

3-2018

# Assessment of Nutrition Knowledge and Dietary Behaviors of Post Bariatric Surgery Patients Attending the Outpatient Clinic of Rashid Hospital, Dubai

Souheir Mahmoud Alia

Follow this and additional works at: [https://scholarworks.uaeu.ac.ae/food\\_theses](https://scholarworks.uaeu.ac.ae/food_theses)

Part of the [Food Science Commons](#)

---

## Recommended Citation

Mahmoud Alia, Souheir, "Assessment of Nutrition Knowledge and Dietary Behaviors of Post Bariatric Surgery Patients Attending the Outpatient Clinic of Rashid Hospital, Dubai" (2018). *Food Science Theses*. 1.  
[https://scholarworks.uaeu.ac.ae/food\\_theses/1](https://scholarworks.uaeu.ac.ae/food_theses/1)

This Thesis is brought to you for free and open access by the Food Science at Scholarworks@UAEU. It has been accepted for inclusion in Food Science Theses by an authorized administrator of Scholarworks@UAEU. For more information, please contact [fadl.musa@uaeu.ac.ae](mailto:fadl.musa@uaeu.ac.ae).

**UAEU**



جامعة الإمارات العربية المتحدة  
United Arab Emirates University

United Arab Emirates University

College of Food and Agriculture

Department of Food Science

ASSESSMENT OF NUTRITION KNOWLEDGE AND DIETARY  
BEHAVIORS OF POST BARIATRIC SURGERY PATIENTS  
ATTENDING THE OUTPATIENT CLINIC OF RASHID HOSPITAL,  
DUBAI

Souheir Mahmoud Alia

This thesis is submitted in partial fulfilment of the requirements for the degree of  
Master of Science in Food Science

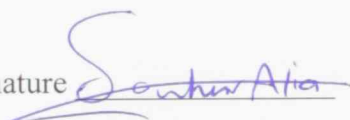
Under the Supervision of Dr. Habiba Ali

March 2018

### Declaration of Original Work

I, Souheir Mahmoud Alia, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this thesis entitled "*Assessment of Nutrition Knowledge and Dietary Behaviors of Post Bariatric Surgery Patients Attending the Outpatient Clinic of Rashid Hospital, Dubai*", hereby, solemnly declare that this thesis is my own original research work that has been done and prepared by me under the supervision of Dr. Habiba Ali, in the College of Food and Agriculture at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my thesis have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this thesis.

Student's Signature



Date 12-5-18

Copyright © 2018 Souheir M. Alia  
All Rights Reserved

## Approval of the Master Thesis

This Master Thesis is approved by the following Examining Committee Members:

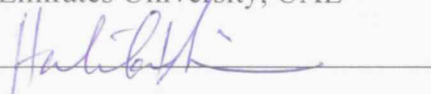
1) Advisor: Dr. Habiba Ali

Title: Associate Professor

Nutrition & Health Department

College of Food and Agriculture

United Arab Emirates University, UAE

Signature 

Date May 3, 2018

2) Member (Internal Examiner): Dr. Javaid Nauman

Title: Associate Professor

Institute of Public Health

College of Medicine and Health Sciences

United Arab Emirates University, UAE

Signature 


Date 03.05.2018

3) Member (External Examiner): Professor Lily Stojanovska

Title: Professor (Emeritus)

College of Health and Biomedicine

Victoria University, Australia

Signature 

Date 03/05/2018

Dr. Mutamed Ayyash  
on Behalf of EE

This Master Thesis is accepted by:

Dean of the College of Food and Agriculture: Professor Bhanu Chowdhary

Signature Bhanu P. Chowdhary Date 15/05/2018

for Dean of the College of Graduate Studies: Professor Nagi T. Wakim

Signature Ali Hassan Date 23/5/2018

Copy 5 of 6

## Abstract

Obesity is regarded as an increasingly prevalent public health problem, with enormous adverse health consequences. It also increases the risk for co-morbidities. There are several means to treat obesity, and bariatric surgery has emerged as one of the most prevalent ways to treat obesity. Despite the vast research assessing nutrition knowledge of patients regarding several health conditions, existing research assessing the nutrition knowledge of post-bariatric surgery patients is limited, although this category of patients is very susceptible to malnutrition post-surgery. The aim of this study was to assess the patients' general nutrition knowledge and the knowledge specific to the dietary protocol post-surgery. This study also assessed the medical and nutritional complications associated with bariatric surgery, including patients' awareness and understanding of dumping syndrome, patients' perception of the clarity of information conveyed by the dietitians and its effect on their levels of compliance with post-surgery dietary protocol and the follow-up appointments with the dietitians. Results of this study showed that patients had good general nutrition knowledge. The questions assessing nutrition knowledge of the dietary protocol showed that the majority of the participants (66.2%) had average knowledge. In addition, most patients did not know what dumping syndrome is, and of those who knew what it is, only had knowledge about the food that promotes its occurrence. On the other hand, most patients followed up with a dietitian, although only 29% showed strong compliance to the dietitian's instructions. This was strongly related to majority of patients (71.2%) finding the information conveyed as vague and unclear. The most experienced symptom post-bariatric surgery was nausea, followed by dizziness, dehydration, and vomiting. As for the overall quality of life, most of the patients never felt agitated, fatigued and/or regretted their decision of undergoing the surgery, and almost all participants found their daily activities to be more enjoyable. Future research on the relation of compliance to dietary protocol and improved quality of patients' life post-bariatric surgeries to extend our findings is needed.

**Keywords:** Obesity, bariatric surgery, nutrition knowledge, dietary behavior.

## Title and Abstract (in Arabic)

تقييم المعرفة التغذوية، والسلوكيات التغذوية للمرضى بعد عمليات جراحة السمنة في العيادات الخارجية لمستشفى راشد بدبي، الإمارات العربية المتحدة

### الملخص

تعتبر السمنة مرضاً بحد ذاته، ويترتب على السمنة العديد من الأمراض المرافقة، وهذا هو السبب في تعدد الطرق لعلاج السمنة، ومن أكثر الطرق انتشاراً في الإمارات العربية المتحدة هو عمليات جراحة السمنة. على الرغم من البحوث الواسعة التي قامت بتقييم مستوى المعرفة التغذوية للعديد من الأمراض كمرض كرونز، وأمراض الكلى... الخ، إلا أنه لا يوجد أي من البحوث التي قامت بتقييم مستوى معرفة المرضى بالنظام التغذوي المتبع بعد عمليات السمنة للمرضى الذين خضعوا لهذه العمليات، على الرغم من أن هذه الفئة من المرضى عرضة بشكل كبير لسوء التغذية بعد هذا النوع من العمليات. كان هدفي في هذه الدراسة تقييم المعرفة التغذوية العامة وكان تركيزي على معرفة المرضى بالنظام التغذوي الذي ينبغي اتباعه بعد العملية، إضافة إلى المضاعفات الطبية والتغذوية بعد العملية، وعلى وجه التحديد معرفة المرضى بمتلازمة التفريغ المعوي السريع، ووضوح المعلومات التي نقلها أخصائيو التغذية وتأثيرها على مستويات امتثالهم للنظام الغذائي بعد الجراحة ومواعيد المتابعة مع أخصائيي التغذية. وأظهرت نتائج هذه الدراسة معرفة تغذوية عامة جيدة إلى حد ما، والأسئلة التي قامت بتقييم المعرفة التغذوية للنظام الغذائي الذي أظهر أن غالبية المشاركين (66.2%) لديهم معرفة متوسطة بالنظام. وبالإضافة إلى ذلك، فإن معظم المرضى لا يعرفون ما هي متلازمة التفريغ المعوي السريع، ومن أولئك الذين على دراية بهذه المتلازمة معظمهم يعرف الاطعمة التي تعزز حدوثها، ونصفهم كان على دراية بأعراض هذه المتلازمة أيضاً. من ناحية أخرى، تابع معظم المرضى مع اختصاصي التغذية، على الرغم من أن 30.1% من المرضى فقط أظهروا الامتثال لتعليمات اختصاصي التغذية، والتي ارتبطت بأن غالبية المرضى (71.2%) وجدوا أن تعليمات اختصاصي التغذية كانت غير واضحة وفتقر إلى سهولة الفهم. إضافة إلى أن أكثر الأعراض التي واجهها المرضى بعد العملية هي الغثيان، تليها الدوخة، والجفاف، وأخيراً القيء. أما بالنسبة لجودة الحياة لمعظم المرضى كانت أفضل مما هي عليه قبل القيام بهذه العملية، ووجد أيضاً أن معظم المرضى وجدوا أنشطتهم اليومية أكثر متعة. ختاماً المرضى الذين خضعوا لعمليات جراحة السمنة هم فئة تحتاج



الى دراسات اكثر ليتم اكتشاف بعض الثغرات في الرعاية الصحية المقدمة لهذه الفئة من المرضى، مما سيحسن هذه الخدمات وبالتالي مرجوع هذه العمليات والتقليل من المضاعفات.

**مفاهيم البحث الرئيسية:** السمنة، عمليات جراحة السمنة، المعرفة التغذوية، السلوك التغذوي.

## **Acknowledgements**

I would like to thank my supervisors, Dr. Habiba Ali, Dr. Taoufik Zoubeidi, and Dr. Sajid Maqsood for their guidance, support, and assistance throughout the preparation for this thesis. I would like to also thank Dr. Mutamed Ayyash the coordinator of the M.Sc. in Food science program and Prof. Afaf Kamal Eldin for their continuous guidance and dedication toward helping the students. I would like to thank Prof. Bhanu Chowdhary, the Dean of the College of Food and Agriculture for being such an inspiration and motivation through sharing with me his journey which was crowned with persistence, and patience. I would also like to thank my research assistant Mariam Ahmed for her hard work and commitment. Lastly, I would like to thank the bariatric coordinator at Rashid Hospital, Mrs. Eman Aljalloudi for her cooperation and help in retrieving patients for this study.

Special thanks to my mother, father, and entire family, friends, and loved ones, for helping me through this, by giving me direct advice and teaching me to be more enduring, patient, and tolerant.

## Dedication

*To my parents who walked me through life, who loved me and supported me unconditionally, and helped me by their emotional and financial support to get through my life and my bachelor's degree, finally to become an independent and responsible lady who looks after herself by all means.*

*Thanks to all my family, friends, and loved ones for the support, love, and giving me life lessons which will make me illegible for a Master's degree in LIFE...*

## Table of Contents

Title .....	i
Declaration of Original Work .....	ii
Copyright .....	iii
Approval of the Master Thesis .....	iv
Abstract .....	vi
Title and Abstract (in Arabic) .....	vii
Acknowledgements .....	ix
Dedication .....	x
Table of Contents .....	xi
List of Tables.....	xiii
List of Figures .....	xiv
Chapter 1: Introduction .....	1
1.1 Overview.....	1
1.2 Statement of Problem .....	5
Chapter 2: Literature Review .....	6
2.1 Benefits of Bariatric Surgeries.....	6
2.1.1 Bariatric surgeries and its implications of type 2 Diabetes and weight loss.....	8
2.1.2 Cost-effectiveness of bariatric surgery .....	8
2.2 Risks of Bariatric Surgeries .....	9
2.2.1 Open vs. laparoscopic Roux-en-Y Gastric Bypass .....	9
2.3 Nutritional Deficiencies in Post-bariatric Surgeries .....	10
2.3.1 Macronutrients deficiencies .....	10
2.3.2 Micronutrients deficiencies.....	11
2.4 Clinical Manifestations of the Nutritional Deficiencies .....	13
2.4.1 Protein malnutrition/protein-energy malnutrition.....	13
2.4.3 Folate and Vitamin B12 .....	13
2.4.4 Calcium, Vitamin D and parathyroid hormone levels .....	14
2.4.5 Vitamin A.....	14
2.4.6 Zinc, Copper and Selenium.....	14
2.4.7 Steatorrhoea .....	15

2.5 Monitoring Nutrition Assessment Post-bariatric Surgery .....	16
2.6 Existing Literature about Types of Deficiencies in Relation to Food Choices and Quality of Life in Patients of Post-Bariatric Surgeries.....	18
2.7 Existing Literature about the Importance of Nutritional Knowledge among Patients of Different Diseases and its Implication on Their Overall Health and Nutritional Status.....	22
Chapter 3: Methods .....	26
3.1 Methods and Research Design.....	26
3.2 Participant Recruitment .....	27
3.3 Data Collection.....	27
3.4 Data Analysis.....	28
3.5 Ethical Approval.....	29
Chapter 4: Results .....	30
4.1 Demographic Data.....	30
4.2 General Nutrition Knowledge.....	30
4.3 Sources of Nutrition Knowledge and Perceived Reliability.....	32
4.4 Nutrition Knowledge Pertaining to Diet Post-bariatric Surgeries .....	33
4.5 Participants' Summary Scores Out of 10 of General Nutrition Knowledge versus Knowledge of the Dietary Protocol Post-surgery.....	38
4.6 Awareness of Dumping Syndrome.....	39
4.7 Perceived Importance of a Dietitian's Follow Up, Clarity of Dietitian's Instructions, and Level of Compliance .....	41
4.8 Commonly Faced Problems Post-surgery .....	44
4.9 Quality of Life Post-bariatric Surgery .....	45
Chapter 5: Discussion .....	47
5.1 Nutrition Knowledge and Patient Compliance.....	48
5.2 Post-Surgery Nutritional Side Effects and Quality of Life.....	53
Chapter 6: Conclusion.....	55
References .....	57
Appendices.....	66
Appendix 1: Ethical Approval (University Student Research Evaluation Committee - Dubai Health Authority) .....	66
Appendix 2: Questionnaire (English).....	68
Appendix 3: Questionnaire (Arabic) .....	71

## List of Tables

Table 1: Schedule for outpatient evaluation.....	17
Table 2: Demographic characteristics of study participants (n= 83) .....	30
Table 3: General nutrition knowledge levels of the participants (n=83) .....	31
Table 4: Knowledge about food group serving recommendations of the study participants (n=83) .....	32
Table 5: Choice of source of nutrition knowledge in relation to the perceived reliability on a scale of 1-10, 1 being the least reliable and 10 being the most reliable.....	33
Table 6: Knowledge levels and adherence to post-bariatric surgery protocols of the participants.....	34
Table 7: Knowledge of post-bariatric surgery dietary protocol.....	36
Table 8: Summary of statistics of scores vs. demographic profile of participants.....	38
Table 9: Comparison of scores between general knowledge and knowledge of the dietary protocol.....	39
Table 10: Knowledge of participants pertaining to dumping syndrome.....	40
Table 11: Awareness of dumping syndrome vs. awareness of symptoms of dumping syndrome .....	40
Table 12: Perceived importance of a dietitian’s follow up, clarity of dietitian’s instructions, and level of compliance .....	42
Table 13: The perceived importance of a dietitian’s follow-up appointment versus the clarity of information provided by the dietitian .....	43
Table 14: The Correlation between level of clarity of information conveyed by dietitian versus level of compliance to the dietary protocol .....	43
Table 15: Testing differences between the level of compliance in relation to the perceived importance of a dietitian’s follow up .....	44
Table 16: Percentage of occurrence of the most common symptoms post- bariatric surgery.....	44
Table 17: Assessment of quality of life of patients’ post-bariatric surgeries.....	46

## List of Figures

Figure 1: Post-bariatric dietary stages of the study participants .....	33
Figure 2: Summary of participants' scores .....	37
Figure 3: Prevalence of the most common symptoms in post-bariatric surgery patients.....	45

## Chapter 1: Introduction

### 1.1 Overview

Obesity is a complex multifactorial chronic disease that is mainly the result of the interaction of different genotypes and the environment. However, specific information about how and why obesity develops is not fully understood. Specifically, the development of obesity entails the integration of social, behavioral, cultural, physiological, metabolic and genetic factors (Kasen et al., 2008). According to the World Health Organization (WHO), at least 2.8 million people die every year because of being overweight or obese (WHO, 2014). Moreover, the worldwide prevalence of obesity has increased manifold between 1980 and 2014, with 13 percent of the world's adult population alone found to be obese during a survey conducted in year 2014 (WHO, 2014). The problem is alarming for the people of the United Arab Emirates (UAE); a report entitled "Global Burden of Disease Study 2013" shows that over 66% of men and 60% of women living in UAE are obese and overweight. Almost 40% of children aged 11 to 16 years and 5% of children under the age of 11 are obese (Institute for Health Metrics and Evaluation, 2013). The prevalence of obesity and the associated health-related threats necessitate serious steps to be taken for eliminating this disease.

