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ORIGINAL RESEARCH

The Association Between Appetite and Quality of Life in Adults with Obesity or Severe Obesity Post-Sleeve Gastrectomy Procedure: A Cross-Sectional Study

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Background: Sleeve gastrectomy (SG) is considered as the most common bariatric procedure in Saudi Arabia. It is a non-reversible procedure defined as removal of a large portion of the stomach.

Objective: The objective of the current study is to compare the appetite and quality of life (QoL) between adults' post-sleeve gastrectomy and obese/morbidly obese adults (pre-SG).

Methods: A cross-sectional study design was conducted in adults (aged between 18 and 65 years), post-sleeve gastrectomy (n = 80, 41 Males and 39 Females) and obese group (n = 60, 28 Males and 32 Females). The study population was recruited from the bariatric surgery clinic of King Abdullah Bin Abdul-Aziz University Hospital. A self-reported questionnaire was collected that included a visual analogue scale (VAS) to assess the appetite level, and SF-36 QoL questionnaire.

Results: No significant differences were found in age and gender between the study groups ($p > 0.05$). The median score feeling of fullness was significantly higher in the SG group (77.5, IQR: 48 and 50, IQR: 40, respectively) than in the obese group ($p < 0.001$). The amount of food eaten was statistically lower in the SG group (30, IQR: 20) than the obese group (50, IQR: 60) ($p = 0.005$). Patients post SG had significantly higher QoL scores in all physical and mental scales, physical component summary and mental component summary ($p < 0.003$).

Conclusion: Patients post SG have improved appetite and QoL. Satiety, less prospective food consumption, BMI, age, gender and comorbidities are associated with QoL. Future studies are needed to compare the QoL in post-SG patients with the normative values of the QoL in Saudi Arabia.

Keywords: appetite, obesity, quality of life, SF-36, sleeve gastrectomy, VAS

Introduction

Obesity is one of the most common health conditions in the world that increases the risk of morbidity and mortality.[1,2] Lifestyle modifications, including following a healthy diet and increasing physical activity, are considered the first-line treatment for obesity.[3] However, failing to lose weight has been observed in patients with obesity.[4] In certain conditions, bariatric surgery can be an effective treatment for obesity, especially when weight reduction through dietary and behavioral changes is limited.[5,6] In Saudi Arabia, one of the most common bariatric surgeries performed is a sleeve gastrectomy (SG). It has been shown that an SG results in a successful weight loss of at least 50% of initial body weight two years post-surgery, leading to significant reduction in overall obesity-related conditions such as diabetes mellitus (DM), hypertension (HTN), and

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hyperlipidemia.[6,7] A recent study found that SG is associated with improving or treating the comorbidities associated with obesity by 30–50%.[5]

Many studies have found that SG is an effective procedure to lose weight, having a positive effect on reducing appetite levels.[8] Several hormones are potential factors associated with weight loss and appetite regulation in gastric sleeve. A study found that ghrelin and leptin concentrations did not change 12 months post SG surgery.[9] It has been established that there is a strong relationship between changes in appetite and the percentage of weight loss post-SG.[10] Whenever the level of appetite changed, percentage of weight loss was increased.[11] Some evidence shows that the appetite level might stay suppressed up to 3 years post SG.[10] Furthermore, another study assessed appetite using visual analogue scales (VAS). The study demonstrated that a feeling of fullness was significantly present 12 weeks post SG. However, hunger when fasting remained unchanged post-SG.[12]

Obesity is associated with increased comorbidities such as DM, cancer, cardiovascular diseases such as HTN and hyperlipidemia, which are all factors associated with a reduced quality of life (QoL).[13–15] Many studies showed that SG was associated with reduced appetite, weight loss, and improvement in the obesity associated comorbidities, such as DM, therefore improving the QoL.[5,13–22] Good or improved QoL was observed in 60–90% of individuals post SG.[18,23,24] Appetite can be considered as independent factor associated with QoL among individuals with obesity. However, limited studies have assessed the association between appetite and QoL in patients post SG compared to individuals with obesity. The primary objectives of the current study were to compare the QoL in adults post SG and individuals with obesity and/or morbid obesity and to compare the appetite in adults post SG and individuals with obesity and/or morbid obesity. The secondary objective is to assess the association between appetite and quality of life in adults post SG and individuals with obesity and/or morbid obesity and to determine the predictors of components of quality of life in adults post SG and individuals with obesity and/or morbid obesity.

Methods

Study Design and Setting

A comparative cross-sectional study was conducted at the King Abdullah bin Abdul-Aziz University Hospital (KAAUH), in Riyadh, Saudi Arabia, in a population of adults aged between 18 and 65 years. The ethical approval was obtained from the Institutional Review Board Committee of Princess Nourah Bint Abdulrahman University (20–0012). Consents were obtained prior to the study.

Study Population

Patients who underwent SG more than 6 months ago (SG group) and participants with obesity (BMI $\geq$ 30 kg/m^2) were recruited from the bariatric and pre-bariatric clinics, respectively. Individuals with other comorbidities or conditions that may affect appetite and/or the QoL, such as DM type 1, celiac disease, irritable bowel disease or having multiple food allergy, were excluded from the study. Any patients who do not read Arabic and pregnant women were excluded from the study.

