ASSESSMENT OF PROTEIN INTAKE AND SOCIAL SUPPORT AMONG BARIATRIC SURGERY PATIENTS

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ABSTRACT

People who have bariatric surgery often fall short of their desired weight loss. The purpose of this study was to assess adherence to protein recommendations of the post-bariatric surgery patients. Results of 59 participants indicated that over half did not meet protein recommendations. Over half used protein supplements to help meet the recommendations. Another purpose of this study was to determine individuals whom post bariatric surgery patients identified as important in their social support network. The use of social support bariatric groups was also assessed. Results showed bariatric support groups were an important form of social support to aid in weight loss. Both studies will aid healthcare professionals deepen their understanding of the long journey of weight loss in post-bariatric surgery patients. Bariatric surgery is an effective solution for individuals with obesity because it results in long-term weight loss; therefore, learning the characteristics of successful bariatric surgery patients is priority.

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CHAPTER 1. INTRODUCTION

The National Health and Nutrition Examination Survey (NHANES) has documented that obesity is increasing at an alarming rate within the United States. Obesity is classified into three main categories, with class I identified as a body mass index (BMI) between 30.0 kg/m^2 and 34.9 kg/m^2; class II as a BMI between 35.0 kg/m^2 and 39.9 kg/m^2; and class III as having a BMI greater than or equal to 40.0 kg/m^2 (National Institute of Health: National Heart, 2016). Between the years 2013-2014, overall age-adjusted prevalence of obesity was 37.7% overall, with 35.0% of men and 40.4% of women were classified as obese (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). Furthermore, between 2013-2014 overall class III obesity, or being over 100 pounds over normal levels, was present in 7.7% of the adult population (Flegal et al., 2016). Moreover, the majority of individuals with obesity are within the 40-59 years age group (see Figure 1.1), resulting in detrimental health consequences (Flegal et al., 2016). Obesity continues to impact millions of people throughout the United States.

	Odds Ratio (95% CI)			
	Men		Women	
	Obese, All Grades	Class III Obesity	Obese, All Grades	Class III Obesity
Age group				
20-39	1 Reference	1 Reference	1 Reference	1 Reference
40-59	1.28 (0.92-1.78)	0.86 (0.50-1.45)	1.37 (1.10-1.71)	1.15 (0.74-1.77)
≥60	1.19 (0.74-1.91)	0.78 (0.29-2.07)	1.05 (0.84-1.32)	0.56 (0.38-0.82)
Education				
High School	1 Reference	1 Reference	1 Reference	1 Reference
<High School	0.92 (0.65-1.31)	0.74 (0.37-1.46)	0.91 (0.67-1.24)	0.88 (0.58-1.35)
>High School	0.96 (0.70-1.31)	0.89 (0.60-1.32)	0.68 (0.54-0.87)	0.90 (0.57-1.41)

Figure 1.1. Prevalence of Age-Adjusted Obesity within the United States: 2013-2014. Adapted from: Flegal et al., 2016, p. 2288.

Geographically, obesity mostly affected individuals in the Midwest and southern regions of the United States in 2014 (see Figure 1.2). In fact, adult obesity is above 20% in all fifty states and above 35% in five states (Segal, Rayburn, & Martin, 2016). Additionally, obesity is most

prevalent in Louisiana and least prevalent in Colorado (Segal et al., 2016). Although the prevalence of obesity has increased in two states (Kansas and Kentucky), it has also decreased in four states (Minnesota, Montana, New York, Ohio), marking the first decline in obesity within the last 10 years (Segal et al., 2016); therefore, showing there are solutions to stop this obesity epidemic from growing.

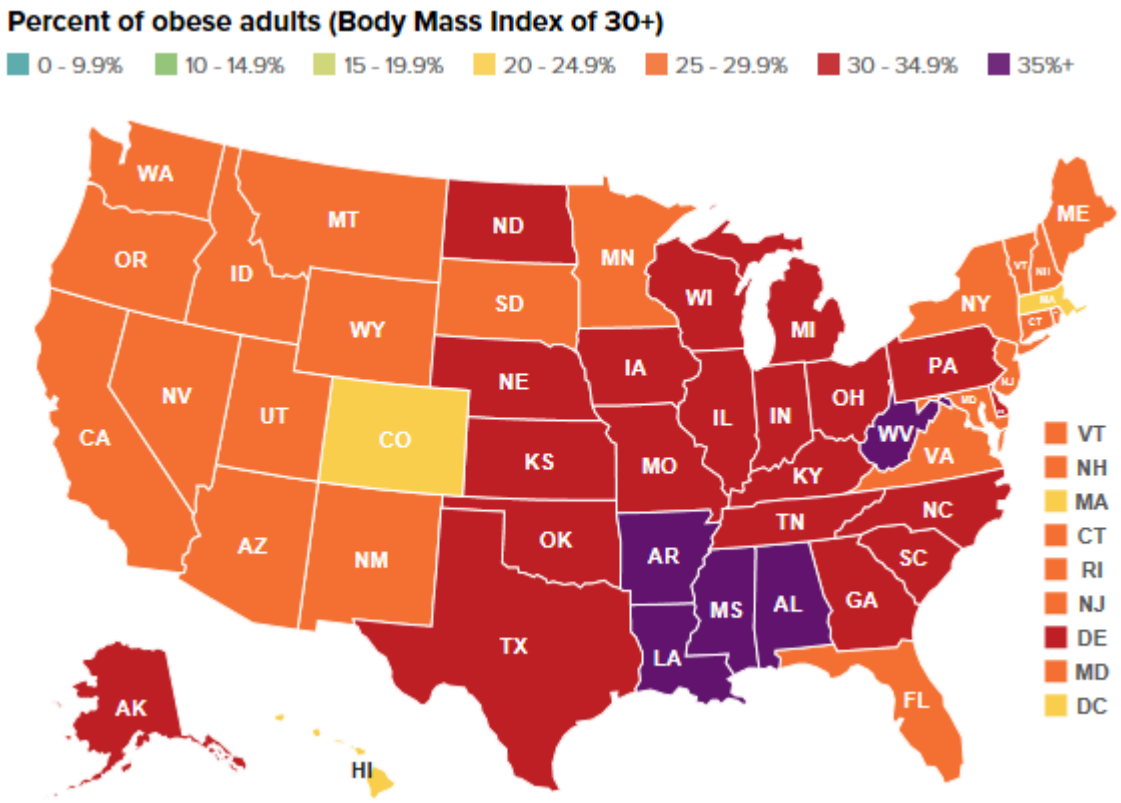


Figure 1.2. Obesity Prevalence by State: 2016.
Used with permission from (Segal et al., 2016).

Bariatric surgery is considered a highly effective treatment for obesity. Bariatric surgery improves obesity-related comorbidities, such as high blood pressure, type II diabetes, and heart disease and results in long-term weight loss (Adams, Davidson, Litwin, & et al., 2012; Arterburn & Courcoulas, 2014; Major et al., 2015; National Institute of Health: National Heart, Lung, and Blood Institute 2016; Schauer et al., 2014). Additionally, increased weight loss and remission of

obesity-related comorbidities result in overall improved quality of life for individuals who choose bariatric surgery as a solution to obesity (Major et al., 2015; Nadalini et al., 2014; Natvik, Gjengedal, & Raheim, 2013). With four different types of bariatric surgery available to individuals, they are able to choose the best surgical procedure for their lifestyle. Listed in order from least to most invasive, the four main types of bariatric surgery include: Laparoscopic Adjustable Gastric Banding (LAGB), Vertical Sleeve Gastrectomy (VSG), Roux-en-Y Gastric Bypass (RYGB), and Biliopancreatic Diversion with Duodenal Switch (BPD-DS) (Marihart, Brunt, & Geraci, 2014). Overall, bariatric surgery is a successful solution to the ongoing obesity epidemic (Adams et al., 2012; Arterburn & Courcoulas, 2014; Major et al., 2015; Nadalini et al., 2014; Natvik et al., 2013; Schauer et al., 2014).

Although bariatric surgery is an effective solution for obesity, it does present challenges that may hinder individuals' success in losing weight. These challenges may include psychological barriers, difficulty meeting nutritional needs, and general weight loss maintenance following bariatric surgery (Geraci, Brunt, & Hill, 2015; Verger et al., 2016). Psychological barriers, such as having a constant fear of gaining back the weight, significantly influences weight status as individuals must find a new way to cope with daily life stressors and emotional eating (Geraci et al., 2015). Maintaining nutrition status while restricting total intake poses a large health risk for individuals, which emphasizes the importance of consistently adhering to supplementation recommendations (Saltzman & Karl, 2013). Exploring how individuals overcome psychological and nutrient intake barriers is key for individuals who assist those who want to find success following bariatric surgery.

Moreover, social support plays an essential role for weight loss after bariatric surgery (Keyserling et al., 2016). Social support may include family members, significant others, friends,

mentors, and bariatric surgery social support groups (Himes et al., 2015; Keyserling et al., 2016). Having a strong social support network influences individuals' weight status, depressive feelings, and self-efficacy (Chacko, Yeh, Davis, & Wee, 2016; Geraci, Brunt, & Marihart, 2014; Himes et al., 2015); hence, social support plays a critical role in assisting individuals to continually lose weight or meet their weight loss goals.

Research Questions

- Does bariatric surgery social support group attendance increase weight loss for individuals post-surgery?
- Do individuals who undergo bariatric surgery adhere with post-surgical protein supplementation recommendations?
- What resources do individuals use to make compliance with supplement recommendations easier following bariatric surgery?

Significance of the Study

This study emphasized the importance of adequate dietary intake, healthy weight maintenance, and overall health status of individuals who have undergone bariatric surgery. Individuals who underwent bariatric surgery did not meet protein recommendations when they were at least three years post-surgery (Giusti et al., 2016). This may be due to calorie restriction, time since surgery, or development of a protein intolerance following surgery (Aron-Wisnewsky et al., 2016; Donadelli et al., 2012; Giusti et al., 2016; Moize et al., 2013; Verger et al., 2016).

Furthermore, evidence determined close monitoring of dietary intake and adherence to the supplementation regime after surgery is key in preventing nutritional deficiencies (Verger et al., 2016). Likewise, evidence using biomedical, dietary history, and clinical methods established that most individuals do not meet protein recommendations several years post-surgery (Andreu,

Moize, Rodriguez, Flores, & Vidal, 2010); however, research failed to account for individuals who consumed adequate protein. The question of how individuals who underwent bariatric surgery adhere to post-surgical protein and micro-nutrient supplementation recommendations persists. If this question were to be answered, it would provide guidance to the bariatric surgery population of how to consume adequate protein post-surgery.

Moreover, research confirmed individuals develop vitamin and mineral deficiencies despite diet and supplementation recommendations because of decreased absorption of nutrients in the small intestine. (Donadelli et al., 2012; Moize et al., 2013). Individuals faced several challenges associated with consuming dietary recommendations post-surgery; but research fails to address what these challenges are. Thus, examining the challenges associated with consuming the dietary recommendations following bariatric surgery would assist individuals in finding solutions to such challenges.

Organization of Thesis

This thesis is organized into chapters and is written in article format. The first chapter includes the introduction, research questions, the significance of the study, delimitations, limitations, and definitions. The following chapter is the literature review. Chapter three is an overview of the methods that will be used to conduct the study. Chapter four and five will consist of articles suitable for publication in a peer-reviewed journal. The final chapter is a summary of the results and conclusion.

Delimitations

This study was delimitated to individuals who have undergone one of the four types of bariatric surgery who are at least six months' post-surgery in the United States. To be included in the study, participants must have internet and email access allowing them to complete the survey.

In order to obtain participants, 10 randomly selected bariatric surgery support groups were contacted for permission to send the survey to its members. Once a minimum of 50 participants responded after contact with the 10 selected support groups, no additional support groups were contacted. Additionally, the survey was only available to participants for a 10-week time span in order for data to be collected.

Limitations

With a minimum goal of 50 participants who have internet and email access, this study may have been limited to the depth and scope of knowledge represented by the members of the bariatric surgery community. If this study was conducted in both the electronic and paper format, more data would have been collected from the older generations who may not have computer skills or access, providing a wider scope of participants who have a different depth of knowledge. Furthermore, due to the online format of the survey, responsibility was placed on the participant to complete the survey. To compensate for this, the researcher sent out the survey in increments of two weeks until the final call was made for participant's last chance to complete the survey 10 weeks later.

Definition of Terms

Biliopancreatic Diversion with Duodenal Switch – a vertical sleeve gastrectomy is constructed and the division of the duodenum is performed immediately beyond the pylorus. One portion of the pylorus is connected to the duodenum, while the other portion is connected to the ileum (Neff, Olbers, & le Roux, 2013).

Dumping Syndrome – a complex GI and vasomotor response to the presence of larger-than-normal quantities of hypertonic foods and liquids in the proximal small intestine. Usually occurs as a result of surgical procedures that allow excessive amounts of liquid or solid foods to

enter the small intestine in a concentrated form (Mahan, Escott-Stump, Raymond, & Krause, 2012).

Healthcare Sponsored Bariatric Support Group – bariatric surgical centers must make available organized and supervised support groups for patients who have undergone bariatric surgery. A licensed healthcare professional must be present or lead all meetings. This form of support group meeting aid patients with drastic dietary and lifestyle changes that accompany bariatric surgery (Orth, Madan, Taddeucci, Coday, & Tichansky, 2008).

Hemoglobin A1c – the accepted measure of long-term plasma glucose control in diabetics (levels ≥7 percent reflect poor blood glucose control) (Kim et al., 2015).

Laparoscopic Gastric Banding – a band with an inner inflatable elastic balloon is placed around the proximal stomach just below the gastroesophageal junction. The band can be tightened through an access port by the injection or withdrawal of saline solution (Neff et al., 2013).

Obesity – a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health is impaired (Ofei, 2005).

Percent of Excess Weight Loss – a common metric tool for reporting weight loss after bariatric surgery. Calculated by subtracting an individual's ideal body weight from their actual weight in order to get their excess weight. Excess weight is then multiplied by the percent of expected weight loss. The percent of expected weight loss differs between procedures (Montero, Stefanidis, Norton, Gersin, & Kuwada, 2011).

Roux-en-Y Gastric Bypass – the stomach is divided into an upper gastric pouch, which is 15 to 30 mL in volume and a lower gastric remnant. The gastric pouch is connected to the jejunum after it has been divided some 30 to 75 cm distal to the ligament of Trietz; this distal

part is brought up as a 'Roux-limb'. The excluded biliary limb, including the gastric remnant, is connected to the bowel some 75 to 150 cm distal to the gastrojejunostomy (Neff et al., 2013).

Vertical Sleeve Gastrectomy – the stomach is cut vertically, creating a gastric tube and leaving a pouch of 100 to 200 mL (Neff et al., 2013)

References

Adams, T. D., Davidson, L. E., Litwin, S. E.,. . . Hunt, S. C. (2012). Health benefits of gastric bypass surgery after 6 years. *Journal of the American Medical Association, 308*(11), 1122-1131. doi:10.1001/2012.jama.11164

Andreu, A., Moize, V., Rodriguez, L., Flores, L., & Vidal, J. (2010). Protein intake, body composition, and protein status following bariatric surgery. *Obesity Surgery, 20*(11), 1509-1515. doi:10.1007/s11695-010-0268-y

Aron-Wisnewsky, J., Verger, E. O., Bounaix, C., Dao, M. C., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Nutritional and protein deficiencies in the short term following both gastric bypass and gastric banding. *PLoS One, 11*(2), e0149588. doi:10.1371/journal.pone.0149588

Arterburn, D. E., & Courcoulas, A. P. (2014). Bariatric surgery for obesity and metabolic conditions in adults. *British Medical Journal, 349*, g3961. doi:10.1136/bmj.g3961

Chacko, S. A., Yeh, G. Y., Davis, R. B., & Wee, C. C. (2016). A mindfulness-based intervention to control weight after bariatric surgery: preliminary results from a randomized controlled pilot trial. *Complementary Therapies in Medicine, 28*, 13-21. doi:10.1016/j.ctim.2016.07.001

Donadelli, S. P., Junqueira-Franco, M. V., de Mattos Donadelli, C. A., Salgado, W., Jr., Ceneviva, R., Marchini, J. S., . . . Nonino, C. B. (2012). Daily vitamin supplementation

and hypovitaminosis after obesity surgery. *Nutrition, 28*(4), 391-396. doi:10.1016/j.nut.2011.07.012

Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Journal of the American Medical Association, 315*(21), 2284-2291. doi:10.1001/jama.2016.6458

Geraci, A., Brunt, A., & Hill, B. (2015). The pain of regain: psychological impacts of weight regain among long-term bariatric patients. *Bariatric Surgical Practice and Patient Care, 10*(3), 110-118. doi:10.1081089/bari.2015.0011

Geraci, A., Brunt, A., & Marihart, C. (2014). The work behind weight-loss surgery: a qualitative analysis of food intake after the first two years post-op. *International Scholarly Research Network Obesity, 2014*, 427062. doi:10.1155/2014/427062

Giusti, V., Theytaz, F., Di Vetta, V., Clarisse, M., Suter, M., & Tappy, L. (2016). Energy and macronutrient intake after gastric bypass for morbid obesity: a 3-y observational study focused on protein consumption. *American Journal of Clinical Nutrition, 103*(1), 18-24. doi:10.3945/ajcn.115.111732

Himes, S. M., Grothe, K. B., Clark, M. M., Swain, J. M., Collazo-Clavell, M. L., & Sarr, M. G. (2015). Stop regain: a pilot psychological intervention for bariatric patients experiencing weight regain. *Obesity Surgery, 25*(5), 922-927. doi:10.1007/s11695-015-1611-0

Keyserling, T. C., Samuel-Hodge, C. D., Pitts, S. J., Garcia, B. A., Johnston, L. F., Gizlice, Z., . . . Ammerman, A. S. (2016). A community-based lifestyle and weight loss intervention promoting a Mediterranean-style diet pattern evaluated in the stroke belt of North Carolina: the Heart Healthy Lenoir Project. *BMC Public Health, 16*, 732. doi:10.1186/s12889-016-3370-9

Kim, N., Schroeder, J., Hoffler, C. E., Matzon, J. L., Lutsky, K. F., & Beredjiklian, P. K. (2015). Elevated hemoglobin A1C levels correlate with blood glucose elevation in diabetic patients following local corticosteroid injection in the hand: a prospective study. *Plastic Reconstructive Surgery, 136*(4), 474e-479e. doi:10.1097/prs.0000000000001624

Mahan, L. K., Escott-Stump, S., Raymond, J. L., & Krause, M. V. (2012). *Krause's food & the nutrition care process*. St. Louis, Mo.: Elsevier/Saunders.

Major, P., Matlok, M., Pedziwiatr, M., Migaczewski, M., Budzynski, P., Stanek, M., . . . Budzynski, A. (2015). Quality of life after bariatric surgery. *Obesity Surgery, 25*(9), 1703-1710. doi:10.1007/s11695-015-1601-2

Marihart, C. L., Brunt, A. R., & Geraci, A. A. (2014). Older adults fighting obesity with bariatric surgery: Benefits, side effects, and outcomes. *SAGE Open Medicine, 2*, 2050312114530917. doi:10.1177/2050312114530917

Moize, V., Andreu, A., Flores, L., Torres, F., Ibarzabal, A., Delgado, S., . . . Vidal, J. (2013). Long-term dietary intake and nutritional deficiencies following sleeve gastrectomy or Roux-en-Y gastric bypass in a mediterranean population. *Journal of the Academy of Nutrition and Dietetics, 113*(3), 400-410. doi:10.1016/j.jand.2012.11.013

Montero, P. N., Stefanidis, D., Norton, H. J., Gersin, K., & Kuwada, T. (2011). Reported excess weight loss after bariatric surgery could vary significantly depending on calculation method: a plea for standardization. *Surgery for Obesity and Related Diseases, 7*(4), 531-534. doi:10.1016/j.soard.2010.09.025

Nadalini, L., Zenti, M. G., Masotto, L., Indelicato, L., Fainelli, G., Bonora, F., . . . Bonora, E. (2014). Improved quality of life after bariatric surgery in morbidly obese patients.

Interdisciplinary group of bariatric surgery of Verona (G.I.C.O.V.). *IL Giornale de Chirurgia, 35*(7-8), 161-164.

National Institute of Health: National Heart, Lung, and Blood Institute. (2016). Classification of overweight and obesity by BMI, waist circumference, and associated disease risks.

Natvik, E., Gjengedal, E., & Raheim, M. (2013). Totally changed, yet still the same: patients' lived experiences 5 years beyond bariatric surgery. *Qualitative Health Research, 23*(9), 1202-1214. doi:10.1177/1049732313501888

Neff, K. J., Olbers, T., & le Roux, C. W. (2013). Bariatric surgery: the challenges with candidate selection, individualizing treatment and clinical outcomes. *BMC Medicine, 11*, 8. doi:10.1186/1741-7015-11-8

Ofei, F. (2005). Obesity - a preventable disease. *Ghana Medical Journal, 39*(3), 98-101.

