weight loss rate was high in patients with good diet quality, and the BMI and depression scores were low ($P_{EWL, BMI} > 0.05$, $P_{Beck} < 0.001$). Diet quality was found to be negatively correlated with body weight, BMI and depression scores and positively correlated with excess weight loss.

Conclusions: Enhancing the diet quality can help patients in overcoming postoperative depression and increasing the success of weight loss. Regular follow-up and guidance provided to the patients by specialized dietitians can further augment the success rates.

Keywords: Bariatric Surgery; Gastrectomy; Body Mass Index; Depression; Body Weight Changes.

Entry Terms: Sleeve gastrectomy.

RESUMEN

Introducción: Este estudio tiene como objetivo determinar la relación de la calidad de la dieta con el cambio de peso, el índice de masa corporal (IMC) y la depresión en mujeres un año después de someterse a una gastrectomía en manga.

Material y métodos: Se trata de un estudio descriptivo transversal con 62 mujeres de 18 a 65 años a las que se les realizó una gastrectomía en manga en un hospital privado y completaron su primer año postoperatorio. Se pidió a los participantes que llenaran un cuestionario sobre el registro de consumo de alimentos de 3 días, las características sociodemográficas y el estado nutricional. Se aplicó el inventario de depresión de Beck (BDI). Se utilizó la razón de adecuación media (MAR) para evaluar la calidad de la dieta.

Resultados: La edad media fue de 33,6 ± 9,5 años. La puntuación media de MAR fue de 76,0 ± 31,8 y la puntuación media de BDI fue de 8,2 ± 6,4. La tasa de pérdida excesiva de peso fue alta en pacientes con buena calidad de la dieta, y las puntuaciones de IMC y depresión fueron bajas (PEWL, IMC> 0,05; PBeck <0,001). Se encontró que la calidad de la dieta se correlacionó negativamente con el peso corporal, el IMC y las puntuaciones de depresión y se correlacionó positivamente con la pérdida excesiva de peso.

Conclusiones: Mejorar la calidad de la dieta puede ayudar a los pacientes a superar la depresión posoperatoria y aumentar el éxito de la pérdida de peso. El seguimiento regular y la orientación proporcionada a los pacientes por dietistas especializados pueden aumentar aún más las tasas de éxito.

Palabras clave: Cirugía Bariátrica; Gastrectomía; Índice de Masa Corporal; Depresión; Cambios en el Peso Corporal.

***Entry Terms*:** Gastrectomía en manga.

KEY MESSAGES

- We determined that the excess weight loss rate is higher in patients with good diet quality.
- As diet quality increases, body mass index decreases in patients one year after undergoing sleeve gastrectomy.
- We found that as diet quality increases, depression scores decrease.
- İmproved diet quality may be helpful in overcoming postoperative depression and increasing the success of weight loss in patients one year after undergoing sleeve gastrectomy.

INTRODUCTION

Bariatric surgery patients are unable to achieve the targeted body weight loss or tend to regain the lost body weight over time since they continue their wrong nutritional habits after surgery. Therefore, bariatric surgery is alone not sufficient to treat obesity. The patients should be guided to develop proper nutrition habits, select healthy foods, and sustain the weight loss through an appropriate physical activity program[1]. Proper nutrition in the postoperative period aids in maintaining the weight loss and ensuring an adequate protein intake. Adopting a healthy lifestyle and adhering to diet quality are important in achieving the long-term benefits of bariatric surgery[2].

Diet quality, which refers to energy and nutrient adequacy, can be affected by malabsorption and food intolerance after bariatric surgery[3,4]. There is a significant decrease in the volume of food consumed and the total energy intake after the surgery. That may endanger the diet quality, especially in the first year of surgery[5]. After bariatric surgery, patients should consume a diet that is balanced in all nutrients such as complex carbohydrates, healthy essential fats, and high-quality proteins[6]. An unbalanced diet may lead to inadequate weight loss as well as weight regain and consequently poor health outcomes in the long run[5,7]. As a matter of fact, while there are many studies showing the relationship of diet quality with body mass index (BMI) and obesity, there are many studies that did not find a significant relationship[8-10.] In a study conducted with 954 male and 1356 female adults, diet quality was not associated with BMI, but was associated with waist circumference measurement[11]. In another study conducted with 6325 men and 7211 women, it was observed that diet quality had a negative relationship with BMI. This relationship was higher in women ($p<0.05$)[12]. These inconsistencies between studies are thought to be due to the diet assessment methods, study protocols, differences in dietary index range and the characteristics of the populations involved in the studies[10]. In addition, the presence of other factors affecting diet quality can also change the results. Because diet quality can also be affected by socioeconomic level, education level, lifestyle and habits[13].