Sampling Technique and Sample Size

The flow chart of participants' recruitment is illustrated in Figure 1. The performed SG procedure started in July 2017 at KAAUH. A list of post-SG patients (from July 2017) was obtained. The laparoscopic approach was utilized SG procedure. The aim of procedure was to reduce the stomach size by about 75%. Calibration tube usually placed alongside lesser curvature of the stomach to guide the steps of stapling.

Another list of patients who were listed in the pre-bariatric clinic who are under the waiting list for the surgery was attained. The lists were reviewed and participants who did not meet the inclusion criteria were excluded from both groups. The power calculation was conducted on the main outcomes (PCS and MCS). The power was 99–74%, respectively.

Research Tool

A self-administered survey consists of three parts and was administered in the Arabic language. The research team has gone through all the participants in the list to assess the inclusion and the exclusion criteria. Participants who met the inclusion

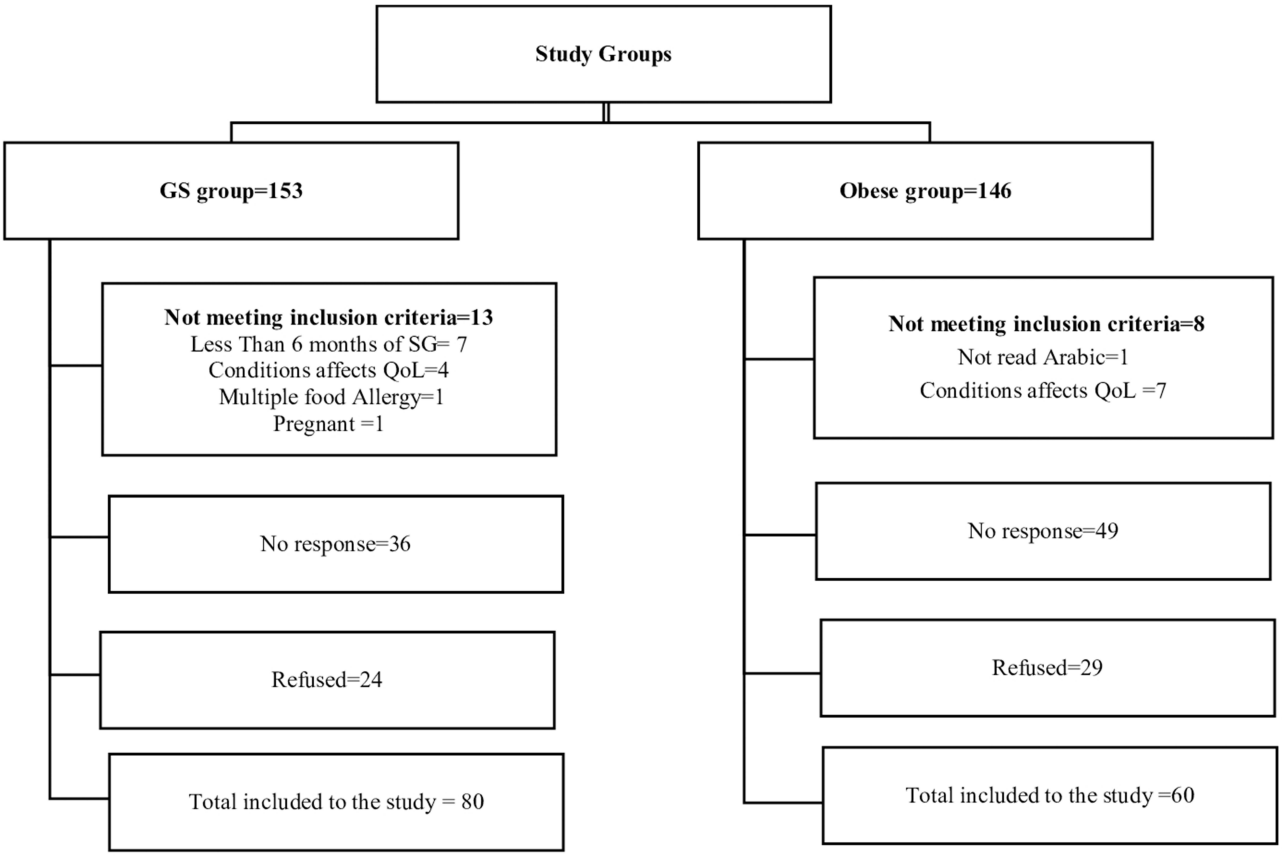

Figure 1 Flow chart of participants recruitment.

criteria, the research team has contacted all the participants via phone or the clinic to introduce the study. Participants who agreed to participate to the study, the link of the study was provided to the participants to be filled on their own time.

Part 1: Sociodemographic Characteristics, Anthropometric Measurements and Medical History

Sociodemographic characteristics (age and gender), anthropometric measures (current weight and height and weight prior to the surgery), and current comorbidities (DM, HTN and dyslipidemia) were collected from patients' medical files.

Part 2: Appetite Test

Visual analogue scales (VASs) are validated scales that assess feelings of hunger and satiety; this scale included 100 mm in the horizontal line.[11] On the left side, the number 0 indicates a non-present/slightest, while the number 100 indicates the highest level of hunger or satiety.[11,25] The VAS consisted of four main questions: "how hungry are you? How full are you? How strong is your desire to eat? And how much food do you think you could eat?" with anchors between "not at all" to "extremely". To standardized the introduction of VAS to both study groups and assess the variation of appetite between groups, the participants were educated to fill the test one time only following the meals.