Orth, W. S., Madan, A. K., Taddeucci, R. J., Coday, M., & Tichansky, D. S. (2008). Support group meeting attendance is associated with better weight loss. *Obesity Surgery, 18*(4), 391-394. doi:10.1007/s11695-008-9444-8

Saltzman, E., & Karl, J. P. (2013). Nutrient deficiencies after gastric bypass surgery. *Annual Review of Nutrition, 33*, 183-203. doi:10.1146/annurev-nutr-071812-161225

Schauer, P. R., Bhatt, D. L., Kirwan, J. P., Wolski, K., Brethauer, S. A., Navaneethan, S. D., . . . Kashyap, S. R. (2014). Bariatric surgery versus intensive medical therapy for diabetes--3-year outcomes. *New England Journal of Medicine, 370*(21), 2002-2013. doi:10.1056/NEJMoa1401329

Segal, L., Rayburn, J., & Martin, A. (Cartographer). (2016). Adult obesity rate by state, 2014. Retrieved from http://stateofobesity.org/adult-obesity/

Verger, E. O., Aron-Wisnewsky, J., Dao, M. C., Kayser, B. D., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Micronutrient and protein deficiencies after gastric bypass and sleeve gastrectomy: a 1-year follow-up. *Obesity Surgery, 26*(4), 785-796. doi:10.1007/s11695-015-1803-7

CHAPTER 2. REVIEW OF LITERATURE

Introduction

With over one third (37.7%) of the national population affected by obesity between 2005 and 2014, the United States has the highest prevalence of obesity and overweight individuals among developed countries (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016; Martin-Rodriguez, Guillen-Grima, Marti, & Brugos-Larumbe, 2015). This becomes even more concerning when 7.7% of the entire population is classified as obese class III or 100 pounds overweight (Flegal et al., 2016). Clearly, millions of people continue to be affected by the obesity epidemic.

Obesity is classified into three main categories, with class I identified as a body mass index (BMI) between 30.0 kg/m^2 and 34.9 kg/m^2; class II as a BMI between 35.0 kg/m^2 and 39.9 kg/m^2; and class III as having a BMI greater than or equal to 40.0 kg/m^2 (National Institute of Health, 2016). Patterns in obesity from 2005 to 2014 showed an increasing trend in overall obesity and class III obesity, particularly in women (Flegal et al., 2016). These prevalence rates illustrate the need to find an effective long-term treatment for obesity. This literature review will describe the benefits and limitations of bariatric surgery; the importance of adhering to protein and supplement guidelines after surgery; and available post-surgery resources.

Investigating these topics will help clinicians assist individuals who have undergone bariatric surgery follow protein and supplementation recommendations and overcome social barriers related to the presence of non-nutrient dense foods leading them to better manage their weight. Individuals who have undergone bariatric surgery are encouraged to follow post-surgery dietary supplementation recommendations; however, supplementation compliance steadily declines up to five years post-surgery (Moize et al., 2013). This research may improve the

physical and mental health of individuals after bariatric surgery because they can successfully manage their weight. Perhaps if the bariatric community was more aware of why they are encouraged to adhere to supplementation guidelines and how to gain the capability of following these guidelines, more individuals would find success in their weight loss journey.

This literature review was conducted using Web of Science, Pubmed, and Google Scholar databases. Key words used in the search were weight loss, bariatric surgery, protein, supplementation following bariatric surgery, obesity, behavioral intervention, quality of life, adult obesity, and weight loss surgery. Additionally, from the articles that were identified, each of the reference lists were reviewed to ensure a comprehensive review of weight loss surgery. Articles included for review were original qualitative or quantitative research and review articles. These articles dated from 2012 to 2016 and focused on lifestyle intervention, bariatric surgery, protein requirements following bariatric surgery, supplementation regime following bariatric surgery, quality of life following bariatric surgery, and how individuals felt following bariatric surgery. A total of 115 articles were reviewed for this study with 36 articles included in this review. Inclusion criteria were determined based on overall relevance to research topic as demonstrated in the abstract, methods, and results of each research study.

Dimensions of wellness.

Living a life that incorporates all the aspects of wellness improves one's overall quality of life. Unfortunately, individuals with obesity may choose not to live a life centered around wellness, causing their life to become unbalanced in various dimensions of wellness. There are traditionally seven dimensions of wellness: physical, intellectual, emotional, social, spiritual, occupational, and environmental (Nathenson, Nathenson, & Divito, 2014). Individuals with obesity may choose to forgo the physical, emotional, or environment dimensions of wellness.

This may cause the presence of unhealthy food in their surrounding environments, leading to emotional eating and weight gain. Wellness is not simply a destination, but rather, a "continuum where an individual takes responsibility to maximize wellness in each of the dimensions" (Nathenson et al., 2014). Individuals are encouraged to incorporate these seven dimensions of wellness into their life after bariatric surgery.

Physical wellness.

Physical wellness requires balanced complete nutrition, adequate physical activity, weight maintenance, sleep, and stress management (Nathenson et al., 2014). For example, consuming a balanced diet by following MyPlate Guidelines (i.e. half of the meal containing fruits/vegetables) would be considered essential in achieving physical wellness, thus improving one's physical quality of life. Another instance of physical wellness would be walking at least 30 minutes four times per week to maintain adequate physical vitality.

Intellectual wellness.

Intellectual wellness is the measure of one's ability to learn from previous experiences. This includes setting goals, planning, and building cognitive capabilities (Nathenson et al., 2014). Often life becomes repetitive and individuals live a habitual life. However, challenging one's self through the mind strengthens intellectual capacity, thus improving wellness and quality of life.

Emotional wellness.

Emotional wellness brings awareness and acceptance to one's feelings. Additionally, emotional maturity is the ability for one to manage one's own stress and feelings (Nathenson et al., 2014). Overall wellness originates from within, beginning with emotional and mental health. Maintaining the ability to understand one's own feelings and accepting those feelings is key to

moving past mental barriers that stop individuals from living a positive life. Finding ways to cope with stress, anxiety, and depression is a lifelong process that leads to individuals living with an improved quality of life.

Social wellness.

Social wellness is the ability to function and collaborate with others. This dimension involves accepting help as well as accepting one's role as a community member (Nathenson et al., 2014). When individuals are depressed, have low self-esteem and self-confidence, they may find themselves alone, excluded from the world around them. This is often the case in individuals suffering from obesity. However, when individuals lose the weight, they often find a renewed sense of acceptance from the public. This, in turn, requires individuals learn how to be social with the world around them, thus, improving their quality of life.

Spiritual wellness.

Spiritual wellness is the search for meaning and purpose in life. Developing a spiritual worldview through tolerance, acceptance, and appreciation of the beliefs of others enables individuals to cultivate an understanding of the world around them (Nathenson et al., 2014). Regardless of individual beliefs, this aspect of wellness is what gives individuals a reason to get up in the morning. Believing there is a superior power contributing to the choices individuals make, builds a sense of purpose and direction in life.

Occupational wellness.

Occupational wellness encompasses personal satisfaction and enrichment in one's career (Nathenson et al., 2014). When individuals dislike their job and feel like their defining characteristics are not being used, they experience unhappiness, which interferes with other aspects in life. On the other hand, when individuals love their jobs and feel as though their

talents and skills are being incorporated into their occupation, they experience joy and fulfillment in their workplace.

Environmental wellness.

Environmental wellness is the ability to manage economic lives to reduce stress and increase financial security. The environment brings daily stresses to individuals' lives; therefore, learning how to manage such stresses is key in improving quality of life (Nathenson et al., 2014). Learning, accepting, and taking responsibility for individuals' behaviors assists in fulfilling a sense of security and overall wellness. Continuously working to develop the seven dimensions of wellness throughout one's lifetime may assist individuals in improving their overall quality of life.

Types of bariatric surgery.

The seven dimensions of wellness are strengthened as individuals live a healthy life. Historically, the research literature has compared components of wellness before and after bariatric surgery. Many research studies have found aspects of wellness were improved following bariatric surgery, thus, improving individuals' quality of life (Major et al., 2015; Nadalini et al., 2014; Natvik, Gjengedal, & Raheim, 2013). Hence, bariatric surgery can be a linking factor between an individual and an improved overall quality of life.

There are four main bariatric surgical procedures, from least invasive to most invasive: Laparoscopic Adjustable Gastric Banding (LAGB), Vertical Sleeve Gastrectomy (VSG), Roux-en-Y Gastric Bypass (RYGB), and Biliopancreatic Diversion with Duodenal Switch (BPD-DS) (see Figure 2.1). These surgeries vary in the amount of excess weight loss (%EWL), nutrient deficiencies, and unpleasant side effects; however, all types of bariatric surgery will also improve individuals' obesity-related comorbidities, overall health-related quality of life, and

increase weight loss in morbidly obese individuals (Adams, Davidson, Litwin, & et al., 2012; Major et al., 2015; Marihart, Brunt, & Geraci, 2014).

Laparoscopic adjustable gastric banding.

The least invasive weight loss surgery is the LAGB, in which an inflatable silicone elastic band is inserted around the stomach. It effectively divides the stomach into an upper and lower section connected by a narrow channel. When food is ingested, the upper portion of the stomach expands quickly because the band is in place, creating a feeling of being full, or satiety (Gletsu-Miller & Wright, 2013; Marihart et al., 2014) (see Figure 2.1b). LAGB complications are related to correct band tightness. If the band is too tight, individuals may experience persistent reflux, nausea, and vomiting. However, a loose band results in insufficient weight loss. In addition, continuous vomiting following this surgery is common and is often a cause of undernutrition. Ensuring the band is at its correct tightness is vital in order for individuals to obtain adequate nutrition (Gletsu-Miller & Wright, 2013). Furthermore, weight loss takes longer with LABG, and individuals may experience weight fluctuations requiring additional band repositioning surgeries. Moreover, LABG is reversible, has a quicker recovery time and shorter initial hospital stay; up against a 50% long-term failure rate (Marihart et al., 2014).

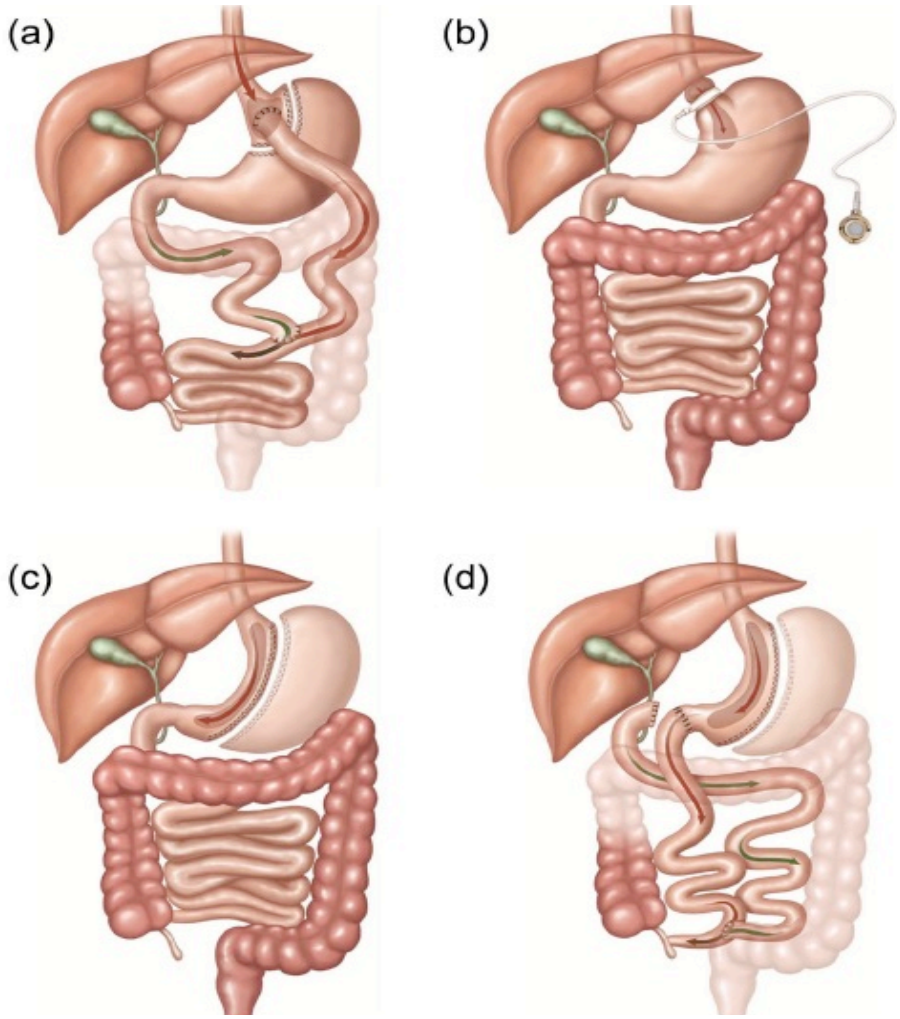


Figure 2.1. Most Common Types of Bariatric Surgery.
Used with permission from (Neff, Olbers, & le Roux, 2013)
Note: (a) is Roux-en-Y gastric bypass, (b) is laparoscopic adjustable gastric banding (LAGB), (c) is vertical sleeve gastrectomy (VSG) and (d) is Biliopancreatic diversion, with a duodenal switch.

Vertical sleeve gastrectomy.

Similar to LAGB, VSG decreases stomach size using a different method. This method consists of reconstruction of the stomach by stapling along the greater curvature of the stomach. Roughly 75% of the stomach is removed; therefore, individuals achieve early satiety following small meals. Early satiety are also be achieved through mechanisms similar to RYGB, because

the hormone ghrelin (known to increase appetite) is decreased (Gletsu-Miller & Wright, 2013) (see Figure 2.1c).

In contrast to the other two bariatric surgery methods, (RYGB and BPD-DS), and comparable to LAGB, VSG allows normal digestive and emptying processes through the stomach to the duodenum; but, unlike LAGB, VSG does not respond to ghrelin resulting in increased satiety. Therefore, VSG has fewer nutrient deficiencies than RYGB and BPD-DS (Gletsu-Miller & Wright, 2013). In addition, VSG has reduced appetite and early satiety. Furthermore, individuals who undergo VSG may experience type II diabetes emission. Unfortunately, VSG may leak over time creating complications. Moreover, weight regain is likely to occur in the long-term (Marihart et al, 2014).

Roux-en-Y gastric bypass.

Roux-en-Y-gastric bypass divides the stomach into two sections, with the upper section functioning as a small pouch that connects to the jejunum using a Y-shaped limb of small intestine. This allows food to bypass the absorptive digestive processes that take place in the duodenum, thereby, causing malabsorption of some nutrients. Instead, digestive secretions mix chyme at the junction of the jejunum and duodenum (see Figure 2.1a). Although RYGB results in decreased absorption of vitamins B-12 and D, iron, copper, calcium, and protein, this procedure has a high success rate for weight loss. In addition, alleviation of obesity-related comorbidities, such as type II diabetes, hypertension, and hyperlipidemia are also likely to occur with RYGB. Furthermore, potential side effects of bone loss, hernia/gallstone formation, and dumping syndrome, a result of decreased transit time through the digestive tract, still exist (Gletsu-Miller & Wright, 2013; Marihart et al., 2014).

Biliopancreatic diversion with duodenal switch.

Finally, the BPD-DS removes 70% of the stomach. Food bypasses the small intestine during digestion, preventing nutrient absorption in the duodenum and jejunum. When food and nutrients reach the distal ileum, excretion processes begin (see Figure 2.1d). In addition, nutrient deficiencies are likely with BPD-DS as food bypasses almost all of the small intestine; therefore, increasing the need for dietary supplements following surgery. Furthermore, BPD-DS puts an individual at an increased risk for dumping syndrome, acid reflux, and gallstone/hernia formation. Moreover, BPD-DS has a 100% remission rate of type II diabetes with improvements in high blood pressure, and a 70-80% EWL in the long-term. (Gletsu-Miller & Wright, 2013; Marihart et al., 2014).

As behavioral therapy showed no long term success in past studies (Adams et al., 2012), bariatric surgery is currently the most successful long-term method to treat obesity. Bariatric surgery results in the greatest %EWL in the long-term (i.e. more than one year post-surgery). Each procedure has its own advantages and disadvantages; it is ultimately up to the individual and the physician as to what type of surgery fits best with the individual's lifestyle and pre-surgical weight. A summary of the procedures is listed below in Table 2.1.

Table 2.1

Description, Potential Side Effects, Disadvantages and Advantages of Bariatric Surgery Procedures

Author	Type of Bariatric Surgery	Description	%EWL	Potential Side Effects	Disadvantages	Advantages
Marihart et al. (2014) Gletsu-Miller et al. (2013)	Laparo-scopic Adjustable Gastric Banding (LAGB)	An elastic band divides the stomach into two sections, connected by a channel	Wt regain likely	Vomiting, acid reflux, band may become loose, leak or slip	50% long-term failure rate, weight fluctuations due to band reposition surgeries	Quicker recovery, reversible, shorter initial hospital stay
Marihart et al. (2014) Gletsu-Miller et al. (2013)	Vertical Sleeve Gastrect-omy (VSG)	Re-sizing of the stomach occurs by removing roughly 75.0% of the stomach	> 50% EWL	Sleeve leakage	Post-surgery weight gain after 5 years	Decreased nutrient deficiencies, reduced appetite, early satiety, diabetes remission
Marihart, et al. (2014) Gletsu-Miller et al. (2013)	Roux-en-Y Gastric Bypass (RYGB)	Stomach made into pouch connected to the jejunum bypassing the duodenum	50% EWL	Dumping syndrome Bone loss, Hernia Gallstones	Thiamin, Vitamin B-12 and D, Iron, Copper, and Calcium deficiencies Decreased protein consumption/ absorption	Alleviation of obesity-related comorbidities
Marihart et al. (2014) Gletsu-Miller et al. (2013)	Bilio-pancreatic Diversion with Duodenal Switch	70.0% of the stomach is removed, limiting digestion and intake	70-80% EWL	Dumping syndrome GERD, gallstone hernia formation.	Nutrient deficiencies Increased need for supplements.	100% remission of type II diabetes with improvements in HTN and CVD.

Bariatric surgery and type ll diabetes.

A positive relationship exists between the remission of obesity related comorbid diseases and bariatric surgery. Steven, Carey, Small, and Taylor (2015) identified 62% (16/26) of

individuals who underwent the RYGB, LAGB, or VSG procedure saw hemoglobin A1c (HgbA1c) levels below 6.1% four years or less after surgery. Hemoglobin A1c is a type of blood test that measures an individual's long-term blood glucose control. For individuals without diabetes, the normal range of HgbA1c is between 5-7%. Individuals with diabetes experience HgbA1c levels above 6.5%; however, maintaining HgbA1c below 7% reduces likelihood of diabetes complications (National Institute of Health, 2014).

Studies have shown almost half of individuals who lost and kept off more than 25 kg four to eight years post-surgery will achieve a HgbA1c less than 6.1% and 62% of individuals experienced diabetes remission six years following surgery (Adams et al., 2012; Steven, Carey, Small, & Taylor, 2015). Furthermore, Major et al. (2015) concluded the percentage of individuals who sought weight loss surgery experienced remission of type II diabetes and high blood pressure was 76.5% and 72.4%, respectively. This demonstrates the effectiveness of bariatric surgery as a long-term solution to obesity and its co-morbidities.

Bariatric surgery and weight loss.

Bariatric surgery is an effective long-term treatment intervention for obesity and obesity related comorbidities, such as high blood pressure, type II diabetes, and heart disease (Adams et al., 2012; Arterburn & Courcoulas, 2014; Major et al., 2015; Moize et al., 2003; National Institute of Health, 2016; Schauer et al., 2014). Not only is it a long-term solution for obesity related comorbidities, but it also results in long-term weight loss.

For instance, Adams and colleagues (2012) found individuals who underwent bariatric surgery lost 27.7% of their initial body weight compared with individuals who opted out of weight loss surgery who did not lose any weight. Furthermore, individuals in the same study who

had surgery maintained a 20% weight loss two to six years' post-surgery. Bariatric surgery assisted individuals in losing the weight and keeping it off in the long term.

Bariatric surgery and overall health-related quality of life.

Research has indicated weight loss following bariatric surgery is associated with improved health-related quality of life post-surgery (Major et al., 2015; Nadalini et al., 2014; Natvik et al., 2013). This enhanced quality of life could be due to several factors including pre-surgical social stigma, improved physical function, and reduced health risks (Nadalini et al., 2014; Natvik et al., 2013); all of which are dramatically improved after extensive weight loss.