It has been observed that unhealthy diet and poor diet quality are also associated with depression symptoms[14]. There are some studies showing that depression and its severity increase in the post-op first year in patients who have undergone bariatric surgery[15,16]. Depression can negatively affect diet quality by causing symptoms such as loss of appetite or overeating[17]. This is a risk factor in reducing the success of surgery and quality of life by negatively affecting the diet quality of patients[2]. Thus, postoperative success should be evaluated not only based on the

weight lost by the individual but also by considering the postoperative psychological well-being and adaptation process[1].

This study aims to determine the relationship of diet quality in women undergoing sleeve gastrectomy with weight change, BMI, and depression one year after the procedure.

MATERIAL AND METHODS

Study design and participants

Necessary permits and approvals were obtained from the hospital where the study was conducted. Ethics Committee approval was obtained from the Ethics Board of Health Sciences Research (dated Dec 11, 2019 and numbered 15). After securing the approval, 62 women who had undergone sleeve gastrectomy in the Bariatric and Metabolic Surgery unit of a private hospital between August and November 2018 were included in the study. The inclusion criteria of this cross-sectional and descriptive study were as follows: age 18–65 years, female gender, underwent laparoscopic sleeve gastrectomy, completed the first postoperative year, not suffering from any chronic disease, and not being pregnant. After the operation, dietitian interviews were made with the patients on the postoperative 2nd week, 4th week, 2nd, 3rd and 4th months. Subsequently, there was no planned meeting, the patients contacted the dietitian when they had any questions.

Procedure

A questionnaire seeking information on general characteristics and sociodemographic data was given to individuals who volunteered to participate in the study. Anthropometric measurements of the participants (body weight and height before and after the surgery) were taken and recorded by the researcher. Body weight was measured using Tanita 360 ST® model Bioelectric Impedance Analysis.

The BMI of the patients was calculated using the following formula: body weight (kg) / height (m^2). The results were evaluated as per the World Health Organization (WHO) classification[18]. According to the weight and BMI values, "excess weight loss" (EWL) values of the patients were calculated [(weight before surgery – weight after surgery) / (weight before surgery – ideal weight)]. Ideal weight was defined as the BMI value corresponding to 25 kg/m^2. Multiplying the result by 100 yielded the EWL percentage[19]. Since this value is used as the difference between normal weight and overweight in the publications, we defined BMI as 25 kg / m^2 in this study[20].

To evaluate the nutritional status of the patients, food consumption record was obtained for three consecutive days (two days on weekdays and one day on the weekend). Energy and nutrients consumed as daily diet were analyzed using the "Computer-Aided Nutrition Information Systems Package Program (BEBİS)" developed for Turkey[21]. The estimated energy and nutrient data were evaluated based on daily recommended intake (DRI) levels[22]. Mean adequacy ratio (MAR) scores calculated from the nutrient adequacy ratio (NAR) were used to evaluate the diet

quality. MAR is one of the most frequently used indices for studying diet quality, especially in terms of its adequacy. The NAR score is calculated by comparing the individual daily consumption amounts of nutrients with the DRI levels categorized according to age and gender[23]. In the present study, the NAR scores were calculated as percentages for the 10 nutrients of carbohydrate, protein, calcium, iron, magnesium, phosphorus, folate, vitamin B_{12}, riboflavin, and niacin.

The MAR score is obtained as a percentage by taking the average of the NAR scores calculated for the 10 nutrients. In the evaluation, ≤50 points is classified as "inadequate," 51–80 points as "need improvement," and >80 points as "good" [24].

