



## Nutritional Education for Patients Undergoing Bariatric Surgery Improves Knowledge of Post-Bariatric Dietary Recommendations

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### ABSTRACT

**Objective:** The short and long-term success of bariatric surgery is determined by patient adherence to post-operative dietary recommendations. Nutritional education programs are reported to be effective in increasing patient adherence to dietary recommendations. The aim of this study was to assess the effect of nutritional education on nutritional knowledge related to post-bariatric dietary recommendations on Saudi bariatric patients and the impact of time on their knowledge retention following the education. **Methods:** In this repeated measure pre- to post-intervention study, 55 patients (19 male, 36 female), aged between 20-65 years, were recruited from the Surgical Clinics at King Abdul-Aziz University Hospital in Jeddah, Saudi Arabia. Patients were asked to complete an Eating after bariatric surgery (EABS) questionnaire before receiving nutritional education and three times after the education: immediately and at one and three months post-nutritional education. **Results:** The nutritional knowledge of patients, measured by EABS, improved significantly ( $p < 0.001$ ) after the educational session; however, total scores after one and three months showed no significant improvement in knowledge compared to the pre-educational period. Hence, nutritional education improved post-bariatric nutritional knowledge in bariatric patients in the short-term; however, this nutritional knowledge was not retained after one to three months. **Conclusion:** We conclude that it is important for nutritional education to be delivered prior to surgery, with ongoing follow-up after surgery, to improve the long-term adherence of patients to dietary recommendations.

**Keywords:** Bariatric surgery, Dietitian, Nutrition, Education, Knowledge

### INTRODUCTION

The progressive urbanization and adoption of western lifestyles have contributed to the rising obesity prevalence in Saudi Arabia [1], which is increasing the risk of a range of non-communicable diseases in the population, including diabetes, cardiovascular diseases, and cancer, thereby causing morbidity and mortality [2]. Consequently, bariatric surgery for weight loss is becoming an increasingly popular procedure in Saudi Arabia, with approximately 15,000 operations performed annually.

Bariatric surgery is considered the most effective treatment for obese patients who fail to lose weight using non-surgical methods, including lifestyle modification or pharmacotherapy. Bariatric surgery typically results in greater weight reduction than other non-surgical interventions [3,4]. Further, it has been associated with significant reductions in risk of non-communicable diseases, including diabetes, hyperlipidemia, and hypertension, and even remission of these conditions [5].

Despite its efficacy, bariatric surgery is associated with a number of nutrition-related problems, including dumping syndrome, food intolerance, nausea/vomiting, dehydration, nutrient deficiencies, and weight regain [6]. Protein, iron,

vitamin B12, folate, calcium, and fat-soluble vitamins are the most common deficiencies following bariatric surgery [7-14]. The prevalence rates of vitamin B12, folate, iron, and vitamin D deficiencies among obese patients are 2-18%, 54%, 45%, and 90%, respectively [15]. Therefore, the American Society for Metabolic and Bariatric Surgery guidelines recommend that all patients should undergo a proper nutritional assessment and evaluation of their ability to integrate nutritional and behavioral changes pre- and post-operation before bariatric surgery is performed [16].

The importance of nutrition education for patients undergoing bariatric surgery has been documented in the western literature in this field, with the majority of studies focused on the impact of nutrition education on weight loss and regain [17-19]. Significant dietary changes are required by patients and communicated via nutritional education and counseling, to prevent non-compliance/adherence to the dietary recommendations, which is associated with post-operative nutrition-related complications and weight regain [20-23]. There is a dearth of evidence, both globally and specifically in Middle Eastern countries, of the effects of nutrition education on post-bariatric nutritional knowledge, with consideration of the development of educational materials, methods of delivery, number and duration of educational sessions, and the characteristics of the targeted audience (e.g. age, sex, ethnicity, sociodemographic variables, and physiological status). Therefore, no standardized educational programs are available to healthcare professionals.