Pre-surgical social stigma is a complex issue related to obesity and the public's opinion of individuals with obesity. Often social stigma increases vulnerability to depression, low self-esteem, and poor body image (Natvik et al., 2013), leaving an individual feeling helpless and alone. However, post-surgery, people who had bariatric surgery noticed others' attentions and were surprised by the endless compliments of weight loss (Nadalini et al., 2014). Additionally, individuals experienced increased mobility post-surgery, allowing them to feel independent. Prior to surgery, individuals relied on caretakers; however, after surgery they no longer had to rely on the help of caretakers when maintaining personal care (Natvik et al., 2013). This allowed individuals to feel a sense of freedom and emancipation as their weight continued to decrease. Physical functioning and mobility is something non-obese individuals take for granted as they can move from one position to another independently. However, individuals with obesity often need assistance when engaging in daily living activities. After extensive weight loss, individuals feel free and liberated to move around as they please without the help of caretakers.

Furthermore, individuals experienced an improvement in their chronic conditions associated with obesity, such as high blood pressure, type II diabetes, and high blood lipids

(Major et al., 2015; Natvik et al., 2013). In fact, one year post-surgery, type II diabetes and hypertension were resolved in 76.5% of individuals who underwent VSG and 72.4% of individuals who underwent RYGB (Major et al., 2015). This enabled individuals to feel empowered by their improved health because they no longer had to complete regular blood glucose, pressure, and lipid testing. Overall, health-related quality of life related to bariatric surgery encompasses not only physical aspects, but also social and emotional dimensions of wellness.

Life after bariatric surgery.

Increased overall health-related quality of life is evident in individuals who underwent bariatric surgery. They experienced reductions in weight, improved obesity related comorbidities, and prolonged survival (Arterburn & Courcoulas, 2014; Major et al., 2015), all of which are related to physical wellbeing. However, an individual's way of thinking does not change as weight loss occurs; meaning an individuals' psychological and emotional wellbeing remain the same after bariatric surgery. Psychological long-term risks of bariatric surgery included a constant fear of weight regain, social isolation, and overcoming physical barriers (Geraci, Brunt, & Hill, 2015; Heidmann & Gronkjaer, 2015; Natvik et al., 2013).

Fear of weight regain.

Bariatric surgery patients tend to gain an average of 1.2 pounds per year beginning 18 months post-surgery following surgery (Geraci et al., 2015). Weight regain is inevitable following bariatric surgery; however, many individuals who do have surgery continue to fear the slightest amount of weight regain. Gaining weight post-surgery may be due to an individual's adherence to post-operative diet recommendations, amount of time since surgery, self-efficacy, and overall well-being. Studies support that after surgery, individuals who had used food to cope

with emotions were challenged to find new ways to deal with their emotions (Geraci et al., 2015; Geraci, Brunt, & Marihart, 2014). Psychological events, such as coping with emotions, managing diet, changing habits, and dealing with cravings were the most common mental barriers following bariatric surgery. These psychological barriers influenced individuals' weight status, causing feelings of shame and defeat following a slight weight regain (Geraci et al., 2015; Peacock, Schmidt, & Barry, 2016). However, people found attending bariatric surgery support groups assisted them in overcoming these feelings of defeat and shame, contributing to an improve quality of life (Geraci et al., 2015). Having a solid support system filled with compassion, empathy, and understanding is essential for individuals post-surgery.

Additionally, individuals found living a healthy lifestyle with adequate exercise, adherence to post-surgical diet recommendations and supplementation regime was more difficult the second year after surgery (Geraci et al., 2014). Weight loss as well as a slight weight regain 18 months post-surgery are inevitable following bariatric surgery; however, the amount of weight regain is dependent on how the individual reacts to life after surgery.

Social isolation.

Another long-term psychological risk following bariatric surgery is social isolation. Weight loss is noticeable after bariatric surgery, drawing others' attention to the individual's new physique. People with this rapid weight loss react differently to this newfound attention; individuals either become more extroverted with an enhanced self-acceptance or they become more introverted by distancing themselves from the environment around them (Natvik et al., 2013). When individuals distanced themselves from the environment and other people around them, they developed depression and feelings of loneliness. Furthermore, depression and feelings of loneliness contributed to weight regain 18 months post-surgery (Geraci et al., 2015).

However, six years following bariatric surgery, individuals felt weight loss was essential for social inclusion and perceived this inclusion as positive for their quality of life (Heidmann & Gronkjaer, 2015); therefore, individuals became more familiar and confident with their new body as time increased from date of surgery.

Overcoming psychological barriers.

As individuals became more familiar with their 'new' body, weight loss offered new opportunities for movement and function, allowing individuals to feel more independent. Nonetheless, familiarization and acclimation to individuals' smaller bodies was often a long and awkward process. Additionally, surplus skin reminded individuals of their 'fat' body and made them revisit what their life was like before surgery on a daily basis (Natvik et al., 2013). Skin folds remained a physical and mental limitation for individuals six years after surgery. Physically the skin folds affected their possibilities for being active; mentally, the skin folds made individuals feel unattractive and less self-confident, leading to a decreased quality of life (Heidmann & Gronkjaer, 2015).

Individuals who have undergone bariatric surgery are at an increased psychological risk as their emotional wellbeing persists following surgery. Simply losing weight does not take away all the hurt, depression, and repressed feelings they experienced before their surgery. Once individuals adjust to their new body and lifestyle, they can focus on their emotional wellbeing; however, this process takes time.

Weight maintenance.

Individuals' psychological health incorporates emotional, physical, social, and even environmental aspects of wellness. These aspects are continually integrated into individuals' lives as bariatric surgery results with an improved health-related quality of life due to long-term

weight loss. However, surgery alone does not take the weight off; rather, it is a combination of the surgery and the individual through weight maintenance strategies used after surgery. Individuals' lowest weight occurs approximately 12 to 18 months following surgery; therefore, it is clear individuals have a constant fear of regaining weight 18 months post surgery. However, weight regain of 1.2 pounds per year 18 months following surgery is fairly common (Geraci et al., 2014); therefore, individuals must use various weight maintenance strategies to prevent large weight regains. Weight maintenance strategies include self-monitoring, stimulus control, mindfulness, goal setting, behavioral contracting, nutrition education, social support, and physical activity (Gorin et al., 2013; Keyserling et al., 2016; Laitner, Minski, & Perri, 2016; Mason et al., 2016), all of which incorporate the dimensions of wellness. Various strategies may be used alone or in conjunction with one another to create a weight maintenance program. A summary of different weight maintenance strategies are presented below in Table 2.2.

Self-monitoring.

Self-monitoring involves recording one's behavior, which serves as the first step in a feedback loop that includes recognizing how behaviors impact an individual's health status. More specifically, self-monitoring incorporates tracking food and beverage consumption in a daily log, such as a food diary (Laitner et al., 2016). Additionally, self-monitoring physical activity patterns also improve one's weight loss. Tracking daily progress of specific physical activity helps one stay focused on their weight loss goal. Furthermore, monitoring physical activity in conjunction with diet results in the most weight lost without muscle loss (Laitner et al., 2016).

Stimulus control.

Stimulus control involves modifying the environment around an individual to promote weight loss and healthy behaviors. Individuals may choose to modify the type and amount of food available and consumed in the home, availability of exercise equipment, and the saliency of consequences of eating choices (Gorin et al., 2013).

Table 2.2

Weight Management Strategies

Author(s)	Weight Management Strategy	Definition	Examples
Laitner, et al., 2016	Self-Monitoring	Recording of one's behavior	Food diaries; tracking food and beverage consumption
Gorin et al. 2013	Stimulus Control	Modifying the environment to promote weight loss and healthy behaviors	Throwing out energy dense and non-nutrient dense food in the cabinets
Mason et al., 2016; Himes et al., 2015; Chacko et al., 2016	Mindfulness	Slowing the rate of eating, allowing hunger signals to subside	Slow eating, being aware of each bite of food consumed
Keyserling et al., 2016	Goal Setting	Setting achievable weight loss goals	Setting a weight loss goal every week/month, following MyPlate Guidelines
Keyserling et al., 2016	Nutrition Education	Dietitian and individual determine a personalized meal plan per individual's needs and food preferences	Reviewing individual's current diet and providing dietary tips for problematic eating behaviors
Keyserling et al., 2016	Social Support	Inclusion of spouses, family members, and friends; attending support groups	Bringing one's social support to weight loss sessions
Keyserling et al., 2016	Physical Activity	Increasing time spent doing physical activity	Walking 7,500 steps/day OR engaging in PA 30 min/day at least 5 days/week

Mindfulness.

Mindfulness connects the mind with how the body is feeling. Mindful eating includes making deliberate food choices, raising awareness of physiological cues related to food intake,

attending to physical versus psychological cues to eat, and responding to cues (Mason et al., 2016).

Individuals who used mindfulness to manage their weight post-surgery found success in both preventing weight regain and improving self-efficacy. For instance, Himes et al. (2015) examined whether incorporating dialectical behavior therapy (DBT), a form of mindfulness, into post-surgical weight management programs was effective. Dialectical behavior therapy improves an individual's ability to handle stress, thus decreasing disordered, emotional eating, and weight regain. Himes' research team discovered when individuals who were 6-10 years post-surgery self-monitor and re-learn post-surgical dietary guidelines, they lost an average of 2-9 pounds during the six week intervention. Additionally, participants reported an improved mood and decreased emotional eating behaviors (Himes et al., 2015).

Chacko et al. (2016) examined the role of mindfulness based approaches in weight maintenance programs post-surgery. Mindfulness also improves an individual's ability to cope with daily stressors of life through strengthening skills such as patience, acceptance, and self-compassion. Similar to Himes et al. (2015), Chacko et al. (2016) found individuals who attended at least seven of the ten group mindfulness training sessions reported improved eating behaviors and self-efficacy. When individuals feel more confident in their abilities, they are more likely to remain positive and adhere to post-surgical dietary guidelines. Incorporating strategies, such as mindfulness and self-monitoring into post-surgical weight maintenance programs assists individuals in preventing weight regain and improving self-efficacy.

Goal setting, nutrition education, social support, and physical activity.

Goal setting involves setting realistic and achievable weight loss goals as well as strategies to achieve those goals. Nutrition education incorporates goal setting and information

regarding a healthy diet. Guidance provided by a Registered Dietitian is essential in nutrition education because they are specially trained to work with individuals by helping to evaluate current dietary behaviors. Registered Dietitians also determine alternatives to problematic eating behaviors to ensure that nutrient deficiencies do not occur. Additionally, social support incorporates family members, significant others, spouses, and friends in an individual's weight loss journey. Moreover, increasing physical activity results in increased weight loss and decreased sedentary behavior (Keyserling et al., 2016).

Social support.

Mindfulness and self-monitoring assist individuals in preventing weight regain; however, other strategies, such as social support, also assist individuals to meet weight loss goals (Chacko, Yeh, Davis, & Wee, 2016; Himes et al., 2015; Keyserling et al., 2016). Presence of social support is an important indicator of weight regain in individuals. Social support is present both pre- and post-surgery and may be group or individual based (Groller, 2017). Individuals who attended bariatric surgery support groups overcame psychological barriers, such as depressive feelings, in order to keep the weight off (Geraci et al., 2014). Additionally, individuals who attended group sessions in a mindfulness based intervention reported improved eating behaviors and improved self-efficacy (Chacko et al., 2016); thus, preventing weight regain. Furthermore, individuals who attended group meetings related to basic dialectical behavior therapy stated improved mood and reduced weight (Himes et al., 2015). The common factor among all individuals is that they obtained social support either through support groups or group meetings. Therefore, social support is a key strategy in preventing weight regain, improving self-efficacy, and reducing negative feelings. Moreover, individual's close family support provided individuals with positive appraisal related to weight loss, encouragement to continue living a recommended

post-surgery lifestyle, and assisting in daily responsibilities (Ogle, Park, Damhorst, & Bradley, 2016). The presence of positive close interpersonal support assisted individuals in staying on track and keeping the weight off (Ogle et al., 2016).

Social situations post-surgery.

Social situations post bariatric surgery involve the presence of both internal and external barriers. Many individuals (77%) identified internal barriers, such as managing post-surgery diet, changing habits, and dealing with cravings as internal barriers. Individuals also identified external barriers (15%), such as logistical challenges associated with dining out post-surgery (Peacock et al., 2016). Fortunately, social support assisted individuals in overcoming internal and external perceived barriers; thus, preventing weight regain post-surgery (Peacock et al., 2016). However, limited research identified what happened when an individual left their support group forever and found themselves in a social situation. More specifically, additional research needs to be conducted on how individuals overcome barriers related to social environments and the presence of non-nutrient dense foods following bariatric surgery.

Nutrition following bariatric surgery.

The post-bariatric surgery dietary guidelines are very complex; continual adherence is essential to prevent weight regain and/or malnutrition. Nutrient deficiencies and weight regain often occur following bariatric surgery (Saltzman & Karl, 2013), which may be due to pre-surgery deficiencies, time since bariatric surgery, or post-surgery dietary adherence (Giusti et al., 2016; Moize et al., 2003; Saltzman & Karl, 2013). It is believed nutrient consumption before surgery may affect nutrient status after surgery (Saltzman & Karl, 2013). Individuals with obesity often consume a diet rich in energy with few nutrients as opposed to a diet rich in

nutrients; thereby contributing to nutrient deficiencies before surgery even takes place (Saltzman & Karl, 2013).

Time since bariatric surgery was performed also plays a role in nutrient status and weight regain post-surgery (Giusti et al., 2016; Moize et al., 2013; Moize et al., 2003; Saltzman & Karl, 2013). The amount of calories an individual should consume increases with time after surgery. For instance, daily caloric intake increased from three months (800 kcals) to 12 months (1200 kcals) to 35 months (1500 kcals), allowing for less restriction on the amount of food individuals consumed (Giusti et al., 2016; Moize et al., 2013). When individuals have less restriction on what they can eat, they may be more likely to consume higher calorie, non-nutrient dense foods over nutrient dense foods. Thus, individuals have an increased chance of regaining weight and having more nutrient deficiencies.

Finally, adherence to post-surgery dietary guidelines reduces the likelihood of weight regain and poor nutrient status post-surgery (Saltzman & Karl, 2013). Poor adherence to supplement regimes and post-surgery dietary guidelines contribute to nutrient deficiencies, especially vitamin B-12, vitamin D, iron, and protein as well as the likelihood of weight regain (Giusti et al., 2016; Saltzman & Karl, 2013). Note, decreased protein intake contributes to weight regain since protein increases satiety and the feeling of being full for a longer period of time. To reiterate, this is where nutrition counseling and weight maintenance strategies come into play because they prevent weight regain and nutrient deficiencies post-surgery.

Protein and supplementation recommendations post-surgery.

Having adequate protein and following the recommended post-bariatric surgery dietary guidelines diet incorporates physical and emotional aspects of wellness. Adhering to the post-bariatric surgery diet, with adequate protein, is one way individuals have prevented weight

regain. Post-bariatric surgery protein recommendations state individuals should consume a minimum of 60 grams of protein per day starting approximately 3 months after surgery to conserve lean body mass and manage weight post-surgery (Moize et al., 2013). Unfortunately, many individuals do not meet this daily recommendation of protein, especially right after surgery due to caloric restriction (Aron-Wisnewsky et al., 2016; Donadelli et al., 2012; Giusti et al., 2016; Moize et al., 2013; Verger et al., 2016).

Challenges associated with adequate protein intake.

Inadequate protein intake may be due to a decreased caloric intake, which is also associated with time since surgery (Giusti et al., 2016; Verger et al., 2016). Three months post-surgery, the average calorie restriction is 800 calories per day, thereby, limiting the amount of protein that is consumed. Note that 60 grams of protein contains 240 calories, still within the Acceptable Macronutrient Distribution Range (AMDR) of 10.0-35.0% of total calories (United States Department of Agriculture, 2005). More than 50.0% of individuals who had bariatric surgery had mild protein depletion three months post-surgery independent of the type of surgery performed (Aron-Wisnewsky et al., 2016). Additionally, total protein intake significantly decreased one year post-surgery with roughly 60.0% of individuals reporting protein intake below the recommended 60 grams per day (Donadelli et al., 2012; Verger et al., 2016). At three years post-surgery, protein intake continued to decrease while carbohydrate and fat intake increased (Giusti et al., 2016); hence, calorie restriction associated with time since surgery play a critical role in adequate protein consumption.

Another cause of inadequate protein intake is post-surgical intolerance to certain protein sources. Over time, individuals may develop a food intolerance to protein sources, such as red meat, following bariatric surgery (Giusti et al., 2016). Studies confirmed that during the first

month post-surgery, individuals' protein intake decreased due to calorie restriction and adherence to a semi-solid diet (Giusti et al., 2016). At three months post-surgery, overall protein intakes then increased; however, decreased again at one year post-surgery due to development of a protein intolerance to red meat (i.e. beef and pork) (Giusti et al., 2016; Moize et al., 2013). Red meat is rich in protein; as red meat consumption decreased due to intolerance, so did overall protein intake. Development of a protein intolerance occurred at least one year post-surgery; therefore, nutrition counseling should discover ways to increase protein intake during the first year post-surgery (Giusti et al., 2016; Moize et al., 2013; Verger et al., 2016).

Challenges associated with dietary recommendations.

Additionally, individuals have a strict post-surgery diet involving adherence to a supplement regime. Protein, along with calcium, iron, vitamin D, and vitamin B-12 supplements are common post-surgery (Andreu, Moize, Rodriguez, Flores, & Vidal, 2010; Moize et al., 2013; Verger et al., 2016). Individuals often have vitamin deficiencies, especially iron, vitamin D and B12, despite dietary supplementation at least one year post-surgery (Donadelli et al., 2012; Moize et al., 2013). Researchers concluded close monitoring of protein intake and supplementation is important for at least one year post-surgery due to the noticeable prevalence of deficiencies post-surgery (Verger et al., 2016).

Post-bariatric surgery resources.

Research also analyzed post-surgery resources (i.e. support groups provided by the facility, educational materials, family/friend support) individuals used to make compliance to post-surgery recommendations easier. It was concluded individuals faced both external and internal barriers post-surgery, making compliance to post-surgery recommendations difficult (Peacock et al., 2016). Most individuals (62.0%) reported receiving at least one helpful resource

post-surgery. The most popular resource included dietitians providing knowledge and support. However, some individuals (27.0%) reported not receiving or not using any resources (Peacock et al., 2016). Individuals also used electronic methods of communication, such as email or online support groups, to increase frequency and intensity of contact with health professionals after surgery (Peacock et al., 2016). Post-surgery resources assisted individuals in staying on track with their weight and nutrition; however, after an extensive literature search, only one out of 115 articles was found to evaluate such resources. Consequently, further examination of resources individuals used to make compliance with supplement recommendations easier post bariatric surgery needs to be conducted.

Summary

Between the years 2005 and 2014, there was an increasing trend of individuals with obesity; and by 2014 roughly 37.7% of the United States population were obese (Flegal et al., 2016). Finding an effective solution to treat individuals with obesity has never been so vital. Two main solutions have been used to treat individuals with obesity: (1) lifestyle treatment and (2) bariatric surgery. However, lifestyle treatment has been shown to be ineffective; the most successful long-term treatment for obesity is bariatric surgery (Adams et al., 2012).

Benefits of bariatric surgery.

Benefits of bariatric surgery include alleviation of obesity-related comorbidities, long-term weight loss, and improved health-related quality of life (Arterburn & Courcoulas, 2014; Major et al., 2015; Steven et al., 2015). Individuals also incorporated the dimensions of wellness when improving their quality of life following bariatric surgery. The dimensions of wellness include physical, intellectual, emotional, social, spiritual, occupational, and environmental. All of these dimensions synergize to maximize overall quality of life (Nathenson et al., 2014).

Limitations of bariatric surgery.

Many individuals prospered after bariatric surgery, however, challenges still persist in the long-term. Challenges following bariatric surgery included adherence to the post-bariatric surgery dietary guidelines, overcoming barriers associated with social environments, and using resources to make adherence with supplement recommendations easier (Geraci et al., 2015; Heidmann & Gronkjaer, 2015; Natvik et al., 2013). The most common limitation individuals experienced post-surgery was a constant fear of weight regain (Geraci et al., 2015). Individuals often found it difficult to manage post-operative diet recommendations, changing habits, and dealing with cravings (Peacock et al., 2016); thus, making weight maintenance challenging post-surgery.

Post-surgery weight maintenance.

Weight management was particularly challenging for individuals post-surgery; consequently, following weight maintenance strategies post-surgery were of utmost importance. These strategies include: self-monitoring, stimulus control, mindfulness, goal setting, nutrition education, social support, and increased physical activity (Gorin et al., 2013; Keyserling et al., 2016; Laitner et al., 2016; Mason et al., 2016). Social support specifically assisted individuals in overcoming internal barriers, such as managing their post-surgery diet, as well as external barriers, such as challenges when dining out post-surgery (Peacock et al., 2016). Furthermore, social support helped individuals increase their self-efficacy; causing individuals to adhere to their post-surgery recommendations and prevent weight regain (Chacko et al., 2016). Unfortunately, research does not unveil what happened when an individual didn't participate in their social support network and found themselves in social situations. Consequently, knowledge

of how individuals overcame barriers related to social environments and the presence of non-nutrient dense foods succeeding bariatric surgery does not exist.