Part 3: Quality of Life

A validated SF-36 questionnaire (Arabic version) was previously used to assess the QoL in both groups of individuals with obesity and post-bariatric surgery patients.[26–29] The SF-36 questionnaire consists of 36 items that are graded on a scale from 0 to 100, the highest score represented a positive health status, with 0 and 100 serving as the lowest and highest possible scores. The 36 questions were grouped into eight health scales to assess physical functioning (PF), role

limitations due to physical health problems (RFP), role limitations due to personal or emotional problems (RFE), energy/fatigue (ENFA), emotional well-being (EWB), social functioning (SF), bodily pain (BP) and general health (GH). To amount to the final score on the different scales, the average of the questions was calculated. Physical Component Summary (PCS) was calculated as the average of PF, RFP, BP and GH, while the Mental Component Summary (MCS) was calculated as the average of RFE, ENFA, EWB, and SF.[30,31]

Statistical Analysis

SPSS version 20 was used for the statistical analysis. Descriptive statistics are presented as means and SD for continuous variables, and as frequencies for categorical variables. Variables that lacked a normal distribution were reported using the median and interquartile range (IQR). Chi-squared tests were used for categorical variables (sociodemographic variables, BMI and associated comorbidities) wherever appropriate. The Mann–Whitney *U*-Test was used to assess the level of significance between the study groups for both the appetite scale and all subscales for the SF36, as they were not normally distributed as determined by the Kolmogorov–Smirnov test. The magnitude of the effect of post SG on both the appetite scale and subscales of the SF36 was also evaluated by the effect size (ES) with the following interpretations: ES 0.2 is "small", 0.5 is "medium", and 0.8 is "large", using Cohen's criteria.[29] Spearman correlation coefficients were also used to investigate the linear correlation between demographics, anthropometrics, the appetite scale, the PCS and the MCS scores for the SF36. Hierarchical multiple linear regression was used to explore the predictive role of significant independent study variables in bivariate analysis on both PCS and MCS scores for the SF36. Sociodemographic variables were entered into the first block of the regression analysis, creating a model including namely: age, gender and educational level. BMI was then entered into the second block. Comorbidities were investigated in the third block. The fourth block included whether participants were operated on or not. In the last model, all subscales of the MCS were added. All the statistical tests were two sided, and a p-value <0.05 was considered as statistically significant.

Ethical Considerations

The study followed the principles of the Helsinki Declaration and ethical approval was obtained from Institutional Review Board in Princess Noura bint Abdulrahman University (IRB log Number: 20–0012) before starting data collection phase. Implied consent from the participant after being informed about the purpose of the study. It is clearly stated that their participation is voluntary; the responses are strictly confidential and anonymous for each participant.

Results

Socio-Demographics, Anthropometrics and Obesity Related Comorbidities

In the SG group, the average time after SG was 3.69 ± 0.47 year, with the majority of the SG group having had the surgery for more than one year (n = 56, 68%).

Table 1 summarizes the sociodemographic characteristics and BMI categories of both study groups with a mean age of 33.9 ± 9.5 years. From the total 140 participants, 80 (57.1%) underwent sleeve gastrectomy. Both age and gender were insignificantly different between the study groups. On the other hand, the educational level showed a significant difference ($p = 0.02$), with nearly half of those who had underwent SG having a bachelor education (n = 41, 50.0%).

Table 2 portrays the anthropometric measurements with weight significantly differing between the sleeve gastrectomy group and the obesity group (96.53 ± 19.9 vs 117.17 ± 17.02, t (−6.44) = −1.9, $p < 0.001$).

Similarly, BMI was significantly lower in the SG group when compared to the obesity group (36.06 ± 7.3 vs 43.15 ± 4.38, t (−6.58) = −1.9, $p < 0.001$).

Figure 2 portrays the obesity related comorbidities in post SG group and the obese group. It is evident that the percentage of health problems is significantly higher among the obese group when compared to the SG group (35.0% vs 12.2%, p = 0.007). In fact, the majority of the SG group had no health problems (72 participants, 87.8%), and the most common comorbidities among the SG group were DM (5 participants, 6.1%), HTN (hypertension) (3 participants, 3.7%) and dyslipidemia (2 participants, 2.4%).

Table 1 Comparison of Sociodemographic Characteristics and BMI Between Patients Post-Sleeve Gastrectomy, and Obese Group (N = 140)

Characteristics	Responses	Total No. (%) 140(100.0)	Study groups		p value
			SG group No. (%) 80(57.1)	Obese No. (%) 60(42.9)	
Age groups	20–29	54(38.6)	35(43.8)	19(31.7)	0.19
	30–39	43(30.7)	25(31.2)	18(30.0)	
	≥40	44(31.0)	20(25.0)	23(38.3)	
	M±SD	33.9±9.5	32.6±9.2	35.8±9.6	0.05*
Gender	Males	69(49.3)	41(51.2)	28(46.7)	0.61
	Females	71(50.7)	39(48.8)	32(53.3)	
Educational level	Primary	12(8.6)	5(6.2)	7(11.7)	0.02*
	Secondary	52(37.1)	29(36.2)	23(38.3)	
	Bachelor	62(44.3)	41(51.2)	21(35.0)	
	Master	9(6.4)	5(6.2)	4(6.7)	
	Diploma	5(3.6)	0(0.0)	5(8.3)	
BMI categories	Class I and II obesity	65(46.4)	56(70.0)	9(15.0)	<0.001*
	Morbid obesity	75(53.6)	15(18.8)	51(85.0)	

Notes: *Significance difference (p≤ 0.05); a: *t* test was used instead of chi square.
Abbreviations: SG, sleeve gastrectomy; M, mean; SD, standard deviation.