Obesity is clearly associated with increased morbidity and mortality. Therefore, resolving the prevailing problem of obesity will lead to improved health. For example, there is strong evidence that when obese individuals lose weight, risk factors for diabetes and cardiovascular diseases (CVD) are reduced (NIH, 2015). In addition, research proves that weight loss leads to a reduction in blood pressure in both overweight hypertensive and non-hypertensive individuals (NIH, 2015). Weight loss also reduces serum triglycerides and increases high-density lipoprotein (HDL)-



cholesterol (NIH, 2015). Furthermore, it generally leads to some reduction in total serum cholesterol and low-density lipoprotein (LDL)-cholesterol. Additionally, weight loss reduces blood glucose levels in overweight and obese people without diabetes and also reduces blood glucose levels and HbA1c in some patients with type 2 diabetes (NIH, 2015). Apparently, the problem of obesity should be taken seriously by an individual to maintain overall good health.

Therapeutic strategies to treat obesity are limited. Although effective, lifestyle intervention is both disappointing regarding the degree of weight loss (Dyson, 2010) and its maintenance in the long term (Wing & Phelan, 2005), so when conservative strategies such as diet improvement, behavior modifications, and physical activity do not produce effective weight loss outcomes, bariatric surgery is considered the most effective treatment for moderate to severe obesity in order to produce significant and sustained weight loss and to markedly reduce obesity comorbidities (Livingston, 2007). Therefore, bariatric surgery, which is currently recommended for patients with BMI above 40kg/m<sup>2</sup> or above 35kg/m<sup>2</sup> when associated with obesity-related diseases (Mechanick et al., 2009), has dramatically risen, reaching 468,000 interventions in 2013 worldwide (a 3.2-fold increase compared to 2003) (Angrisani et al., 2015). Bariatric surgery enables major and sustainable weight loss as well as significant improvement of obesity related-diseases (Buchwald, 2004). Multiple surgical procedures are available among which 60% are represented by Roux-en-Y gastric bypass (GBP) and adjustable gastric banding (AGB) (Angrisani et al., 2015). Although decreasing in number of interventions, AGB remains the first choice in young obese patients, who become candidates for bariatric surgery earlier in life (Zitsman et al., 2015). Weight loss mechanisms after bariatric surgery include food restriction due to gastric narrowing in all surgical procedures, and an added reduction in nutrient

absorption due to proximal alimentary limb diversion in GBP which leads to a certain degree of malabsorption (Dixon et al., 2011).

Laparoscopic bariatric surgery was introduced in 1994 when Wittgrove et al. (Wittgrove et al., 1994) published the results of their first five Roux-en-Y gastric bypass cases. Since then, several large series of laparoscopic Roux-en-Y gastric bypass cases (Abdel-Galil & Sabry, 2002) and three randomized controlled trials (Lujan et al., 2004) comparing laparoscopic and open Roux-en-Y gastric bypass have been published.

Each approach poses unique risks. Open surgery results in more postoperative pain, slower return to normal activity, and higher rates of iatrogenic splenectomy and abdominal wall complications (up to 20% of patient have incisional hernias). One review of more than 3,000 gastric bypass cases showed that the laparoscopic approach results in less postoperative pain, better postoperative pulmonary function, and significantly fewer wound complications, but it has higher rates of anastomotic stricture (4.7% vs 0.7%,  $P < .001$ ), gastrointestinal bleeding (1.9% vs 0.6%,  $P = .008$ ), and late postoperative bowel obstruction (3.1% vs 2.1%,  $P = .02$ ) than open surgery (Podnos et al., 2003). The incidence of anastomotic leak was higher with laparoscopic surgery in some series, but not in the randomized trials or in a comprehensive review of the topic (Podnos et al., 2003).

Laparoscopic surgery takes time to learn, and complication rates with laparoscopic Roux-en-Y gastric bypass tend to decline as surgeons gain experience. (Schauer et al., 2003) With experience, operative time and rates of technical complications such as gastrojejunal anastomotic leak decline to those seen with the open approach.

The total number of bariatric procedures performed worldwide in 2013 was 468,609, out of which 95.7 % were carried out laparoscopically. The highest number ( $n = 154,276$ ) was from the USA/Canada region (Angrisani et al., 2015). Candidates for bariatric surgery must have a body mass index (BMI) greater than  $40 \text{ kg/m}^2$  or a Body Mass Index (BMI) greater than 35 with significant obesity-related disease, Inability to achieve a healthy weight loss sustained for a period of time with prior weight loss efforts (American Society for Metabolic and Bariatric Surgery, 2018). Typically, patients are between the ages of 18 and 60 years. However, carefully selected older patients and adolescents can also benefit from bariatric surgery and the current indications will likely broaden as long-term data on various subgroups of patients becomes available (Buchwald, 2004).

The risks and benefits of each procedure are evaluated in the context of the patient's preference, expectations, BMI, comorbidities, and ability to comply with the different follow-up requirements for each procedure (Courcoulas et al., 2003). One of the most important benefits of bariatric surgery is weight loss and is typically expressed as the percentage of excess weight loss after the surgery (Buchwald, 2004). Another benefit is increased life expectancy as morbid obesity is associated with decreased life span (Christou et al., 2004). As for the risks of bariatric surgery, in a systematic review of the international literature that included 64 studies and 8,504 patients, done by Chapman and colleagues (2004) which reported tube or port malfunction requiring reoperation in 1.7% of cases, band erosion into the gastric lumen in 0.6%, and pouch dilation or band slippage in 5.6%. Overall, complications requiring reoperation can occur in up to 18% of patients, but complications decrease as experience with this procedure increases.

## 1.2 Statement of Problem

Patients with history of bariatric surgery are at a greater risk of malnutrition. However, there is limited research about their nutrition knowledge. Therefore, studies evaluating the nutrition knowledge of patients with history of bariatric surgery are warranted. Moreover, there is a need to examine dietary behaviors and food choices in the post-bariatric surgery period, so in turn, this study assessed the nutrition knowledge and dietary behavior among patients with history of bariatric surgery attending the outpatient clinic of Rashid Hospital, Dubai, United Arab Emirates. The hypotheses tested in this study were:

- i. Primary hypothesis: Nutrition knowledge level among patients post-bariatric surgery is low and can be improved through more frequent contacts with the dietitian.
- ii. Secondary hypothesis: Patients post-bariatric surgery don't adhere to the dietary protocol post-surgery.

## **Chapter 2: Literature Review**

There are a number of studies that have examined health benefits of bariatric surgeries as well as the associated risk of malnutrition (Mechanick et al., 2013). However, studies evaluating the nutrition knowledge of these patients are limited. Few studies have also explored the cost effectiveness of bariatric surgery and its implications on the healthcare system as a whole (Sampalis et al., 2004), as well as the risks and benefits of the surgery and nutritional complications post-surgery, in addition to importance of follow up post-surgery. This literature reviews cover the following topics: benefits of bariatric surgeries, risks of bariatric surgeries, nutritional deficiencies post-bariatric surgeries, clinical manifestations of the nutritional deficiencies, monitoring nutrition assessment post-bariatric surgeries, existing literature about types of deficiencies in relation to food choices and quality of life of patients post-bariatric surgeries, and finally existing literature about the importance of nutritional knowledge among patients of different diseases and its implication on their overall health and nutritional status.

### **2.1 Benefits of Bariatric Surgeries**

The weight-loss procedures in use today range from placement of an intragastric balloon (the least invasive option) to open biliopancreatic diversion (the most invasive). Bariatric procedures are classified according to their mechanism of action: restrictive, malabsorptive, or a combination of restrictive and malabsorptive. Restrictive procedures are so called because the surgeon creates a small gastric pouch with a narrow outlet that restricts the amount of food that the patient can eat at one time. The two restrictive procedures most often performed are vertical banded gastroplasty and laparoscopic adjustable gastric banding. Vertical banded gastroplasty

was developed in 1980 but only 5% of bariatric surgeons still perform it; many patients had long-term complications that necessitated another operation, and long-term weight loss was small (Kim & Sarr, 1991; Ramsey-Stewart, 1995; Balsiger et al., 2000). Laparoscopic adjustable gastric banding has the advantage of using an adjustable inner collar that allows one to fine-tune the size of the outlet to minimize side effects and maximize weight loss. It was approved for use in the United States in 2001 and now is the second most commonly performed bariatric procedure, after the Roux-en-Y gastric bypass. Malabsorptive procedures bypass a segment of the small intestine so that less food is absorbed. Biliopancreatic diversion was developed in 1979 by Scopinaro and colleagues (Scopinaro et al., 1998) and is performed at specialized centers using the open and laparoscopic techniques. The duodenal switch, a modification of the biliopancreatic diversion, was developed to decrease the incidence of dumping symptoms and anastomotic ulceration seen with biliopancreatic diversion. It too can be performed laparoscopically.

Combination procedures, eg, the Roux-en-Y gastric bypass, use both mechanisms to achieve weight loss. In this procedure, which can be performed either laparoscopically or as open surgery, food intake is restricted by creating a small (15–30 mL) gastric pouch, and absorption is limited by bypassing the proximal intestine with a Roux limb. The standard Roux limb is 75 to 150 cm long and bypasses the distal stomach, duodenum, and a short segment of the jejunum. More than 95% of the small bowel is left intact, so malabsorptive side effects such as diarrhea and protein malabsorption are very uncommon. The Roux-en-Y gastric bypass now accounts for approximately 80% of all bariatric procedures performed in the United States.

### **2.1.1 Bariatric surgeries and its implications of type 2 Diabetes and weight loss**

Bariatric surgeries reduce co-morbidities. In one study, gastric bypass surgery reduced the total number of co-morbid conditions of participating patients by 96% (USC Metabolic & Bariatric Surgery Program, 2016). In some cases, resolution of type 2 diabetes occurred within days of the surgery and another meta-analysis stated that several studies found that bariatric surgery patients felt better, spent more time doing recreational and physical activities, benefited from enhanced productivity and economic opportunities, and had more self-confidence than they did prior to surgery (USC Metabolic & Bariatric Surgery Program, 2016).

A study that assessed two types of bariatric surgery procedures (gastric bypass and biliopancreatic diversion) versus conventional medical therapy for type 2 diabetes patients with a BMI equal to or more than 35; found that the two types of bariatric surgery were more effective than conventional medical therapy in the control of hyperglycemia in such patients with severe obesity (Geltrude et al., 2012). Moreover, gastric bypass and biliopancreatic diversion were associated with increased rates of remission of hyperglycemia (relative risk, 7.5 and 9.5 respectively) and greater reduction from baseline in levels of fasting glucose and glycated hemoglobin, compared to medical therapy (Geltrude et al., 2012).

### **2.1.2 Cost-effectiveness of bariatric surgery**

The direct and indirect costs of morbid obesity are high. Most of the costs associated with obesity are related to the chronic comorbidities of diabetes, hypertension and cardiovascular disease. In 2000, the Center for Disease Control and Prevention estimated the total cost associated with morbid obesity to be \$117 billion

per year. Sampalis and colleagues (2004) in their study compared long-term direct health care costs in 1,035 patients who underwent bariatric surgery and 5,746 age matched and gender-matched obese controls. Open Roux-en-Y gastric bypass accounted for 79% of procedures. The surgical group had lost 67% of their excess body weight by 5 years. At 3.5 years, the cost of surgery was compensated by a reduction in total cost. By 5 years, there was a 29% reduction in costs for the surgical group.

Medication costs, specifically for antihypertensive and diabetic medications, are reduced by 77% after bariatric surgery (Craig & Tseng, 2002). Snow and colleagues (2004) found that after laparoscopic Roux-en-Y gastric bypass, the savings in drug costs was equal to the cost of surgery at 32 months. The Swedish Obese Subjects trial compared drug use in 510 surgically treated patients, 455 medically treated patients, and 958 normal-weight controls. By 6 years, surgical patients had a significant reduction in costs for diabetic and cardiovascular medication, but this was offset by increased use of gastrointestinal medication and nutritional supplements (Narbro et al., 2002).

## **2.2 Risks of Bariatric Surgeries**

### **2.2.1 Open vs. laparoscopic Roux-en-Y Gastric Bypass**

A review of more than 3,000 gastric bypass cases showed that the laparoscopic approach results in less postoperative pain, better postoperative pulmonary function, and significantly fewer wound complications, but it has higher rates of anastomotic stricture (4.7% vs 0.7%,  $P < .001$ ), gastrointestinal bleeding (1.9% vs 0.6%,  $P = .008$ ),



and late postoperative bowel obstruction (3.1% vs 2.1%,  $P = .02$ ) in comparison to open surgery (Podnos et al., 2003).

### **2.3 Nutritional Deficiencies in Post-bariatric Surgeries**

All bariatric procedures affect nutritional intake and some procedures may affect the absorption of macronutrients and / or micronutrients (Mechanick et al., 2013). Patients are required to stay on lifelong nutritional supplements and have to keep a lifelong monitoring of their nutritional status (Mechanick et al., 2013). For example, in gastric bypass as the stomach and duodenum are bypassed; iron, vitamin B12, and other micronutrient deficiencies can occur after standard gastric bypass (Bloomberg et al., 2005). Nutritional deficiency involves macro and micro nutrients as discussed below:

#### **2.3.1 Macronutrients deficiencies**

Protein is the major macronutrient after bariatric surgery, associated with malnutrition in the patient. The guidelines of the American Endocrine Society Clinical Practice Guidelines of the year 2010, suggest that bariatric patients should ingest 60–120 g of protein daily (Heber et al., 2010). However, many patients need to work closely with a dietitian after bariatric surgery in order to reach the goal of 60 g of protein intake. Protein malnutrition is a potentially serious complication of bariatric surgery, especially in those individuals who postoperatively have a short common channel owing to the diminished length of small intestine available for mixture of pancreatic secretions with dietary protein (Skroubis, 2002). In many bariatric surgery patients, hair loss is the first symptom of protein malnutrition. Other signs and symptoms of protein malnutrition, according to the WHO guidelines (Ramírez-Prada

et al., 2011) include the clinical presence of oedema, emaciation and altered hair status, biochemical findings of anemia and hypoalbuminemia. As serum albumin is an acute phase reactant (Gehring et al., 2006) other symptoms in patients with hypoalbuminemia could include an acute inflammatory disorder, chronic liver disease or small intestinal bacterial overgrowth.

### **2.3.2 Micronutrients deficiencies**

A number of studies have examined micronutrient deficiencies after Roux-en-Y gastric bypass surgery (Heber et al., 2010). A study involving 318 patients, who had their vitamin levels measured at 1 year of follow-up after a laparoscopic Roux-en-Y gastric bypass (Heber et al., 2010), revealed deficiencies of vitamin A (11%), vitamin C (34.6%), vitamin D (7%), thiamine (18.3%), riboflavin (13.6%), vitamin B6 (17.6%) and vitamin B12 (3.6%). These results must be considered in relation to both the patient's preoperative nutritional status as well as the body's reserves for specific vitamins (for example, up to 3 years for vitamin B12 but as little as 18 days for thiamine). A study comparing the micronutrient status of patients who have undergone a duodenal switch with Roux-en-Y gastric bypass (Aasheim et al., 2009), found that the duodenal switch was associated with a greater risk of thiamine deficiency in the initial months after surgery, and deficiencies of vitamin A and vitamin D in the first postoperative year. These results support the concern that bariatric procedures with a greater mal absorptive component, such as the duodenal switch, produce more long-term risks of complications induced by micronutrient deficiencies.