Conclusion

This literature review examined past research relating to bariatric surgery. Although previous research extensively quantified post-surgery dietary guidelines, questions still persist regarding the bariatric lifestyle. First, literature analyzed the post-surgery diet recommendations and found many individuals had difficulty adhering to strict protein and supplementation guidelines. This research only evaluated practices of individuals who did not meet recommendations and failed to assess the individuals who met the guidelines. Therefore, examination of individuals' compliance of protein and micro-nutrient supplementation recommendations is needed. Future research should determine the challenges associated with consuming the dietary recommendations following bariatric surgery.

Finally, limited research has been conducted regarding resources that individuals' find helpful that are available post-surgery. Hence, additional research identifying individuals' social support networks and protein adherence strategies post-surgery needs to be collected. By following a cross-sectional research design, current attitudes, behaviors, and characteristics of the bariatric surgery population will be determined at a specific point in time (Cottrell & McKenzie, 2011).

References

Adams, T. D., Davidson, L. E., Litwin, S. E.,. . . Hunt, S. C. (2012). Health benefits of gastric bypass surgery after 6 years. *Journal of the American Medical Association, 308*(11), 1122-1131. doi:10.1001/2012.jama.11164

Andreu, A., Moize, V., Rodriguez, L., Flores, L., & Vidal, J. (2010). Protein intake, body composition, and protein status following bariatric surgery. *Obesity Surgery, 20*(11), 1509-1515. doi:10.1007/s11695-010-0268-y

Aron-Wisnewsky, J., Verger, E. O., Bounaix, C., Dao, M. C., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Nutritional and protein deficiencies in the short term following both gastric bypass and gastric banding. *PLoS One, 11*(2), e0149588. doi:10.1371/journal.pone.0149588

Arterburn, D. E., & Courcoulas, A. P. (2014). Bariatric surgery for obesity and metabolic conditions in adults. *British Medical Journal, 349*, g3961. doi:10.1136/bmj.g3961

Chacko, S. A., Yeh, G. Y., Davis, R. B., & Wee, C. C. (2016). A mindfulness-based intervention to control weight after bariatric surgery: preliminary results from a randomized controlled pilot trial. *Complementary Therapies in Medicine, 28*, 13-21. doi:10.1016/j.ctim.2016.07.001

Cottrell, R., & McKenzie, J. F. (2011). *Health Promotion & Education Research Methods: Using the Five Chapter Thesis/ Dissertation Model*: Jones & Bartlett Learning.

Donadelli, S. P., Junqueira-Franco, M. V., de Mattos Donadelli, C. A., Salgado, W., Jr., Ceneviva, R., Marchini, J. S., . . . Nonino, C. B. (2012). Daily vitamin supplementation and hypovitaminosis after obesity surgery. *Nutrition, 28*(4), 391-396. doi:10.1016/j.nut.2011.07.012

Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Journal of the American Medical Association, 315*(21), 2284-2291. doi:10.1001/jama.2016.6458

Geraci, A., Brunt, A., & Hill, B. (2015). The pain of regain: psychological impacts of weight regain among long-term bariatric patients. *Bariatric Surgical Practice and Patient Care, 10*(3), 110-118. doi:10.1081089/bari.2015.0011

Geraci, A., Brunt, A., & Marihart, C. (2014). The work behind weight-loss surgery: a qualitative analysis of food intake after the first two years post-op. *International Scholarly Research Network Obesity, 2014*, 427062. doi:10.1155/2014/427062

Giusti, V., Theytaz, F., Di Vetta, V., Clarisse, M., Suter, M., & Tappy, L. (2016). Energy and macronutrient intake after gastric bypass for morbid obesity: a 3-y observational study focused on protein consumption. *American Journal of Clinical Nutrition, 103*(1), 18-24. doi:10.3945/ajcn.115.111732

Gletsu-Miller, N., & Wright, B. N. (2013). Mineral malnutrition following bariatric surgery. *Advanced Nutrition, 4*(5), 506-517. doi:10.3945/an.113.004341

Gorin, A. A., Raynor, H. A., Fava, J., Maguire, K., Robichaud, E., Trautvetter, J., . . . Wing, R. R. (2013). Randomized controlled trial of a comprehensive home environment-focused weight-loss program for adults. *Health Psychology, 32*(2), 128-137. doi:10.1037/a0026959

Groller, K. D. (2017). Systematic review of patient education practices in weight loss surgery. *Surgery for Obesity and Related Diseases*. doi:10.1016/j.soard.2017.01.008

Heidmann, J., & Gronkjaer, M. (2015). Health-related quality of life 6 years after gastric bypass: a mixed methods study. *Bariatric Surgical Practice and Patient Care*. doi:10.1089/bari.2014.0052

Himes, S. M., Grothe, K. B., Clark, M. M., Swain, J. M., Collazo-Clavell, M. L., & Sarr, M. G. (2015). Stop regain: a pilot psychological intervention for bariatric patients experiencing weight regain. *Obesity Surgery, 25*(5), 922-927. doi:10.1007/s11695-015-1611-0

Keyserling, T. C., Samuel-Hodge, C. D., Pitts, S. J., Garcia, B. A., Johnston, L. F., Gizlice, Z., . . . Ammerman, A. S. (2016). A community-based lifestyle and weight loss intervention promoting a Mediterranean-style diet pattern evaluated in the stroke belt of North Carolina: the Heart Healthy Lenoir Project. *BMC Public Health, 16*, 732. doi:10.1186/s12889-016-3370-9

Laitner, M. H., Minski, S. A., & Perri, M. G. (2016). The role of self-monitoring in the maintenance of weight loss success. *Eating Behavior, 21*, 193-197. doi:10.1016/j.eatbeh.2016.03.005

Major, P., Matlok, M., Pedziwiatr, M., Migaczewski, M., Budzynski, P., Stanek, M., . . . Budzynski, A. (2015). Quality of life after bariatric surgery. *Obesity Surgery, 25*(9), 1703-1710. doi:10.1007/s11695-015-1601-2

Marihart, C. L., Brunt, A. R., & Geraci, A. A. (2014). Older adults fighting obesity with bariatric surgery: Benefits, side effects, and outcomes. *SAGE Open Medicine, 2*, 2050312114530917. doi:10.1177/2050312114530917

Martin-Rodriguez, E., Guillen-Grima, F., Marti, A., & Brugos-Larumbe, A. (2015). Comorbidity associated with obesity in a large population: The APNA study. *Obesity Research and Clinical Practice, 9*(5), 435-447. doi:10.1016/j.orcp.2015.04.003

Mason, A. E., Epel, E. S., Kristeller, J., Moran, P. J., Dallman, M., Lustig, R. H., . . . Daubenmier, J. (2016). Effects of a mindfulness-based intervention on mindful eating, sweets consumption, and fasting glucose levels in obese adults: data from the SHINE

randomized controlled trial. *Journal of Behavioral Medicine, 39*(2), 201-213. doi:10.1007/s10865-015-9692-8

Moize, V., Andreu, A., Flores, L., Torres, F., Ibarzabal, A., Delgado, S., . . . Vidal, J. (2013). Long-term dietary intake and nutritional deficiencies following sleeve gastrectomy or Roux-en-Y gastric bypass in a mediterranean population. *Journal of the Academy of Nutrition and Dietetics, 113*(3), 400-410. doi:10.1016/j.jand.2012.11.013

Moize, V., Geliebter, A., Gluck, M. E., Yahav, E., Lorence, M., Colarusso, T., . . . Flancbaum, L. (2003). Obese patients have inadequate protein intake related to protein intolerance up to 1 year following Roux-en-Y gastric bypass. *Obesity Surgery, 13*(1), 23-28. doi:10.1381/096089203321136548

Nadalini, L., Zenti, M. G., Masotto, L., Indelicato, L., Fainelli, G., Bonora, F., . . . Bonora, E. (2014). Improved quality of life after bariatric surgery in morbidly obese patients. Interdisciplinary group of bariatric surgery of Verona (G.I.C.O.V.). *IL Giornale de Chirurgia, 35*(7-8), 161-164.

Nathenson, P. A., Nathenson, S. L., & Divito, K. S. (2014). Implementing the new CARF wellness standards. *Journal of Stroke Cerebrovascular Diseases, 23*(5), 1118-1130. doi:10.1016/j.jstrokecerebrovasdis.2013.09.027

National Institute of Health. (2014). The A1c test and diabetes. Retrieved from https://www.niddk.nih.gov/health-information/diabetes/diagnosis-diabetes-prediabetes/a1c-test

National Institute of Health. (2016). Classification of overweight and obesity by BMI, waist circumference, and associated disease risks.

Natvik, E., Gjengedal, E., & Raheim, M. (2013). Totally changed, yet still the same: patients' lived experiences 5 years beyond bariatric surgery. *Qualitative Health Research, 23*(9), 1202-1214. doi:10.1177/1049732313501888

Neff, K. J., Olbers, T., & le Roux, C. W. (2013). Bariatric surgery: the challenges with candidate selection, individualizing treatment and clinical outcomes. *BMC Medicine, 11*, 8. doi:10.1186/1741-7015-11-8

Ogle, J. P., Park, J., Damhorst, M. L., & Bradley, L. A. (2016). Social support for women who have undergone bariatric surgery. *Qualitative Health Research, 26*(2), 176-193. doi:10.1177/1049732315570132

Peacock, J. C., Schmidt, C. E., & Barry, K. (2016). A qualitative analysis of post-operative nutritional barriers and useful dietary services reported by bariatric surgical patients. *Obesity Surgery, 26*(10), 2331-2339. doi:10.1007/s11695-016-2096-1

Saltzman, E., & Karl, J. P. (2013). Nutrient deficiencies after gastric bypass surgery. *Annual Review of Nutrition, 33*, 183-203. doi:10.1146/annurev-nutr-071812-161225

Schauer, P. R., Bhatt, D. L., Kirwan, J. P., Wolski, K., Brethauer, S. A., Navaneethan, S. D., . . . Kashyap, S. R. (2014). Bariatric surgery versus intensive medical therapy for diabetes--3-year outcomes. *New England Journal of Medicine, 370*(21), 2002-2013. doi:10.1056/NEJMoa1401329

Steven, S., Carey, P. E., Small, P. K., & Taylor, R. (2015). Reversal of Type 2 diabetes after bariatric surgery is determined by the degree of achieved weight loss in both short- and long-duration diabetes. *Diabetes Medicine, 32*(1), 47-53. doi:10.1111/dme.12567

United States Department of Agriculture. (2005). *Dietary reference intakes: macronutrients*. Retrieved from https://www.nal.usda.gov/sites/default/files/fnic_uploads//macronutrients.pdf.

Verger, E. O., Aron-Wisnewsky, J., Dao, M. C., Kayser, B. D., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Micronutrient and protein deficiencies after gastric bypass and sleeve gastrectomy: a 1-year follow-up. *Obesity Surgery, 26*(4), 785-796. doi:10.1007/s11695-015-1803-7

CHAPTER 3. METHODOLOGY

Purpose and Research Questions

The purpose of this study was to gain insight of how well individuals who undergo bariatric surgery adhere to post-surgical protein supplementation recommendation. A secondary purpose of this study was to examine the social support systems and resources individuals use after surgery. The study is designed to answer the following research questions:

- Does bariatric surgery social support group attendance increase weight loss for individuals post-surgery?
- Do individuals who undergo bariatric surgery adhere with post-surgical protein supplementation recommendations?
- What resources do individuals use to make compliance with supplement recommendations easier following bariatric surgery?

Research Design

This study used a mixed methods cross-sectional survey design. The survey was created using questions from previous studies (Geraci, 2015). Before the survey was finalized, a pilot study was conducted with two content experts and two individuals who underwent bariatric surgery to ensure validity. Survey questions were revised per recommendations. Survey questions included demographics, surgery type, date of surgery, height, weight at surgery, lowest weight, highest weight, and current weight. This electronic questionnaire was administered through the Qualtrics survey generator, allowing participants to easily complete the survey. Additionally, electronic surveys provide flexibility in design format of the survey making the survey enticing to participants; which may lead to reduced time to complete a response (Cottrell

& McKenzie, 2011). The Institutional Review Board (IRB) at North Dakota State University approved this research (Appendix A) prior to the recruitment of participants.

Participants

A minimum of 50 individuals who were at least six months post-bariatric surgery and 18 years of age or older were recruited throughout the United States to participate in this research study. Participants may have undergone one of the four types of bariatric surgery procedures: (1) Laparoscopic Gastric Bypass (2) Vertical Sleeve Gastrectomy (3) Roux-en-Y Gastric Bypass (4) Biliopancreatic Diversion with Duodenal Switch. Additionally, participants were either currently attending healthcare provided bariatric support groups, attended healthcare provided bariatric support groups in the past but no longer used this form of support, or had never attended healthcare provided bariatric support groups.

Participants were selected and identified through snowball sampling and contacting various bariatric surgery support groups across the United States. Snowball sampling was used to recruit participants through study subject and researcher acquaintances. Participants were contacted through a prepared email for permission to send the survey (Appendix B). Contacting various bariatric support surgery support groups involved using a prepared phone script (Appendix C) that reached out to bariatric support groups across the United States and sought permission for the research survey to be sent out to its members. Potential bariatric surgery support groups are listed in Table 3.1. Participants were contacted to complete the research survey via email where a link to the survey was embedded. This survey was created through reading research articles collected for the literature review. This survey was also created through using previous survey questions created by researchers Cindy Marihart and Angela Geraci. A pilot study was conducted consisting of 4-5 individuals which ensured this survey was reliable

and valid. At least 2 of these individuals were content experts in the bariatric surgery community.

Data Collection and Procedures

Data were collected by randomly selecting and contacting five healthcare sponsored bariatric surgery support groups following IRB approval. The survey was sent out to participants' email addresses. Four reminders to complete the survey were sent out in 2 week increments. Because an insuffient number of participants had completed the survey, five more bariatric surgery support groups were randomly selected and contacted. This procedure continued until at least 50 individuals responded to the survey.

Participants were asked to complete an online survey (Appendix D) through North Dakota State University's Qualtrics survey generator. Informed consent (Appendix E) was provided to the participant through Qualtrics. This survey generator allowed participants the option to either 'continue' or exit out of the survey; if they chose to exit out of the survey, this means they did not give consent. This survey included demographic data pertaining to age, gender, state of residence, and marital status. Information regarding type of surgery, date of surgery, height, current weight, and lowest/highest weight since surgery were also asked. Additional questions regarding diet (protein specifically), supplementation, and post-bariatric surgery resources were included in the survey.

Participants' responses were recorded online using Qualtrics and were entered into an Excel spreadsheet to organize data. Information on the Excel spreadsheet was then uploaded to SAS 9.4 to allow for data analysis.

Table 3.1

Potential Bariatric Surgery Support Groups

Bariatric Support Group	State
Allina Health Bariatric Surgery Support Group	Minnesota
Allina Health Bariatric Surgery Support Group-St. Francis Regional Medical Center	Minnesota
New U Support Group-U of M Medical Center	Minnesota
Minnesota Institute for Minimally Invasive Surgery Support Group	Minnesota
Pacific Bariatrics Program-Campbell, CA	California
Pacific Bariatrics Program-Orange, CA	California
Pacific Bariatrics Program-High Desert, CA	California
Pacific Bariatrics Program-Sand Diego, CA	California
Pacific Bariatrics Program-Staying on Track-Riverside/Jurupa Valley, CA	California
Bellevue Medical Center	Washington
Everett Medical Center	Washington
Federal Way Medical Center	Washington
Olympia Medical Center	Washington
Seattle-Capitol Hill Campus	Washington
Sanford Sioux Falls Weight Loss Surgery Support Group	South Dakota
Avera McKennan Hospital	South Dakota
NEW Beginnings	Wisconsin
ALOHA-Wausa Hospital Support Group	Wisconsin
Bariatric Institute Wisconsin	Wisconsin
Weight Loss Surgery Support Group	Wisconsin
Bariatric Success Circle	Wisconsin
Choose to Lose Bariatric Center Weight Loss Support Group	New York
Faxton-St.Luke's Healthcare Bariatric Support Group	New York
St. Catherine of Siena Medical Center Bariatric Support Group	New York
Bariatric Surgery Support Group-St. Joseph Hospital	Illinois
Trinity Bariatric Center-Support Group	Illinois
Why Weight—MacNeal Hospital	Illinois
Iowa Bariatrics	Iowa
Iowa Weight Loss Specialists Support Group	Iowa
Bariatric Support Group	Iowa
North Colorado Medical Center LAP-Band/Gastric Bypass Patients Support Group	Colorado
Western Slope WLS Support Group	Colorado

Analysis

Data were analyzed using SAS 9.4 and compared demographic, surgery type, weight loss, protein intake, barriers to weight loss, and types of resources. The Likert scale tables were

analyzed using frequency tables and Chi-square analysis against various demographic data. The multiple-choice questions were analyzed by frequencies of response patterns and Chi-square against various demographic data. An interval ratio was used to analyze the one to ten scale. Additionally, descriptive statistics were used to analyze and rank answers when participants were asked to 'select all that apply'. Finally, ANOVA was used to analyze similar Likert scale tables.

References

Cottrell, R., & McKenzie, J. F. (2011). *Health Promotion & Education Research Methods: Using the Five Chapter Thesis/ Dissertation Model*. Sudbury, MA: Jones & Bartlett Learning.

CHAPTER 4. THE RELATIONSHIP BETWEEN PROTEIN INTAKE IN INDIVIDUALS AT LEAST 6 MONTHS POST BARIATRIC SURGERY AND BMI REDUCTION

Abstract

Introduction: Bariatric surgery is an effective treatment for individuals with obesity. Individuals may experience improved control of type ll diabetes, sleep apnea, blood pressure, and blood lipid levels following surgery. Following surgery, individuals must adhere to a strict diet and supplementation routine, with emphasis on protein, to prevent weight regain. The purpose of this study is to evaluate adherence to protein recommendations of individuals who are at least six months' post-surgery.

Materials and Methods: Using a mixed methods cross-sectional survey design, 59 participants completed an online survey regarding consumption of the recommended amounts of protein.

Results: Participants either had Vertical Sleeve Gastrectomy (VSG) (n=28) or Roux-en-Y Gastric Bypass (RYGB) (n=31). Approximately, 35 (59.3%) participants consumed 60 grams or less of protein over the last month. Thirty-six (61.0%) participants consumed protein shakes/bars very often after surgery. VSG participants consumed protein bars and shakes more frequently than those with the RYGB (p=0.026). On average individuals lost between 150 to 180 pounds since time of surgery.

Conclusion: More individuals who underwent VSG consumed protein shakes and bars as a protein source post-surgery. However, in respect to BMI reduction and protein consumption since time of surgery, RYGB participants achieved a lower BMI than VSG participants, indicating clinical significance. Since individuals lost between 150 to 180 pounds since time of surgery, this would improve individuals' health-related and overall quality of life.

Introduction

With approximately 37.7% of the United States population being affected by obesity in 2014 (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016), finding solutions to combat this epidemic (or maybe pandemic) are essential. Increased Body Mass Index (kg/m^2) (BMI) is associated with type II diabetes, high blood pressure, sleep apnea, and overall decreased quality of life (Adams, Davidson, Litwin, & et al., 2012; Heidmann & Gronkjaer, 2015; Major et al., 2015; Martin-Rodriguez, Guillen-Grima, Marti, & Brugos-Larumbe, 2015; Nadalini et al., 2014; Natvik, Gjengedal, & Raheim, 2013). Bariatric surgery is considered a highly effective treatment for individuals with obesity. With four different types of bariatric surgery available, individuals are able to choose the best surgical procedure for their lifestyle. Listed in order from least to most invasive, the four main types of bariatric surgery include: Laparoscopic Adjustable Gastric Banding (LAGB), Vertical Sleeve Gastrectomy (VSG), Roux-en-Y Gastric Bypass (RYGB), and Biliopancreatic Diversion with Duodenal Switch (BPD-DS) (Marihart, Brunt, & Geraci, 2014).

Bariatric surgery improves obesity-related comorbidities, such as high blood pressure, type II diabetes, and results in long-term weight loss (Adams et al., 2012; Arterburn & Courcoulas, 2014; Major et al., 2015; National Institute of Health, 2014, 2016; Schauer et al., 2014). Overall, bariatric surgery is a successful solution to the ongoing obesity epidemic (Adams et al., 2012; Arterburn & Courcoulas, 2014; Major et al., 2015; Nadalini et al., 2014; Natvik et al., 2013; Schauer et al., 2014). Additionally, increased weight loss and remission of obesity-related comorbidities result in overall improved quality of life for individuals who choose bariatric surgery as a solution to obesity (Major et al., 2015; Nadalini et al., 2014; Natvik et al., 2013).

Unfortunately, there are also complications individuals may face post-surgery. As surgery invasiveness increases, so do the complications and risks. Complications post-surgery include dumping syndrome, nutrient deficiencies, food intolerances, and change in taste preferences (Gletsu-Miller & Wright, 2013; Marihart et al., 2014). Additional challenges individuals may face post-surgery include difficulty meeting protein needs and general weight loss maintenance following surgery (Geraci, Brunt, & Hill, 2015; Verger et al., 2016). Maintaining protein status while restricting total intake poses a large health risk for individuals (Giusti et al., 2016; Saltzman & Karl, 2013). Factors such as adequate dietary intake, healthy weight maintenance, and overall health status are of utmost concern for individuals post-surgery.