Table 2 Comparison of Anthropometric Measures Between Patients Post-Sleeve Gastrectomy and Obese Group (N = 140)

Anthropometric Measures	Study Groups		*T* test	P value
	SG Group n = 80 M±SD	Obese Group n = 60 M±SD		
Current weight (kg)	96.53±19.9	117.17±17.02	−6.44	<0.001*
Height (cm)	164.2±10.4	164.60±8.8	−0.35	0.73
BMI (kg/m^2)	36.1±7.3	43.2±4.4	−6.58	<0.001*

Notes: *Significance difference (p≤ 0.05).
Abbreviations: M, mean; SD, standard deviation; BMI, body mass index; cm, centimeter; Kg, kilograms; SG, sleeve gastrectomy.

Appetite Test: Visual Analogue Scale Questionnaire

Table 3 represents the appetite test (VAS) in patients' post-SG and in the obese group. The Mann–Whitney *U*-test revealed that the median number describing feelings of fullness was significantly higher in the SG group (77.5, *IQR*:49, U = 1420.5, p < 0.001, d = 0.77).

Regarding the desire to eat, analysis showed statistically significant differences between the study groups with a moderate effect size. The median score in the SG group was 30 (*IQR*:20). The Mann–Whitney *U*-test revealed that desire to eat scores significantly differed between both groups ($U = 1815.5$, $p = 0.003$, d = 0.46).

Similarly, the amount of food intake could be eaten was statistically significantly lower in the SG group, with a moderate effect size and the median score value was 30 (*IQR*:20) in the SG group. The Mann–Whitney *U*-test revealed that the amount of food that could be eaten significantly differed between both groups ($U = 1786.5$, p 0.003, d = 0.48).

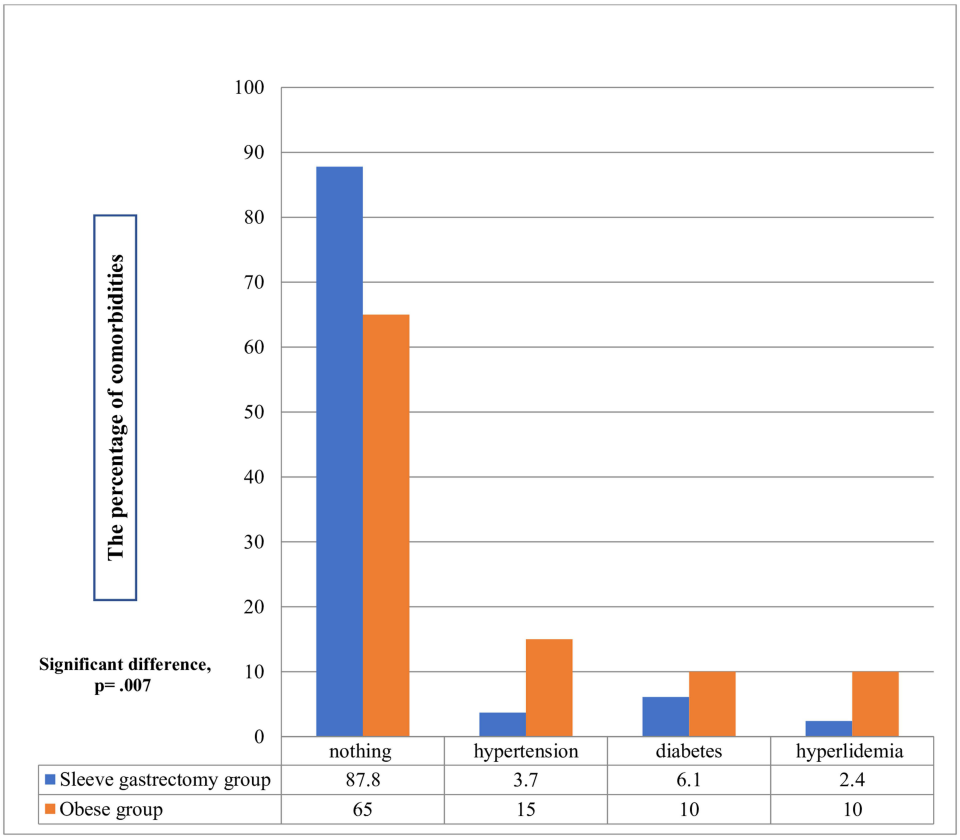

Figure 2 Comparison of the percentage of comorbidities between patients post-sleeve gastrectomy, and obese group.

Quality of Life Evaluation: SF-36 Questionnaire

Table 4 illustrates the comparison of all the subscales of the SF-36 among the study groups. The PSC and all its subscales were statistically different between the study groups, with a strong effect size and a median PSC score value of 93.75 (*IQR*:12) in the SG group.