Low serum levels of zinc and copper are more common in individuals who undergo biliopancreatic diversion (prevalence of hypocupremia 30.3%) as compared to patients who undergo Roux-en-Y gastric bypass (prevalence of hypocupremia

3.8%) (Balsa et al., 2011), supporting the absorption of these micronutrients in the mid to distal jejunum. Moreover, severe malformations have been reported in neonates born to mothers who had biliopancreatic diversion for weight loss before pregnancy (Huerta et al., 2002).

The nutritional deficiencies that occur post bariatric surgeries can be prevented if a multidisciplinary team regularly assists the patient. Malnutrition is generally reverted with nutrient supplementation, once it is promptly diagnosed (Alvarez-Leite & Jacqueline, 2004). Special attention should be given to adolescents, especially to girls at reproductive age who have a substantial risk of developing iron deficiency. Future studies need to be conducted in order to detect nutrient abnormalities after new procedures and to evaluate the safety of bariatric surgery in young obese patients (Alvarez-Leite & Jacqueline, 2004).

Taking a single multivitamin tablet alone is insufficient to prevent iron and vitamin B12 deficiencies after laparoscopic Roux-en-Y gastric bypass (Alvarez-Leite & Jacqueline, 2004). Iron deficiency occurs in 13% to 52% of patients within 2 to 5 years after surgery, and supplementation with iron can reduce iron deficiency significantly (Alvarez-Leite & Jacqueline, 2004). Up to 37% of patients who have been prescribed a multivitamin after surgery can still develop vitamin B12 deficiency (Alvarez-Leite & Jacqueline, 2004). Once a specific deficiency is identified during follow-up, additional supplementation is provided.

Calcium absorption in the duodenum and jejunum and vitamin D absorption in the jejunum and ileum are impaired after Roux-en-Y gastric bypass as well. Calcium deficiencies can occur in up to 10% of patients and vitamin D deficiency in up to 51%, depending on the length of the bypass (Bloomberg et al., 2005). These deficiencies can

lead to secondary hyperparathyroidism and can result in increased bone turnover and decreased bone mass as early as 3 to 9 months after the surgery (Bloomberg et al., 2005).

## **2.4 Clinical Manifestations of the Nutritional Deficiencies**

### **2.4.1 Protein malnutrition/protein-energy malnutrition**

Protein malnutrition can occur for a number of reasons including poor dietary choice, a compact gastric band, anastomotic stricture or protein malabsorption. It may prevail several years after the surgery. Protein energy malnutrition is accompanied by edema.

### **2.4.2 Anemia**

Whilst iron deficiency anemia is relatively common following the gastric bypass, it must not be assumed that this is the only cause. If the anemia is not due to iron deficiency or blood loss, other nutritional causes should be considered. These include deficiency of folate, vitamin B12, zinc, copper and selenium (O’Kane et al., 2014).

### **2.4.3 Folate and Vitamin B12**

Low folate levels may be an indication of noncompliance with multivitamin and mineral supplements. However, it could also be an indication of severe malabsorption especially if there are other nutritional deficiencies. Megaloblastic anemia is caused by folate deficiency or vitamin B12 deficiency. Vitamin B12 deficiency, if untreated, results in irreversible peripheral neuropathy (O’Kane et al., 2014).

#### **2.4.4 Calcium, Vitamin D and parathyroid hormone levels**

Secondary hyperparathyroidism may result from Vitamin D deficiency to maintain calcium levels. For instance, procedures that bypass a portion of the small intestine, for example the gastric bypass carry the greatest risk of nutritional deficiencies. The proximal small intestine is the primary site of vitamin D, calcium, copper and iron absorption. Not surprisingly, the risk of malabsorption and nutrient deficiencies increases proportionally with the length of bypassed proximal intestine (Gracia et al., 2007). In addition to this, 25 to 80% of adult pre-bariatric patients may have baseline vitamin D deficiency to begin with (Flancbaum et al., 2006).

#### **2.4.5 Vitamin A**

Patients who have steatorrhea or who have had a duodenal switch may be at higher risk of developing vitamin A deficiency (Mechanik et al., 2013). Therefore, duodenal switch patients should be taking fat-soluble vitamins. Despite this, Vitamin A levels may drop over time in patients who have had duodenal switch after fat-soluble vitamins supplementation. Changes in night vision may be an indication of vitamin A deficiency in patients.

#### **2.4.6 Zinc, Copper and Selenium**

Unexplained anemia, poor wound healing, hair loss, neutropenia, peripheral neuropathy or cardiomyopathy may be symptomatic of zinc, copper or selenium deficiency (Mechanik et al., 2013). Zinc and copper share a common pathway hence, supplementation with zinc can induce copper deficiency and vice versa.

### **2.4.7 Steatorrhea**

Patients who have had a duodenal switch or long limbed gastric bypass are at the greatest risk of malabsorption and steatorrhea. Consequently, these patients may develop protein malnutrition and become deficient in fat soluble vitamins and zinc, (Mechanik et al., 2013).

The Israel Dietetic Association members recognized the need for bariatric centers to have uniform, evidence-based guidelines and summarized the current scientific literature and expert opinions on the nutritional care of bariatric patients, pre and post-surgery, in order to optimize long-term success and to prevent nutritional and metabolic complications (Dagan et al., 2017).

### **2.4.8 Dumping Syndrome (DS)**

DS is a known complication of patients following gastrectomy, although it is frequently underdiagnosed. The term “Dumping” itself was tailored by Wyllys and colleagues in 1920 (Wyllys et al., 1920). DS includes gastrointestinal (GI) and vasomotor symptoms that occur following ingestion of a meal. Symptoms following early DS (DS occurring 15 minutes to 1 hour after a meal ingestion) are mainly GI and they are caused by osmotically driven fluid shifts from the blood to the lumen. Symptoms of late DS (DS occurring 1 hour to 3 hours following a meal) are mainly vasomotor. They are caused by reactive hypoglycemia that is induced by a surge in insulin secretion that overcompensates for the glucose load delivered to the portal circulation (Camilleri & Prather, 1998).

Early DS GI symptoms include diarrhea, nausea, epigastric fullness, borborygmus, and abdominal cramps. Late DS symptoms may include vasomotor

symptoms such as sweating, decreased consciousness, shakiness, hunger, and difficulty to concentrate. DS incidence and severity have been correlated to the type of gastrectomy performed (Takiguchi et al., 2015).

## **2.5 Monitoring Nutrition Assessment Post-bariatric Surgery**

A Registered Dietitian should perform a complete nutrition assessment for all patients with a history of bariatric surgery (Academy of Nutrition and Dietetics, 2013). Dietitians play a vital role in the multidisciplinary team before and after bariatric surgery. Previous studies have shown that adherence to a regular nutritional follow-up contributes to weight reduction post-surgery (Endevelt et al., 2013) and prevents weight regain (Faria et al., 2010).

It is advised to determine the patients' awareness and understanding of the planned operation, potential operational risks, postoperative adverse effects and benefits, and lifestyle changes required to achieve the most favorable outcomes (Neff et al., 2013).

**Patient Monitoring:** Periodic medical evaluations are recommended following bariatric surgery. During the early postoperative period, the frequency of follow-up is usually determined by the bariatric surgery team managing the case. A reasonable schedule for outpatient evaluation is shown in the Table 1.

Table 1: Schedule for outpatient evaluation

After Bariatric Surgery	Frequency of Postoperative Evaluations
First 6 months	Every 4 to 6 weeks
Second 6 months	Every 3 months (i.e., at 9 and 12 months)
One year	Annually or more often, as clinically indicated

\*Schedule for outpatient evaluation post bariatric surgery (Academy of Nutrition and Dietetics, 2013)

Outpatient evaluation should include the following: Assess adherence to dietary recommendations by obtaining a dietary recall. Vital signs, including weight, should be obtained and evaluated when performing a targeted physical examination, as clinically indicated, at each visit. Screening for nutrition deficiencies with routine laboratory testing is recommended at three, six, and twelve months postoperatively, then annually. Testing should include: total blood count (CBC), electrolytes, glucose, albumin, liver panel (liver enzymes, alkaline phosphatase, bilirubin), lipid profile, iron, and ferritin, vitamin B12, thiamine, folate, zinc, copper, 25-hydroxyvitamin D, and parathyroid hormone (Heber et al., 2010).

Non-adherence with dietary recommendations maybe present in a variety of ways and might impact negatively on the health of the inmate or the orderly running of the institution (Kushner & Cummings, 2013). These include:

- Noncompliance with medical diet order, or supplemental feeding/snacks provided by food service
- Noncompliance with receiving nutrition supplements
- Non-compliance with behavioral modifications
- Providing supplemental feeding/snacks or nutrition supplements to other inmates



Non-adherence should be managed on a case-by-case basis, through inmate education and other appropriate interventions, and be documented in the medical record. Discontinuation of supplemental feeding/snacks or nutrition supplements may be considered by the primary care provider in consultation with the Registered Dietitian on a case-by-case basis (Kushner & Cummings, 2013).

## **2.6 Existing Literature about Types of Deficiencies in Relation to Food Choices and Quality of Life in Patients of Post-Bariatric Surgeries**

It has been reported that there is a prevalence of weight regain from the initial weight in the second year following bariatric surgeries (ranging from 46 to 63 % regain of weight initially lost (Freire et al., 2012) with a significant relapse in obesity comorbidities and, consequently, a deterioration in the patient's quality of life. Inadequate weight loss or weight regain after bariatric surgery, along with micronutrient deficiencies, are longitudinal risks that have to be monitored in the bariatric surgery patients (Concors et al., 2016). Freire and colleagues (2012) reported that poor diet quality, lack of physical exercise, and poor nutritional counseling follow-up visits were significant predictors of weight regain in patients after bariatric surgery.

In addition, Papalaszrou and colleagues (2010) reported that weight loss varied considerably even among patients undergoing the same surgical procedure depending on eating behavior modifications, food consumption frequency, and physical activity which may affect weight changes postoperatively. For these reasons, it is important for bariatric patients to be monitored and counseled through interviews and questionnaires in the pre-operative period and over their lifespan to ensure proper nutrition and behaviors to support positive bariatric surgery outcomes. In addition, it was shown in a large-scale study based on data from the Scandinavian Obesity

Registry that weight loss of 9.5% before Roux-en-Y gastric bypass was associated with a marked reduction in important postoperative complications, such as anastomotic leakage, deep infection or abscess, and minor wound complications. These findings were even more significant in patients with BMIs > 45.8 (Anderin et al., 2015). However, more preoperative weight loss has been associated with surgical advantages, such as shortening the time of the surgery (Huerta et al, 2008). Moreover, preoperative weight loss leads to an improved glycemic state before surgery (Ross et al., 2016).

A study conducted by Turconi and colleagues (2003) evaluated eating habits and lifestyle of patients with obesity before and after bariatric surgeries who have undergone Roux-en-Y gastric bypass (RYGB) and Sleeve Gastrectomy (SG). The aim of the study was to evaluate and compare dietary habits and lifestyle patterns, especially physical activity and smoking habits, of patients with obesity who have undergone RYGB and SG by using a validated self-administered questionnaire (Turconi et al., 2003) to ascertain the adequacy of lifestyle changes. The results indicated that although dietary habits improved, patients did not change their physical activity level or their smoking habits. Therefore, patients should receive adequate lifestyle counseling to experience maximum benefits from bariatric surgery.

On the other hand, another study named “Nutritional and Protein Deficiencies in the Short Term following Both Gastric Bypass and Gastric Banding” examined the nutritional and protein deficiencies in patients in the short-term period, following Gastric bypass and Gastric Banding (Aron-Wisnewsky et al., 2016). The aim was to analyze the effect of food restrictions (on nutritional parameters) on morbid obesity in the short-term (3 months) period after bariatric surgery. This was a prospective study, that followed 22 obese women who had undergone Roux-en-Y gastric bypass (GBP)

or adjustable gastric banding (AGB) at baseline (T0), 1(T1) and 3(T3) months after surgery. Food intake, nutrient adequacy and serum concentrations of vitamins and minerals known to be a risk for deficiency following BS were evaluated.

Before surgery, it had been observed that suboptimal food intakes lead to a risk of micronutrient deficiencies. Serum analysis confirmed nutritional deficiencies for iron and thiamine for 27% and 23% of the patients, respectively. The drastic energy and food reduction seen in the short term led to very low probability of adequacy for nutrients equivalent across both surgeries. Serum analysis demonstrated a continuous decrease in prealbumin during the follow-up, indicating mild protein depletion in 21% and 57% of GBP patients and 50% and 63% of AGB patients respectively. Regarding vitamins and minerals, systematic supplementation after GBP prevented most nutritional deficiencies. By contrast, AGB patients, for whom there is no systematic supplementation, developed such deficiencies.

Due to poor absorption, GBP further exacerbates baseline nutritional deficiencies in the long term as acknowledged in multiple studies (Coupaye et al., 2014). These observations have led to the systematic prescription of multivitamin and mineral supplements after GBP that needs to be maintained over lifetime (Bennett et al., 2007). Conversely, after AGB, supplementation is not used routinely but recommended only when mineral and vitamin deficiencies are detected (Scopinaro et al., 2013).

In the above mentioned study by Aron-Wisnewsky and colleagues (2016) this was one of the first reports that studied the relationship between food intake, nutrient adequacy of the diet and nutritional biological parameters measured before and in the short term (3 months) after GBP and AGB. In this study where the patients had similar

clinical characteristics at baseline (except for type-2 diabetes and glucose intolerance prevalence), the main findings were that: (i) protein intake significantly decreases after both surgeries, inducing mild protein depletion in 59% of all the patients at T3, (ii) AGB is not harmless, since it significantly reduces food consumption, leading to biologically proven vitamin and mineral deficiencies. This suggests that a systematic multivitamin and mineral supplementation could be required at least in the short term, (iii) systematic multivitamin and mineral supplementation after GBP seems to prevent these early nutritional deficiencies.

Surveillance for deficiencies and patient compliance vary as well, although most bariatric surgeons recommend annual blood testing. Monitoring of micronutrients deficiency include a complete blood count and iron and B12 levels before surgery, 6 months and 1 year after surgery, and yearly thereafter. Routine daily supplementation including multivitamin, iron, vitamin B12, and calcium are generally recommended (Brolin & Leung, 1999).

In conclusion, the reported incidence of specific deficiencies after Roux-en-Y gastric bypass varies widely in the current literature: between 10% and 50% for vitamin B-12 and iron (Alvarez-Leite, 2004) and between 0 and 40% for folic acid (Ybarra et al., 2005). Hypovitaminosis D with secondary hyperparathyroidism was found in up to 80% of patients both pre- and postoperatively (Ybarra et al., 2005). No data are available for deficiencies of vitamins B-1 and B-6, magnesium, and zinc. However, most authors report the incidence of specific deficiencies at different times after surgery, without considering the number of patients who will require any substitutive treatment during follow-up. In addition, in some of the studies a multivitamin supplement was subscribed to some of the patients immediately after

Roux-en-Y gastric bypass while others were not, potentially confounding results of the various studies. Compliance with long-term follow-up is vital, as nutritional and metabolic problems can be easily treated or avoided. With increasing number of patients undergoing bariatric surgery, physicians other than the initial surgeon will need to become involved in the follow-ups of such patients (Stocker, 2003).

### **2.7 Existing Literature about the Importance of Nutritional Knowledge among Patients of Different Diseases and its Implication on Their Overall Health and Nutritional Status**

Family physicians and dietitians see patients with a variety of illnesses. Many of these patients have medical conditions that require them to adhere to specific diets. For instance, a hypertensive patient must maintain a low-sodium diet and a hypercholesterolemic patient is expected to restrict intake of fats. Mounting evidence also links diet to the most prevalent chronic diseases, such as cardiovascular disorders, cancer, stroke and diabetes (Shikany & White, 2000). Physicians and dietitians often instruct patients to adopt specific dietary regimens; however, adherence tends to be limited. One factor in patients' dietary noncompliance may be lack of basic nutritional knowledge.