More specifically, in terms of dietary intake and weight maintenance, protein plays a prominent role. Protein is a powerful macronutrient post-surgery because it increases satiety, preserves muscle mass, and prevents weight regain post-surgery (Andreu, Moize, Rodriguez, Flores, & Vidal, 2010; Donadelli et al., 2012; Geraci et al., 2015; Moize et al., 2013; Verger et al., 2016). At least 60 grams of protein is recommended starting three months post-surgery (Moize et al., 2013), making it challenging for individuals to consume adequate protein post-surgery to maintain health and prevent weight regain (Aron-Wisnewsky et al., 2016; Donadelli et al., 2012; Geraci, Brunt, & Marihart, 2014; Giusti et al., 2016; Moize et al., 2013; Moize et al., 2003; Verger et al., 2016). The purpose of this study is to evaluate adherence to protein recommendations and the challenges associated with protein intake of individuals who are at least six months' post-surgery.

Materials and Methods

Research design and instrument development.

This study used a mixed methods cross-sectional survey design. The survey was created using questions from previous studies (Geraci, 2015). Before the survey was finalized, a pilot study was conducted with two content experts and two individuals who underwent bariatric surgery to ensure validity. A readability test was not conducted for this questionnaire. Survey questions were revised per recommendations. Survey questions included demographics, surgery type, date of surgery, height, weight at surgery, lowest weight, highest weight, and current weight. The main focus of the survey related to individuals' intake of protein from food sources, shakes, and bars. The North Dakota State University Institution Review Board approved all aspects of this research before the study began. The survey was administered and data were collected using a web-based survey system (Qualtrics).

Participant recruitment.

Participants were selected and identified through snowball sampling and contacting various bariatric surgery support groups across the United States. Snowball sampling was used to recruit participants through study subject and researcher acquaintances. Using the entire listing of the Obesity Action Coalition, a list of selected bariatric surgery support groups was developed (Obesity Action Coalition, 2017). Employing a prepared phone or email script, five randomly selected groups were initially contacted. Every two weeks afterward, an additional five groups were contacted until at least 50 participant responses were collected. The groups that were contacted are listed in Table 4.1.

Table 4.1

Bariatrics Support Groups Contacted

Bariatric Support Group	State
Allina Health Bariatric Surgery Support Group-St. Francis Regional Medical Center	Minnesota
Pacific Bariatrics Program-Campbell, CA	California
Pacific Bariatrics Program-Oceanside/Vista, CA	California
Silverdale Medical Center	Washington
Olympia Medical Center	Washington
ALOHA-Wausa Hospital Support Group	Wisconsin
Weight Loss Surgery Support Group	Wisconsin
Bariatric Surgery Support Group-St. Joseph Hospital	Illinois
Why Weight—MacNeal Hospital	Illinois
Western Slope WLS Support Group	Colorado

(Obesity Action Coalition, 2017)

Participants.

There were a total of 76 initial respondents; 16 respondents did not complete the questionnaire and were excluded. After descriptive statistics were used to analyze demographic data, only one respondent reported having LAGB; therefore, that respondent was excluded from any additional statistical analysis to prevent skewing the results. This left 59 study participants.

Analysis.

Body mass index (BMI) at time of surgery was calculated for each participant by dividing individuals' weight (pounds) at time of surgery by their height (inches) squared. This number was then multiplied by 703, which equaled individuals' BMI at time of surgery. Participants' lowest BMI was calculated by dividing individuals' lowest weight (pounds) by their height (inches) squared. This number was then multiplied by 703, which equaled individuals' lowest

BMI. Likewise, BMI was calculated for individuals' current BMI by using their current weight (pounds) and height. Reduction in BMI was calculated by subtracting BMI at the time of surgery from BMI of current weight. Using SAS 9.4, demographic data were analyzed using descriptive statistics. Additional statistical tests, such as ANOVA, Chi-Square, T-tests, and F-tests were used to analyze demographic variables with protein related variables, while controlling for age. Age was controlled for due to changes in body composition, appetite, and metabolism that naturally occur with aging. Lastly, protein groups were either ≤60 grams or > 60 grams.

Results

Participant demographics.

A total of 60 participants completed the survey. One participant was excluded from all analysis due to being a potential outlier, leaving a total of 59 participants. Most participants were between the ages of 46-60 (n=22, 37.3%) years; however, participants' ages ranged from 30 years to 71 years. Participants' gender was predominantly female (n=53, 89.9%), with a small number of male participants (n=6, 10.2%). Most participants were married (n=41, 69.5%) with the rest of participants being single, widowed, in a domestic partnership, or divorced. Geographically, most participants lived in Wisconsin (n=19, 32.2%). Demographic data are presented in Table 4.2.

Table 4.2

Characteristics of Study Participants (N=59)

Characteristic	Result *n (%)*
Age (y)	
30-45	18 (30.5)
46-60	22 (37.3)
>61	19 (32.2)
Gender	
Male	6 (10.2)
Female	53 (89.8)
Marital Status	
Married	41 (69.5)
Single, never married	7 (11.9)
Widowed	4 (6.7)
Domestic Partnership	4 (6.7)
Divorced	3 (5.0)
Current State Residence	
Wisconsin	19 (32.2)
Illinois	12 (20.3)
Washington	10 (17.0)
California	10 (17.0)
Upper Midwest (Iowa, Minnesota, North Dakota, South Dakota)	7 (11.9)
Colorado	1 (1.7)
Surgery Type	
Roux-en-Y Gastric Bypass	31 (51.7)
Vertical Sleeve Gastrectomy	28 (46.7)

Participants' surgery type and BMI.

As seen in Table 4.3 the participants' overall BMI and BMI between surgery types (RYGB and VSG) were compared. Initially, participants who underwent RYGB had a mean BMI of 47.6 kg/m^2 while VSG participants had a mean BMI of 47.7 kg/m^2. Currently, RYGB participants have a mean BMI of 31.7 kg/m^2 while VSG participants have a mean BMI of 33.1 kg/m^2 (Table 4.3). T-test analysis showed a trend toward significance ($p=0.054$) for mean lowest BMI post-surgery. ANOVA analysis showed mean BMI reduction between surgery types was not significant ($p>0.128$).

Table 4.3

Comparison between Participants' Surgery Types and BMI, Age, and Time between Surgery

	Total N 59	RYGB n (%) 31 (51.7)	VSG n (%) 28 (46.7)	p-value
BMI at time of surgery (kg/m^2)	47.7	47.6	47.7	0.98
Lowest BMI (kg/m^2)	30.3	28.7	32.1	0.05
Current BMI (kg/m^2)	32.4	31.7	33.1	0.44
BMI reduction (kg/m^2)	15.3	15.9	14.6	0.13
Mean age (years)	54	56	52	0.52
Days Between Day of Surgery and Lowest Weight	561 ± 467	599 ± 538	519 ± 378	0.52

BMI reduction=highest BMI-current BMI

Protein intake.

Participants reported a mean intake of 101 grams of protein (±37.5), a median of 94.4 grams, and a range intake of 47.2 - 193.2 grams over the past month. Overall, 35 (59.3%) participants consumed 60 grams or less of protein over the last month. Of this total, 31 (52.5%) participants had RYGB and 28 (47.5%) participants had VSG (Table 4.4). Overall, 36 (61.0%) participants consumed protein shakes/bars very often after surgery. Comparing further, 20 (71.4%) VSG and 16 (51.6%) RYGB participants reported they consumed protein shakes/bars very often after surgery. Many participants stated they prefer less-sweet protein shakes and bars because they can tolerate them better. Participants' comments concerning protein supplements are:

> "Having [protein bars] that are more flavorful and less sweet tasting would be nice. Most bars have chocolate or some sort of sweetness added to it."
>
> "I stay away from protein bars – to me, they are sweet, higher in calories and sugars and are a 'gateway' food, and tempting me to eat sweets…they are just like a candy bar and for me that is not good…"

Participants have also learned what brands and flavors of protein shakes/bars work for them through trial and error, requiring further patience post-surgery.

> "Protein shakes are very filling and can be very tasteful if you use ingredients such as fruit. There are also many protein bars on the market that have a good taste. You just have to do some research and trial and error."

> "You have to find the right brand that you will enjoy consuming it daily."

Generally, participants found protein shakes/bars helpful in assisting them to consume the recommended amount of protein per day post-surgery.

Table 4.4

Participants' Intake of Protein shakes/bar/foods According to Surgery Type

	Over all N (%)	RYGB[a] 31 (52.5)	VSG[a] 28 (47.5)	p-value
Protein intake (g)				0.750
> 60	24 (40.7)	12 (38.7)	12 (42.9)	
≤ 60	35 (59.3)	19 (61.3)	16 (57.1)	
Weekly Consumption of Protein Shakes/Bars After Surgery				0.026*
Never	1 (1.7)	1 (3.2)	0	
Rarely	3 (5.1)	3 (9.7)	0	
Sometimes	7 (11.9)	5 (16.1)	2 (7.1)	
Quite Often	12 (20.3)	6 (19.4)	6 (21.4)	
Very Often	36 (61.0)	16 (51.6)	20 (71.4)	
Total	59	31	28	
Weekly Consumption of High Protein Foods After Surgery [b]				0.110
Never	0	0	0	
Rarely	2 (3.5)	2 (6.7)	0	
Sometimes	6 (10.3)	3 (10.0)	3 (10.7)	
Quite Often	13 (22.4)	9 (30.0)	4 (14.3)	
Very Often	37 (63.8)	16 (53.3)	21 (75.0)	
Total	58	30	28	

[a] N = 58.

* significant at < 0.05

While there were no differences in the amount of protein consumed between the two surgery groups, nor the perceived high protein consumption, the sources of protein differed. The VSG participants consumed protein bars and shakes more frequently than those with the RYGB.

Overall, 37 (63.8%) participants reported consuming high protein foods very often after surgery. Additionally, 16 (53.3%) RYGB and 21 (75.0%) VSG participants consumed high protein food very often after surgery. Moreover, significance was found between surgery type and weekly consumption of protein bars/shakes post-surgery (p=0.026) (Table 4.4).

The most frequently consumed high protein foods, three to four times per week, included beef (n=14, 23.7%), chicken (n=23, 40.4%), milk/cottage cheese (n=14, 25.5%), and eggs (n=18, 32.7%). Additionally, half of participants (n=28, 50.9%) reportedly never consumed protein bars over the last week and over three quarter of participants (n=41, 78.9%) reportedly never consumed plant protein shakes over the last week (Table 4.5).

Table 4.5

Participant Consumption of High Protein Foods in a Week

High Protein Food Choice	Consumption Per Week	Overall n (%)
Beef	Never	8 (13.6)
	1-2 times/week	34 (57.6)
	3-4 times/week	14 (23.7)
	5-6 times/week	1 (1.7)
	7 times/week	2 (3.4)
Pork[a]	Never	19 (36.5)
	1-2 times/week	29 (55.8)
	3-4 times/week	4 (7.7)
Chicken/Turkey[b]	Never	1 (1.8)
	1-2 times/week	20 (35.1)
	3-4 times/week	23 (40.4)
	5-6 times/week	10 (17.5)
	7 times/week	3 (5.3)
Fish/Seafood[c]	Never	9 (16.4)
	1-2 times/week	33 (60.0)
	3-4 times/week	8 (14.6)
	5-6 times/week	4 (7.3)
	7 times/week	1 (1.9)
Milk/Cottage Cheese[c]	Never	13 (23.6)
	1-2 times/week	16 (29.1)
	3-4 times/week	14 (25.5)
	5-6 times/week	7 (12.7)

Table 4.5 *Participant Consumption of High Protein Foods in a Week (continued)*

High Protein Food Choice	Consumption Per Week	Overall n (%)
	7 times/week	5 (9.1)
Greek Yogurt[d]	Never	17 (30.4)
	1-2 times/week	19 (33.9)
	3-4 times/week	6 (10.7)
	5-6 times/week	6 (10.7)
	7 times/week	8 (14.3)
Eggs[c]	Never	3 (5.5)
	1-2 times/week	22 (40.0)
	3-4 times/week	18 (32.7)
	5-6 times/week	6 (10.9)
	7 times/week	6 (10.9)
Beans[d]	Never	10 (17.9)
	1-2 times/week	32 (57.1)
	3-4 times/week	8 (14.3)
	5-6 times/week	5 (8.9)
	7 times/week	1 (1.8)
Other:		
Tofu	1-2 times/week	2
Cheese	3-4 times/week	1
	7 times/week	1
Lentils, bulgar		1
Whey Protein Shakes[c]	Never	26 (47.3)
	1-2 times/week	6 (10.9)
	3-4 times/week	5 (9.1)
	5-6 times/week	7 (12.7)
	7 times/week	11 (20.0)
Plant Protein Shakes[a]	Never	41 (78.9)
	1-2 times/week	6 (11.5)
	3-4 times/week	4 (7.7)
	7 times/week	1 (1.9)
Protein Bars[a]	Never	28 (50.9)
	1-2 times/week	11 (20.0)
	3-4 times/week	5 (9.1)
	5-6 times/week	4 (7.3)
	7 times/week	7 (12.7)
Atkins Protein Shake		1

[a] n=52 [b] n=57 [c] n=55 [d] n=56

Protein intake and BMI.

Regarding protein intake and mean BMI reduction, participants who consumed 60 grams or less (n=35) of protein over the last month experienced a mean BMI reduction of 13.5 (±5.6) units regardless of surgery type. Importantly, five BMI units is equal to approximately 30 pounds; therefore, participants lost an average of 81 pounds (Center for Disease Control and

Prevention, 2008). Similarly, participants who consumed greater than 60 grams (n=24) of protein over the last month had an average BMI reduction of 17.9 (±6.0) units or 107 pounds regardless of surgery type. This is a difference of 4.3 kg/m^2 or about 26 pounds. Moreover, Figure 4.3 shows that participants who consumed greater than 60 grams of protein over the past month experienced a BMI reduction of over 30 units or 180 pounds. However, participants who consumed 60 grams or less of protein over the past month did not experience a BMI reduction over 25 units or 150 pounds. Hence, participants who consumed greater than 60 grams of protein reduced their BMI by over 30 units or 180 pounds. Furthermore, this research demonstrated through ANOVA and F-test analysis that overall protein intake and BMI reduction since time of surgery was statistically significant after controlling for age and surgery type (p=0.048).

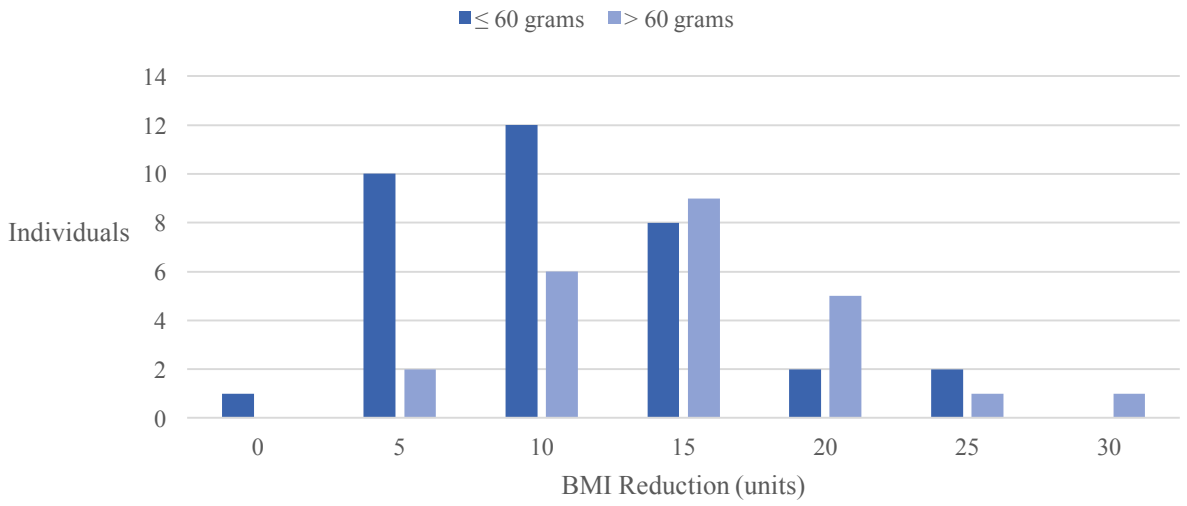


Figure 4.1. Comparison of the Number of Individuals' BMI Reduction Post-Surgery to Protein Recommendations Over the Past Month (N=59).
BMI reduction = difference in body mass index between surgery date and current weight
5 BMI units=30 pounds

Discussion

One purpose of this study was to examine individuals' adherence to protein recommendations six months' post-bariatric surgery. Nationwide, surgical recommendations state individuals should consume a minimum of 60 grams of protein per day starting approximately three months after surgery to conserve lean body mass and manage weight post-surgery (Moize et al., 2013). This research study demonstrated most participants consumed ≤60 grams, indicating respondents did not meet the nationwide protein recommendations. In a similar study, Miller et al (2014) found 41.2% of individuals sampled consumed less than the recommended amount of protein when they were six months post-surgery. This study found at least 59.3% of individuals did not meet nationwide protein recommendations at least six months' post-surgery. However, protein needs may also be calculated by multiplying adjusted body weight (in kilograms) by 1-2 grams; resulting in a more individualized protein needs approximation (Schollenberger et al., 2016). After calculating participants' protein needs using their current weight, protein needs ranged from 47 to 193 grams of protein per kilogram per day, resulting in a large range of protein needs for this sample of people. This research study demonstrated most participants consumed ≤60 grams, indicating participants did not meet the nationwide protein recommendations, but may have met individualized protein recommendations according to their adjusted body weight. This may explain why more participants consumed 60 grams or less or protein over the past week.

Participants consumed chicken, beef, pork, beans, and eggs as their preferred method to reach protein recommendations. Most of these food sources were consumed only 1-2 times per week (i.e. beef, pork, beans, and eggs), indicating participants preferred to consume a variety of both plant and animal protein food sources per week. This research study also indicated surgery

type and consumption of protein bars/shakes post-surgery showed significance; therefore, protein intake from bars/shakes post-surgery may be influenced by surgery type. There may be a host of reasons why VSG participants used protein shakes/bars more frequently than RYGB participants. Historically, VSG is a newer surgery as it was first conducted as a stand-alone surgery in 2000 (Gumbs, Gagner, Dakin, & Pomp, 2007); therefore, participants may have been more open to incorporating protein shakes/bars into their post-surgical diet due to the wide availability of these products. While older participants may be used to consuming high protein food sources, such as beef, chicken, beans, and eggs; they may prefer to continue consuming more natural forms of protein because that is what they are accustom. Additionally, protein shakes/bars continue to evolve and become better tasting; participants who had their surgeries five to ten years ago may perceive protein shakes/bars as unappetizing. Participants who underwent their surgery more recently may be more likely to consume protein bars/shakes due to the creation of better tasting protein shakes/bars.

Discrepancies between the data indicates a difference between what participants say and do. Approximately 61% (n=36) of participants reported consuming protein shakes/bars post-surgery regardless of surgery type. However, when asked how often they consumed whey protein shakes, plant protein shakes, and protein bars, most participants stated they never consumed these forms of protein over the last week. One reason for these inconsistencies may have been participant perception and understanding of survey questions. Participants in this study may have perceived the protein shakes/bars questions as right after surgery and the food frequency questions as 1.5 years post-surgery, which is where most participants in this study are currently in their weight loss journey. These inconsistencies emphasize the need for participants to have a clear understanding of the survey questions through an explanation. Due to the wide

variety of participant perceptions and experiences, an explanation describing the purpose of each survey question would have reduced these inconsistencies. In light of these inconsistencies, time since surgery may have largely influenced participant perception of survey questions. Previous research has shown that protein shakes/bars may be more tolerated right after surgery, therefore, participants who are six months post-surgery may consume protein shakes/bars more frequently than someone who is one year post-surgery. Protein shakes/bars are consumed more frequently due to the gradual introduction of solid foods post-surgery (Andreu et al., 2010; Geraci et al., 2015; Giusti et al., 2016). Overall, this study's results remain inconclusive as to how often participants consume protein shakes/bars.

Yanos et al (2015) concluded protein intake along with several other modifiable factors (i.e. physical activity, avoiding sweets, fluid consumption) were greatly associated with post-operative weight regain. Like this study, participants who consumed over 60 grams of protein experienced a greater BMI reduction and increased weight loss. Although overall protein intake and BMI reduction was found slightly statistically significant, there was clinical significance found within the results of this study. Participants who consumed 60 grams or less of protein lost approximately 150 pounds, while participants who consumed greater than 60 grams of protein lost approximately 180 pounds. Clinically, individuals who lost this amount of weight also experienced improved blood pressure, lipid levels, and diabetes control (Martin-Rodriguez et al., 2015; Nadalini et al., 2014; Schauer et al., 2014); thus, improving overall and health related quality of life (Arterburn & Courcoulas, 2014; Major et al., 2015; Natvik et al., 2013). After losing the weight and improving their quality of life, many participants do not regret their surgery and would undergo surgery again if given the opportunity (Marihart, Geraci, & Brunt, 2017). Lastly, like this study, Soares et al (2014) study sample consisted mostly of women with

very few male participants. This could have influenced the results since women tend to consume less protein than men. If the study sample consisted mostly of men, results may have differed.