In the present study, Beck depression inventory (BDI) was used to measure the symptoms of depression and determine their degree. BDI is scored between 0 and 63. The adaptation of the system to the Turkish population was performed by Hisli[25] (Cronbach alpha value: 0.86–0.81). The cutoff score of the scale was accepted as 17 in this case. BDI is a 4-point Likert-type scale, and each question is scored as 0, 1, 2, or 3. Scores are evaluated as normal (1–10 points), mild mental distress (11–16 points), borderline clinical depression (17–20 points), moderate depression (21–30 points), severe depression (31–40 points), and highly severe depression (>40 points) [25].

Statistical analysis

All data were analyzed using the IBM SPSS Statistics 23 program. While evaluating the study data, frequency distributions were provided for the categorical variables and descriptive statistics (mean, standard deviation, minimum, and maximum) were provided for the numerical variables. Besides, normality of the quantitative variables was tested. Parametric tests were used for variables with normal distribution, whereas non-parametric tests were used for those that did not exhibit a normal distribution.

For non-parametric comparisons, Kruskal–Wallis H test was employed to test the significance of the difference between the averages of three or more groups. Furthermore, Mann–Whitney U test was utilized to analyze one independent variable with two sub-groups, and Chi-square analysis was applied to evaluate the relationship between two independent categorical variables. Spearman Correlation Test was used to define the relationship between quantitative variables.

RESULTS

The mean age of the participants was 33.6 ± 9.5 years, and 50% were between 26 and 35 years of age. Besides, 45.1% were workers, 33.9% were civil servants, and 21% were unemployed. The diet quality was "good" in 46.8% of the patients, 30.6% needed improvement, and 22.6% had "inadequate" diet quality. The mean total MAR score was 76.0 ± 31.8. When the BDI scores were examined, 71.0% of the participants were normal and 21.0% had mild mental disorder. None of the patients had highly severe depression. The mean BDI score of the participants was 8.2 ± 6.4 (Table 1).

Table 1. Distribution of patients according to their demographic characteristics, MAR score and Beck depression score classifications.

	N (62)	%
Age groups (years)		
18-25	12	19.3
26-35	31	50.0
36-45	13	21.0
46 and over	6	9.7
Occupation		
Not working	13	21.0
Officer	21	33.9
Worker	28	45.1
Educational level		
No formal education	1	1.6
Middle School	5	8.0
High school	22	35.5
Undergraduate	26	41.9
Postgraduate	8	12.9
Smoking status		
Yes	25	40.3
No	37	59.7
MAR score classification		
Insufficient (≤ 50)	14	22.6
Need to be improved (51-79)	19	30.6
Good (≥ 80)	29	46.8
Beck depression classification		
Normal	44	71.0

Mild mental disorder	13	21.0
Borderline clinical depression	2	3.2
Moderate depression	2	3.2
Severe depression	1	1.6
Very severe depression	-	-

The mean postoperative body weight and BMI of the patients were significantly lower when compared with the preoperative period ($p < 0.001$). Moreover, 96.8% of the patients exhibited an EWL value of ≥50% (Table 2).

Table 2. Average of anthropometric measurements of patients.

	Min-Max	**$\overline{x}$ ± SD**
Body weight (kg)		
Before surgery	99.0-200.0	125.7±19.9
Post-op first year	55.0-112.0	79.5±14.0
P *	**0.000†**	
BMI (kg/m²)		
Before surgery	40.0-61.8	45.1±5.7
Post-op first year	21.2-41.9	28.6±4.5
P *	**0.000†**	
EWL	28.6-125.3	84.1±19.6
	N (62)	**%**
EWL <%50	2	3.2
EWL ≥ %50	60	96.8

*BMI: Body mass index, EWL: Excess weight loss, *paired sample t-test, †: P<0.001*

According to the MAR score classification, 64.3% of those with poor nutritional quality had mild mental disorder, 14.3% had borderline clinical depression, 14.3% had moderate depression, and 7.1% had severe depression. Furthermore, 21.1% of the patients in the group whose diet quality needed improvement had mild mental disorder. Depression was not observed in patients with good nutritional quality. The difference between the depression classes with respect to diet quality classification was statistically significant ($p < 0.001$) (Table 3).