Few studies have examined the average patient's nutritional knowledge. An extensive, recent study in England suggests serious gaps in adults' knowledge about even basic nutritional recommendations (Parmenter et al., 2000). Investigations focusing on the nutritional knowledge of patient populations for whom dietary modifications have been recommended have generally found that knowledge in these groups is lower than desired (Kessler & Wunderlich, 1995). For example, a 1995 survey study of cardiac patients revealed poor knowledge of heart-healthy dietary recommendations (Plous et al., 1995). This study also revealed that most patients given

written nutritional information do not fully understand the presented material and proposed that nutrition counseling should be given a higher priority in the care of patients with heart disease.

A study examining “Heart failure patients' perceptions on nutrition and dietary adherence” concluded that despite advances in heart failure (HF) treatment about 59% of patients with HF are readmitted to hospitals within 19 months of discharge (Cowie et al., 2002). Exacerbations of HF symptoms are strongly linked to lack of appropriate self-care (Bennet et al., 1998). One of the most problematic self-care behaviors is adherence to dietary recommendations. Estimates of adherence rates to dietary recommendations vary from 38% to 88% (DiMatteo, 2004) but are typically lower than medication adherence rates (Evangelista et al., 2001). Non-adherence to dietary recommendations is closely related to worsening HF symptoms or hospitalizations in patients with HF (Gariballa et al., 2006). Fluid retention secondary to excessive sodium intake may be responsible for admissions for HF decompensation (Michalesan et al., 1998).

Conversely, a previous study (Gillespie & Kadiyala, 2005) assessed nutritional knowledge, attitudes, and practices of HIV positive patients, and drew focus on the role of malnutrition in adversely affecting the treatment course (Gillespie & Kadiyala, 2005). The results from the study indicated that the basic HIV-related knowledge was lacking among the subjects. However, their knowledge on the nutritional aspects was moderate.

Similarly, in a study conducted to examine the relationship between nutritional knowledge and dietary diversity among cancer patients. Results showed that there is a relationship between nutrition knowledge and level of education, indicating that most

of the nutrition knowledge the patients have is from what they are taught in school (Forrest et al., 2014). The basic nutritional knowledge of patients was average. However, patients had little knowledge on diet –disease relationship which showed that the patients could not create a link between what they eat and their health status (Brown et al., 2003).

After an extensive search in the scientific literature, currently there are no studies that examined nutrition knowledge of patients who had undergone bariatric surgery. Given the high risk of malnutrition among patients who had undergone bariatric surgery, studies examining their nutrition knowledge, attitudes, and behaviors need to be conducted. Very few studies related to this topic have been conducted in other demographic contexts but not in in the United Arab Emirates. It is important to note that many patients get re-admitted to hospitals due to complications post-surgery and they take extensive time to recover due to being nutritionally malnourished (Straton et al., 2003) and are unable to manage their daily dietary intake due to limited adherence and nutrition knowledge related to post-surgery diet.

Therefore, it is important to assess the nutritional knowledge, attitude, and behavior of patients who have undergone bariatric surgery since they are at a greater risk of malnutrition. Corrective measures can be taken by the healthcare system based on the findings of this study to improve patients' health. Previous researches have shown the importance of nutritional knowledge in improving dietary adherence and outcome of patients with various medical conditions (Baldwin & Weekes, 2011). This study aims to fill some of the gaps related to our current knowledge of dietary behaviors, nutrition knowledge and attitudes of bariatric patients in the UAE. In addition, the study aims to evaluate nutrition knowledge and dietary habits and

perceptions of patients who had undergone bariatric surgery in the UAE. The results of this study will be beneficial in the development of educational measures to improve patient dietary adherence for better health outcomes.



## Chapter 3: Methods

### 3.1 Methods and Research Design

In this cross-sectional study, data were collected from post-bariatric surgery patients attending Rashid Hospital outpatient clinic during the period of May to July, 2017. The sampling method used is a stratified random sample by gender where the sample sizes were proportional to the actual strata sizes in order to take into consideration any possible differences between both genders, so in turn the sample consisted of 70% females, and 30% males to reflect the actual population gender distribution (Hari et al., 2012). The required sample size to estimate the proportion of the knowledgeable versus the unknowledgeable patients with an error of 10%, based on hospital statistics of 336 female bariatric patients and 144 male bariatric patients per year, was 58 females and 25 males, which came to a total of 83 patients and it was calculated using Minitab. However, the actual collected sample of patients consisted of 29 males and 54 females, which is close to the target sample size, as it is worthwhile mentioning that there has been no previous studies of similar nature to use as a reference in calculating the sample size. Only UAE nationals were recruited for the study since Rashid Hospital is a governmental hospital which provides free healthcare services to UAE nationals, who were obese, with or without co-morbidities, and who had undergone bariatric surgery. Data were collected over the course of 3 months. It was a broad age range study since patients of various age groups undergo this type of surgery either for the purpose of weight loss or to address and lessen the co-morbidities related to obesity. The inclusion criteria only took into account patients who attended their follow-up at the clinic and gave consent for their participation and showed willingness to give unbiased answers. The age range of the population surveyed within

this criterion was 18 to 60 years old. Those who did not receive any nutritional education prior to or after their bariatric surgery were not included in the study.

### **3.2 Participant Recruitment**

Potential participants were approached by the researcher in the outpatient surgical and dietitian clinic. Consent was taken verbally and signed the consent form to participate. A hard copy of the questionnaire was handed to them to be completed and any help while answering the questions was provided by the researcher. The patients were given the option to contact the principle investigator at any time throughout the study.

### **3.3 Data Collection**

The data was collected through a questionnaire adapted from related literature including the "Nutrition Awareness among Adults Questionnaire", validated by Parmenter and colleagues (1999). Additional questions related to the adherence of the post-bariatric surgery diet of Rashid Hospital were added. These questions were developed by the research team from the existing educational materials that post-bariatric patients receive from Rashid Hospital dietitians.

The questionnaire consisted of two parts:

- The first part assessed general nutritional knowledge.
- The second part assessed nutritional knowledge specific to the diet which is followed after bariatric surgery along with the complications that may occur.

The questionnaire was developed in both Arabic and English language, however, and only the Arabic questionnaire was used, since all the patients were Arabic speaking. A pilot study was conducted in the outpatient clinic with 6 post-

bariatric surgery patients and the questionnaire was modified based on the feedback from the pilot study participants.

### **3.4 Data Analysis**

Data was analyzed using the Statistical Package for Social Science (IBM-SPSS) version 23.0. Descriptive statistics such as frequencies, proportions, means, and standard deviations were used. For questions about nutritional knowledge, a score of one was assigned to each correct answer and a score of zero to every incorrect answer. Categorical questions were assigned in numerical codes in SPSS. The first part of the questionnaire was interpreted using frequencies and percentages from which conclusions were then drawn. Correlations were established between certain sets of questions using either the Chi-Square test of independence or Pearson's correlation, depending on whether it was a comparison between categorical or quantitative variables, respectively. The significance of the differences between the mean values of quantitative variables across various categories was tested using the analysis of variance (ANOVA) test, if the assumptions of the ANOVA test were satisfied. If not, the non-parametric test equivalent to the ANOVA test which is the Kruskal-Wallis test was used. Normality was tested using the Shapiro-Wilk test, while Levene's test was used to test the equality of variances. The Independent Sample T-Test was used to compare the mean scores of different questions across two groups. The true and false questions were compiled together to give a maximum cumulative score of 14, in which patients who scored 7 or below were considered to have a relatively poor knowledge, while patients who scored 8-11 had satisfactory knowledge, and those who scored more than, or equal to 12, had very good nutritional knowledge. The sum of the correct answers was calculated for each question after which the percentage of correct answers

for each question was then calculated. In addition, Paired Sample T-Test was used to compare between the cumulative score out of 10 of the general nutrition knowledge versus the nutrition knowledge pertaining to the dietary protocol post-surgery. For these analyses a p-value of  $< 0.05$  was considered statistically significant.

### **3.5 Ethical Approval**

Ethical approval was obtained from University Students Research Evaluation Committee of Dubai Health Authority, in Dubai, United Arab Emirates (Appendix 1). All participants were informed that their participation in the project is voluntary and that all information collected will remain anonymous and confidential. Verbal and written consent was obtained from each participant prior collecting any data.

## Chapter 4: Results

### 4.1 Demographic Data

This study was conducted to assess nutrition knowledge of patients attending the outpatient bariatric clinic of Rashid Hospital in Dubai. Both general and nutrition knowledge of post-bariatric dietary protocols of Rashid Hospitals were evaluated. A total of 83 patients between the ages of 18 and 60 years participated in the study. The majority of the participants (65.1%) were females (Table 2).

Table 2: Demographic characteristics of study participants (n= 83)

Gender	n (%)
Male	29 (34.9)
Female	54 (65.1)
Marital Status	
Married	51 (61.4)
Single	32 (38.6)

### 4.2 General Nutrition Knowledge

The first section of the questionnaire assessed the general nutritional knowledge which consisted of 5 questions. The patients scored highest in the question asking about the lowest fat snack in which 86.7% identified popcorn as the lowest fat snack versus French fries and Lay's chips. In addition, 89.2% of participants answered that it is best to have sugar containing foods as a snack rather than part of a main meal, whereas a fair number, 67.5% of the participants correctly answered the question asking about the highest fiber foods of the choices given which was carrots and apples (Table 3).

Table 3: General nutrition knowledge levels of the participants (n=83)

Nutrition knowledge of the snack of lowest fat content.		
	n	%
Lay's chips	8	9.6
Popcorn	72	86.7
French fries	3	3.6
Is it best to eat sugar-containing food only as a snack rather than a part of a meal?		
	n	%
True	74	89.2
False	9	10.8
Which of these foods contains the highest amount of fiber?		
	n	%
Biscuits & cake	8	9.6
Carrot & apples	56	67.5
French-fries & fatayer (savory pastries)	8	9.6
Fish & chicken	11	13.3

On the other hand, participants did not respond as well in questions asking about the recommended servings of fruits and vegetables as well as cups of milk per day. Only 12% of participants correctly guessed the recommended daily fruits and vegetables serving size and 41% selected 2 cups of milk (Table 4). From this, we concluded that a modest number of participants had adequate knowledge on general nutrition.

Table 4: Knowledge about food group serving recommendations of the study participants (n=83)

How many fruits and vegetables should be eaten per day?		
	n	%
1 servings of fruits and vegetables	16	19.3
3 to 4 servings of fruits and vegetables	54	65.1
5 or more fruits and vegetables	10	12.0
It is unnecessary to eat any fruits and vegetables	3	3.6
How many cups of milk should you have per day?		
½ cup	6	7.2
1 cup	43	51.8
2 cups	34	41.0

### 4.3 Sources of Nutrition Knowledge and Perceived Reliability

Regarding the patients' primary source of nutrition knowledge, the most common knowledge about Food Group Serving Recommendations of the study participants (n=83) response was social media followed by other forms of media such as the radio, TV, and magazines (Table 5). The participants rated these sources as highly reliable by giving social media a mean score of  $8.9 \pm 1.70$ , radio/TV/magazines a score of  $8.2 \pm 1.34$ , on a scale of 1 to 10, 10 being the most reliable (Table 5). Furthermore, performing a Kruskal Wallis test showed that there was no significant difference of the mean reliability scores of the various sources of nutrition knowledge examined (p-value 0.230) as shown in Table 5.

Table 5: Choice of source of nutrition knowledge in relation to the perceived reliability on a scale of 1-10, 1 being the least reliable and 10 being the most reliable

	n (%)	Mean	Standard Deviation	*p-value
School	1 (1.2)	7.00		
Work Place	7 (8.4)	9.28	1.49	0.230
Radio/TV/Magazines	28 (33.7)	8.96	1.34	
Social Media	32 (38.6)	8.28	1.71	
Others	15 (18.1)	8.33	3.08	

\*Kruskal Wallis Test, level of significance  $\alpha=0.05$ , ( $p<0.05$ )

#### 4.4 Nutrition Knowledge Pertaining to Diet Post-bariatric Surgeries

The second part of the questionnaire was specific to the dietary protocol of post-bariatric surgeries. Figure 1 illustrates an overall view of percentages of the type of diets the participants were on at the time of the survey. Of the total participants 71.1% of patients had resumed a regular diet, 13.3% were following a mashed diet, 9.6% were on a soft diet, and only 6% were on clear fluids (Figure 1).

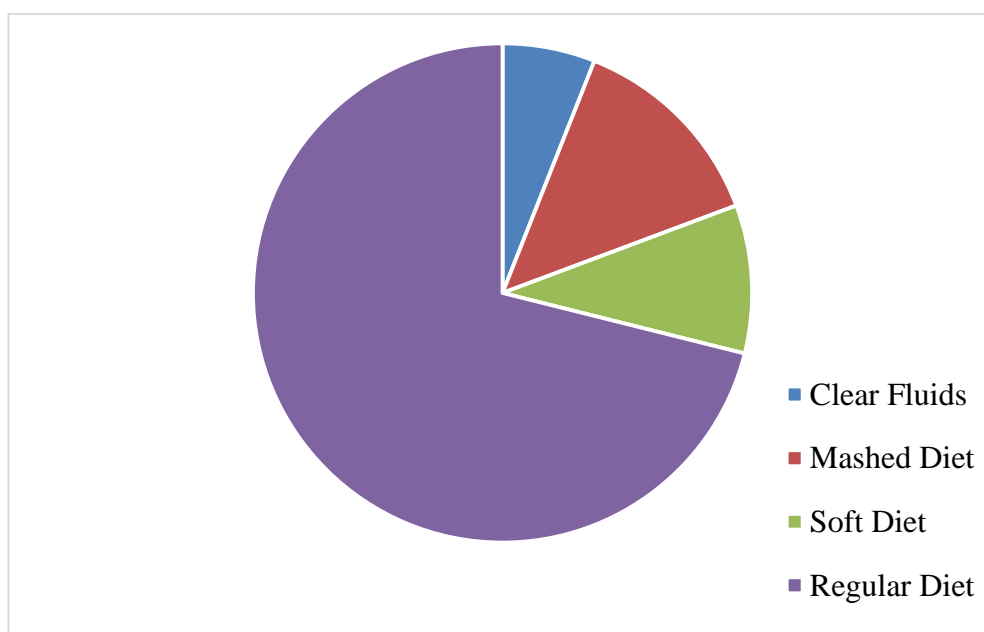


Figure 1: Post-bariatric dietary stages of the study participants



The following questions addressed the participant's knowledge of a post-bariatric surgery diet and their compliance to it. Most of the participants, 78.3%, correctly identified which foods were allowed during the first stage of the diet, as presented in Table 6. Similarly, 79.5% of patients showed compliance with the physician's instructions to take vitamin/mineral supplements daily after their surgery while 20.5% of the participants did not adhere to the physician's instructions related to vitamin/mineral supplement intake (Table 6).

Table 6: Knowledge levels and adherence to post-bariatric surgery protocols of the participants

Which of these foods is not okay to have during the first stage (clear fluids)?		
	N	%
Cream soup	65	78.3
Clear soup	3	3.6
Chicken stock	11	13.3
Vegetable stock	4	4.8
Are you compliant with taking your vitamin/mineral supplements?		
Yes	66	79.5
No	17	20.5

The study assessed participants' knowledge of post-bariatric surgery dietary protocols in 14 questions. The maximum possible knowledge score was 14. The score calculation was based on allocating one point for each correct answer. Post-bariatric dietary protocol knowledge scores of the participants in the study ranged from 4 to 14. The sums of the scores were then grouped in ranges, the higher the score, the more knowledgeable the participant is considered to be. In this study, a score of  $\leq 50\%$  was considered to be poor knowledge, a score of ( $>50\%$  -  $\geq 78\%$ ) is average knowledge,

and a score of  $\geq 85\%$  is satisfactory knowledge, in which 14.4% of participants received a score of  $\leq 7$  which indicated poor knowledge, 66.4% of patients scored between 8–11 which indicated moderately acceptable knowledge, while only 19.2% scored within the higher range of  $\geq 12$  which indicated sufficient knowledge (Figure 2). In addition, it was observed that patients were well informed about coffee consumption post-surgery and the importance of avoiding pulp with fruit juices during the 2<sup>nd</sup> stage of post-surgery diet. They also showed a fair amount of knowledge about the importance of avoiding full-fat dairy products and the right way of consuming fluids prior to their meals as illustrated in Table 7.