It is essential to evaluate the post-bariatric nutritional knowledge of patients, specifically related to diet progression, dietary-related behaviors, use of protein and micronutrient supplements, and nutritional therapy for common gastrointestinal symptoms, to identify common knowledge gaps and determine learning strategies that could help minimize the risk of post-operative complications and increase successful outcomes of bariatric surgical intervention. Studies by Taube-Schiff *et al.* in Canada and Alia, *et al.*, in the United Arab Emirates showed that pre-operative nutritional education significantly improves the nutrition knowledge of patients undergoing bariatric surgery [21,24]; however, as yet no study has been conducted in Saudi Arabia to evaluate knowledge of post-surgery eating among bariatric patients before and after an educational session.

The aim of this study was to assess the effect of nutritional education on post-operative nutritional knowledge in patients undergoing bariatric surgery. There were two objectives: the primary objective was to evaluate patients' knowledge of post-surgery eating recommendations before and after the educational session, while the secondary objective was to evaluate the ability of bariatric patients to retain knowledge at one and three months post-nutrition education. We hypothesized that the educational session would improve the nutritional knowledge of patients and that the length of time between receiving nutrition education and recall would negatively affect knowledge retention.

## MATERIALS AND METHODS

### Study Design and Subjects

An interventional study was carried out in outpatient surgical clinics at King Abdulaziz University Hospital. Inclusion criteria included: patients scheduled to undergo bariatric surgery (laparoscopic sleeve gastrectomy, laparoscopic gastric bypass, and laparoscopic single anastomosis gastric bypass), aged >18 years, both male and female, with a body mass index (BMI)  $\geq 35$  kg/m<sup>2</sup>, and with or without a medical condition (chronic disease). Repeat surgery patients were excluded as they had already received some nutritional information during the first bariatric procedure. Recruited patients were briefed about the aim and hypothesis of the study and provided written informed consent if they were willing to participate. Demographic information, including age, sex, education level, income level, marital status, occupation, and medical history (blood pressure and any history of heart disease, diabetes, tumor, or gastrointestinal disease) was obtained directly from participants by the research team using a questionnaire. Anthropometric measurements, including body weight, body height, and BMI, were retrieved from the patient medical files at King Abdulaziz University Hospital. Ethical approval was obtained from the Faculty of Medicine Research Committee at King Abdul-Aziz University (Reference no. 81-18).

### Sample Size Calculations

The sample size was calculated using GPower version 3.1 (Dusseldorf University) based on data from a previous study by Taube-Schiff *et al.*, using the mean comparison between nutritional knowledge pre-education versus post-education as a primary outcome [21]. In bariatric patients, nutritional knowledge scores increased from  $46.9 \pm 14.4$  to  $56.9 \pm 14.1$  after attending a nutrition education class. Assuming a similar effect size of  $d=0.7$ , a total of 34 patients would be sufficient to detect a similar difference ( $\beta=0.99$ , two-tailed  $\alpha=0.05$ ). Based on previous experience with similar trials, the dropout rate was approximately 25% after one month of the intervention. In our study as the duration was three months, we allowed for a 35% dropout rate, resulting in a total minimum sample size for recruitment of  $n=53$ .

### Study Procedure and Instruments

**Development of nutritional education:** The nutrition education session was developed by the research team and reviewed by registered dietitians, based on a review of the literature and guidelines [15,25-27]. The nutrition education session covered the following topics: post-bariatric surgery diet phases and progression, based on the latest recommendations, including clear liquid diet, full liquid diet, pureed diet, soft diet, and lifelong healthy diet, with the permitted portion size at each stage; the importance of protein intake after surgery, including the recommended amount, main sources, and estimated portion sizes; food that bariatric patients must avoid, including the reasons why; and supplements that are commonly prescribed by the doctor after surgery. In addition, the most common nutritional complications faced by patients undergoing bariatric surgery, including nausea/vomiting, abdominal pain, diarrhea, constipation, gas, dumping syndrome, nutrient deficiencies, food intolerances, and dehydration, were described and tips to avoid them also covered.

**Nutrition education intervention:** All patients received a nutrition education intervention in a group setting and completed the Eating after bariatric surgery (EABS) questionnaire to assess their nutritional knowledge before the intervention. A registered dietitian delivered the nutrition education intervention in a 45-minute session facilitated using a video and PowerPoint presentation. The sessions (including information, script, materials, members, and duration) were delivered in a standardized format to limit variation between sessions. Each session included less than four patients and each participant attended a single session.