The Mann–Whitney *U*-test revealed that PSC scores significantly differed between both groups ($U = 756$, $p < 0.001$, d = 1.46). Similarly, the MSC and all its subscales were statistically different between the study groups, with a strong effect size and a median MSC score value of 86.8 (*IQR*:16) in the SG group. The Mann–Whitney *U*-test revealed that MSC scores significantly differed between both groups ($U = 1{,}743.0$, $p < 0.001$, d = 3.26).

Table 3 Comparing Appetite test (visual analogue scale questionnaire) in patients post-sleeve gastrectomy and obese group (N = 140)

Appetite test Scales	Study Groups				p^U value	d_{Cohen}**
	SG group n = 80		Obese Group n = 60			
	Median (IQR)	Mean rank	Median (IQR)	Mean rank		
Hungry feeling	50(30)	64.41	50(30)	77.58	0.05*	0.31
Full feeling	77.5(48)	84.18	50(40)	5.86	0<.001*	0.77
The strong desire to eat	30(20)	73.46	50(60)	82.3	0.003*	0.46
The amount of food could be eaten	30(20)	61.66	50(60)	82.27	0.003*	0.48

Notes: *Significance difference (p≤ 0.05); **d: effect size; U: Mann-Whitney U.
Abbreviations: IQR, interquartile range; SG, sleeve gastrectomy.

Table 4 Comparing Quality of life (SF-36 Health Survey) in patients post-sleeve gastrectomy, and obese group (N = 142)

SF-36 Scales	Study Groups				p^U value	d_{Cohen}**
	SG Group n = 82		Obese Group n = 60			
	Median (IQR)	Mean Rank	Median (IQR)	Mean rank		
PCS						
PF	95(5)	94.24	62.5(35)	38.85	0<.001*	1.8
RFP	100(0)	78.26	100(100)	60.16	0.001*	3.25
BP	100(14)	83.93	75(55)	52.59	0<.001*	3.3
GH	87(20)	88.18	65(25)	46.92	0<.001*	1.18
PCS	93.75(12)	92.28	68.44(35)	43.10	0<.001*	1.46
MCS						
RFE	100(0)	78.44	100(100)	59.92	0.001	3.25
ENFA	80(30)	89.98	55(40)	53.85	0<.001*	3.26
EWB	84(16)	80.51	76(36)	59.19	0.003*	3.25
SF	100(3)	89.12	62.5(38)	45.68	0<.001*	1.26
MCS	86.8(16)	86.33	72.15(39)	49.39	0<.001*	3.26

Notes: *Significance difference (p≤ 0.05); **d: effect size; U: Mann-Whitney U.
Abbreviations: IQR, interquartile range; SG, sleeve gastrectomy; BP, bodily pain scale; ENFA, energy/fatigue scale; EWB, emotional well-being scale; GH, general health; MCS, mental component summary; PF, physical functioning scale; PCS, physical component summary; RFE, role limitations due to personal or emotional problems scale; RFP, role limitations due to physical health problems scale; SF, social functioning scale.

Correlations Between the Study Variables

Correlation analyses using the Spearman correlation coefficient to describe the correlations between the variables are illustrated in Table 5. Being operated on was negatively correlated with comorbidities (r = −.22, p = 0.002), indicating that

Table 5 Correlation Matrix Between Personal Characteristics, Appetite Scale and QoL Subscales, Among Study Groups

Variables	Correlation Variables											
	Study groups	Age	Gender	Education	BMI	Comorbidities	APS1	APS2	APS3	APS4	PCS	MCS
Study groups	1											
Age	0.17	1										
Gender	0.05	0.07	1									
Education	−0.02	−0.16	−0.02	1								
BMI	0.49**	0.08	−0.14	−0.07	1							
Comorbidities	−0.22**	−0.23**	−0.01	0.02	−0.04	1						
APS1	0.20	−0.08	0.01	−0.04	0.07	−0.03	1					
APS2	−0.35**	−0.08	−0.09	0.09	−0.08*	0.07	−0.43**	1				
APS3	−0.29**	−0.15	−0.05	0.11	−0.02	0.08	0.25**	0.4*	1			
APS4	−0.29**	−0.15	−0.05	0.05	0.02	−0.06	0.34**	−0.09	0.38**	1		
PCS	−0.57**	0.11	−0.18**	0.06	−0.22**	0.09	−0.25	0.18**	0.18	−0.18	1	
MCS	−0.43**	0.09	−0.02*	0.10	−0.09*	−0.06	−0.16	0.18*	0.17	−0.17	0.73**	1

Notes: *Correlation is significant at 0.05 level; ** Correlation is significant at 0.01 level.
Abbreviations: SG, sleeve gastrectomy; BMI, body mass index. APS1, Hungry feeling; APS2, Full feeling; APS3, The strong of desire to eat; APS4, The amount of food could eat; PCS, physical component summary; MCS, Mental component summary.

obesity-related comorbidities decreased significantly. Moreover, three subscales of the appetite scale were inversely correlated with being operated on: the feeling of fullness (r = −.35, p < 0.001), the strong desire to eat (r = −.29, p = 0.007), and the amount of food that could be eaten (r = −.29, p = 0.005).