Table 7: Knowledge of post-bariatric surgery dietary protocol

Item	n	Correct Response
		%
It is ok to resume with drinking coffee as soon as you are operated once you are allowed to eat and drink.	49	59
In stage two (full fluids); you can have a fruit juice with pulp.	41	49.4
In stage two, you can have a full fat pudding or custard.	54	65.1
You should drink your fluids using a straw to keep things under control.	35	42.2
You should drink minimum of 1 liter of water in the first two weeks post operation.	69	83.1
In stage 3 (mashed diet), you can eat scrambled eggs but not boiled eggs.	58	69.9
You should limit your portion size by having your own set of small plates and bowls.	74	89.2
You can drink fluids prior to food directly.	63	75.9
Main meals should not exceed $\frac{3}{4}$ of a cup and snacks should be within $\frac{1}{4}$ to $\frac{1}{2}$ of a cup.	65	78.3
Apple sauce is considered to be ok to have in stage 3, unlike a whole apple.	34	41
Of the four cheeses (cheddar, akkawi, halloumi, cottage cheese) which is considered to be the lowest in fat and is suitable for patients post-surgery?	50	60.2
It is advisable to have low fiber intake post-surgery in order to prevent blockage.	57	68.7
It is advisable to have a high protein diet through consuming the protein supplements prescribed by the dietitian in order to help in sparing your muscle mass, and to help in the wound healing process.	77	92.8
The diet you should follow post-bariatric surgery on the long run should be low in fat, low to moderate in fiber, medium to high in protein, and low in simple sugars.	76	91.6

See the appendix for full questionnaire.

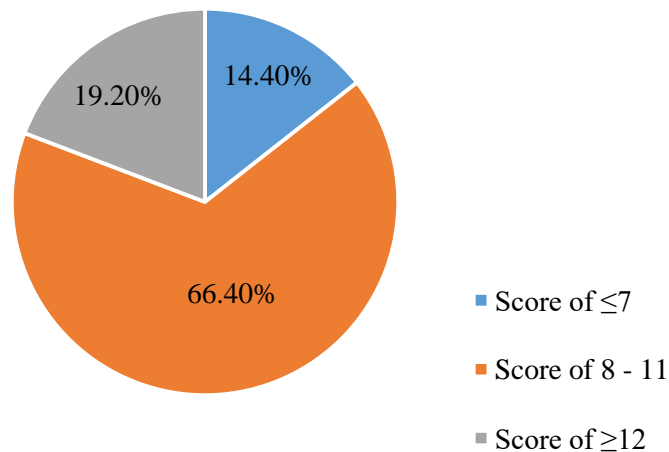


Figure 2: Summary of participants' scores

The mean nutrition knowledge scores were compared in relation to the demographic data including gender and marital status using the Independent Samples t-Test. A significant difference was found between the total nutrition knowledge scores of male and female participants ( $p$ -value= 0.02, Table 8). The mean score for males was  $9.0 \pm 1.88$  and for female participants,  $10.0 \pm 2.05$  ( $p= 0.022$ ). However, there was no significant difference between the scores of married and single participants ( $p$ -value= 0.313, Table 8). The mean scores for married participants was  $9.8 \pm 1.63$  versus  $9.3 \pm 2.57$  for the unmarried participants.

Table 8: Summary of statistics of scores vs. demographic profile of participants

	n	Mean	Std. Deviation	*p-value
Male	29	8.96	1.88	
Female	54	10.03	2.05	0.02

	n	Mean	Std. Deviation	p-value
Married	51	9.86	1.63	
Single	32	9.34	2.57	0.313

\*Levene's Test for testing equality of variance was used.

Independent Sample Test was used to test significance (equal variances not assumed)

Level of significance  $\alpha=0.05$ , (p-value < 0.05)

#### **4.5 Participants' Summary Scores Out of 10 of General Nutrition Knowledge versus Knowledge of the Dietary Protocol Post-surgery**

The score out of 14 for the knowledge of the dietary protocol post-surgery (maximum possible score 14) was converted to 10 to facilitate the comparison of the dietary post-bariatric surgery protocol and the general nutrition knowledge score which was out of 5. As shown in Table 9, there was a significant difference between the scores of the participants' general nutrition knowledge and post-bariatric dietary protocol knowledge ( $P<0.001$ ).

The results of the study showed participants' knowledge of post-bariatric surgery dietary protocol was much higher compared to their knowledge about nutrition in general. Moreover, the scores were more homogeneous with less variability than those of general knowledge. The average scores of post-surgical dietary protocol exceed the scores of general nutrition knowledge by 2.1-3.1.

Table 9: Comparison of scores between general knowledge and knowledge of the dietary protocol

	Mean	Std. Deviation	*p-value
Knowledge of dietary protocol post-surgery	6.91	1.47	0.000
General nutrition knowledge	4.27	1.89	

\*Paired sample t-test was used to test if there was a significant difference between participants' general nutrition knowledge versus knowledge pertaining to the dietary protocol post-surgery. Level of significance  $\alpha=0.05$ , (p-value < 0.05)

#### 4.6 Awareness of Dumping Syndrome

In the questionnaire, dumping syndrome was assessed in three questions to evaluate the participants' awareness levels of dumping syndrome, its symptoms, and the foods that promote its occurrence. Most patients (71.1%) did not know what dumping syndrome is as shown in Table 10. From those who answered "yes", to knowing what dumping syndrome is, only 19.3% correctly knew which foods promote it (Table 10). The list of foods which they knew to promote dumping included the following: meat, rice, water right after meals, fried/fatty/sugary foods, ice cream, milk, milkshakes, and macaroni.

A total of 44.6% of patients knew the correct symptoms of dumping syndrome followed by 9.6% of participants who were confused with partially correct answers and remainder of answers being incorrect and 45.8% who answered incorrectly (Table 10). From the patients who claimed to know what dumping syndrome is, only 16 of them knew the correct symptoms of the syndrome, whereas 8 participants answered incorrectly, however none were confused or had partially correct answers (Table 11).

In conclusion, there was a significant difference between the awareness of dumping syndrome and its symptoms among the participants as shown in Table 11(p= 0.017).

Table 10: Knowledge of participants pertaining to dumping syndrome

Do you know what dumping syndrome is?		
	n	%
<i>Yes</i>	24	28.9
<i>No</i>	59	71.1
Do you know which foods promote the occurrence of dumping syndrome?		
	n	%
<i>Yes</i>	16	19.3
<i>No</i>	8	9.6
<i>Not applicable</i>	59	71.1
Symptoms of dumping syndrome are all except for...		
	n	%
<i>Bleeding only</i>	37	44.6
<i>Bleeding + others</i>	8	9.6
<i>No bleeding</i>	38	45.8

Table 11: Awareness of dumping syndrome vs. awareness of symptoms of dumping syndrome

	Bleeding only	Bleeding + others	No Bleeding	Total	*p-value
Yes	16	0	8	24	0.017
No	21	8	30	59	

\*Chi-Square test was performed to test relation between awareness of dumping syndrome and its symptoms.

Level of significance  $\alpha=0.05$  (p-value <0.05).

#### **4.7 Perceived Importance of a Dietitian's Follow Up, Clarity of Dietitian's Instructions, and Level of Compliance**

The last section of the questionnaire assessed perceptions of post-bariatric patients about the importance of a dietitian after their surgery as well as their compliance to their dietitian's instructions. Finally, they rated the clarity of the information conveyed by the dietitian on a scale of 1 to 10, 1 being very clear and 10 being vague and unclear. A total of 79.5% of patients stated that they follow up with their dietitian, followed by 8.4% who did not follow up, and 12% who did not care to (Table 12). When assessing the level of compliance to the dietitian's instructions, only 30.1% of patients rated themselves to be non-compliant, 40.9% moderately compliant, and a 29% were classified themselves as very compliant with the dietitian's instructions (Table 12).

Regarding the clarity of information conveyed by the dietitian, on a scale 1-10, only 8.4% of patients gave a score of 4 or less which indicated clearly conveyed information. 17% of patients gave a score between 5 and 7 which indicated moderate clarity of the information they received. Furthermore, 71.2% of the participants gave a score between 8 and 10 which suggests the information conveyed to them was either unclear or vague (Table 12).



Table 12: Perceived importance of a dietitian's follow up, clarity of dietitian's instructions, and level of compliance

Are you following up with your dietitian or do you feel it is unimportant?		
	n	%
Yes	66	79.5
No	7	8.4
I don't care	10	12.0
Rate your compliance with the post-bariatric surgery dietary protocol (1 being non-compliant, 10 being very compliant).		
	n	%
1-5	25	30.1
6-8	34	40.9
8-10	24	29
Rate the clarity of information conveyed by the dietitian (1 being very clear, 10 being unclear and vague).		
	n	%
1-4	7	8.4
5-7	17	20.4
8-10	59	71.2

The correlation between how patients perceive the importance of a dietitian and their follow up appointments in relation to the level of clarity of their dietitian's instructions was evaluated using Kruskal Wallis test. There was significant difference in how the three groups perceive the importance of a dietitian, in relation to the level of clarity of information conveyed by the dietitian ( $p=0.010$ ). The mean rate of clarity of the "I don't care" group was  $6.2\pm 3.85$ , followed by the "no" group,  $6.86\pm 1.57$ , and lastly the "yes" group which had the highest mean score of  $8.58\pm 2.11$  (Table 13).

Table 13: The perceived importance of a dietitian's follow-up appointment versus the clarity of information provided by the dietitian

	n	Mean	Std. Deviation	*p-value
Yes	66	8.57	2.11	0.01
No	7	6.85	1.57	
I don't care	10	6.20	3.85	

\*Kruskal Wallis Test, (p-value <0.05), level of significance  $\alpha=0.05$ .

Further, correlation was tested between the level of clarity of the dietitian's instructions versus the level of compliance of patients' post-bariatric surgery dietary protocol using Pearson's correlation (p=0.00), and the Pearson's correlation score 0.518 which indicated a moderately strong, positive correlation between the clarity of information conveyed and the compliance with the dietary protocol post-surgery (Table 14).

Table 14: The Correlation between level of clarity of information conveyed by dietitian versus level of compliance to the dietary protocol

Pearson Correlation*	1	.518**
p-value		.00
N	83	83
Pearson Correlation	.518**	1
p-value	.00	
N	83	83

\*Pearson's Correlation (p-value <0.05), level of significance  $\alpha=0.05$ .

The difference between how the patients perceived the importance of the follow up with the dietitian in relation to their level of compliance, was tested using Kruskal Wallis test (p= 0.002). A significant difference was noted among the participants' perception of the importance of dietary follow-up visits in relation to their level of compliance to dietary protocol. The patients who answered "yes" to the question assessing the perceived importance of a dietitian's follow up had a mean score of

compliance of  $7.45 \pm 2.19$ , whereas the ones who answered "no" had a mean score of  $4.5 \pm 2.63$ . Finally, those who chose the option "I do not care" had a mean score of  $4.9 \pm 2.88$  (Table 15).

Table 15: Testing differences between the level of compliance in relation to the perceived importance of a dietitian's follow up

	n	Mean	Std. Deviation	*p-value
Yes	66	7.45	2.19	.002
No	7	4.57	2.63	
I don't care	10	4.90	2.88	

\*Kruskal Wallis, (p-value<0.05), level of significance  $\alpha=0.05$

#### 4.8 Commonly Faced Problems Post-surgery

The most common problems that bariatric patients face post-surgery were also explored. The majority of the participants (61.4%) experienced nausea, 53% experienced dizziness, 45.8% experienced dehydration, 41% experienced vomiting, and 28.9% experienced dumping syndrome. Only 22.9% of the participants did not experience any of the aforementioned symptoms associated with post-bariatric surgery. On the other hand, 13.3% of the participants stated that they have experienced all of the symptoms listed (Table 16, Figure 3).

Table 16: Percentage of occurrence of the most common symptoms post-bariatric surgery

Nausea	Vomiting	Dizziness	Dehydration	Dumping Syndrome	None of the former	All of the former
61.4%	41%	53%	45.8%	28.9%	22.9%	13.3%

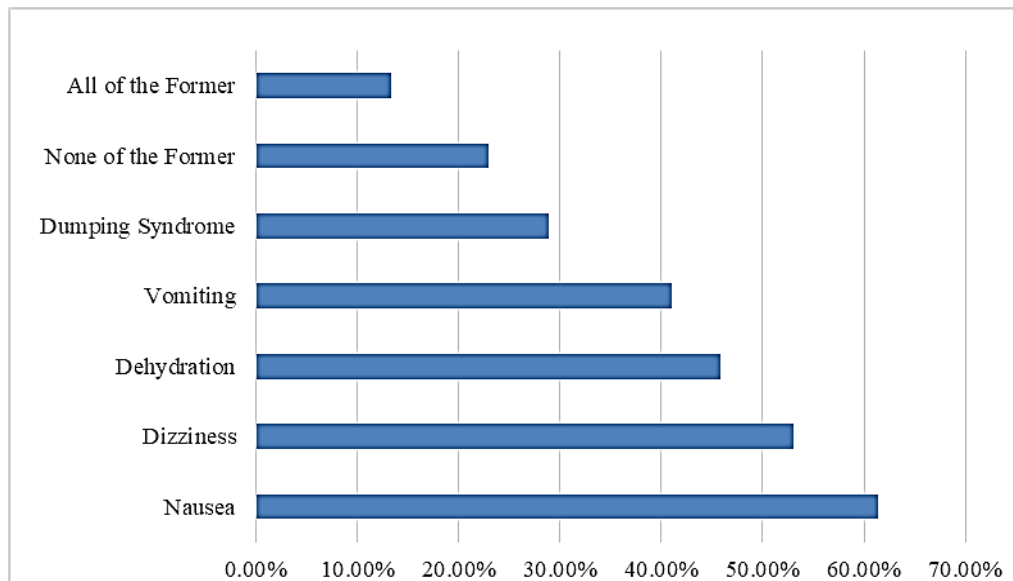


Figure 3: Prevalence of the most common symptoms in post-bariatric surgery patients

#### 4.9 Quality of Life Post-bariatric Surgery

The final two questions of the questionnaire explored the participants' quality of life after undergoing surgery. Among the participants, 48.5% stated that they have not felt fatigued, agitated, or regretted their decision of choosing to undergo bariatric surgery. However, 28.9% stated they had sometimes experienced fatigue, agitation or regretted at their decision to undergo bariatric surgery. Less than twenty-percent (19.3%) rarely had these negative emotions and only six percent always felt these emotions following bariatric surgery (Table 17). Regarding the respondents' reflection of the quality of their daily lives and leisure activities, the majority of the participants (83.1%) stated that they found their quality of life to be more enjoyable than before their surgery. On the other hand, 13.3% found no difference and fewer than five percent (3.6%) found their quality of life to be less enjoyable (Table 17).

Table 17: Assessment of quality of life of patients' post-bariatric surgeries

How often do you feel agitated, fatigued, or regretted your decision of being operated on?	n (%)	Do you now find your daily and leisure activities?	n (%)
Never	38 (45.8)	More enjoyable	69 (83.1)
Sometimes	24 (28.9)	Less enjoyable	3 (3.6)
Rarely	16 (19.3)	I didn't notice any change	11 (13.3)
Always	5 (6.0)		n= 83

## Chapter 5: Discussion

Adequate nutritional knowledge aids and supports the patients' building their way to better health. Whether it is bariatric surgery, heart failure, gastrointestinal disorders, or even prevention of a disease - nutrition is one of the most vital components of multidisciplinary action of care of any disease. The first survey designed to assess nutritional knowledge of patients with cardiac disease concluded that majority of patients viewed diet as an important factor in treating and preventing their disease. However, their knowledge of the matter was marginal and hindered them in doing so (Plous et al., 1995). When it comes to gastrointestinal ailments, nutrition could not play a more important role in the treatment. Prince and colleagues (2011) assessed knowledge, attitudes, and beliefs of patients and healthcare providers about the role of nutrition in treating and curing inflammatory bowel disease. Patients with irritable bowel disease placed greater emphasis on nutritional knowledge that could play a vital role in their disease's management.