Table 3. Distribution of mental states of patients according to their dietary quality.

Beck depression score classification	MAR Score Classification						P*
	Insufficient		Need to be improved		Good		
	N	%	N	%	N	%	
Normal	-	-	15	78.9	29	100	
Mild mental disorder	9	64.3	4	21.1	-	-	
Borderline clinical depression	2	14.3	-	-	-	-	**0.000**†
Moderate depression	2	14.3	-	-	-	-	
Severe depression	1	7.1	-	-	-	-	

*Chi- square test, †:*P<0.001*

Mean body weight, BMI, and BDI scores were high in patients with poor diet quality ($p > 0.05$, $p > 0.05$, $p < 0.001$, respectively). In patients with poor diet quality, EWL, protein, carbohydrate, riboflavin, niacin, folate, vitamin B_{12}, calcium, magnesium, phosphorus, and iron levels were low ($p > 0.05$ for EWL, $p < 0.05$ for others) (Table 4).

Table 4. Comparison of diet quality levels of patients with some parameters.

	Insufficient	Need to be improved	Good	P†
	X±SD	X±SD	X±SD	
Body weight (kg)	81.1±14.4	80.9±14.8	77.9±13.7	0.685
EWL (%)	79.2±22.2	84.7±22.9	86.0±16.0	0.573
BMI (kg/m^2)	29.8±5.5	28.3±4.6	28.1±3.9	0.523
Beck Depression Score	17.3±6.0	5.8±4.3	5.4±3.0	**0.000****
Protein (g)	26.1±9.1	56.4±15.5	82.0±29.0	**0.000****
Carbohydrate (g)	45.5±25.8	72.1±26.9	111.8±47.0	**0.000****
Fat (g)	38.9±19.3	36.6±18.3	40.8±21.2	**0.002***
Riboflavin (mg)	0.3±0.1	0.8±0.2	1.4±0.4	**0.000****
Niacin (mg)	3.3±2.1	6.9±2.8	13.0±7.5	**0.000****
Folate (mcg)	105.5±65.9	132.5±66.0	185.6±76.2	**0.002***
Vitamin B_{12} (mcg)	1.0±0.8	2.6±1.5	4.2±1.8	**0.000****
Calcium (mg)	205.2±80.5	437.2±141.2	630.4±265.1	**0.000****
Magnesium (mg)	68.2±35.4	123.4±26.9	202.7±71.9	**0.000****
Phosphorus (mg)	312.4±80,9	640.3±130.7	915.3±260.1	**0.000****
Iron (mg)	2.5±0.9	4.4±1.4	6.1±2.3	**0.000****

*BMI: Body mass index, EWL: Excess weight loss, †: Anova Test, *: P<0.05, **:P<0.001*

The MAR score was negatively correlated with postoperative body weight and BMI ($p < 0.05$). The score was positively, albeit insignificantly, correlated with EWL and fat intake ($p > 0.05$). The score displayed a significant negative correlation with BDI and a positive correlation with protein, carbohydrate, riboflavin, niacin, folate, vitamin B_{12}, calcium, magnesium, phosphorus, and iron levels ($p < 0.05$). The BDI score was positively correlated with age, postoperative body weight, and BMI, while it was negatively correlated with EWL and all nutrients (Table 5).

Table 5. The relationship between patients' MAR scores and beck depression scores with some parameters.