In addition, regarding the measures of the SF36, PCS and MCS were negatively correlated with being operated on (r = −.57, p < 0.001; r=−.43, p < 0.001, respectively). PCS was inversely correlated with gender (r = −.18, p = 0.008), and BMI (r = −.22, p = 0.001), and was positively correlated with feelings of fullness on the appetite scale (r = 0.18, p = 0.007). Similarly, MCS was inversely correlated with being operated on (r=−.43, p < 0.001), gender (r = −.02, p = 0.01), and BMI (r = −.09, p = 0.02) and was positively correlated with feelings of fullness on the appetite scale (r = 0.18, p = 0.031) and PCS (r = 0.73, p ≤ 0.001).

Hierarchical Regression Analyses

To Determine Predictors of PCS of SF36

The hierarchical regression analyses examining the relationship between the dependent variable (PCS) and the independent variables illustrated in Table 6 to explore factors potentially predicting PCS.

Only 5% of the outcome variance was explained by Model 1 (R^2 = 0.05, p = 0.08), which had no statistically significant relationship to PCS. However, the age variable in model 1 was a significant predictor of PCS (ß = −0.19, t =

Table 6 Hierarchical Regression Analysis to Factors Predicting Physical Component Summary

MODEL	Predictors	Coefficients[a]						R^2	$R^{2\ change}$	F	P
		B	ß	T	Sig.	95.0% CI for B					
						Lower	Upper				
Model 1	(Constant)[b]	91.6		9.7	<0.001*	72.92	110.3	0.05	0.05	2.3	0.08
	Age	−8.18	−0.19	−2.23	0.03*	−15.43	−0.94				
	Education	−0.36	−0.02	−0.17	0.86	−4.52	3.80				
Model 2	(Constant)[c]	122.7		9.14	<0.001*	96.12	149.21	0.11	0.07	4.3	0.002*
	Age	−9.8	−0.23	−2.74	0.007*	−16.9	−2.73				
	Education	−0.56	−0.02	−0.28	0.783	−4.59	3.47				
	BMI	−0.80	−0.26	−3.16	0.002*	−1.30	−0.30				
Model 3	(Constant)[d]	120.51		7.55	<0.001*	88.915	152.097	0.12	0.01	3.5	0.006*
	Age	−9.81	−0.23	−2.73	0.007*	−16.92	−2.70				
	Education	−0.55	−0.02	−0.27	0.79	−4.59	3.49				
	BMI	−0.80	−0.26	−3.15	0.002*	−1.30	−0.29				
	Comorbidities	0.48	0.02	0.25	0.01*	−3.32	4.29				
Model 4	(Constant)[e]	122.74		9.05	<0.001*	95.89	149.58	0.37	0.26	12.5	<0.001*
	Age	−6.83	−0.16	−2.22	0.03*	−12.93	−0.74				
	Education	0.27	0.01	0.16	0.88	−3.17	3.72				
	BMI	0.11	0.04	0.45	0.66	−0.38	0.61				
	Comorbidities	−1.89	−0.08	−1.13	0.26	−5.19	1.41				
	Operated	−26.01	−0.60	−7.13	<0.001*	−33.22	−18.79				

(*Continued*)

Table 6 (Continued).

MODEL	Predictors	Coefficients[a]						R^2	R^2 change	F	P
		B	ß	T	Sig.	95.0% CI for B					
						Lower	Upper				
Model 5	(Constant)[f]	61.14		5.32	<0.001*	38.40	83.87	0.69	0.32	27.9	<0.001*
	Age	−2.49	−0.06	−1.11	0.27	−6.93	1.94				
	Education	−0.38	−0.02	−0.30	0.76	−2.89	2.13				
	BMI	−0.05	−0.02	−0.28	0.78	−0.41	0.31				
	Comorbidities	−0.17	−0.01	−0.14	0.89	−2.58	2.25				
	Operated	−9.36	−0.22	−3.12	0.002*	−15.29	−3.42				
	RFE	0.11	0.21	3.33	0.001*	0.05	0.18				
	ENFA	0.11	0.12	1.62	0.11	−0.03	0.25				
	EWB	−0.04	−0.04	−0.43	0.67	−0.21	0.13				
	SF	0.37	0.48	5.72	<0.001*	0.24	0.49				

Notes: *P ≤ 0.05 is significance; B: unstandardized beta" regression coefficient"; β: standardized beta; T: t-value and corresponding p-value; [a]Dependent variable: physical component summary, [b]Predictors: (Constant), age, education, [c]Predictors: (Constant), age, education, BMI, [d]Predictors: (Constant), age, education, BMI, comorbidities, [e]Predictors: (Constant), age, education, BMI, comorbidities, operated [f]Predictors: (Constant), age, education, BMI, comorbidities, operated.

Abbreviations: ENFA, energy/fatigue scale; EWB, emotional well-being scale; RFE, role limitations due to personal or emotional problems scale; SF, social functioning scale.

−2.2, p = 0.03). BMI has been decreased due to the operation significantly increased the amount of explained variation (R^2 = 0.07, F = 4.3, p = 0.002) in model 2 by being a strong predictor of PCS (ß = −0.26, t = −3.16, p 0.002). Similar to model 2, related comorbidities in model 3 strongly predicted PCS (ß = 0.02, t = 0.25, p = 0.01). Regarding model 4, it significantly predicted 37% of the variance in PCS (ß = −0.6, t = −7.13, p < 0.001), significantly adding to the amount of explained variance (ΔR^2 = 0.26, F = 12.5, p < 0.001). The fifth model showed that the MCS subscales had the best ability to predict PCS and RFE scores (ß = 0.21, t = 3.33, p = 0.001), while the SF scores were the significant predictor of PCS, significantly predicting 69.0% of the outcome variance (R^2 = 0.69, p = 0.001). This finding is considered as significant according to the Cohen guidelines (Table 6).