The present study assessed the nutrition knowledge of bariatric patients attending Rashid Hospital's outpatient bariatric clinics in Dubai. Since patients who undergo bariatric surgeries are at greater risk of malnutrition, this study aimed at identifying the strengths and weaknesses of patients' education and compliance to post-bariatric dietary protocol. The results of the study will be useful to the dietitians in improving patients' nutrition education after bariatric surgery with the goal of improving the patients' health and quality of life.

## 5.1 Nutrition Knowledge and Patient Compliance

This study assessed patients' general nutrition knowledge as well as knowledge about dietary protocol after bariatric surgery. Basic nutrition knowledge questions were poorly answered e.g. food group serving sizes, reflecting a lack of information about the main principles of a healthy and balanced diet for any individual. This may be one underlying reasons for the high number of bariatric surgeries due to obesity in the region. An extensive study in England suggested gaps in the average adults' knowledge about the most basic nutritional recommendations (Shikany & White, 2000).

However, surprisingly more specific questions such as identifying low fat snacks or when to consume sugar-containing foods were answered very well. Media may play an important role in this regards as it promotes following a healthy diet but not the basic protocols that govern it. Our patients selected social media as their most common primary source of information followed by radio/TV/magazines. Media is a persuasive and powerful source of conveying information to the general public. However the information relayed is not always reliable because there is no research-based evidence or scientific governance required to promote it.

Looking at the patients' knowledge on post-bariatric dietary protocol, two-thirds of our patients fell in the moderately acceptable category. In comparison to general nutritional knowledge, that of post-bariatric dietary protocol outweighed the former. This may reflect that some patients received adequate patient education prior or post the surgery. According to the guidelines published by the American Society for Metabolic & Bariatric Surgery (ASMBS) (Mechanick et al., 2013), All patients should undergo an appropriate nutritional evaluation, including micronutrient

measurements, before any bariatric surgical procedure<sup>^</sup> (p. 166). Furthermore, these guidelines also state Ball patients should undergo evaluation of their ability to incorporate nutritional and behavioral changes before and after bariatric surgery<sup>^</sup> (p. 166). These recommendations are in line with research revealing that when bariatric patients do not adhere to recommended dietary guidelines post-operatively, they are at risk for the development of nutrition-related complications (Carlos do Rego Furtado, 2010; Beckman & Earthman, 2013).

In addition, the importance of nutrition education for bariatric surgery patients' post-surgical success has been documented in the bariatric literature. For example, in a sample of Hispanic Americans that were provided with a postoperative comprehensive nutrition education program following a roux-en-Y gastric bypass (RYGB), increased excess weight loss was found as compared to those that did not receive this intervention (Nijamkin et al., 2012). Furthermore, a pilot study conducted by Sarwer and colleagues (Sarwer et al., 2012) found that providing post-operative dietary counseling helped bariatric surgery patients adhere to eating behaviors that aid in long-term weight loss maintenance (i.e., lower mean consumption of calories, sweets and fats, and greater mean consumption of protein) (Sarwer et al., 2012).

Furthermore, patients who received this counseling achieved greater weight loss compared to those who did not; however, it is important to note that this difference was not statistically significant (Sarwer et al., 2012). Interestingly, both of these studies focused on the provision of nutrition education following surgery. However, the optimal timing for bariatric patients to receive nutrition education has not been established in the literature. It is also a result of the zeal and concern a patient has before a procedure to acquire knowledge on the precautions he/she must take.



Subsequently, a large number of patients were also compliant with taking their supplemental vitamins and minerals.

Although compliance was not tested for difference between the two genders, women were found to be the more knowledgeable on overall nutrition knowledge; that could be attributed to the fact that women usually outperform men on tests on nutritional knowledge (Shikany & White, 2000; Parmenter et al., 2000).

From the remaining third, only less than half of the participants (14.4%) had insufficient dietary knowledge. One of the main barriers we found among patients acquiring sufficient knowledge was preoperative anxiety. Preoperative anxiety and stress are common in patients awaiting surgical procedures (Badner et al., 1990; McCleane & Cooper, 1990) In particular, anxiety of postoperative pain, intraoperative awareness, waiting for operation, appearing foolish, and venous cannulation are common anxieties in the preoperative period (McCleane & Cooper, 1990). Although a very inevitable limitation, the amount of fear can be significantly reduced by providing proper education and counselling to patients simultaneously by the surgical team and the clinical dietitian. It has been found that some patients typically viewed their physician as their primary source for accurate nutritional information as opposed to the clinical dietitian (Marrietta et al., 1999). If uncertainties regarding the procedure and diet are addressed in the presence of both healthcare providers, the dietitian's instructions can be received with more confidence by the patients. The lack of significance given to the dietitian's instructions can subsequently affect their compliance to post-operative protocol. With better communication of nutrition knowledge, we can expect better patient's compliance to the prescribed diet for improved health.

The results of this study also showed that four out of every five patients had regular follow-ups with their dietitian in the out-patient clinic at Rashid Hospital. These numbers may be a result of the scheduling protocol implemented at the clinic. The hospital assigns each patient to a bariatric coordinator who ensures that the patient consults with both their surgeon and dietitian prior to being discharged from the hospital as well as throughout their follow-up. Awareness of good nutrition after surgery is also well promoted by the clinical staff, positively contributing to patients' perceived importance of regular follow-ups with their dietitian.

Interestingly, the patients' compliance to the dietitian's instructions was only rated average. As mentioned earlier, lack of sufficient knowledge is one reason for this finding. However, multiple personal reasons also influence patients' compliance including social pressures. In an environment where unhealthy diet is prevalent it may be difficult for patients to adhere to a strict healthy diet. Many people also find food as a source of enjoyment, therefore compliance to protocol becomes weak when palatability is given more importance. However, it is important that patients need to comprehend that surgery has changed their body, but not their environment. Therefore, it is pertinent that they choose healthy foods, avoid skipping meals, and regularly visit their dietitians' after their surgery as per the follow-up protocols.

Additionally, patients who have undergone bariatric surgery are vulnerable to nutritional deficiencies. It may result in poor memory recall and concentration if the daily nutrition needs are not fulfilled (Becker et al., 2012). This could also make it difficult for the patients, especially older to be compliant with the post-operative protocols.

Similarly, the effects of anesthesia post-op also influence the patients' level of concentration (Harris & Chung, 2013). Post-operative cognitive dysfunction is a fairly common occurrence in patients. 9.9% of patients who undergo major non-cardiac surgery have faced temporary decreased cognitive function or post-op delirium due to general anesthesia (Harris & Chung, 2013). The potent analgesia given post-op along with post-surgical stress also decreases concentration among patients. During this period, patients may find it hard to retain given instructions, hence decreasing their compliance to the prescribed diet.

Finally, miscommunication and lack of clarity and simplicity in the dietitian's conveyance of instructions lead to poor knowledge and subsequently decreased compliance to dietary protocol among patients. Although most patients in this study highlighted the importance of visiting the dietitian, they rated the dietitian's instructions as vague and unclear. In fact, there was a strong positive correlation between the level of clarity of information conveyed and patients' compliance. This could be a result of a common mistake made by healthcare providers where information is provided to the patient, but their level of understanding is not reassessed which is a vital part of patients' education. Moreover, it was found that only some of the patients received dietitian consultation prior to the surgery whereas majority of the patients received consultation after the surgery, when they were undergoing the cognitive and physical side effects of anesthesia and post-surgical stress to the body. This could be another reason for the lack of clarity of information received by the patients.

## 5.2 Post-Surgery Nutritional Side Effects and Quality of Life

Dumping syndrome is a complication that many candidates of bariatric surgery endure with a prevalence reaching up to 50% (Chaves & Destefani, 2016). Majority of the patients who were surveyed (71.1%) did not know what dumping syndrome is or its symptoms; although a fair number of patients (28.9%) were knowledgeable about it. This could be attributed to the fact that the patients were not given adequate patient education about the medical terms which were used in the survey but responded affirmatively when asked in the clinic about their symptoms.

Nausea and vomiting were the two most common symptoms experienced by over 50% of the patients. These symptoms are due to a number of reasons but the two most common reasons are noncompliance to a post-bariatric surgery diet and the physiological side effects of surgery (Halliday & Sundgvist, 2017). A high number of patients who experienced these symptoms can be correlated with the decreased compliance to dietary instructions in patients; however, the physiological aspects cannot be differentiated. The mechanical and physiological complications that occur in the gut are due to its change in anatomy – the most common complication being ulcers at the site of anastomosis (Pandolfino, 2004). Ulcers are known to cause both, nausea and vomiting even in non-surgical candidates. A high incidence of nausea and vomiting in the post gastropasty period was previously reported even when anti-emetic prophylaxis was given to the patients (Halliday & Sundgvist, 2017). Nonetheless, when it comes to a disease, lack of appropriate self-care and symptoms of disease are often linked with lack of adherence to the dietary recommendations which is crucial for the control of symptoms (Bennet et al., 1998; DiMatteo, 2004).

When the participants of the present study were asked to reflect on their decision to undergo bariatric surgery, majority of participants (69%) had positive responses about their quality of life. They stated that they were able to enjoy life more and participate in more activities than before. One of the reasons for this could be because patients, who undergo post-bariatric surgery and lose weight, have better motor function and exercise tolerance. Motor abilities are impaired with obesity as increased adiposity is related to poor muscle quality which is directly related to motor fitness (Wang et al., 2016). With an increased BMI and fat tissue there is decreased motor conduction velocity along with motor control and speed (Wang et al., 2016). There is also an increased level of cognition after the procedure. When there is an excess in body weight, there is an increase in insulin resistance and inflammation in the body which puts stress on cerebral catabolism. This process is reversed with weight loss (Hawkins et al., 2015; Marques et al., 2014). With the improvement of mental and physical functionality, there is a significant improvement in how our patients felt about their body-image which boosted their self-confidence, self-esteem, and subsequently quality of life.

Only a small number (5%) of participants in this present study stated that they regret their decision to undergo post-bariatric surgery and complained feeling fatigued and agitated most of the times. However, their compliance to post-surgical protocol was not compared with their lack of improvement of daily life to draw a comparative conclusion. The psychological effects of having undergone a major surgery also play a vital role in the way each patient feels about themselves post-op. When there is weight-regain or when the expectations from a bariatric surgery are not met, there is inevitable psychological failure having a marked effect in patients' quality of life (Kubik et al., 2013).

## Chapter 6: Conclusion

The aim of the study was to assess patients' dietary knowledge and adherence to post-bariatric dietary protocol. Overall, the participants had moderately acceptable knowledge of post-bariatric surgery dietary protocol. On the other hand, their compliance to the dietary instructions was limited. Possible reasons for their poor adherence to the dietitians' instructions were identified. These results will be useful in improving nutrition counseling provided to post-bariatric surgeries patients and have the potential to improve patients' compliance to the recommended dietary protocols. Furthermore, future research on the relation of compliance to dietary protocols and improved quality of patient's life post-bariatric surgeries are needed to further our understanding the relationship of bariatric patients and nutritional attitudes.

The main limitation of this study was the relatively small number of patients' surveyed which left us with 10% error, in addition to the fact that the sample size had no scientific basis in relation to previous studies of the same kind on similar patients since this study to the best of our knowledge is done for the very first time. With a larger sample size, participants could have been grouped according to age and it could have provided better understanding about the association between age and compliance to dietary instructions. Previous studies have reported less compliance among elderly patients to protocols following major procedures due to higher rates of post-operative cognitive dysfunction (Harris & Chung, 2013). By comparing the level of compliance and dietary knowledge among the different age groups, we could identify the gaps for the requirements of more care and counseling in order to improve the quality of patient care. On the other hand, there was some selection bias, since this study was only conducted in Rashid's hospital outpatient clinic, and did not include other Dubai

Health Authority (DHA) facilities. There was also lack of a “gold standard” nutritional questionnaire designed specifically for patients who have undergone a bariatric surgery. Most of the instruments developed to examine nutritional knowledge have not been validated or have only cross-examined a specific subtopic within the field of nutrition (e.g. fat content, cholesterol content) (Steenhuis et al., 1996). A more efficient method of data collection would allow for accurate results and effective means that can be made which can help in incorporating improvements in the dietary management process. Another limitation is that the stage in which the patients are on (e.g.: clear fluids, full fluids.. etc.), will reflect on their answers, they will either have better responses for the knowledge of the dietary protocol post-op since they had more encounters/follow-up visits with the dietitian or they will have less knowledge since it was long ago since they have been operated on and received education of the dietary protocol post-op, so it is a two sided coin. If similar studies are conducted, it could possibly lead to the setting of a unified, scientific-based guideline to be followed globally for the dietary management of post-bariatric patients. In addition, it is recommended that in the booklet handed to patients pre-discharge at Rashid Hospital and other DHA facilities, it includes information about nausea, vomiting, food intolerance, hair loss, constipation, hypoglycemia, dumping syndrome and ways to identify it and deal with it in case it occurs, as well as preventive measures.

## References

1. Aasheim, E., Mala, T., Olbers, T. (2009). Vitamin status after bariatric surgery: a randomized study of gastric bypass and duodenal switch. *American Journal of Clinical Nutrition*, 90(1): 15–22.
2. Abdel-Galil, E., Sabry, A. (2002). Laparoscopic Roux-en-Y gastric bypass—evaluation of three different techniques. *Obes Surg*, 12: 639–642.
3. Academy of Nutrition and Dietetics, (2013). Nutrition Care Manual. Retrieved from <http://www.nutritioncaremanual.org>.
4. Alvarez-Leite, J.I. (2004) Nutrient deficiencies secondary to bariatric surgery. *Current Opinion in Clinical Nutrition & Metabolism Care*; 7(56): 9–75.
5. American Society for Metabolic and Bariatric Surgery, (2018). Candidates for a Bariatric Surgery, <https://asmbs.org/patients/who-is-a-candidate-for-bariatric-surgery>.
6. Anderin, C., Gustafsson, U.O., Heijbel, N., and Thorell, A. (2015). Weight loss before bariatric surgery and postoperative complications: data from the Scandinavian Obesity Registry (SOReg). *Annals of Surgery*; 261: 909–13.
7. Angrisani, L., Buchwald, H., Formisano, G. (2015). Bariatric Surgery Worldwide 2013. *Obesity Surgery*, 10:1822-32
8. Aron-Wisnewsky, J., Verger, E. O., Bounaix, C., Dao, M. C., Oppert, J.M., Bouillot, J.L., Clément, K., (2016). Nutritional and Protein Deficiencies in the Short Term following Both Gastric Bypass and Gastric Banding. *PLoS ONE*. 11(2). <http://doi.org/10.1371/journal.pone.0149588>
9. Badner, N., Nielson, W., Munk, S., Kwiatkowska, C., Gelb, A. (1990). Preoperative anxiety: detection and contributing factors. *Can J Anaesth*, 37: 444-7.
10. Baldwin, C., & Weekes, C., (2011). Dietary advice with or without oral nutritional supplements for disease-related malnutrition in adults. *The Cochrane Database of Systematic Reviews*, 9: 26-37
11. Balsa, J., Arrieta, F., Vazques, C. (2011). Copper and zinc serum levels after derivative bariatric surgery: differences between Roux-en-Y gastric bypass and biliopancreatic diversion. *Obesity. Surgery*. 217: 44–750.