Limitations.

One limitation of this study was the study sample, which consisted mostly of women. Because of snowball sampling and contacting health-care sponsored social support groups, the study sample consisted mostly of female participants. Researchers indicated four out of the six male participants were only slightly under or exceeded protein recommendations. A more balanced gender distribution could have altered the results about protein intake. Additionally, some bias may have influenced responses in the survey due to researcher-respondent relationships. Participants may have already known the researcher, which in turn, may have influenced participant responses and whether they chose to respond.

Another limitation of this study was that it is not generalizable to a broader population. The study sample size totaled to be 59 participants; this is not a large enough sample to generalize conclusions to the entire bariatric surgery community. To improve generalizability, a larger study sample would need to be recruited.

A final limitation of this study was in the survey design and coincides with participant responses. Participant intake was not actually measured and the survey relied heavily on self-report of protein source intake. Participant actions did not match what participants answered in the survey, leading to potential discrepancies in the results and inconclusive findings.

Conclusions

This study explored protein consumption in individuals who were at least six months post bariatric surgery. Findings suggested most individuals consumed 60 grams or less or protein over the past month; therefore, they did not meet the nationwide bariatric protein recommendations.

Moreover, this research study showed statistical significance between surgery type and protein shakes/bars consumption. More individuals who underwent VSG consumed protein shakes/bars than individuals who underwent RYGB, which may be due to a younger population of people who underwent VSG. Additionally, clinical significance indicated individuals lost between 150 to 180 pounds post-surgery. Losing this amount of weight in a short amount of time, results in improved blood glucose control, sleep apnea, lipid levels, and blood pressure for individuals (Martin-Rodriguez et al., 2015; Nadalini et al., 2014; Schauer et al., 2014). Improvement of these comorbidities also results in an improved overall and health related quality of life for individuals post-surgery (Arterburn & Courcoulas, 2014; Major et al., 2015; Natvik et al., 2013). Future research should focus on VSG participant consumption of protein shakes/bars in comparison to RYGB participant consumption of protein shakes/bars. Also, future research should investigate discrepancies between protein food frequency questionnaires.

References

Adams, T. D., Davidson, L. E., Litwin, S. E.,. . . Hunt, S. C. (2012). Health benefits of gastric bypass surgery after 6 years. *Journal of the American Medical Association, 308*(11), 1122-1131. doi:10.1001/2012.jama.11164

Andreu, A., Moize, V., Rodriguez, L., Flores, L., & Vidal, J. (2010). Protein intake, body composition, and protein status following bariatric surgery. *Obesity Surgery, 20*(11), 1509-1515. doi:10.1007/s11695-010-0268-y

Aron-Wisnewsky, J., Verger, E. O., Bounaix, C., Dao, M. C., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Nutritional and protein deficiencies in the short term following both gastric bypass and gastric banding. *PLoS One, 11*(2), e0149588. doi:10.1371/journal.pone.0149588

Arterburn, D. E., & Courcoulas, A. P. (2014). Bariatric surgery for obesity and metabolic conditions in adults. *British Medical Journal, 349*, g3961. doi:10.1136/bmj.g3961

Center for Disease Control and Prevention. (2008). *Obesity Trends Among U.S. Adults BRFSS, 1990, 1999, 2008*. Atlanta, Georgia Retrieved from https://www.cdc.gov/obesity/data/index.html.

Donadelli, S. P., Junqueira-Franco, M. V., de Mattos Donadelli, C. A., Salgado, W., Jr., Ceneviva, R., Marchini, J. S., . . . Nonino, C. B. (2012). Daily vitamin supplementation and hypovitaminosis after obesity surgery. *Nutrition, 28*(4), 391-396. doi:10.1016/j.nut.2011.07.012

Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Journal of the American Medical Association, 315*(21), 2284-2291. doi:10.1001/jama.2016.6458

Geraci, A. (2015). *The impact of psychosocial outcomes in long-term bariatric patients.* (Doctoral dissertation). North Dakota State University, Fargo, ND. (Appendix C). Retrieved from: https://search.proquest.com/pqdtglobal/docview/1683995593/BD3C9A2E80C4FB7PQ/1?accountid=6766

Geraci, A., Brunt, A., & Hill, B. (2015). The pain of regain: psychological impacts of weight regain among long-term bariatric patients. *Bariatric Surgical Practice and Patient Care, 10*(3), 110-118. doi:10.1081089/bari.2015.0011

Geraci, A., Brunt, A., & Marihart, C. (2014). The work behind weight-loss surgery: a qualitative analysis of food intake after the first two years post-op. *International Scholarly Research Network Obesity, 2014*, 427062. doi:10.1155/2014/427062

Giusti, V., Theytaz, F., Di Vetta, V., Clarisse, M., Suter, M., & Tappy, L. (2016). Energy and macronutrient intake after gastric bypass for morbid obesity: a 3-y observational study focused on protein consumption. *American Journal of Clinical Nutrition, 103*(1), 18-24. doi:10.3945/ajcn.115.111732

Gletsu-Miller, N., & Wright, B. N. (2013). Mineral malnutrition following bariatric surgery. *Advanced Nutrition, 4*(5), 506-517. doi:10.3945/an.113.004341

Gumbs, A. A., Gagner, M., Dakin, G., & Pomp, A. (2007). Sleeve Gastrectomy for Morbid Obesity. *Obesity Surgery, 17*(7), 962-969. doi:10.1007/s11695-007-9151-x

Heidmann, J., & Gronkjaer, M. (2015). Health-related quality of life 6 years after gastric bypass: a mixed methods study. *Bariatric Surgical Practice and Patient Care*. doi:10.1089/bari.2014.0052

Major, P., Matlok, M., Pedziwiatr, M., Migaczewski, M., Budzynski, P., Stanek, M., . . . Budzynski, A. (2015). Quality of life after bariatric surgery. *Obesity Surgery, 25*(9), 1703-1710. doi:10.1007/s11695-015-1601-2

Marihart, C. L., Brunt, A. R., & Geraci, A. A. (2014). Older adults fighting obesity with bariatric surgery: Benefits, side effects, and outcomes. *SAGE Open Medicine, 2*, 2050312114530917. doi:10.1177/2050312114530917

Marihart, C. L., Geraci, A., & Brunt, A. (2017). Without a doubt, I would do it again: a study of physical quality of life in bariatric surgery adults. *Journal of Obesity and Therapeutics, 1*(1). doi:10.4172/2325-9612.1000102

Martin-Rodriguez, E., Guillen-Grima, F., Marti, A., & Brugos-Larumbe, A. (2015). Comorbidity associated with obesity in a large population: The APNA study. *Obesity Research and Clinical Practice, 9*(5), 435-447. doi:10.1016/j.orcp.2015.04.003

Miller, G. D., Norris, A., & Fernandez, A. (2014). Changes in nutrients and food groups intake following laparoscopic Roux-en-Y gastric bypass (RYGB). *Obesity Surgery, 24*(11), 1926-1932. doi:10.1007/s11695-014-1259-1

Moize, V., Andreu, A., Flores, L., Torres, F., Ibarzabal, A., Delgado, S., . . . Vidal, J. (2013). Long-term dietary intake and nutritional deficiencies following sleeve gastrectomy or Roux-en-Y gastric bypass in a mediterranean population. *Journal of the Academy of Nutrition and Dietetics, 113*(3), 400-410. doi:10.1016/j.jand.2012.11.013

Moize, V., Geliebter, A., Gluck, M. E., Yahav, E., Lorence, M., Colarusso, T., . . . Flancbaum, L. (2003). Obese patients have inadequate protein intake related to protein intolerance up to 1 year following Roux-en-Y gastric bypass. *Obesity Surgery, 13*(1), 23-28. doi:10.1381/096089203321136548

Nadalini, L., Zenti, M. G., Masotto, L., Indelicato, L., Fainelli, G., Bonora, F., . . . Bonora, E. (2014). Improved quality of life after bariatric surgery in morbidly obese patients. Interdisciplinary group of bariatric surgery of Verona (G.I.C.O.V.). *IL Giornale de Chirurgia, 35*(7-8), 161-164.

National Institute of Health. (2014). The A1c test and diabetes. Retrieved from https://www.niddk.nih.gov/health-information/diabetes/diagnosis-diabetes-prediabetes/a1c-test

National Institute of Health. (2016). Classification of overweight and obesity by BMI, waist circumference, and associated disease risks.

Natvik, E., Gjengedal, E., & Raheim, M. (2013). Totally changed, yet still the same: patients' lived experiences 5 years beyond bariatric surgery. *Qualitative Health Research, 23*(9), 1202-1214. doi:10.1177/1049732313501888

Obesity Action Coalition. (2017). Find a support network. Retrieved from http://www.obesityaction.org/advocacy/support-groups

Saltzman, E., & Karl, J. P. (2013). Nutrient deficiencies after gastric bypass surgery. *Annual Review of Nutrition, 33*, 183-203. doi:10.1146/annurev-nutr-071812-161225

Schauer, P. R., Bhatt, D. L., Kirwan, J. P., Wolski, K., Brethauer, S. A., Navaneethan, S. D., . . . Kashyap, S. R. (2014). Bariatric surgery versus intensive medical therapy for diabetes--3-year outcomes. *New England Journal of Medicine, 370*(21), 2002-2013. doi:10.1056/NEJMoa1401329

Schollenberger, A. E., Karschin, J., Meile, T., Kuper, M. A., Konigsrainer, A., & Bischoff, S. C. (2016). Impact of protein supplementation after bariatric surgery: a randomized controlled double-blind pilot study. *Nutrition, 32*(2), 186-192. doi:10.1016/j.nut.2015.08.005

Soares, F. L., Bissoni de Sousa, L., Corradi-Perini, C., Ramos da Cruz, M. R., Nunes, M. G., & Branco-Filho, A. J. (2014). Food quality in the late postoperative period of bariatric surgery: an evaluation using the bariatric food pyramid. *Obesity Surgery, 24*(9), 1481-1486. doi:10.1007/s11695-014-1198-x

Verger, E. O., Aron-Wisnewsky, J., Dao, M. C., Kayser, B. D., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Micronutrient and protein deficiencies after gastric bypass and sleeve gastrectomy: a 1-year follow-up. *Obesity Surgery, 26*(4), 785-796. doi:10.1007/s11695-015-1803-7

Yanos, B. R., Saules, K. K., Schuh, L. M., & Sogg, S. (2015). Predictors of lowest weight and long-term weight regain among Roux-en-Y gastric bypass patients. *Obesity Surgery, 25*(8), 1364-1370. doi:10.1007/s11695-014-1536-z

CHAPTER 5. SOCIAL SUPPORT AND TIME SINCE SURGERY AS A DETERMINANT FOR WEIGHT LOSS IN INDIVIDUALS WHO ARE AT LEAST 6 MONTHS POST BARIATRIC SURGERY

Abstract

Introduction: Bariatric surgery is a proven weight loss solution for individuals with morbid obesity. Individuals who undergo bariatric surgery reap long-term benefits of controlled diabetes, blood pressure, lipid levels, and experience an improved overall quality of life. Social support plays a critical role in attaining and maintaining weight loss post-surgery. The purpose of this paper is to explore the interpersonal relationships which provided the most support in individuals who are at least six months post-surgery.

Materials and Methods: A total of 59 participants completed a 33 question online survey in this mixed method cross-sectional study. Participants either underwent Vertical Sleeve Gastrectomy (VSG) or Roux-en-Y Gastric Bypass (RYGB).

Results: The top five forms of social support that participants reported were spouse/significant other (n=42), friends (n=39), friends who've had bariatric surgery (n=31), physician (n=30), and support group members (n=28). Individuals' spouse/significant other were perceived as their most important form of social support. Mean BMI reduction for individuals who attended support groups every few months was 11.8 kg/m^2 (71 pounds), while individuals who attended support groups less than a couple times per year had a mean BMI reduction of 14.6 kg/m^2 (88 pounds). ANCOVA demonstrated a significant relationship between face to face support group attendance, time since surgery, and current BMI reduction ($p=0.032$).

Conclusions: Participants viewed social support groups members as an important part of their support network, however, most participants did not use support groups regularly.

Individuals used other forms of support, such as significant others and friends more frequently for support. Time since surgery and support group attendance play a critical role in weight loss for individuals post-surgery. This indicates individuals may attend support group meetings more frequently right after their surgery than where they are now in their weight loss journey.

Introduction

Bariatric surgery has been considered an effective long-term solution for weight loss for individuals who suffer from obesity (Major et al., 2015; Nadalini et al., 2014; Natvik, Gjengedal, & Raheim, 2013). Surgical intervention as a solution for obesity is considered only after all other nonsurgical weight loss methods have been attempted and failed. The qualifications for individuals who are considered for bariatric surgery include a Body Mass Index (BMI) of 40.0 kg/m^2 or more or a BMI of 35.0-39.9 kg/m^2 with one or more comorbidities (Marihart, Brunt, & Geraci, 2014). Individuals who undergo bariatric surgery reap long-term benefits such as improved health related quality of life, possible remission of type II diabetes, and improved blood pressure and sleep apnea conditions (Adams, Davidson, Litwin, & et al., 2012; Arterburn & Courcoulas, 2014; Heidmann & Gronkjaer, 2015; Martin-Rodriguez, Guillen-Grima, Marti, & Brugos-Larumbe, 2015; Nadalini et al., 2014; Natvik et al., 2013). This translates into individuals living a healthy and fulfilling life, both physically and mentally.

The four types of bariatric surgery, ranging from least to most invasive, are Laparoscopic Adjustable Gastric Banding (LAGB), Vertical Sleeve Gastrectomy (VSG), Roux-en-Y Gastric Bypass (RYGB), and Biliopancreatic Diversion with Duodenal Switch (BPD-DS) (Neff, Olbers, & le Roux, 2013). Similar to nonsurgical interventions for obesity, bariatric surgery poses challenges (Chacko, Yeh, Davis, & Wee, 2016; Gorin et al., 2013; Himes et al., 2015; Keyserling et al., 2016; Laitner, Minski, & Perri, 2016; Mason et al., 2016). Specifically,

individuals may face challenges related to psychological barriers, difficulty meeting nutritional needs, and general weight maintenance after the weight is lost (Geraci, Brunt, & Hill, 2015; Verger et al., 2016). These challenges emphasize the need for social support to assist individuals in adhering to dietary recommendations (Chacko et al., 2016; Keyserling et al., 2016; Saltzman & Karl, 2013).

Social support plays a critical role in attaining and maintaining weight loss after bariatric surgery and may include family members, significant others, friends, and bariatric support groups (Chacko et al., 2016; Himes et al., 2015; Keyserling et al., 2016). Individuals who attended bariatric surgery support groups overcame psychological barriers, such as feelings of defeat, and maintained weight loss despite challenges faced when dining out post-surgery. (Geraci, Brunt, & Marihart, 2014; Groller, 2017; Himes et al., 2015; Peacock, Schmidt, & Barry, 2016). It has been previously demonstrated that an individual's close family support provided individuals with positive appraisal relating to weight loss and encouragement to continue living the recommended post-surgery lifestyle (Ogle, Park, Damhorst, & Bradley, 2016). Therefore, the physical and psychological presence of positive close interpersonal support assists individuals in staying on track and maintaining weight loss (Bradley et al., 2017; Chacko et al., 2016; Ogle et al., 2016). The purpose of this paper is to explore the interpersonal relationships which provided the most support in individuals who are at least six months post-surgery.

Materials and Methods

Research design and instrument development.

This study used a mixed methods cross-sectional survey design. The survey was created using questions from previous studies (Geraci, 2015). To ensure validity, a pilot study was conducted with two content experts and two individuals who underwent bariatric surgery before

the survey was finalized. A readability test was not conducted for this questionnaire. Survey questions included demographics, surgery type, date of surgery, height, weight at surgery, lowest weight, highest weight, and current weight. BMI reduction was calculated using the difference in BMI at the time of surgery and current BMI. The survey focused on who was in the participants' social support network and the participant's frequency of using bariatric surgery specific support groups. The North Dakota State University Institution Review Board (NDSU IRB) approved all aspects of this research before the study began. The survey was administered and data were collected using a web-based survey system (Qualtrics).

Participant recruitment.

Participants were selected and identified through snowball sampling and contacting various bariatric surgery support groups across the United States. Snowball sampling was used to recruit participants through study subjects and researcher acquaintances. Using the entire listing of the Obesity Action Coalition, a list of selected bariatric surgery support groups was developed (Obesity Action Coalition, 2017). Employing a prepared phone or email script, five randomly selected groups were initially contacted. Every two weeks afterward, an additional five groups were contacted until at least 50 participant responses were collected. The groups that were contacted are listed in Table 5.1.

Table 5.1

Bariatrics Support Groups Contacted

Bariatric Support Group	State
Allina Health Bariatric Surgery Support Group-St. Francis Regional Medical Center	Minnesota
Pacific Bariatrics Program-Campbell, CA	California
Pacific Bariatrics Program-Oceanside/Vista, CA	California
Silverdale Medical Center	
Olympia Medical Center	Washington
ALOHA-Wausa Hospital Support Group	Wisconsin
Weight Loss Surgery Support Group	Wisconsin
Bariatric Surgery Support Group-St. Joseph Hospital	Illinois
Why Weight—MacNeal Hospital	Illinois
Western Slope WLS Support Group	Colorado

(Obesity Action Coalition, 2017)

Participants.

A total of 76 individuals responded; however, 16 respondents were excluded due to questionnaire incompletion. After descriptive statistics were used to analyze demographic data, only one respondent reported having LAGB; therefore, that respondent was also excluded from any additional analysis to prevent skewing the results. This left 59 study participants.

Analysis.

Reduction in BMI was calculated by subtracting BMI at the time of surgery from current weight. Depending on analysis, BMI reduction was considered either a continuous (ANCOVA) or categorical (ANOVA) variable. Using SAS 9.4, demographic data were analyzed using descriptive statistics. Additional statistical tests, such as ANOVA, ANCOVA, Chi-Square, T-tests, and F-tests were used to analyze demographic variables with social support related

variables, while controlling for age. Age was controlled for due to inevitable changes in social support networks as individuals' age. Lastly, the participant's perceived most important form of social support was analyzed by calculating the mean rank over all participants for each form of social support.

Results

Participant demographics.

A total of 59 participants who were at least six months post-surgery completed the survey. As seen in Table 5.2, the ages of participants ranged from 30 to 71 years with the majority being female (n=53, 89.9%). Participants were from nine states from various regions of the U.S. Mean BMI reduction was 15.3 (±6.1) kg/m^2 with an average of 4.2 years between day of surgery and participants' weight June 2017. Participants had RYGB (n=31, 51.7%), VSG (n=28, 46.7%), or LAGB (n=1, 1.7%). See Table 5.2 for additional participant demographics.

Table 5.2

Characteristics of Study Participants

Demographic	*n (%)*
Age (y)	
30-45	18 (30.5)
46-60	22 (37.3)
>61	19 (32.2)
Gender	
Male	6 (10.2)
Female	53 (89.8)
Marital Status	
Married	41 (69.5)
Single, never married	7 (11.9)
Widowed	4 (6.7)
Domestic Partnership	4 (6.7)
Divorced	3 (5.0)
Current State Residence	
Wisconsin	19 (32.2)
Illinois	12 (20.3)
Washington	10 (17.0)
California	10 (17.0)
Upper Midwest/Great Plains (Colorado, Iowa, Minnesota, North Dakota, South Dakota)	8 (13.6)
BMI (kg/m^2)	*mean±standard deviation*
Highest	51.9 ± 9.8
At time of surgery	47.7 ± 8.6
Current	32.4 ± 6.3
Lowest	30.3 ± 6.7
Reduction	15.3 ± 6.1
	mean number of days (years)
Time Between Day of Surgery and Lowest Weight	561 ± 467 (1.5 ± 1.3 years)
Time between day of surgery and current weight	1544 ± 1200 (4.2 ± 3.3 years)
Surgery Type	*n (%)*
Roux-en-Y Gastric Bypass	31 (51.7)
Vertical Sleeve Gastrectomy	28 (46.7)

Surgery type and BMI reduction.