	MAR scores		Beck Depression Scores	
	r	p†	r	p†
Age (years)	-0.083	0.519	0.045	0.727
Body weight after surgery (kg)	-0.157	0.223	0.054	0.654
BMI after suregery (kg/m^2)	-0.116	0.368	0.194	0.130
EWL (%)	0.076	0.559	-0.144	0.264
Beck depression score	-0.541	**0.000****	1	-
Protein (g)	0.777	**0.000****	-0.472	**0.000****
Fat (g)	0.058	0.657	0.030	0.313
Carbohydrate (g)	0.625	**0.000****	-0.381	**0.002***
Riboflavin (mg)	0.735	**0.000****	-0.344	**0.006***
Niacin (mg)	0.909	**0.000****	-0.475	**0.000****
Folate (mcg)	0.756	**0.000****	-0.419	**0.001***
Vitamin B_{12} (mcg)	0.523	**0.000****	-0.115	0.371
Calcium (mg)	0.680	**0.000****	-0.468	**0.000****
Magnesium (mg)	0.721	**0.000****	-0.388	**0.002****
Phosphorus (mg)	0.819	**0.000****	-0.503	**0.000***
Iron (mg)	0.670	**0.000****	-0.356	**0.005***

*BMI: Body mass index, EWL: Excess weight loss, †Spearman correlation, *: P<0.05, **:P<0.001*

DISCUSSION

In the study, we observed that BMI and depression were lower and excess weight loss was higher in patients with high dietary quality at the end of the first year after undergoing sleeve gastrectomy. As the diet quality increased, body weight, BMI and depression scores decreased, and excess weight loss rate increased. These results shed light on the importance of considering dietary quality beyond dietary intake restriction and adequate protein intake. The study suggests that both psychological and nutritional approaches can contribute to weight change in such an operation that psychologically challenges patients.

According to the global registration report of the International Federation for the Surgery of Obesity and Metabolic Disorders between 2014 and 2019, the proportion of female patients undergoing bariatric surgery to all patients undergoing the surgery in the world is 77.1%. Furthermore, women constitute the majority in all countries[26]. In this study, the participants were entirely women because they were the ones who predominantly underwent the surgery.

After the bariatric surgery, patients have limited nutritional capacity and low energy intake. To ensure that this does not lead to malnutrition, it is necessary for them to have a high diet quality[27,28]. Nutrients should be taken in sufficient quantities, various nutrient groups should be provided, and both nutrients and food groups should be present in recommended quantities in the diet[29]. In the present study, 46.8% of the individuals had good diet quality, 30.6% needed to improve their diet quality, and 22.6% had inadequate diet quality. In a study, the mean MAR score of the patients was 43 ± 15 in the first postoperative year, and their nutrient intake was inadequate[28]. For long-term success in weight loss after the bariatric surgery, it is imperative to evaluate the nutrition of patients and improve their diet quality.

The risk of morbidity, mortality, and obesity-associated diseases is significantly reduced in bariatric surgery patients as a result of total weight loss and the EWL[30]. In a study involving patients who had undergone laparoscopic sleeve gastrectomy, the weight of the patients decreased from 116.6 ± 18.6 kg to 77.5 ± 13.8 kg. [31] In a study comprising 1574 participants, the average BMI difference before and after the surgery was 16.8 ± 5.6 kg/m^2 [32]. In the present study, significant reductions were observed in weight and BMI values. The weight loss achieved can be considered as "good" when the percentage of EWL after bariatric surgery is ≥50%[33]. In the present study, 96.8% of the patients achieved this score.

Improving the diet quality can positively affect health just as how low diet quality can affect body weight and BMI, leading to several problems. According to studies, low diet quality can lead to an

increase in body weight and BMI[34,35]. In the present study, it was found that body weight and postoperative BMI increased as diet quality decreased. This issue can jeopardize the success of the surgery and pose risks such as metabolic difficulties to the patients.

Current literature shows that bariatric surgery can be effective in reducing depression symptoms in the first year after surgery. However, there are also studies showing the opposite of it for 1-3 years after the operation[14,15]. In a study in which 2458 patients who underwent bariatric surgery were included, the mean beck depression score was found to be 4.1 (no depression) in the first postoperative year[14]. In this study, the mean beck depression score of the patients was 8.2 ± 6.4 (no depression). However, while 71% of patients do not have depression, 29% of them have depression.

Depression can lead to either overeating or loss of appetite[17]. Especially while increased appetite is associated with overweight and obesity, this may disrupt the weight loss goals in this group of patient and reduce the quality of diet with an unhealthy diet. Poor diet quality can also increase depression[36]. This situation, on the other hand, may reduce the success of the surgery by putting the patient in a vicious circle, and further reduce the patient's quality of life.