12. Balsiger, B., Poggio, J., Mai, J., Kelly, K., Sarr, M. (2000). Ten and more years after vertical banded gastroplasty as primary operation for morbid obesity. *J Gastrointest Surg*, 4: 598–605.
13. Becker, D., Balcer, L., & Galetta, S., (2012). The Neurological Complications of Nutritional Deficiency following Bariatric Surgery. *Journal of Obesity*, 12: 1-8.
14. Beckman, L., Earthman, C. (2013). Nutritional implication of bariatric surgery and the role of registered dietitians. *J Acad Nutr Diet*, 113(3): 398–9.
15. Bennett, S., Huster, G., Baker, S., Milgrom, L., Kirchgassner, A., & Birt, J., (1998). Characterization of the precipitants of hospitalization for heart failure decompensation. *American Journal of Critical Care*, 7: 168–174.
16. Bloomberg, R.D., Fleishman, A., Nalle, J.E., Herron, D.M., & Kini, S., (2005). Nutritional deficiencies following bariatric surgery: what have we learned? *Obesity Surgery*, 15: 145–154.
17. Brolin, R.E., & Leung, M., (1999). Survey of vitamin and mineral supplementation after gastric bypass and biliopancreatic diversion for morbid obesity. *Obesity Surgery*; 9: 150–154.
18. Brown, J.K., Byers, T., Doyle, C., (...) & Sawyer, A.K., (2003). Nutrition and physical activity during and after cancer treatment: An American cancer society guide for informed choices. *A Cancer Journal for Clinicians*, 53(5): 268-291.
19. Buchwald, H., (2004). Bariatric surgery: a systematic review and meta-analysis. *JAMA*, 292(14): 1724–1737.
20. Camilleri M., Prather, M. (1998). Gastric motor physiology and motor disorders. In: Feldman M., Scharschmidt B. F., Sleisenger M. H., editors. *Sleisenger and Fordtran's Gastrointestinal and Liver Disease*. 6th. chapter 37. Philadelphia, Pa, USA: WB Saunders; 1998. pp. 572–586.
21. Carlos do Rego Furtado, L. (2010). Nutritional management after Roux-en-Y gastric bypass. *Br J Nurs*, 19(7):428–36.
22. Chapman, A., Kiroff, G., Game, P., (2004). Laparoscopic adjustable gastric banding in the treatment of obesity: a systematic literature review.
23. Chavez, S., & Destefani, A. (2016). Pathophysiology, Diagnosis, and Treatment of Dumping Syndrome and its Relation to Bariatric Surgery. *Arg Bras Cir Dig*, 29: 116-119

24. Concors, S.J., Ecker, B.L., & Dempsey, D.D., (2016). Complications and surveillance after bariatric surgery. *Current Treatment Options in Neurology*, 18(5): 1-12.
25. Coupaye, M., Rivière, P., & Dupré, T. (2014). Comparison of nutritional status during the first year after sleeve gastrectomy and Roux-en-Y gastric bypass. *Obesity Surgery*, 24(2): 276–83.
26. Courcoulas, A., Perry, Y., Buenaventura, P., & Luketich, J., (2003). Comparing the outcomes after laparoscopic versus open gastric bypass: a matched paired analysis. *Obesity Surgery*; 13: 341–346.
27. Cowie, M., Fox, K., & Coats, A., (2002). Hospitalization of patients with heart failure: a population-based study. *European Heart Journal*, 23: 877–885.
28. Craig, B.M., & Tseng, D.S., (2002). Cost-effectiveness of gastric bypass for severe obesity. *American Journal of Medicine*, 113: 491–498.
29. Dagan, S., Goldenshluger, A., & Sinai, T., (2017). Nutritional Recommendations for Adult Bariatric Surgery Patients. *Clinical Practice Advances in Nutrition*, 8(2): 382–394.
30. DiMatteo, M., (2004) .Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. *Medical Care*, 42: 200–209.
31. Dixon, J., Straznicky, N., Lambert, E., Schlaich, M., Lambert, G. (2011). Surgical approaches to the treatment of obesity. *Nat Rev Gastroenterol Hepatol*, 8(8):429–37.doi:10.1038/nrgastro.2011. 112PMID:21727936
32. Dyson, P., (2010).The therapeutics of lifestyle management on obesity. *Diabetes Obes Metab*, 12 (11):941–6.
33. Endevelt, R., Ben-Assuli, O., Klain, E., & Zelber-Sagi, S., (2013). The role of dietician follow-up in the success of bariatric surgery. *Surgery for Obesity & Related Diseases*, 9(6): 963–8.
34. Evangelista, L., Berg, J., & Dracup, K., (2001). Relationship between psychosocial variables and compliance in patients with heart failure. *Heart Lung: The Journal of Critical Care*, 30: 294–301.
35. Faria, S.L., Kelly, E., Lins, R.D., & Faria, O.P, (2010). Nutritional management of weight regain after bariatric surgery. *Obesity Surgery*, 20: 135–9.

36. Flancbaum, L, Belsley, S., & Drake, V. (2006). Preoperative nutritional status of patients undergoing Roux-en-Y gastric bypass for morbid obesity. *Journal of Gastrointestinal Surgery*, 10: 1033–1037.
37. Forrest, L., White, M., Rubin, G. & Adams, J., (2014). The role of patient, tumor and system factors in socioeconomic inequalities in lung cancer treatment: population-based study. *British Journal of Cancer*, 111(3): 608-618.
38. Freire, R.H., Borges, M.C., Alvarez-Leite, J.I., & Correia, M.I., (2012). Food quality, physical activity, and nutritional follow-up as determinant of weight regain after Roux-en-Y gastric bypass. *Nutrition*, 28(1): 53–58.
39. Gariballa, S., Forster, S., Walters, S., & Powers, H., (2006). A randomized, double-blind, placebo-controlled trial of nutritional supplementation during acute illness. *American Journal of Medicine*, 119(8): 693–699.
40. Gehring, N., Imoberdorf, R., Wegmann, M., Rühlin, M. & Ballmer, P., (2006). Serum albumin—a qualified parameter to determine the nutritional status? *Swiss Medical Weekly*, 136: 664–669.
41. Geltrude, M., Simona, P., Caterina, G. & Iaconelli, A. (2012). Bariatric Surgery versus Conventional Medical Therapy for Type 2 Diabetes. *The New England Journal of Medicine*, 366: 1577-1585
42. Gillespie, S., & Kadiyala, S., (2005). HIV/AIDS and food and nutrition security: from evidence to action. *Food Policy Review*, 7: 149-158.
43. Gracia, J.A., Martinez, M., & Aguilera, V. (2007). Postoperative morbidity of biliopancreatic diversion depending on common limb length. *Obesity Surgery*, 17: 1306–11.
44. Institute for Health Metrics and Evaluation, (2013). GBD Results Tool. Retrieved from <http://ghdx.healthdata.org/gbd-results-tool>
45. Halliday, T., & Sundqvist, A. (2017). Post-operative nausea and vomiting in bariatric surgery patients: an observational study. *Acta Anaesthesiologica Scandinavica*, 61(5): 471-479.
46. Hari, P., Nerusu, K., Veeranna, V., Sudhakar, R., Zalawadiya, S., Ramesh, K., Afonso, L. (2012). A Gender-Stratified Comparative Analysis of Various Definitions of Metabolic Syndrome and Cardiovascular Risk in a Multiethnic U.S. Population. *Metab Syndr Relat Disord*, 10(1): 47–55.
47. Harris, M. & Chung, F. (2013). Complications of General Anesthesia. Retrieved from <http://tinyurl.com/j48qmvd>

48. Hawkins, M., Mitchen, E., Strain, G. (2015). The association between reduced inflammation and cognitive gains after bariatric surgery. *Psychosomatic Medicine*, 77(6): 688-696
49. Heber, D., Greenway, F.L., Kaplan, L.M., Livingston, E., Salvador, J., & Still, C., (2010). Endocrine and nutritional management of the post-bariatric surgery patient: an Endocrine Society Clinical Practice Guideline. *The Journal of Clinical Endocrinology & Metabolism*, 95(11): 4823–4843.
50. Huerta, S., Rogers, L., Livingston, E. (2002). Vitamin A deficiency in a newborn resulting from maternal hypovitaminosis A after biliopancreatic diversion for the treatment of morbid obesity. *American Journal of Clinical Nutrition*, 76: 426–429.
51. Huerta, S., Dredar, S., & Livingston, E.H., (2008). Preoperative weight loss decreases the operative time of gastric bypass at a Veterans Administration hospital. *Obesity Surgery*, 18: 508–512.
52. Kasen, S., Cohen, P., Chen, H. (2008). Obesity and psychopathology in women: a three decade prospective study. *International Journal of Obesity*, 32(3): 558-566.
53. Kessler, H., Wunderlich, S. (1995). Relationship between use of food labels and nutrition knowledge of people with diabetes. *Diabetes Educ*, 25: 549-559.
54. Kim, C., Sarr, M. (1992). Severe reflux esophagitis after vertical banded gastroplasty for treatment of morbid obesity. *Mayo Clin Proc*, 67:33–35.
55. Kubik, J., Gill, R., Laffin, M., & Karmali, S., (2013). The Impact of Bariatric Surgery on Psychological Health. *Journal of Obesity*, 8: 1-5. <http://dx.doi.org/10.1155/2013/837989>.
56. Kushner, R., Cummings, S. (2013). Overview of medical management of patients after bariatric surgery. In: UpToDate, Duda, RB, ed. Waltham, MA: UpToDate.
57. Liberman, M., Sampalis, S., Stephane, A. (2004). Surgery decreases long-term mortality, morbidity, and health care use in morbidly obese patients. *Annals of Surgery*; 240: 416–423.
58. Livingston, E. (2007). Bariatric surgery in the new millennium. *Arch Surg*, 142(10): 919–922.
59. Lujan, J., Frutos, M., Hernandez, Q., et al. (2004). Laparoscopic versus open gastric bypass in the treatment of morbid obesity: a randomized prospective study. *Ann Surg*, 239: 433–437.

60. Marietta, A., Welshimer, K., & Anderson, S.L., (1999). Knowledge, attitudes, and behaviors of college students regarding the 1990 Nutrition Labeling Education Act food labels. *Journal of American Dietitian Association*, 99: 445-449.
61. Marques, E., Prando, S., Santo, M. (2014). Changes in Neuropsychological Tests and Brain Metabolism after Bariatric Surgery. *The Journal of Clinical Endocrinology & Metabolism*, 99(11): 2347-2352
62. McCleane, G., Cooper, R. (1990). The nature of pre-operative anxiety. *Anaesthesia*, 45: 153-5.
63. Mechanick, J., Kushner, R., Sugerman, H., Gonzalez-Campoy, J., Collazo-Clavell, M., Spitz, A. et al. (2009). American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery medical guidelines for clinical practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. *Obes Silver Spring Md*, 17, Suppl1:S1–70, v.
64. Mechanick, J.I., Youdim, A., & McMahon, M.M. (2013). Clinical Practice Guidelines for the Perioperative Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient- 2013 Update: Cosponsored by the American Association of Clinical Endocrinologist, The Obesity Society, and American Society for Metabolic and Bariatric Surgery. *Surgery for Obesity and Related Disease*. 9(2): 159-191.
65. Michalsen, A., Konig, G., & Thimme, W., (1998). Preventable causative factors leading to hospital admission with decompensated heart failure. *Heart*, 80: 437–441.
66. Muthike, C., Imungi, J., & Muchemi, G. (2015). Nutritional knowledge and dietary diversity of cancer patients at cancer treatment center, Kenyatta National Hospital. *African Journal of Food, Agriculture, Nutrition and Development*, 15(5): 67-78.
67. Narbro, K., Agren, G., & Jonsson, E., (2002). Pharmaceutical costs in obese individuals: comparison with a randomly selected population sample and long-term changes after conventional and surgical treatment: the SOS intervention study. *Archive of Internal Medicine*, 162: 2061–2069.
68. Neff, K.J., Olbers, T., & Roux C.W., (2013). Bariatric surgery: the challenges with candidate selection, individualizing treatment and clinical outcomes. *BMC Medicine*, 11(8): 11-16.
69. NIH, (2015). *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity*. Retrieved from [www.nhlbi.nih.gov](http://www.nhlbi.nih.gov).

70. Nijamkin, M., Campa, A., Sosa, J. et al. (2012). Comprehensive nutrition and lifestyle education improves weight loss and physical activity in Hispanic Americans following gastric bypass surgery: a randomized controlled trial. *J Acad Nutr Diet*, 112(3):382–90.
71. O’Kane, M., Pinkney, J., Aasheim, E., Barth, J., Batterham, R., & Welbourn, R., (2014). BOMSS Guidelines on perioperative and postoperative biochemical monitoring and micronutrient replacement for patients undergoing bariatric surgery. [e-report] *British Obesity and Metabolic Surgery Society*. Retrieved from [www.bomss.org.uk/wp-content/.../2014/09/BOMSS-guidelines-Final-version](http://www.bomss.org.uk/wp-content/.../2014/09/BOMSS-guidelines-Final-version).
72. Pandolfino, J., Krishnamoorthy, B., & Lee, T., (2004). Gastrointestinal Complications of Bariatric Surgery [e-article]. Retrieved from <https://www.medscape.com/viewarticle/4719525>.
73. Papalazarou, A., Yannakoulia, M., Kavouras, S., Komesidou, V., (2010). Lifestyle intervention favorably affects weight loss and maintenance following obesity surgery. *Obesity*, 18(7):1348–1353.
74. Parmenter, K., Waller, J., & Wardle, J., (2000). Demographic variation in nutrition knowledge in England. *Health Education Research*, 15: 163-174.
75. Plous, S., Chesne, R.B., & McDowell, A.V., (1995). Nutrition knowledge and attitudes of cardiac patients. *Journal of the American Dietician Association*, 95: 442-446.
76. Podnos, Y.D., Jimenez, J.C., Wilson, S.E., Stevens, C.M., & Nguyen, N.T., (2003). Complications after laparoscopic gastric bypass: a review of 3464 cases. *Archives of Surgery*, 138: 957–961.
77. PoitouBernert, C., Ciangura, C., & Basdevant, A., (2007). Nutritional deficiency after gastric bypass: diagnosis, prevention and treatment. *Diabetes & Metabolism*, 33(1): 13– 24
78. Prince, A., Whelan, K., & Moosa, A., (2011). Nutritional problems in inflammatory bowel disease: the patient perspective. *Journal of Crohn’s & Colitis*, 5(5): 443–450.
79. Ramírez-Prada, D., Delgado, G., Hidalgo Patiño, C., Pérez-Navero, J. & Gil Campos, M., (2011). Using of WHO guidelines for the management of severe malnutrition to cases of marasmus and kwashiorkor in a Colombia children's hospital. *Nutricion Hospitalaria*, 26: 977–983.
80. Ramsey-Stewart, G. (1995). Vertical banded gastroplasty for morbid obesity: weight loss at short and long-term follow up. *Aust N Z J Surg*, 65:4–7.