To Determine Predictors of MCS of the SF36

Table 7 illustrates factors potentially predicting MCS using hierarchical regression analyses. Among the sociodemographic variables entered into the first block of the regression analysis, age was a significant predictor of MCS (ß = −0.20, t = −2.39, p = 0.018).

Table 7 Hierarchical Regression Analysis to Factors Predicting Mental Component Summary

MODEL	Predictors	Coefficients[a]						R^2	R^2 Change	F	P
		B	ß	T	Sig.	95.0% CI for B					
						Lower	Upper				
Model 1	(Constant)[b]	67.39		6.74	<0.001*	47.62	87.18	0.05	0.05	2.40	0.07
	Age	−9.28	−0.20	−2.39	0.018*	−16.93	−1.63				
	Education	1.61	0.06	0.73	0.47	−2.78	6.01				

(*Continued*)

Table 7 (Continued).

MODEL	Predictors	Coefficients[a]						R^2	R^2 Change	F	P
		B	ß	T	Sig.	95.0% CI for B					
						Lower	Upper				
Model 2	(Constant)[c]	90.59		6.27	<0.001*	62.02	119.15	0.086	0.03	3.6	0.02*
	Age	−10.5	−0.23	−2.72	0.007*	−18.12	−2.88				
	Education	1.46	0.06	0.67	0.51	−2.87	5.79				
	BMI	−0.59	−0.18	−2.19	0.03*	−1.14	−0.06				
Model 3	(Constant)[d]	95.47		5.56	<0.001*	61.50	129.44	0.088	0.002	2.5	0.03*
	Age	−10.5	−0.23	−2.72	0.01*	−18.14	−2.85				
	Education	1.43	0.06	0.65	0.52	−2.92	5.78				
	BMI	−0.60	−0.2	−2.2	0.03*	−1.14	−0.06				
	Comorbidities	−1.1	−05	−0.53	0.59	−5.19	2.99				
Model 4	(Constant)[e]	97.52		6.35	<0.001*	67.13	127.91	0.28	0.19	8.1	<0.001*
	Age	−7.77	−0.17	−2.23	0.03	−14.67	−0.86				
	Education	2.19	0.085	1.110	0.27	−1.71	6.08				
	BMI	0.24	0.073	0.83	0.41	−0.33	0.79				
	Comorbidities	−3.27	−0.14	−1.73	0.09	−7.01	0.47				
	Operated	−23.8	−0.52	−5.77	<0.001*	−32.00	−15.66				
Model 5	(Constant)[f]	18.47		1.14	0.26	−13.61	50.54	0.63	0.35	21.30	<0.001*
	Age	−2.29	−0.05	−0.88	0.38	−7.43	2.85				
	Education	1.79	0.069	1.24	0.22	−1.06	4.63				
	BMI	0.13	0.039	0.59	0.55	−0.29	0.54				
	Comorbidities	−2.35	−0.09	−1.66	0.09	−5.14	0.44				
	Operated	−7.37	−0.16	−1.95	0.05*	−14.87	0.12				
	PF	−0.04	−0.04	−0.44	0.66	−0.19	0.13				
	RFP	0.230	0.380	5.59	<0.001*	0.15	0.31				
	BP	0.192	0.229	3.07	0.003*	0.07	0.32				
	GH	0.325	0.278	3.57	0.001	0.15	0.51				

Notes: *P ≤ 0.05 is significance; B: unstandardized beta "regression coefficient"; β: standardized beta; T: t-value and corresponding p-value; [a]Dependent variable: mental component summary, [b]Predictors: (Constant), age, education, [c]Predictors: (Constant), age, education, BMI, [d]Predictors: (Constant), age, education, BMI, comorbidities, [e]Predictors: (Constant), age, education, BMI, comorbidities, operated [f]Predictors: (Constant), age, education, BMI, comorbidities, operated,

Abbreviations: BP, bodily pain scale; PF, physical functioning scale; RFP, role limitations due to physical health problems scale, GH, general health.

In model 2, BMI has been decreased due to the operation was a significant predictive factor of MCS (ß = −0.18, t = −2.19, p = 0.03), adding to the amount of explained variance ($\Delta R^2 = 0.02$, F = 2.5, p = 0.03). Model 4 significantly predicted 28% of the variance in PCS ($R^2 = 0.28$, $p < 0.001$), with being operated on with an SG being a significant predictive factor (ß = −0.52, t = −5.77, $p < 0.001$), significantly adding to the amount of explained variance ($\Delta R^2 = 0.19$, F = 8.1, $p < 0.001$). In the 5th

model, all subscales of the PCS were added, showing the greatest predictive capacity of the MCS, with RFP scores (ß = 0.38, t = 5.59, p < 0.001), BP scores (ß = 0.19, t = 2.23, p = 0.003) and GH scores (ß = 0.27, t = 3.57, p = 0.001) as potential predictors of the MCS, significantly predicting 63.0% of the outcome variance (R^2 = 0.63, p < 0.001). These findings are considered to be significant according to the Cohen guidelines.