While both diet quality and depression can be affected by each other, the presence of other factors that affect these two factors makes it difficult to get clear results. Socioeconomic and demographic factors play a huge role in both diet quality and depression including family, lifestyle, and employment[11,13]. For this reason, there is a need for more detailed studies with larger samples, in which these factors are considered together.

An adequate and balanced diet has been shown to have significant impacts on physiological health as well as reduce the risk of depression[37]. It has been established that insufficient intake of micronutrients, especially zinc, folate, and vitamin D, increases the risk of depression[38]. In the present study, negative correlations were found between depression and daily intake of proteins, carbohydrates, riboflavin, niacin, folate, calcium, magnesium, phosphorus, iron, and zinc ($p < 0.05$). As the diet quality increases, the daily intake of proteins, carbohydrates, riboflavin, niacin, folate, vitamin B_{12}, calcium, magnesium, phosphorus, iron and zinc also increase. Dietary applications in which diet quality will be improved may help eliminate the patients' current depression.

In bariatric surgery patients, poor diet quality and the resultant nutrient deficiency, especially insufficient protein consumption, adversely affects the health in the first postoperative year. In the long run, it can cause the secondary development of sarcopenia and reduce the quality of

life[39]. In the first year after surgery, sleeve gastrectomy is more effective in inducing EWL and body fat loss than conservative treatments; however, increased lean muscle mass and protein loss have been reported[40]. In the present study, protein intake increased with improvement in the diet quality during the first postoperative year (r: 0.777, p<0.001), and the depression scores decreased (r: -0.541, p<0.001). It can be argued that improving the diet quality and increasing the protein intake to the recommended levels will positively affect the health, depression occurrence and quality of life of the patients.

Strengths and Limitations of the Study

There are few studies on post-period diet quality of patients who have undergone bariatric surgery. This study is important in this respect. In addition, diet quality in the study was evaluated on the basis of nutrients using MAR and NAR values, which is very valuable considering the nutrient intake and deficiencies in bariatric surgery. On the other hand, participants could potentially be suffering from or receiving prior treatment for mental health conditions such as anxiety, bipolar disorder or eating disorders but any pre-existing mental health conditions were not checked in the present study. That is one of the limitations of the present study. In addition, patients' mental health wasn't evaluated and compared according the socioeconomic factors which may play an important role in affecting dietary aspects.

CONCLUSIONS

Nutrient deficiencies are common in bariatric patients, which can also indicate a poor diet quality. The prevalence of depression is high in patients with low diet quality, which establishes the effects of nutrition on psychology. These deficiencies affect not only the overall health of the patients but also their quality of life. However, it is possible to achieve the goal of ideal weight and avoid long-term weight gain after bariatric surgery with a quality diet. In particular, the patient's expectations and weight-related goals should be discussed realistically with a dietitian specializing in bariatric surgery. During this process, the patient should be made to understand that developing healthy eating habits and making lifestyle changes is a priority. Long-term follow-up by the obesity surgery teams in a multidisciplinary manner both in the preoperative and postoperative period is vital.

AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design. Diagnosis and surgeries of the patients were performed by GÖ. Patients nutritional cares were followed by NA. Material preparation, data collection and analysis were performed by NA and BAÖ.

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COMPETING INTERESTS

The authors state that there are no conflicts of interest in preparing the manuscript.

REFERENCES

(1) Nguyen N, Brethauer SA, Morton JM, Ponce J, Rosenthal RJ, eds. The ASMBS textbook of bariatric surgery. New York: Springer, 2020.

(2) Freire RH, Borges MC, Alvarez-Leite JI, Correia MITD. Food quality, physical activity, and nutritional follow-up as determinant of weight regain after roux-en-y gastric bypass. Nutrition. 2012; 28(1):53–58.

(3) Soares FL, De Sousa LB, Corradi-Perini C, Da Cruz MRR, Nunes MGJ, Branco- Filho AJ. Food quality in the late postoperative period of bariatric surgery: an evaluation using the bariatric food pyramid. Obes Surg. 2014; 24: 1481-1486.