Mean BMI reduction post-surgery was 15.3 (±6.1) kg/m^2 or roughly 91.8 pounds. Note, five BMI units is equal to approximately 30 pounds (Center for Disease Control and Prevention, 2008). Therefore, RYGB participants who experienced a mean BMI reduction of 15.9 kg/m^2

(±5.56) lost 95.4 pounds. Likewise, VSG participants who had a mean BMI reduction of 14.6 kg/m^2 (±6.69) lost 87.6 pounds. As seen in Figure 5.1, 13 (46%) participants who underwent RYGB and five (16%) participants who underwent VSG reduced their BMI by 10-15 units or 60-90 pounds. Most VSG participants reduced their BMI by five to ten units (30-60 pounds) and the majority of RYGB participants reduced their BMI by 10-15 units (60-90 pounds) since time of surgery. Comparing RYGB and VSG further, participants who underwent RYGB had, on average, a greater lowest BMI after surgery (28.7 kg/m^2) than VSG participants (32.1 kg/m^2) (p=0.054).

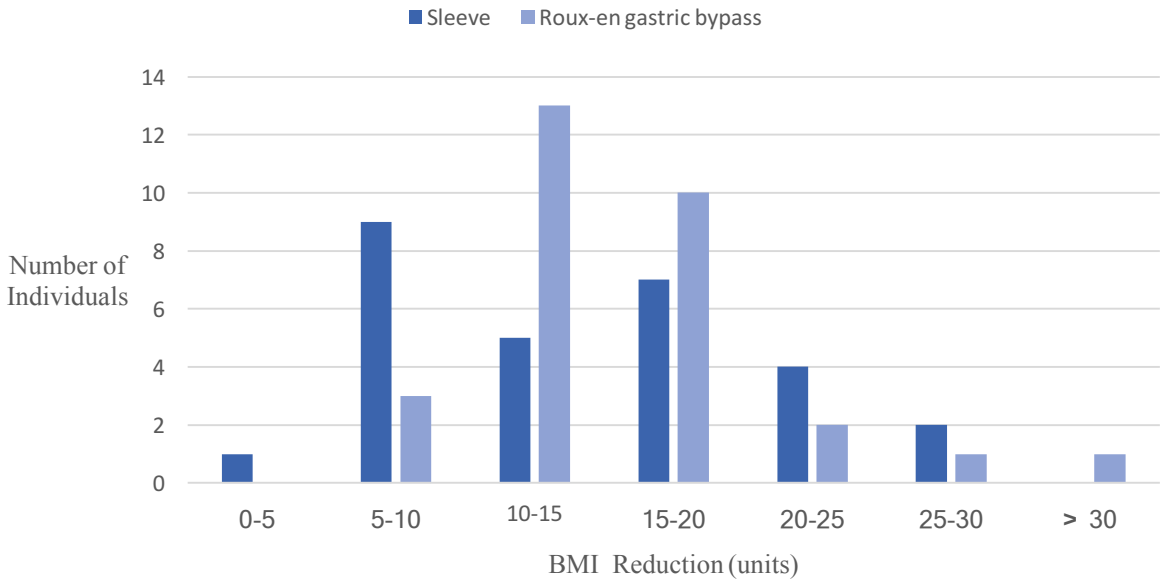


Figure 5.1. Comparison between Mean BMI Reduction since Surgery and Surgery Type (N=59).
BMI reduction = difference in body mass index between surgery date and current weight
5 BMI units=30 pounds

Social support post-surgery.

The most frequent form of social support participants used when making dietary choices for weight loss was their spouse or significant other (n=42, 95.5%). When asked to indicate the level of significance a spouse or significant other had in their support network, participants

perceived them as their most important form of social support. Many participants expressed their gratitude and appreciation of their supportive spouse through various comments listed below:

> "Husband is wonderful. He will check out places to eat ahead of time to make sure there will be something I can enjoy…"
>
> "My husband and I eat together 100% of the time at home, so he eats only post-op health meals…he also did the pre-op liquid diet with me, and this was vital to me. I can't overstate the necessity of this to me."
>
> "My husband has been my biggest support, I would fail without him cheering me on…"

The second most frequent form of social support participants used when making dietary choices for weight loss was friends (n=39, 90.7%). The least frequent forms of social support participants used when making dietary choices for weight loss were their children (n=2), therapist (n=2), and spiritual group (n=1). Moreover, 28 (77.8%) participants used bariatric surgery support group members as a form of social support when making dietary choices for weight loss (Figure 5.2). In terms of perceived importance of social support, participants perceived physicians, registered dietitians, support group members, and spouse/significant others as their most influential form of social support when making dietary choices.

Face to face bariatric surgery social support groups were used equally by those who had either RYGB or VSG. Nevertheless, over half (33, 55.9%) did not use face to face support groups very frequently. Overall, 14 (24.6%) participants went to face to face support groups once a month; while only six (10.5%) participants took part in online support groups regularly. Further analysis according to surgery type showed eight (26.7%) RYGB participants went to face to face support groups once a month whereas six (22.2%) VSG participants went to face to face support

groups once a month (Table 5.3). ANOVA analysis demonstrated time since surgery and face to face support group attendance was not significant (p=0.567).

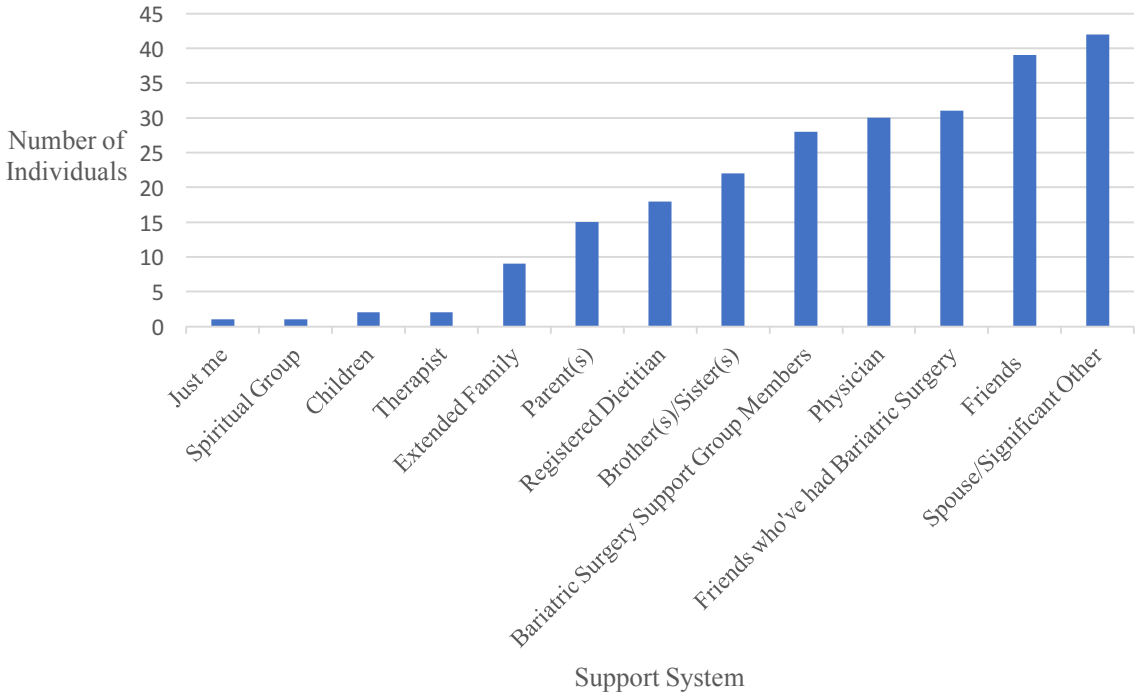


Figure 5.2. Ranking of Individuals' Social Support System Based on Participants' Perception.

Furthermore, participants rarely, if ever, used online bariatric surgery support groups. Over two-thirds of participants (45, 79%) reported either using online support groups every few months or never. Only four (7%) participants used online support groups weekly and six (10.5%) participants used online support daily. Referring to Table 5.3, 14 (51.9%) VSG participants reported they never use online support groups; while 24 (80%) RYGB participants reported they never use online support groups. Analysis was not conducted for online support group participation due to the variance of data collected.

Table 5.3

Participants' Description of Surgery Type and Support Group Attendance and Participation

	Overall N (%)	RYGB 31 (51.7)	VSG 28 (46.7)	p-value
Face-to-face support group attendance[a]				0.570
Never	20 (35.1)	10 (33.3)	10 (37.0)	
Couple of times per year	13 (22.8)	8 (26.7)	5 (18.5)	
Every few months	10 (17.5)	4 (13.3)	6 (22.2)	
Once a month	14 (24.6)	8 (26.7)	6 (22.2)	
Total	57	30	27	
Online support group participation[a]				0
Never	38 (66.7)	24 (80.0)	14 (51.9)	
Every few months	7 (12.3)	2 (6.7)	5 (18.5)	
Once a month	2 (3.5)	0	2 (7.4)	
Weekly	4 (7.0)	2 (6.7)	2 (7.4)	
Daily	6 (10.5)	2 (6.7)	4 (14.8)	
Total	57	30	27	

[a] Some totals are less than 59 due to non-response by participants

The most common reasons respondents reported participating in bariatric surgery support groups were accountability, encouragement to stay on track, and suggestions to overcome challenges post-surgery. Some participant comments concerning why they attend support groups are:

> "Learn, give, and receive suggestions with one another, identify challenges medically, nutritionally, and emotionally. Friendship!"
>
> "A support group is there to pick you up when you fall, which we all do. They encourage which is very important."
>
> "I participate to give and get support, new foods, and recipes, and also to know there are other people dealing with exactly the same problems. It is nice to belong to a group who understand."

Social support and BMI reduction.

Another purpose of this study was to determine the relationship between participant attendance at bariatric social support groups and BMI reduction since time of surgery. Participants who went to face to face support groups once a month had a mean reduction in BMI of 19.1 (±6.8) kg/m^2 or approximately 107 pounds. Participants who only went to support groups every few months had a mean reduction in BMI of 11.8 (±5.7) kg/m^2 or approximately 67 pounds (Figure 5.3). Participants who went to social support groups less than a couple times per year or never had a mean reduction of BMI of 14.6 (±5.6) kg/m^2 (81.8 pounds) and 15 (±5.3) kg/m^2 (84 pounds), respectively. In terms of perceived social support, participants whose spouse or significant was perceived as part of their support when making dietary choices (n=42) had a mean BMI reduction of 14.9 (±5.5) kg/m^2 (83.4 pounds).

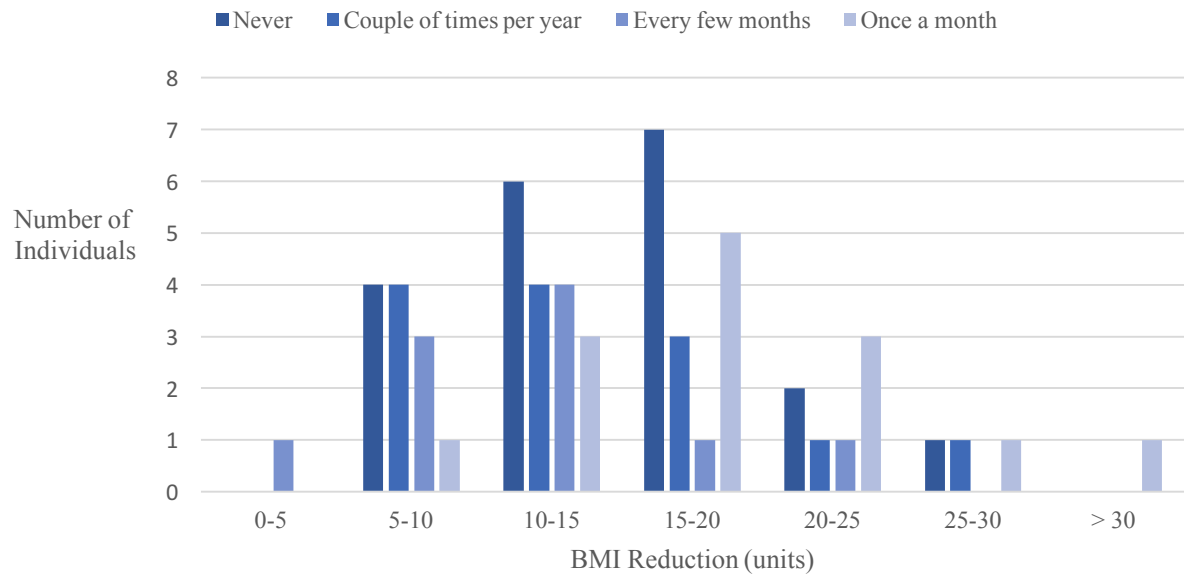


Figure 5.3. Comparison between Participants' Mean BMI Reduction since Surgery and Face-to-Face Bariatric Surgery Support Group Attendance (N=57).
BMI reduction = difference in body mass index between surgery date and current weight
5 BMI units=30 pounds

Participants who perceived their friends as part of their support network when making dietary choices (n=39) had a mean BMI reduction of 15.7 (±4.8) kg/m^2 (87.9 pounds). Participants who perceived bariatric surgery support group member (n=28) as part of their support when making dietary choices had a mean BMI reduction of 16.5 (±6.9) kg/m^2 (92.6 pounds). Lastly, ANCOVA controlled for and demonstrated a significant relationship between face to face support group attendance, time since surgery, and current BMI reduction (p=0.032).

Discussion

Many individuals were provided with social support through significant others, friends, friends who've had bariatric surgery, and bariatric surgery support groups. Individuals' significant others and friends were perceived as the most important form of social support. Nevertheless, 50% of the study participants viewed the bariatric surgery support groups as an important part of the social support system. Participants used bariatric surgery support groups to maintain accountability, get encouragement from others, and overcome barriers. In terms of weight loss, participants who used social support groups as a form of support when making dietary choices for weight loss experience the greatest amount of weight loss. Moreover, this research study suggests time since surgery and face to face support group attendance play a role in weight loss (BMI reduction).

Similar to this study, Robinson et al (2014) reported individuals who regularly attended either face to face or online support groups were more successful in post-operative weight loss than those who did not participate in any form of social support group (Robinson et al., 2014). Researchers found face to face support group attendance and BMI reduction since surgery plus time since surgery was significant. The addition of time since surgery to this analysis made it

significant, emphasizing the role time since surgery plays in BMI reduction and face to face support group attendance. As time goes on, individuals may gain an understanding of their nutrition needs and better understand how their body functions after surgery. Therefore, they may not attend support groups as frequently as they did right after surgery.

Moreover, results indicated majority of participants currently do not use face to face support groups very frequently, however, perceive it as an important form of the support system. Participants who went to support groups every few months had a mean reduction in BMI of 11.8 (±5.7) kg/m^2 or approximately 67 pounds. Comparatively, participants who never attended face to face social support groups reduced their BMI by 15 kg/m^2 or 84 pounds. Interestingly, participants who never attended face to face support groups lost more weight than those who attended support groups every few months. One explanation for this result is that individuals have already reached and maintained their goal weight, they may view support groups as a last resort if they begin regaining weight. so they don't find it necessary to attend support groups. Another reason behind this result is that individuals are already getting adequate support from their spouse/significant other or friends, so they don't find it necessary to attend support group meetings.

In a qualitative study consisting of personal interviews with individuals who were at least 30 months post-surgery, Liebl et al (2016) uncovered how positive social support related to weight loss success (Liebl et al., 2016). This mixed methods study did not contain the depth of explanation relating to social support post-surgery, however, there were similarities. Liebl et al (2016) found participants would be lost without the supportive network around them and would not be successful in maintaining weight loss. Supportive networks included family members, support groups, and bariatric health professionals (Liebl et al., 2016). These findings are very

similar to the comments participants in this study reported. Many of this participants expressed their gratitude towards their spouse, significant other, friends, and specific bariatric surgery support group members in helping them stay on their weight loss journey.

Limitations.

One limitation of this study was the snowball sampling method used. Snowball sampling does not allow researchers control over specific requirements needed for study participants. There may be many participants in one geographic area and very few in another geographic area. Many participants are from the Midwest region of the United States, so it's important to take this area's social norms into consideration when thinking about social support. Additionally, there may be bias when using snowball sampling. Friends, family, and other individuals close to the researchers may have been asked to complete this survey, possibly creating false results regarding social support.

Another limitation of this study was the small sample size of 59 participants. This small sample size makes these results not generalizable to the bariatric surgery community. A larger sample size is needed to generalize results to a broader bariatric surgery community.

A final limitation pertains to survey design and the addition of options to improve survey question completion and clarity. Specifically, the addition of a third column indicating the participant does not use this form of support would have improved analysis for clarity. Finally, incorporating more questions regarding online support groups, discussion groups, and other resources would have broadened the scope of the survey.

Conclusions

This study emphasizes the importance of social support networks for individuals who are at least six months post-surgery. An individual's spouse, significant other, friends, and bariatric

surgery support group members facilitate weight loss maintenance post-surgery. Individuals who participated in bariatric surgery support groups yielded the greatest BMI reduction since time of surgery. This may be largely due to the relationships formed based on similar challenges, successes, and experiences throughout their weight loss journey. Additionally, this research indicates social support group attendance and time since surgery play a significant role in weight loss for individuals' post-surgery.

Finally, an area of future research should compare participation in face to face and remote (online or phone) support groups. Specifically research should focus on how individuals who are post-surgery find time to participate in face to face or remote support groups, allowing others to find an accountability group of their own.

References

Adams, T. D., Davidson, L. E., Litwin, S. E.,. . . Hunt, S. C. (2012). Health benefits of gastric bypass surgery after 6 years. *Journal of the American Medical Association, 308*(11), 1122-1131. doi:10.1001/2012.jama.11164

Arterburn, D. E., & Courcoulas, A. P. (2014). Bariatric surgery for obesity and metabolic conditions in adults. *British Medical Journal, 349*, g3961. doi:10.1136/bmj.g3961

Bradley, L. E., Forman, E. M., Kerrigan, S. G., Goldstein, S. P., Butryn, M. L., Thomas, J. G., . . . Sarwer, D. B. (2017). Project HELP: a remotely delivered behavioral intervention for weight regain after bariatric surgery. *Obesity Surgery, 27*(3), 586-598. doi:10.1007/s11695-016-2337-3

Center for Disease Control and Prevention. (2008). *Obesity Trends Among U.S. Adults BRFSS, 1990, 1999, 2008*. Atlanta, Georgia Retrieved from https://www.cdc.gov/obesity/data/index.html.

Chacko, S. A., Yeh, G. Y., Davis, R. B., & Wee, C. C. (2016). A mindfulness-based intervention to control weight after bariatric surgery: preliminary results from a randomized controlled pilot trial. *Complementary Therapies in Medicine, 28*, 13-21. doi:10.1016/j.ctim.2016.07.001

Geraci, A. (2015). *The impact of psychosocial outcomes in long-term bariatric patients* (Doctoral dissertation). North Dakota State University, Fargo, ND. (Appendix C). Retrieved from: https://search.proquest.com/pqdtglobal/docview/1683995593/BD3C9A2E80C4FB7PQ/1?accountid=6766

Geraci, A., Brunt, A., & Hill, B. (2015). The pain of regain: psychological impacts of weight regain among long-term bariatric patients. *Bariatric Surgical Practice and Patient Care, 10*(3), 110-118. doi:10.1081089/bari.2015.0011

Geraci, A., Brunt, A., & Marihart, C. (2014). The work behind weight-loss surgery: a qualitative analysis of food intake after the first two years post-op. *International Scholarly Research Network Obesity, 2014*, 427062. doi:10.1155/2014/427062

Gorin, A. A., Raynor, H. A., Fava, J., Maguire, K., Robichaud, E., Trautvetter, J., . . . Wing, R. R. (2013). Randomized controlled trial of a comprehensive home environment-focused weight-loss program for adults. *Health Psychology, 32*(2), 128-137. doi:10.1037/a0026959

Groller, K. D. (2017). Systematic review of patient education practices in weight loss surgery. *Surgery for Obesity and Related Diseases, 13*(6): 1072-1085. doi:10.1016/j.soard.2017.01.008

Heidmann, J., & Gronkjaer, M. (2015). Health-related quality of life 6 years after gastric bypass: a mixed methods study. *Bariatric Surgical Practice and Patient Care, 10*(2): 56-61. doi:10.1089/bari.2014.0052

Himes, S. M., Grothe, K. B., Clark, M. M., Swain, J. M., Collazo-Clavell, M. L., & Sarr, M. G. (2015). Stop regain: a pilot psychological intervention for bariatric patients experiencing weight regain. *Obesity Surgery, 25*(5), 922-927. doi:10.1007/s11695-015-1611-0

Keyserling, T. C., Samuel-Hodge, C. D., Pitts, S. J., Garcia, B. A., Johnston, L. F., Gizlice, Z., . . . Ammerman, A. S. (2016). A community-based lifestyle and weight loss intervention promoting a Mediterranean-style diet pattern evaluated in the stroke belt of North Carolina: the Heart Healthy Lenoir Project. *BMC Public Health, 16*, 732. doi:10.1186/s12889-016-3370-9

Laitner, M. H., Minski, S. A., & Perri, M. G. (2016). The role of self-monitoring in the maintenance of weight loss success. *Eating Behavior, 21*, 193-197. doi:10.1016/j.eatbeh.2016.03.005

Liebl, L., Barnason, S., & Brage Hudson, D. (2016). Awakening: a qualitative study on maintaining weight loss after bariatric surgery. *Journal of Clinical Nursing, 25*(7-8), 951-961. doi:10.1111/jocn.13129

Major, P., Matlok, M., Pedziwiatr, M., Migaczewski, M., Budzynski, P., Stanek, M., . . . Budzynski, A. (2015). Quality of life after bariatric surgery. *Obesity Surgery, 25*(9), 1703-1710. doi:10.1007/s11695-015-1601-2

Marihart, C. L., Brunt, A. R., & Geraci, A. A. (2014). Older adults fighting obesity with bariatric surgery: benefits, side effects, and outcomes. *SAGE Open Medicine, 2*, 2050312114530917. doi:10.1177/2050312114530917

Martin-Rodriguez, E., Guillen-Grima, F., Marti, A., & Brugos-Larumbe, A. (2015). Comorbidity associated with obesity in a large population: The APNA study. *Obesity Research and Clinical Practice, 9*(5), 435-447. doi:10.1016/j.orcp.2015.04.003

Mason, A. E., Epel, E. S., Kristeller, J., Moran, P. J., Dallman, M., Lustig, R. H., . . . Daubenmier, J. (2016). Effects of a mindfulness-based intervention on mindful eating, sweets consumption, and fasting glucose levels in obese adults: data from the SHINE randomized controlled trial. *Journal of Behavioral Medicine, 39*(2), 201-213. doi:10.1007/s10865-015-9692-8

Nadalini, L., Zenti, M. G., Masotto, L., Indelicato, L., Fainelli, G., Bonora, F., . . . Bonora, E. (2014). Improved quality of life after bariatric surgery in morbidly obese patients. Interdisciplinary group of bariatric surgery of Verona (G.I.C.O.V.). *IL Giornale de Chirurgia, 35*(7-8), 161-164.