**Study intervention measures:** After nutrition education, patients were asked to complete an EABS questionnaire at three-time points: immediately after the nutritional education session, and one and three months of post-nutritional education. The questionnaire was adapted from Taube-Schiff, et al. [21], modified, and translated from English to Arabic using the Brislin back-translation method [28,29]. The adapted questionnaire consisted of two parts: 1) demographic and anthropometric information and 2) EABS knowledge questions. The EABS knowledge questions covered the dietary guidelines for patients following bariatric surgery, including post-operative diet phases, macronutrient and micronutrient supplementation, portion size, fluid requirements, and surgery complications. The questionnaire contained twelve questions divided into three sections. The first section comprised seven multiple-choice questions, the second consisted of three fill-in-the-blank questions, and the third section contained two short answer questions. To quantify the level of knowledge of patients, they received 1 point for each correct answer and 0.5 points were deducted for each incorrect answer given in the first section. In the second and third sections, patients received up to 5 points for each correct answer with no deductions for incorrect answers. The scores from each section were then combined to calculate a total score for each patient, out of a possible total of 85 points, with higher scores reflecting greater levels of knowledge.

### Statistical Analysis

Data were entered using Microsoft Office 365 Pro Plus to calculate the scores for each participant in the questionnaire and are expressed as median and Interquartile range (IQR). Comparisons between baseline, pre-operative, one month post-operative, and three-month post-operative scores were carried out using the t-test in SPSS version 23.0 (IBM Corp., Armonk, NY, USA).  $p < 0.05$  were considered to indicate statistical significance.

## RESULTS

### Subject Characteristics

Patient demographic and anthropometric characteristics are presented in Table 1. A total of 55 patients were recruited and were predominantly female (65.5%,  $n=36$ ), and the mean age was 37.3 (SD 10.6) years. Approximately 40% of patients were classified in the lowest income category of income (<5000 Saudi Riyal per month), and 60% were educated to at least a Bachelor's degree level. The majority of patients were classified as BMI obese class 3 (87.2%) with an average BMI of 47.9 (SD 7.3)  $\text{kg/m}^2$ .

**Table 1 Demographic and anthropometric data (n=55; 36 female and 19 male)**

Variable	Mean	SD
Age (years)	37.3	10.6
Height (m)	162.1	11
Weight (kg)	126.5	27.9
BMI ( $\text{kg/m}^2$ )	47.9	7.3

<b>BMI categories</b>	<b>n</b>	<b>%</b>
Obese class 1	0	0
Obese class 2	7	12.7
Obese class 3	48	87.2
<b>Income, SR per month</b>	<b>n</b>	<b>%</b>
<5000	18	40.9
5000-10000	12	27.3
10000-15000	6	13.6
>15000	8	18.1
<b>Education</b>	<b>n</b>	<b>%</b>
Illiterate	2	3.8
Primary school	6	11.3
Secondary school	2	3.8
High school	11	20.7
University level	22	41.5
Higher education level	10	18.9

SR: Saudi Riyal; BMI categories were defined as follows: obese class 1 (BMI, 30.0-34.9 kg/m<sup>2</sup>), obese class 2 (BMI, 35.0-39.9 kg/m<sup>2</sup>), and obese class 3 (BMI ≥ 40 kg/m<sup>2</sup>)

### EABS Questionnaire

The median knowledge scores of patients improved significantly following the nutritional education session, from 23.5 points (IQR 14.5-31.0) before the session to 43.5 points (IQR 32.8-53.8) after the session ( $p<0.001$ ; Table 2), an increase of approximately 85%. Specifically, scores for knowledge about liquid ( $p=0.017$ ), pureed ( $p<0.001$ ), and soft diets ( $p<0.001$ ) increased significantly following nutritional education. Similarly, knowledge scores for questions about the high protein diet ( $p<0.001$ ), vitamins and minerals ( $p=0.005$ ), maximum amount of food that should be eaten at one meal after healing ( $p<0.001$ ), time spent without eating after weight loss surgery ( $p<0.001$ ), recommended amount of fluid that should be drunk after healing ( $p<0.001$ ), the amount of protein that should be eaten after weight loss surgery ( $p<0.001$ ), and how to prevent nausea/vomiting and dumping syndrome ( $p<0.001$ ) also increased (Table 2). Overall, significant improvements were demonstrated in 11 out of 12 knowledge areas related to eating after bariatric surgery in patients following the nutritional education session. The only area of knowledge that did not improve was that related to the signs of dumping syndrome.