(4) Freeman RA, Overs SE, Zarshenas N, Walton KL, Jorgensen JO. Food tolerance and diet quality following adjustable gastric banding, sleeve gastrectomy and roux-en-y gastric bypass. Obes Res Clin Prac. 2014; 8(2): 115–200.

(5) Zarshenas N, Tapsell LC, Neale EP, Batterham M, Talbot ML. The relationship between bariatric surgery and diet quality: a systematic review. Obes Surg. 2020; 30(5): 1768-1792.

(6) Kanerva N, Larsson I, Peltonen M, Lindroos AK, Carlsson LM. Changes in total energy intake and macronutrient composition after bariatric surgery predict long-term weight outcome: findings from the Swedish Obese Subjects (SOS) study. Am J Clin Nutr. 2017; 106(1):136-145.

(7) Sanlier N, Pehlivan M, Sabuncular G, Bakan S, Isguzar Y. Determining the relationship between body mass index, healthy lifestyle behaviors and social appearance anxiety. Ecol Food Nut. 2018; 57(2): 124- 139.

(8) Woodruff SJ, Hanning RM, Lambraki I, Storey KE, Mc-Cargar L. Healthy eating index-c is compromised among adolescents with body weight concerns, weight loss dieting, and meal skipping. Body Image. 2008; 5:404–408.

(9) Drenowat C, Shook RP, Hand GA, Hebert JR, Blair SN. The independent association between diet quality and body composition. Scientific reports. 2014; 4: 4928.

(10) Sundararajan K, Campbell MK, Choi YH, Sarma S. The relationship between diet quality and adult obesity: evidence from Canada. J Am Coll Nutr. 2014; 33(1): 1–17.

(11) Ateş Özcan B, Yeşilkaya B, Yaldız N, Pehlivan M. Factors affecting diet quality in adolescents: the effect of sociodemographic characteristics and meal consumption. Progress in Nutrition. 2020; 22(4): e2020094.

(12) López-Olmedo N, Popkin BM, Mendez MA, Taillie LS. The association of overall diet quality with body mass index and waist circumference by education level in Mexican men and women. Public Health Nutr. 2019; *22*(15): 2777.

(13) Freitas TID, Previdelli AN, Ferreira MPDN, Marques KM, Goulart RMM, Aquino RDCD. Factors associated with diet quality of older adults. Rev Nutr. 2017; 30(3): 297-306.

(14) Mitchell JE, King WC, Chen JY, Devlin MJ, Flum D, Garcia L, et al. Course of depressive symptoms and treatment in the longitudinal assessment of bariatric surgery (LABS-2) study. Obesity (Silver Spring). 2014; 22(8): 1799-806.

(15) Ivezaj V, Grilo CM. When mood worsens after gastric bypass surgery: characterization of bariatric patients with increases in depressive symptoms following surgery. Obes Surg. 2015; 25(3): 423-429.

(16) Molendijk M, Molero P, Sánchez-Pedreño FO, Van der Does W, Martínez-González MA. Diet quality and depression risk: a systematic review and dose-response meta-analysis of prospective studies. J Affect Disord. 2018; 226: 346-354.

(17) Mills JG, Thomas SJ, Larkin TA, Deng C. Overeating and food addiction in Major Depressive Disorder: Links to peripheral dopamine. Appetite. 2020; 148: 104586.

(18) World Health Organization. Body mass index- BMI. Available in: http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi. Accessed in: November 15, 2020.

(19) Van De Laar AW, Van Rijswijk AS, Kakar H, Bruin SC. Sensitivity and specidicity of 50% excess weight loss (50%EWL) and twelve other bariatric criteria for wieght loss success. Obes Surg. 2018; 28(8): 2297-2304.

(20) Brethauer SA, Kim J, El Chaar M, Papasavas P, Eisenberg D, Rogers A, et al. Standardized outcomes reporting in metabolic and bariatric surgery. Obes Surg. 2015; 25(4): 587-606.

(21) Ebispro for Windows, Stuttgart, Germany, BEBİS, Turkish version and Data Bases: Bundeslebenmittelschlüssell, 11.3 and other sources. Nutrition Information Systems, 2004.