Natvik, E., Gjengedal, E., & Raheim, M. (2013). Totally changed, yet still the same: patients' lived experiences 5 years beyond bariatric surgery. *Qualitative Health Research, 23*(9), 1202-1214. doi:10.1177/1049732313501888

Neff, K. J., Olbers, T., & le Roux, C. W. (2013). Bariatric surgery: the challenges with candidate selection, individualizing treatment and clinical outcomes. *BMC Medicine, 11*, 8. doi:10.1186/1741-7015-11-8

Obesity Action Coalition. (2017). Find a support network. Retrieved from http://www.obesityaction.org/advocacy/support-groups

Ogle, J. P., Park, J., Damhorst, M. L., & Bradley, L. A. (2016). Social support for women who have undergone bariatric surgery. *Qualitative Health Research, 26*(2), 176-193. doi:10.1177/1049732315570132

Peacock, J. C., Schmidt, C. E., & Barry, K. (2016). A qualitative analysis of post-operative nutritional barriers and useful dietary services reported by bariatric surgical patients. *Obesity Surgery, 26*(10), 2331-2339. doi:10.1007/s11695-016-2096-1

Robinson, A. H., Adler, S., Stevens, H. B., Darcy, A. M., Morton, J. M., & Safer, D. L. (2014). What variables are associated with successful weight loss outcomes for bariatric surgery after 1 year? *Surgery for Obesity and Related Diseases, 10*(4), 697-704. doi:10.1016/j.soard.2014.01.030

Saltzman, E., & Karl, J. P. (2013). Nutrient deficiencies after gastric bypass surgery. *Annual Review of Nutrition, 33*, 183-203. doi:10.1146/annurev-nutr-071812-161225

Verger, E. O., Aron-Wisnewsky, J., Dao, M. C., Kayser, B. D., Oppert, J. M., Bouillot, J. L., . . . Clement, K. (2016). Micronutrient and protein deficiencies after gastric bypass and sleeve gastrectomy: a 1-year follow-up. *Obesity Surgery, 26*(4), 785-796. doi:10.1007/s11695-015-1803-7

CHAPTER 6. SUMMARY AND CONCLUSIONS

This study explored the challenges relating to social support and the social support networks individuals who undergo bariatric surgery use post-surgery. Additionally, this study will increase the depth of knowledge of how individuals adhered to the post-bariatric surgery protein recommendations. Bariatric surgery is an effective solution for individuals with obesity because it results in long-term weight loss; therefore, this study strengthens researchers understanding of specific characteristics of successful bariatric surgery patients.

Summary

There was a wide variation in the social support networks participants in this study used post-surgery. The most common social support network used when making dietary choices for weight loss was the individuals' spouse or significant other. Likewise, individuals' spouse or significant other was perceived as their most important form of social support. Participants expressed nothing but comments of gratitude for their supportive and understanding spouse or significant other. One reasoning behind this result may be the amount of time spent with and co-habitation of an individuals' spouse or significant other. Typically, individuals may spend a lot of time or live in the same home as their spouse or significant other; therefore, they are able to constantly provide support.

In addition to an individual's spouse or significant other, the second most frequent form of social support was their friends followed closely by their friends who've had bariatric surgery. Similar to an individual's spouse or significant other, friends consistently see and visit with one another, providing a constant stream of support for individuals post-surgery. Interestingly, bariatric surgery support group members ranked the fifth most frequent form of social support for participants. This may be due to the amount of time individuals spend with their support

group members and the relationships they may or may not form during monthly meetings. This further indicates participants may be more comfortable sharing their experiences with their spouse, significant other, and friends.

Another finding in regards to the use of social support networks was that social support groups were used equally by participants who had either Roux-en-Y Gastric Bypass (RYGB) or Vertical Sleeve Gastrectomy (VSG) surgery types. Nonetheless, over half of study participants did not use face to face support groups very frequently. This lack of participation in support groups may have been due to the constant support they were receiving from their spouses, significant others, or friends. Furthermore, analysis confirmed a strong relationship between face to face support group attendance, time since surgery, and BMI reduction post-surgery. This analysis confirms that individuals who are in the early stage of their post-surgery journey may attend social support groups more frequently. In comparison individuals who are later in their post-surgery journey may attend support groups less often. Likewise, individuals in the later stage of their post-surgery journey may only attend social support groups when they are faced with a challenge or barrier their spouse, significant other, or friends are unable to assist them with. Participants may have used social support groups as a last resort in terms of the challenges faced post-surgery.

Findings of this study also found participants consumed a daily mean of 101 grams of protein over the past month. Unfortunately, most participants consumed 60 grams or less of protein over the last month, therefore, not meeting nationwide protein recommendations. Comparing protein intake further, results indicated more VSG participants consumed protein bars/shakes more frequently than RYGB participants. This may have been because VSG is an overall newer and upcoming surgery type. Individuals who have undergone VSG may be

younger and more willing to consume protein shakes/bars due to the gradual improvement in taste of these protein items.

Regarding protein intake and BMI reduction, results showed the more protein individuals consumed, the larger BMI reduction they experienced. Considering, five BMI units is equivalent to approximately 30 pounds, participants who consumed greater than 60 grams of protein reduced their BMI by 30 units or approximately 180 pounds. This clinical significance may emphasize the importance of bariatric surgery, weight loss, and protein consumption post-surgery. Losing a large amount of weight in such a short amount of time improves type ll diabetes control, blood pressure, lipid levels, and overall quality of life. In fact, when asked if participants would do bariatric surgery again, most answered they would never go back to their old ways and previous weight struggles. Bariatric surgery assisted them in losing weight to improve their quality of life and allowed them to strive to achieve the seven dimensions of wellness.

Limitations

There are several limitations to take into consideration when interpreting the results of this study. One limitation was the study sample, which consisted mostly of women. Due to snowball sampling and contacting health-care sponsored social support groups, the study sample consisted mostly of female participants. A more diverse sample regarding gender could have altered the results about protein intake and social support networks. Additionally, there may have been bias that influenced responses in the survey due to researcher-respondent relationships. Participants may have already known the researcher, which in turn, may have influenced participant response.

Another limitation of this study was that it's not generalizable to a broader population. The sample size was 59, which is not large enough to generalize conclusions to the entire bariatric surgery population.

Furthermore, participant responses differed between what participants say and do. This survey relied heavily on self-report of protein intake and social support attendance. Participant actions did not match what participants answered in the survey, leading to discrepancies in the results and inconclusive findings.

Moreover, the addition of options to improve survey question completion and clarity would have improved the social support section of the survey. Specifically, addition of a third column indicating the participant does not use a certain type of social support would have improved researcher analysis clarity. Finally, incorporating more questions regarding online support groups, discussion groups, and resources would have broadened the scope of the survey.

Conclusions

Overall, this study concluded individuals' who are at least six months post-surgery use their spouse, significant other, friends, and bariatric surgery support group members as support. Individuals who attended bariatric surgery support groups lost the most weight; however, most participants did not actually report attending support group meetings. This indicates social support groups may be used as a last resort for support when faced with a challenge or barrier. Additionally, social support group attendance and time since surgery play a significant role in weight for individuals' post-surgery. Similarly, this study found individuals who consumed more protein lost more weight, indicating clinical significance for healthcare professionals. Individuals who underwent VSG also consumed more protein shakes/bars than RYGB individuals possibly due to the evolution of better tasting protein supplements.

In light of these results, future research should focus on VSG participant consumption of protein shakes/bars in comparison to RYGB participant shakes/bars. Future research should also investigate discrepancies between protein food frequency questionnaires. Another area of future research should relate to individuals' social support networks post-surgery. Specifically relating to a comparison between participation in face to face and remote (online or phone) support groups.

APPENDIX A. IRB APPROVAL LETTER

NDSU NORTH DAKOTA STATE UNIVERSITY

February 24, 2017

Dr. Ardith Brunt
Health, Nutrition & Exercise Sciences

Re: IRB Determination of Exempt Human Subjects Research:
Protocol #HE17168, "Assessment of supplement intake and social support among bariatric surgery patients"

Co-investigator(s) and research team: Ashley Gehl

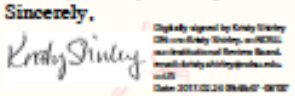
Certification Date: 2/24/2017 Expiration Date: 2/23/2020
Study site(s): online
Sponsor: n/a

The above referenced human subjects research project has been certified as exempt (category #2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the revised protocol submission (received 2/20/2017).

Please also note the following:
• If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
• The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
• Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
• Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,



Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult http://www.ndsu.edu/research/integrity_compliance/irb/. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
NDSU Dept 4000 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.8995 | Fax 701.231.8098 | ndsu.edu/irb
Shipping address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102
NDSU is an EO/AA university

APPENDIX B. PARTICIPANT RECRUITMENT EMAIL

Hi (bariatric surgery support group leader/researcher acquaintance),

My name is Ashley Gehl and I am currently a graduate student at North Dakota State University studying Health, Nutrition, and Exercise Science. Ardith Brunt is contacting you in regards to your participation in my graduate research studies relating to bariatric surgery. My research is studying how individuals who undergo bariatric surgery adhere to post-surgical protein, supplementation, and dietary guidelines as well as any resources individuals use to help them stay on track. Below are the exact purposes of my research is to:

1.) Examine individuals' adherence of protein and micro- nutrient supplementation.
2.) Identify challenges associated with consuming the dietary recommendations following bariatric surgery.
3.) Determine how individuals overcome barriers related to social environments and the presence of non-nutrient dense foods succeeding bariatric surgery.
4.) Identify resources individuals use to make compliance with supplement recommendations easier following bariatric surgery.

In order to conduct this research, I am sending out a survey via email using a secure survey database, Qualtrics. This survey is anonymous and does not involve providing any personal identification specifics and will take roughly 15 minutes to complete. Additionally, this survey will ask questions regarding type of bariatric surgery, date of surgery, height, and lowest/highest weight since surgery. Finally, this survey will ask questions related to protein and micro-nutrient supplementation following surgery, post-bariatric surgical resources you may have used, and the support you used following surgery.

Your participation in completing this survey would be greatly appreciated in the bariatric surgery community. Discovering solutions to post-bariatric surgery challenges would help several individuals overcome these barriers and succeed in their weight loss journey.

If bariatric surgery support group leader, the email will continue below:

If you think members of the (name of support group) will be interested in taking this survey, please forward this email on to their email addresses.

If you are interested in taking this survey, please follow the link below:

(Email Link)

Please let me know if you have any questions or concerns regarding my research. I look forward to hearing from you.

Thank you for your time,

Ashley Gehl

If researcher acquaintance, the email will continue below:

If you are interested in taking this survey, please follow the link below:

(Email Link)

Please let me know if you have any questions or concerns regarding my research. I look forward to hearing from you.

Thank you for your time,

Ashley Gehl

APPENDIX C. PARTICIPANT RECRUITMENT PHONE SCRIPT

Hi (contact person name/support group name),

My name is Ashley Gehl and I'm a graduate student attending North Dakota State University (NDSU). As part of my graduate studies, I am conducting research on how individuals who undergo bariatrics surgery adhere to post-surgery protein supplementation and dietary recommendation as well as any resources individuals use to help them stay on track, especially social support.

In order to conduct this research, I am sending out a survey via email using a secure survey database, Qualtrics. This survey is anonymous and does not involve providing any personal identification specifics and will take roughly 15 minutes to complete.

I was hoping that you would be able to send my survey link to members of (name of support group) members? This survey is generated through Qualtrics and involves sending an email to participants where they are able to access the survey. This survey only requires individuals' email addresses and no other personal identifiers.

I appreciate your help and consideration.

Thank you. Goodbye.

If have to leave voicemail, script continues below:

If you could get back to me at (my phone number), that would be helpful. I look forward to hearing from you.

Thank you. Goodbye.

APPENDIX D. PARTICIPANT SURVEY

**Please note: question #1 is the Informed Consent in Qualtrics

Demographic Data:

2.) What is your age?

3.) What is your gender?
- Woman
- Man
- Decline to answer

4.) Where do you currently live? (State initials)

5.) What is your marital status?
- Single, never married
- Married
- Domestic partnership
- Separated
- Divorced
- Widowed

Surgery Data:

6.) What type of surgery did you have?
- Roux-en-Y Gastric Bypass
- Laparoscopic Adjustable Gastric Banding
- Vertical Sleeve Gastrectomy
- Duodenal Switch with Biliopancreatic Diversion

7.) When was your bariatric surgery?
Month: Year:

8.) Where did you have surgery done? (State and/or country)

9.) What is your height? (in feet/inches)

10.) What is your current weight? (in pounds)

11.) What was your weight at the time of your surgery? (in pounds)

12.) What was your highest weight before surgery? (in pounds)

13.) What was your lowest weight after surgery? (in pounds)

14.) When did you achieve your lowest weight after surgery? (in pounds)
Month: Year:

The following questions are about your protein intake:

15.) On average, how many grams of protein did you consume daily over the last month?
- less than 30 grams
- 31-40 grams
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90
- 91+

16.) How often did you consume protein shakes/bars before surgery?
- Never
- Rarely
- Sometimes
- Quite often
- Very often

17.) How often do you consume protein shakes/bars after surgery?
- Never
- Rarely
- Sometimes
- Quite often
- Very often

18.) How often do you consume high protein foods after surgery?
- Never
- Rarely
- Sometimes
- Quite often
- Very often

19.) Over the past week, how often do you consume protein from:

Protein Source	Never	1-2 times/week	3-4 times/week	5-6 times/week	7 times/week
Beef					
Pork					
Chicken/turkey					
Fish/seafood					
Beans					
Greek Yogurt					
Milk/cottage cheese					
Eggs					
Whey protein shakes					
Plant protein shakes					
Protein Bars					
Other (please specify):					

20.) On a scale of one to ten, how would you rate the taste of your protein shakes/bars now? (1=awful/10=very pleasant) (circle one)

1 2 3 4 5 6 7 8 9 10

21.) Do you have any problems consuming protein shakes/bars?

- Yes
- No

22.) If yes, what problems do you have in taking protein shakes/bars? Check all that apply

- I do not like the taste of them
- My schedule is hectic-I don't have time to prepare them
- I forget to take them
- They make me feel sick
- I can't afford them
- Keeping the schedule is too complicated

Other (please specify):

23.) How often do you use protein shakes/bars between meals?

- Never
- Rarely
- Sometimes
- Quite often
- Very often

24.) Is there anything else you would like to tell us about protein shakes/bars?

25.) How often do you go out to eat with friends/family/significant others?

- Hardly ever (2-3 times per month)
- Weekly
- 3-5 times per week
- Almost everyday
- 1 or more times per day

26.) When I go out to eat with friends/family/significant others, I: (Select all that apply)

- Look at the menu before, but order whatever the restaurant offers that follows my post-op diet guidelines (no plan before I go)
- Look at menu before to see if the restaurant has menu choices in line with my post-op diet guidelines from my surgeon
- Look at the menu ahead of time for choices that won't affect post-op food sensitivities (cruciferous vegetables, certain proteins, etc.)
- Order diet guideline friendly meal when I get to the restaurant
- Order whatever I want when I get to restaurant
- Eat at home before I go to the restaurant, then order only a beverage.
- Other: (please specify)

27.) When thinking about making dietary choices for weight loss, my support system includes:

Support System Member	Check if included in support system	On a scale of 1-10, rate the level of importance of this support (1=most important)
Spouse/Significant other		
Friends who've had bariatric surgery		
Friends		
Parent/s		
Brother(s)/Sister(s)		
Extended Family (i.e. aunt, uncle, grandparents, etc.)		
Registered Dietitian		
Physician		
Bariatric Surgery Support Group Members		
Other: (please specify)		

28.) How often do you go to face-to-face bariatric support groups?

- Weekly
- Once a month
- Every few months
- Couple times per year
- Never

29.) How often do you participate in an online bariatric support groups?

- Daily
- Weekly
- Once a month
- Every few months
- Never

30.) If you participate in bariatric support groups regularly, why do you participate in them?

31.) Is there anything else you would like to tell me about your social support that you have?

32.) If you had to do it over again, would you still have bariatric surgery?

- Very unlikely
- Unlikely
- Undecided
- Likely
- Very likely

33.) Is there anything else you would like to tell us about your bariatric surgery experience?

APPENDIX E. PARTICIPANT INFORMED CONSENT

NDSU North Dakota State University
Health, Nutrition, and Exercise Sciences
NDSU Dept 2620
Fargo, ND 58108-6050
701-231-7475

Assessment of supplement intake and social support among bariatric surgery patients

Dear Post Bariatric Surgery Patient,

My name is Ashley Gehl and I am a Graduate Student I am a graduate student in the Department of Health, Nutrition and Exercise Sciences at North Dakota State University, and I am conducting a research project to understand the challenges you have had after your bariatric surgery. It is our hope that with this research we will be able to help others who have had bariatric surgery and are facing challenges with their protein and supplement intake. We are seeking to find what works with bariatric patients in their weight loss journey.

If you are an individual who is at least 6 months' post bariatric surgery, you are asked to complete this survey. Whether you consider yourself successful in your weight loss or not, we encourage you to complete the survey. Your participation is entirely your choice, and you may change your mind or quit participating at any time, with no penalty to you.

It is not possible to identify all potential risks in research procedures, but we have taken reasonable safeguards to minimize any known risks. These known risks include: emotional discomfort while responding to questions. You do not need to provide your name for this survey; however, we do ask that you identify the state where you live. Only data that have been compiled will be released so that no individual respondent can be identified.

Taking part in this research study benefits you by allowing for self-reflection of your own daily habits. Self-reflection may allow you to grow and become more aware of how your actions impact your health following bariatric surgery. However, you may not get any benefit from being in this research study. Benefits to other people include advancing the knowledge related to post-bariatric surgery supplementation adherence and support in the bariatric community. Additionally, with this new knowledge, individuals will also be able to self-reflect, allowing them the opportunity to grow into a beneficial post-surgery lifestyle.

It should take about 15 minutes to complete the entire survey. There is no compensation available for completing the survey.

Your participation in this research is your choice. If you decide to participate in the study, you may change your mind and stop participating at any time without penalty or loss of benefits to which you are already entitled. You can choose not to participate by exiting out of the screen.

This study is anonymous. That means that no one, not even members of the research team, will know that the information you give comes from you.

You have rights as a participant in research. If you have questions about your rights, or complaints about this research, you may talk to the researcher or contact the NDSU Human Research Protection Program by:

- Telephone: 701.231.8995 or toll-free 1.855.800.6717
- Email: ndsu.irb@ndsu.edu
- Mail: NDSU HRPP Office, NDSU Dept. 4000, PO Box 6050, Fargo, ND 58108-6050.

The role of the Human Research Protection Program is to see that your rights are protected in this research; more information about your rights can be found at: www.ndsu.edu/irb .

Thank you for your taking part in this research. If you wish to receive a copy of the results, please contact Ardith Brunt at 701-231-7475 or Ashley.Gehl@ndsu.edu.

Documentation of Informed Consent:

You are freely making a decision whether to be in this research study. Clicking 'continue' means you are giving your consent to participate in this research study. Clicking 'continue' means:

1. you have read and understood this consent form
2. you have had your questions answered, and
3. you have decided to be in the study.

If you want to participate in this research study, click 'next.