81. Ross, L.J., Wallin, S., Osland, E.J., & Memon, M.A., (2016). Commercial very low energy meal replacements for preoperative weight loss in obese patients: A systematic review. *Obesity Surgery*, 26: 1343-1351.
82. Sampalis, J.S., Lieberman, M., Auger, S., & Christou, N., (2004). The impact of weight reduction surgery on health-care costs in morbidly obese patients. *Obesity Surgery*, 14: 939-947.
83. Sarwer, D., Moore, R., Spitzer, J. et al. (2012). A pilot study investigating the efficacy of postoperative dietary counseling to improve outcomes after bariatric surgery. *Surg Obes Relat Dis*, 8:561-8.
84. Schauer, P., Ikramuddin, S., Hamad, G., Gourash, W. (2003). The learning curve for laparoscopic Roux-en-Y gastric bypass is 100 cases. *Surg Endosc*, 17:212-215.
85. Scopinaro, N., Adami, G., Marinari, G., (1998). Biliopancreatic diversion. *World J Surg* 22:936-946.
86. Scopinaro, N., Torres, A.J., & Weiner, R., (2013). Interdisciplinary European Guidelines on metabolic and bariatric surgery. *Obesity Facts*, 6(5): 449-68.
87. Shikany, J.M., & White, G.L, (2000). Dietary guidelines for chronic disease prevention. *The Southern Medical Journal*, 93: 1157-1161.
88. Skroubis, G., (2002). Comparison of nutritional deficiencies after Roux-en-Y gastric bypass and after biliopancreatic diversion with Roux-en-Y gastric bypass. *Obesity Surgery*, 12: 551-558.
89. Snow, L.L., Weinstein, L.S., & Hannon, J.K., (2004). The effect of Roux-en-Y gastric bypass on prescription drug costs. *Obesity Surgery*, 14(8): 1031-1035.
90. Steenhuis, I.H.M., Brug, J., VanAssema, P., & Imbos, T., (1996). The validation of a test to measure knowledge about the fat content of food products. *Nutrition & Health*, 10: 331-339.
91. Stocker, D.J., (2003). Management of the bariatric surgery patient. *Endocrinol and Metabolism Clinics of North America*, 32(2): 437-457.
92. Stratton, R., Green, C., & Elia, M., (2003). Disease-Related Malnutrition: An Evidence-Based Approach to Treatment. [e-book], CABI Publishing, Wallingford, UK.
93. Takiguchi, N., Takahashi, M., Ikeda, M. (2015). Long-term quality-of-life comparison of total gastrectomy and proximal gastrectomy by Postgastrectomy

- Syndrome Assessment Scale (PGSAS-45): a nationwide multi-institutional study. *Gastric Cancer*, 18(2):407–416. doi: 10.1007/s10120-014-0377-8.
94. Turconi, G., Celsa, M., Rezzani, C., Biino, G., Sartirana, M.A., & Roggi, C., (2003). Reliability of a dietary questionnaire on food habits, eating behavior and nutritional knowledge of adolescents. *European Journal of Clinical Nutrition*, 57(6): 753–763.
95. UPMC, (2016). USC Metabolic & Bariatric Surgery Program. Retrieved from <http://www.upmc.com/Services/bariatrics/candidate/Pages/benefits.aspx>
96. Wang, C., Chang, J., Ren, L., & Yan, J., (2016). Obesity Reduces Cognitive and Motor Functions across the Lifespan. *Neural Plasticity*, 1-13. doi:10.1155/2016/2473081
97. Weintraub, M., Sundaresan, P.R., & Madan, M., (1992). Long-term weight control study. I (weeks 0 to 34). The enhancement of behavior modification, caloric restriction, and exercise by fenfluramine plus phentermine versus placebo. *Clinical Pharmacology & Therapeutics*, 51: 586-594.
98. WHO, (2014). Obesity Statistics Globally and in UAE. Retrieved from <http://www.who.int/en/>
99. Wing, R., Phelan, S. (2005). Long-term weight loss maintenance. *Am J Clin Nutr*, 82(1Suppl):222S– 225S.PMID:16002825
100. Wittgrove, A., Clark, G., Tremblay, L. (1994). Laparoscopic gastric bypass, Roux-en-Y: preliminary report of five cases. *Obes Surg*, 4:353–357.
101. Ybarra, J., Sánchez-Hernández, J., & Gich, I., (2005). Unchanged Hypovitaminosis D and secondary hyperparathyroidism in morbid obesity after bariatric surgery. *Obesity Surgery*, 15: 330–5.
102. Zitsman, J., DiGiorgi, M., Fennoy, I., Kopchinski, J., Sysko, R., Devlin, M. (2015) .Adolescent laparoscopic adjustable gastricbanding (LAGB): prospective results in 137 patients followed for 3 years. *Surg Obes Relat Dis Off J Am Soc Bariatr Surg*, 11(1):101–9.
103. Wyllys, E., Andrews, E., Mix, C. (1920). ‘Dumping stomach’ and other results of gastrojejunostomy: operative cure by disconnecting old stoma. *Surgery Clinic Chicago*, 4:879–892.



## Appendices

### Appendix 1: Ethical Approval (University Student Research Evaluation Committee - Dubai Health Authority)

 GOVERNMENT OF DUBAI	<b>DUBAI SCIENTIFIC RESEARCH ETHICS COMMITTEE APPROVAL LETTER</b>	 هيئة الصحة بدبي DUBAI HEALTH AUTHORITY
--	---	--

<b>From :</b>	Dubai Scientific Research Ethics Committee (DSREC) Dubai Health Authority	<b>Date :</b>	05 Jul 2017
<b>To :</b>	Ms. Souheir Alia, United Arab Emirates University	<b>Ref :</b>	DSREC-SR-07/2017_01
<b>Study Site</b>	Rashid Hospital, DHA		

Subject: Approval for the research proposal, **"Assessment of nutrition knowledge, and dietary behavior of patient's post-bariatric surgery in the outpatient clinic in Rashid hospital, Dubai, UAE."**

Dear Ms. Souheir Alia,


Thank you for submitting the above mentioned research proposal to Dubai Scientific Research Ethics Committee, DHA. The Dubai Scientific Research Ethics Committee has been organized and operates in accordance with the ICH/GCP guidelines and the committee is registered with the Office for Human Research Protection (OHRP).

Your request was discussed with Dubai Scientific Research Ethics Committee. We are pleased to advise you that the committee has granted ethical approval for the above mentioned study to be conducted in Dubai Health Authority. However, you will have to approach the Medical Director of the Hospitals to secure permission to review any hospital records and to carry out your study in the hospital.

Please note that it is DSREC's policy that the principal investigator should report to the committee of the following:

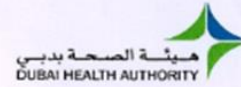
1. Anything which might warrant review of ethical approval of the project in the specified format, including:
  - any serious or unexpected adverse events and
  - unforeseen events that might affect continued ethical acceptability of the project
2. Any proposed changes to the research protocol or to the conduct of research
3. Any new information that may affect adversely the safety of the subjects
4. If the project is discontinued before the expected date of completion (reason to be specified)
5. Annual report to DSREC about the progress of the study
6. A final report of the finding on completion of the study

The approval for the study expires on **05 JUL 2018**. Should you wish to continue the study after this date, please submit an application for renewal together with the Annual Study site progress report **no later than 30 days** prior to the expiry date.





**DUBAI SCIENTIFIC RESEARCH ETHICS  
COMMITTEE  
APPROVAL LETTER**



DSREC wishes you every success in your research.

Yours faithfully,

**Dr. Suhail Abdulla Mohd Alrukn**  
Chairman  
Dubai Scientific Research Ethics Committee  
Dubai Health Authority

**Dubai Scientific Research Ethics Committee  
Dubai Health Authority  
Dubai, UAE.**



## Appendix 2: Questionnaire (English)

### Assessment of Nutrition Knowledge and Dietary Behaviors of Post Bariatric Surgery Patients Attending the Outpatient Clinic of Rashid Hospital, Dubai

#### General Information:

Gender: -Male -Female.

Marital Status: -Married -Not married.

#### General nutrition-related knowledge:

1. Which of the following is a low fat snack?

-Lay's chips -Popcorn -Fried chips

2. It is best to eat sugar-containing food only as a snack rather than a part of a meal

-True -False

3. How many fruits and vegetables should be eaten?

-1 fruit and vegetable a day -3 to 4 fruits and vegetables per day -5 or more fruits and vegetables -There is no need to eat fruits and vegetables

4. How much milk should you have a day?

-1/2 cup -1 cup -2 cups

5. Which foods contain a lot of fiber?

-Cakes and biscuits -Apples and carrots -Chips and pies -Chicken and fresh fish

6. From where do you get information about nutrition?

-School -Friends -Work -Radio/TV/magazines -Social media -Others

7. Of the choices you chose in the above question, score it on a scale of 1-10, 1 being the least reliable and 10 being the most reliable:

1 2 3 4 5 6 7 8 9 10

#### Nutrition knowledge pertaining to diet post-bariatric surgery:

1. What stage are you at now pertaining to the dietary protocol post-bariatric surgery?

-Clear fluids -Full fluids -Mashed diet -Soft diet -Regular diet

2. Which of these foods is not ok to have during the first stage (clear fluids)?

-Cream soup -Clear soup -Vegetable stock -Chicken stock

3. It is ok to resume with drinking coffee as soon as you are operated once you are allowed to eat and drink  
-True -False
4. In stage two (full fluids) you can have a fruit juice with pulp  
-True -False
5. In stage two, you can have a full fat pudding or custard  
-True -False
6. You should drink your fluids using a straw to keep things under control  
-True -False
7. You should drink minimum of 1 liter of water in the first two weeks post operation  
-True -False
8. in stage 3 (mashed diet), you can eat scrambled eggs but not boiled eggs  
-True -False
9. You should limit your portion size by having your own set of small plates and bowls  
-True -False
10. You can drink fluids prior to food directly  
-True -False
11. Main meals should not exceed  $\frac{3}{4}$ <sup>th</sup> of a cup and snacks should be within  $\frac{1}{4}$  to  $\frac{1}{2}$  of a cup  
-True -False
12. Apple sauce is considered to be ok to have in stage 3, unlike a whole apple  
-True -False
13. Which of these cheeses is considered to be the lowest in fat and is suitable for patients post-surgery?  
-Cheddar cheese -Akkawi -Halloumi -Cottage cheese and/or AlQarish
14. It is advisable to have low fiber intake post-surgery in order to prevent blockage  
-True -False
15. Are you compliant with taking your vitamin/mineral supplement?  
-Yes -No
16. It is advisable to have a high protein diet through consuming the protein supplements prescribed by the dietitian in order to help in sparing your muscle mass, and to help in the wound healing process  
-True -False

17. Do you know what dumping syndrome is?

-Yes -No

18. Do you know which foods promote the occurrence of dumping syndrome?

-Yes -No. If yes specify \_\_\_\_\_

19. The diet you should follow post bariatric surgery on the long run should be low in fat, low to moderate in fiber, medium to high in protein, and low in simple sugars

-True -False

20. Symptoms of dumping syndrome are all except for:

-Nausea -Cramping -Diarrhea -Low blood sugar levels -Sweating -Fast heart rate -Bleeding

21. Are you following up with your dietitian or you think it is not that much of an importance:

-Yes I am -No I am not -Who cares?

22. Rate your compliance with the post-bariatric surgery dietary protocol on a scale of 1 to 10 (1 being non-compliant and 10 being very compliant)

1 2 3 4 5 6 7 8 9 10

23. Rate the clarity of the information conveyed to you by the dietitian on a scale of 1 to 10(1 being so clear, 10 being vague and unclear nor understood)

1 2 3 4 5 6 7 8 9 10

24. Which of these problems have you encountered?

-Nausea -Vomiting -Dizziness -Dehydration -Dumping Syndrome -None - All of the former

25. Post your surgery, how often you felt agitated, fatigue, and regretted your decision of getting operated

-Never -Sometimes -Rarely -All the time

26. In your daily activities and your leisure activities are they

-More enjoyable -Less enjoyable -Same as before surgery

### Appendix 3: Questionnaire (Arabic)

تقييم المعلومات التغذوية والسلوك التغذوي للمرضى بعد عمليات السمنة في العيادات الخارجية في مستشفى راشد بدبي, الامارات العربية المتحدة.

#### معلومات عامة:

الجنس: ذكر انثى، الحالة الاجتماعية: متزوج غير متزوج.

#### معلومات تغذوية عامة

من من هذه الاكلات يجتوي على اقل كمية دهون؟

شيبس لايز الفوشار البطاطس المقلية

يعد من الافضل ان تأكل الاكلات العالية في السكر كوجبات خفيفة عوضا عن مع الوجبات الرئيسية

صح خطأ

كم حصة من الخضروات والفواكه ينبغي عليك ان تأخذ يوميا

حبة واحدة من الخضروات والفواكه 3 الى 4 حبات 5 او أكثر ليس من الضروري ان تحصل على الخضروات والفواكه

كم كوب حليب يتوجب عليك ان تأخذ باليوم الواحد؟

2\1 1 2

من من هذه الاكلات يحتوي على أعلى كمية ألياف؟

البسكويت والكيك التفاح والجزر البطاطس المقلية والبطاطس الدجاج والسكك

من اين تحصل على معلومات غذائية؟

المدرسة مكان العمل الراديو\التلفاز\المجلات الاعلام المجتمعي غير ذلك

من اختيارك اعلاه, يرجى تحديد مستوى المصدقية من 1-10 على ان 1 تدل على عدم المصدقية و 10 على مصداقية كاملة من الاختيار من السؤال اعلاه

10 9 8 7 6 5 4 3 2 1

#### المعلومات التغذوية المتعلقة بالحمية التي يجب اتباعها بعد عمليات السمنة

انت في أي مرحلة؟

السوائل الشفافة السوائل الكاملة الاكل المهروس الاكل اللين الاكل العادي

اي من هذه الاكلات لا يتوجب أكله في مرحلة السوائل الشفافة؟

شوربة الكريمة شوربة الشفافة مرق الدجاج مرق الخضار

انه من الممكن شرب القهوة, بعدما تمت العملية وسمح لك بالاكل والشرب

صح خطأ

في المرحلة الثانية, يمكنك شرب عصير الفواكه مع اللب

صح خطأ

في المرحلة الثانية, يمكنك تناول الكسترد كامل الدسم

صح خطأ

يمكنك شرب السوائل باستخدام المصاصة

صح خطأ

يجب ان تشرب لتر من الماء على الاقل في اول اسبوعين بعد العملية

صح خطأ

في المرحلة الثالثة وهي الاكل المهروس يمكنك اكل البيض المخفوق

صح خطأ

يجب ان تحد من كمية الاكل عن طريق استخدام صحون اصغر من ما انت معتاد عليه

صح خطأ

يمكنك شرب السوائل قبل الاكل مباشرة

صح خطأ

الوجبات الرئيسية يجب الا تتعدى 4\3 كوب والوجبات الخفيفة ما بين 1\4 الى 1\2 كوب

صح خطأ

صلصة التفاح او مربى التفاح من الاطعمة المسموحة في المرحلة الثالثة على عكس التفاح الطازج

صح خطأ

اي من هذه الاجبان يعد اقل نسبة دهون ويناسب المريض بعد عمليات السمنة

التشيدر العكاوي الحلومي القرش او الكوتج

يجب ان يتبع نظام غذائي قليل بالالياف بعد عمليات السمنة لكي لا تسد الامعاء

صح خطأ

هل انت ملتزم بحبوب الفيتامينات والمعادة التي وصفها طبيبك

نعم لا

يجب على المريض بعد اجراء العملية ان يتبع حمية عالية بالبروتين لكي يحافظ على كتلته العضلية و يساعد

على التنام الجروح

صح خطأ

هل سمعت عن متلازمة التفريغ المعوي السريع "الدمبنج سيندروس"

نعم لا

هل تعرف اي الاكلات او الاطعمة التي تحفز حصول هذه المتلازمة

نعم لا. اذا كانت الاجابة نعم يرجى كتابة هذه

الاطعمة

الحمية التي تجب اتباعها على المدى البعيد يجب ان تكون عالية في البروتين, منخفضة الى متوسطة بالالياف, قليلة بالدهون, وقليلة بالسكريات البسيطة

صح خطأ

اعراض متلازمة التفريغ المعوي السريع هي جميع ما ذكر ادناه الا:

الاحساس باللوعة الانقباضات المعوية الاسهال انخفاض مستوى السكر في الدم التعرق سرعة خفقان القلب النزيف

هل تتبع نصائح اخصائية التغذية او تظن انه ليس له اهمية؟

نعم لا لا ابالي

حدد على مقياس من 1 الى 10 مستوى تقييدك والتزامك بالحمية التي يجب ان تتبعها بعد عملية السمنة (مثال: 10 اتبعتها تماما, 1 لم اتبعها على الاطلاق)

10 9 8 7 6 5 4 3 2 1

حدد على مقياس من 1 الى 10 مدى وضوح المعلومات التي وصلتك من اخصائية التغذية (مثال: 1 كانت غير واضحة على الاطلاق, 10 كانت واضحة جدا)

1 2 3 4 5 6 7 8 9 10

اي من هذه المشاكل قمت بمواجهتها بعد العملية

الاحساس باللوعة الاعياء الدوخة الجفاف متلازمة التفريغ السريع للمحتوى المعوي كل ما ذكر لاشيء مما ذكر

بعد العملية, هل تشعر بضيق, وتعب, وتشعر بالندم بشكل مستمر

-ابدا -في بعض الاحيان -نادرا -دائما

في نشاطاتك اليومية ونشاطاتك الترفيهية هل تشعر انها

-أكثر متعة -أقل متعة -لم أشعر بأي تغيير