(22) National Institutes of Health (NIH). Nutrient recommendations: dietary reference intakes (DRI). Available in: https://ods.od.nih.gov/HealthInformation/nutrientrecommendations.sec.aspx. Accessed in: November 10, 2020.

(23) Feskanich D, Rockett HRH, Colditz GA. Modifying the healthy eating ındex to assess diet quality in children and adolescents. J Am Diet Assoc. 2004; 104(9): 1375-83.

(24) Kirkil C, Aygen E, Korkmaz MF, Bozan MB. Quality of life after laparoscopic sleeve gastrectomy using baros system. ABCD, arq bras cir dig. 2018; 31(3):1385.

(25) Hisli N. A reliability and validity study of beck depression inventory in a university student sample. J Psychol. 1989; 7: 3-13.

(26) Ramos A, Kow L, Brown W, Welbourn R, Dixon J, Kinsman R, et al. Fifth IFSO global registry report- 2019. Obes Surg. 2019; 29(3): 782-795.

(27) McGrice MA, Porter JA. What are gastric banding patients eating one year post-surgery? Obes Surg. 2012; 22(12): 1855-1858.

(28) Hosseini-Esfahani F, Khalaj A, Valizadeh M, Azizi F, Barzin M, Mirmiran P. Nutrient intake and deficiency of patients 1 year after bariatric surgery: tehran obesity treatment study (TOTS). J Gastrointest Surg. 2020; 1-8.

(29) Alkerwi AA. Diet quality concept. Nutrition. 2014; 30(6): 613-618.

(30) Fried M, Yumuk V, Oppert JM, Scopinaro N, Torres AJ, Weiner R, et al. Interdisciplinary european guidelines on metabolic and bariatric surgery. Obes Facts. 2013; 6: 449–468.

(31) Coluzzi I, Raparelli L, Guarnacci L, Paone E, Del Genio G, le Roux CW, et al. Food intake and changes in eating behavior after laparoscopic sleeve gastrectomy, Obes Surg. 2016; 26: 2059-2067.

(32) Grover BT, Morell MC, Kothari SN, Borgert AJ, Kallies KJ. Defining weight loss after bariatric surgery: a call for standardization. Obes Surg. 2019; 29: 3493- 3499.

(33) Reinhold RB. Critical analysis of long-term weight loss following gastric bypass. Surg Gynecol Obstet. 1982; 155(3): 385-394.

(34) Drenowatz C, Shook RP, Hand GA, Hebert JR, Blair SN. The independent association between diet quality and body composition. Sci Rep. 2014; 4(1): 1-6.

(35) Ford DW, Hartman TJ, Still C, Wood C, Mitchell D, Ericson P, et al. Body mass index, poor diet quality, and health-related quality of life are associated with mortality in rural older adults. J Nutr Gerontol Geriatr. 2014; 33(1): 23-34.

(36) Khalid S, Williams CM, Reynolds SA. Is there an association between diet and depression in children and adolescents? A systematic review. Br J Nutr. 2016; 116(12): 2097-2108.

(37) Opie RS, Itsiopoulos C, Parletta N, Sanchez-Villegas A, Akbaraly TN, Ruusunen A, et al. Dietary recommendations for the prevention of depression. Nutr Neurosci. 2017; 20(3): 161-171.

(38) Sanchez-Villegas A, Martinez-Gonzalez MA. Diet, a new target to prevent depression? BMC Med. 2013; 11: 1-4.

(39) Güneş Y, Karip B, Ergin A, Bulut NE, Fersahoğlu MM, Memişoğlu K. The impact of protein support on weight loss, sarcopenia, and quality of life after sleeve gastrectomy. Bariatr Surg Pract P. 2019; 14(3): 131-136.

(40) Dagan SS, Tovim TB, Keidar A, Raziel A, Shibolet O, Zelber- Sagi S. Inadequate protein intake after laparoscopic sleeve gastrectomy surgery is associated with a greater fat free mass loss. Surg Obes Relat Dis. 2017; 13(1): 101-109.