**Table 2 Changes in knowledge after the educational session**

No.	Question subject (max possible score)	Knowledge pre-educational session (n=55)		Knowledge post-educational session (n=55)		p-value
		Median	IQR (Q1-Q3)	Median	IQR (Q1-Q3)	
1	Liquid diet phase (7)	3	1.8-3.3	3	2.0-4.0	0.017
2	Pureed diet phase (6)	3	2.0-4.0	5	3.0-5.5	<0.001
3	Soft diet phase (5)	2.5	1.5-3.5	3.5	2.8-4.0	<0.001
4	High protein diet (7)	3	1.5-4.5	4.5	3.0-5.5	<0.001
5	Vitamins and minerals (3)	1.5	0.8-1.5	2	1.0-2.5	0.003
6	Signs of dumping syndrome (1)	0	(-0.5)-1.0	0.5	(-0.5)-1.0	0.301
7	Maximum amount of food that should be eaten at one meal after healing (1)	-0.5	(-0.5)-(-0.5)	1	(-0.5)-1.0	<0.001
8	Maximum amount of time that one should go without eating after weight loss surgery (5)	0	0.0-5.0	5	5.0-5.0	<0.001
9	Recommend fluid intake after healing (5)	0	0.0-5.0	5	0.0-5.0	<0.001
10	Amount of protein that should be eaten after weight loss surgery (5)	0	0.0-0.0	5	0.0-5.0	<0.001
11	Preventing nausea and vomiting (20)	5	0.0-10.0	10	5.0-10.0	<0.001
12	Preventing dumping syndrome (20)	0	0.0-5.0	5	5.0-10.1	<0.001
	Total questions (85)	23.5	14.5-31.0	43.5	32.8-53.8	<0.001

### Retention of Nutritional Knowledge Overtime

There were unexpectedly high dropout rates following the education session of approximately 60% after one month and 75% after three months. The median total scores for the EABS questionnaire for the remaining patients decreased to 28.3 (IQR 22.9-40.6) after one month and 29.3 (IQR 16.0-39.0) after three months from the nutritional education (Table 3). These scores were not significantly different from those recorded pre-nutritional education ( $p=0.067$  and  $p=0.805$ , respectively).

**Table 3 Changes in nutrition knowledge over time**

No.	Time point	Median EABS score	IQR (Q1-Q3)	p-value
1	Before nutritional education (n=55)	23.5	14.5-31.0	
2	Immediately after nutritional education (n=55)	43.5	32.8-53.8	<0.001 <sup>a</sup>
3	One month after nutritional education (n=22)	28.3	22.9-40.6	0.067 <sup>b</sup>
4	Three months post-nutritional education (n=14)	29.3	16.0-39.0	0.805 <sup>c</sup>

<sup>a</sup>Pre- vs. post-nutritional education; <sup>b</sup>Pre vs. one-month post-nutritional education; <sup>c</sup>Pre vs. three months post-nutritional education

### Associations between Patient Characteristics and Nutritional Knowledge over Time

Patients with a lower pre-operative BMI scored higher on average in the post-nutritional educational assessment ( $p=0.043$ ); however, this advantage was not retained at one or three months post-education. Further, the education level of the patient was significantly correlated with their knowledge retention at one month following the educational session ( $p=0.010$ ; Table 4).