Discussion

The objective of the current study was to assess the appetite level and QoL, using a validated subjective tool, in adults who underwent SG, and compare them with individuals with obesity or severe obesity. The results of the study found that the SG group feels "fuller", has less desire to eat, and less prospective food consumption when compared to the obese group. The SG group had higher QoL score in both PCS and MCS compared to the obese group. PCS is associated with age, BMI, and comorbidities, while MCS is associated with age, gender, and BMI. PCS and MCS are positively associated with feeling "full".

Health-related QoL refers to the measurement of satisfaction in several aspects of life such as the physical, social, and emotional.[27] Studies have shown that obesity is associated with poor QoL, whereas the QoL is improved after SG.[14,15,32,33] The analysis in the current study showed that QoL scores are better in the SG group compared to the obese group in all the QoL aspects. However, improvement of the QoL post SG was not consistent with previous studies due to several factors: 1) the duration post SG, 2) the presence of a comparative or a reference group, and 3) comparing the QoL between pre SG and post SG.[14,15,32–34] The reference QoL scores vary between countries and different ages (young adults vs elderly).[15,35] Finally, the validity of the measures of QoL has been questioned in some previous studies.[15,34]

In the current study, there were many variables associated with the QoL including age, BMI, gender, and comorbidities. A previous study has found some comorbidities to improve or even resolve post SG.[36] In addition, increased weight loss up to six years post SG has been shown in many studies.[36,37] All the above-mentioned variables are factors that can enhance the physical and the emotional aspect of the QoL. In addition, weight reduction is an independent factor associated with enhanced QoL among women.[38] A recent study found that women with ≥10% weight reduction had improved QOL in the emotional and physical aspects compared to women with <5% weight reduction. The current study has found that the female sex and BMI are factors associated with enhanced QoL in both physical and mental components.

The results of the appetite test (VAS) showed greater reporting of feelings of fullness in the SG group compared to the other group. This result was similar to a previous study where patients who were 6 to 12 weeks post SG reported more feelings of "fullness" compared to the pre-SG group.[12] Makaronidis et al reported that changes in appetite post-SG are significantly associated with a high percentage of weight loss.[10] In addition, Karamanakos et al reported that the SG procedure contributes to additional weight loss due to appetite being highly suppressed up to one-year post-surgery.[8] Previous research has suggested that weight loss was attributed to a decrease in appetite caused by hormonal changes in the leptin and ghrelin levels which usually control appetite.[8,10,12]

The association between a poor appetite and QoL has been studied in different populations such as patients with kidney diseases and the elderly.[39–41] In general, previous studies have found that a good appetite was associated with an enhanced QoL score, especially in the physical component, due to an improved nutrition.[39–41] However, the current study found that both BMI and appetite are associated with QoL. This could be explained by obesity being associated with comorbidities having a negative impact on the QoL and the influence of the surgery on Body weight and therefore it is associated with improved QoL.

The current study has several limitations including not having a reference group to assess the QoL in the KSA. In the current study, we have used an obese group as the comparative group when comparing the QoL with the SG group. However, we were not able to conclude that the QoL measures among the SG group were similar to the norm values. This is due to the fact that there are no norm values for SF-36 scores in Saudi Arabia. Second, the current study has assessed appetite subjectively using a validated tool VAS. Assessing appetite subjectively and objectively via appetite hormones such as cholecystokinin (CCK), glucagon-like-peptide 1 (GLP1), peptide tyrosine–tyrosine (PYY), and Ghrelin will be ideal. This study is a will be a preliminary result of a clinical study to assess appetite subjectively and objectively among patients post SG. Finally, the current study did not assess important aspects related to weight regain or maintaining a stable body weight, in addition to not checking if patients were following up with any registered dietitians. This latter factor could have an immense role in preventing weight gain post SG.[42,43]

In conclusion, patients post SG have an improved QoL due to sleeve gastrectomy which leads to reduced body weight and therefore improved QoL. Subjective appetite test revealed that patients post SG used to feel full, had less desire to eat and less prospective food consumption. Feeling satiety and perception about prospective food consumption are two factors associated with QoL in patients post SG. Other factors associated with enhancing the QoL improvement BMI, age, gender and comorbidities.

Future studies are needed to compare the QoL in patients' post-SG with the normative values of the QoL in Saudi Arabia. In addition, examine the long-term outcomes of the segmental gastrectomy patients should be assessed, including percentage excess weight loss, comorbidities and QoL.

Abbreviations

BMI, Body Mass Index; BP, Bodily Pain Scale; DM, Diabetes Mellitus; ENFA, Energy/Fatigue Scale; EWB, Emotional Well-Being Scale; GH, General Health; HTN, Hypertension; IQR, Interquartile Range; KAAUH, King Abdullah Bin Abdul-Aziz University Hospital; KSA, kingdom of Saudi Arabia; MCS, Mental Component Summary; PCS, Physical Component Summary; PF, Physical Functioning Scale; QoL, Quality of Life; RFE, Role Limitations Due To Personal Or Emotional Problems Scale; RFP, role limitations due to physical health problems scale; SG, sleeve gastrectomy; SPSS, Statistical Package For The Social Sciences; SF, Social Functioning Scale; VAS, Visual Analog Scale.

Ethics Approval

The study was ethically approved by the Institutional Review Board (IRB) at Princess Nourah bint Abdulrahman University (20-0012), Riyadh, Saudi Arabia.

Consent to Participate

Informed consent was obtained from the participants.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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