**Table 4 Correlations between patient characteristics and knowledge scores at different time points**

Variable	Age	Sex	Education	Pre-operative BMI
EABS score pre-nutritional education (n=55)	0.127 (0.356)	-0.078 (0.570)	0.116 (0.408)	-0.257 (0.059)
EABS score immediately after nutritional education (n=55)	0.048 (0.727)	-0.196 (0.152)	0.238 (0.086)	-0.274 (0.043)*
EABS score one month post-nutritional education (n=22)	-0.001 (0.997)	0.238 (0.264)	0.525 (0.010)*	-0.242 (0.254)
EABS score three months post-nutritional education (n=14)	0.514 (0.060)	-0.165 (0.574)	0.172 (0.556)	-0.128 (0.664)

\*Correlation is significant at the 0.05 level

## DISCUSSION

The current interventional study was performed to evaluate the effect of delivering a small-group nutritional education session to patients shortly before they underwent bariatric surgery on knowledge of post-operative eating, and to assess how well this knowledge was retained over time.

This study demonstrated an overall significant improvement of 85% in median EABS score after, relative to before, the nutrition education session. These findings support the results of Taube-Schiff et al. [21], who also showed a significant increase in nutritional knowledge from the pre-operative to the post-operative phase following a nutritional education session.

Overall, the scores for questions on 11/12 eating knowledge areas improved significantly among patients after bariatric surgery. The total median score for the twelve questions was low (median: 23.5/85 points, 28% correct) before the nutritional educational session and significantly improved after the education session by 85% (median: 43.5/85 points, 51% correct). Additional educational sessions may be needed to ensure adequate communication and learning of all core recommendations regarding eating after bariatric surgery. Regarding specific individual questions, knowledge about the recommended amount and sources of protein that should be consumed after surgery was largely absent before the education (median score: 0/5 points, 0%); however, this information was successfully communicated during the education session, such that the median score post-education reached 5/5 points (100%). The poor scores recorded prior to education indicate that patients undergoing bariatric procedures without nutritional education are at risk for consuming less than adequate amounts of protein, which are needed to facilitate healing after surgery and to preserve lean body mass. Moize, et al., reported that a protein intake of  $\geq 60$  gram/day is associated with better lean tissue mass preservation at four and twelve months after bariatric surgery [30]. In addition, the knowledge about the prevention of nausea and vomiting was relatively poor (median 5/20 points, 25%) before education and improved (median 10/20 points, 50%) afterward.

This study also assessed the effects of time following nutrition education intervention on patient retention of nutrition knowledge. We found that the increased length of time between nutrition education intervention effect was associated with decreased knowledge scores. This finding could imply that one session is sufficient to induce a significant improvement in knowledge about eating after bariatric surgery. Further, it suggests that the time between pre-surgical nutrition education and bariatric surgery should be minimized and that patients who have a longer wait time until surgery should receive additional educational classes. The effect of time requires further study, due to the high dropout rate, which left the study underpowered.

To our knowledge, this is the first study conducted in Saudi Arabia to evaluate the impact of nutrition education on patient knowledge regarding diet after bariatric surgery and to assess the retention of that nutritional knowledge over time. The significant improvement in EABS knowledge scores after, relative to before, the educational session highlights the important role of registered dietitians in supporting bariatric patients to adhere to post-operative dietary recommendations.

The study had several limitations. Retention of patients for the full length of the study was very challenging. There was difficulty in contacting participants for their one-month and three-month follow-up assessments, with many patients unresponsive to calls and messages. It has been reported previously that the adherence of bariatric patients to follow up appointments is poor, with up to 89% attrition [31]; therefore, further studies that attempt to assess the effect of the nutritional education need to consider these high dropout rates when calculating sample size for this type of intervention. Our findings highlight the importance of establishing guidelines or programs in Saudi Arabia, focusing on both short and long-time care for patients undergoing bariatric surgery, with the aim of assisting their adherence to recommendations.

### CONCLUSION

Nutritional education improved post-bariatric nutritional knowledge in bariatric patients; however, the acquired knowledge reduced over time. It is important that nutritional education is provided for patients prior to bariatric surgery, with ongoing follow-up. The results of this study strongly support the establishment of such programs in hospitals to be implemented by the Ministry of Health using evidence from western studies until evidence from Saudi studies can be updated to the equivalent standard. Such a program will ensure dietary compliance and reduce nutrition-related complications.

### DECLARATIONS

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#### Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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