OLDER ADULTS FIGHTING OBESITY WITH BARIATRIC SURGERY: BENEFITS, SIDE EFFECTS AND OUTCOMES

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

DOCTOR OF PHILOSOPHY

SUPERVISORY COMMITTEE:

Ardith Brunt
Chair

Susan Ray-Degges

Brent Hill

Claudette Peterson

Mark Strand

Approved:

4/6/2015
Date

Gregory Sanders
Department Chair

ABSTRACT

The prevalence of obesity has increased at a rapid rate indicating that it is one of the fastest growing diseases in the older adult population. Since life expectancy has increased, some obese older adults are living longer; their quality of life may be compromised. Obese older adults may be facing years of discomfort, lack of mobility, and chronic ill health. This study compares bariatric surgery outcomes across four adult age groups, specifically comparing changes in body mass index (BMI), surgery side effects, existing disease outcomes and quality of life concerns. Satisfaction with the surgery and weight loss is also reviewed as well as the patients overall feelings about their health and future. The research design for this study was a survey method, using a cross-sectional, self-reported questionnaire. The 534 respondents who were 18 months or more post- surgery were divided into four age groups in years: 18-49 (n=171), 50-59 (n=148), 60-69 (n=138) and ≥ 70 (n=77). All age groups lost weight after bariatric surgery and all groups experienced some weight regain. The older and oldest age groups were as successful at losing weight and keeping it off as the young and midlife age groups. There were significant improvements in eight chronic diseases across all age groups. Older and oldest age groups had similar or better outcomes compared to the young and midlife groups on most diseases and had fewer side effects. Satisfaction with the weight loss since surgery was reported by over 79% of all the age groups, and there were significant improvements in quality of life among all age groups. While all the age groups improved greatly, the young age group (ages 18 – 49) perceptions seemed less positive than the other three age groups which were all 50 years old and older. In conclusion bariatric surgery should be considered for disease management for older adults as much as it is for younger adults.

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DEDICATION

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I. INTRODUCTION

The prevalence of obesity in older adults is rapidly expanding due to the aging of the baby boomer generation. Estimates of obesity in older Americans, increased from 9.9 million (24%) in 1990 to 14.6 million (32%) in 2000 to an estimated 22.2 million (37%) in 2010 (Salihu, Bonnema, & Alio, 2009). Since the baby boomers, defined as those born between 1946-1964, are reaching their sixth decade heavier than previous generations, there is a public health concern that these overweight adults will become obese, leading to greater risk of chronic disease (Leveille, Wee, & Iezzoni, 2005). The baby boomers were more overweight and became obese at younger ages than previous generations (Zevin, Aggarwal, & Grantcharov, 2012). When the silent generation members, defined as those born between 1926-1945, were aged 35-44 years, 14 to 18% were obese, but when the baby boomers were in that age range, those percentages doubled to 28-32% (Zevin et al., 2012).

Bariatric surgery is now the leading treatment for long-term weight loss (Grimaldi & Van Etten, 2010). The word *bariatric* comes from the Greek word *baros* meaning burden or heavy. Bariatric surgery includes several procedures designed to reduce food intake and cause weight loss for individuals who failed to lose weight through diet and exercise (Karmali et al., 2010). Bariatric surgery has various advanced options available. These options range from less invasive and generally reversible procedures, such as laparoscopic adjustable gastric banding (LAGB), to more invasive, non-reversible procedures such as Roux-en-Y gastric bypass (RYGB) and biliopancreatic diversion with duodenal switch (BPD-DS). Each has its risks, side effects, and benefits which need careful consideration when choosing a procedure that is a best match for the patient.

Effects of Obesity

With the increased obesity rates for older adults, increased life expectancy does not necessarily mean an increase in healthy years (Han, Tajar, & Lean, 2011). Instead, obese elderly may be facing additional years of discomfort, lack of mobility, and chronic ill health (Mathus-Vliegen, 2012; Mathus-Vliegen et al., 2012). The most common obesity related chronic diseases are type II diabetes, hypertension, heart disease, stroke, certain types of cancers, metabolic syndrome, respiratory disease, sleep apnea, fatty liver disease, osteoarthritis, gall bladder disease, pulmonary embolism, gastro-esophageal reflux disease (GERD), urinary incontinence, chronic renal failure, gout, and depression (Zamosky, 2013).

Obesity creates far-reaching problems, not only for the obese person, but also for family members and society as a whole. For individuals, obesity increases psychological problems, lowers sleep quality, and decreases one's quality of life (Algul et al., 2009; Hopman et al., 2007; Wee et al., 2008). Obesity is also associated with increased mortality and reduced life expectancy as a result of increased medical risks (de Beer et al., 2007; Maggard et al., 2005; Padwal, 2005; Sach et al., 2007). Many obese people may struggle with physical mobility as a result of their weight, and problems can be greatly exacerbated.

Obesity and Nursing Home Considerations for Older Adults

In 1992 fewer than 15% of recently admitted residents were obese compared to greater than 25% in 2002 (Dybicz, Thompson, Molotsky, & Stuart, 2011). In 2013, reports indicate more than two thirds of all nursing homes reviewed in a study had obesity rates of 15% to 27%, with some facilities ranging as high as 58% for overall obesity (Zhang, Li, & Temkin-Greener, 2013).

A 2011 report of obese nursing home residents revealed 46.8% have severe or morbid obesity (Markway, Chang, & Mehrle, 2011).

Obese older adults with diabetes are twice as likely to be residents of nursing homes as non-obese older adults (Zhang et al., 2013). Residents with diabetes account for one out of every four days of nursing home care (Dybicz et al., 2011). The projected cost for providing nursing home care for patients with diabetes increased from $5.5 billion in 1997 to $13.9 billion in 2002 to $19.6 billion in 2012 (Dybicz et al., 2011). According to the American Diabetes Association, national estimates of the cost of nursing home care are $207 per day and $75,555 annually for a semi-private room (Newswire, 2013). Further, nursing home administrators claim that obese residents have extensive care needs and cost more than non-obese residents (Felix, 2008; Felix et al., 2010; Powell et al., 2010).There is frequently a need for more expensive equipment and supplies, larger space for maneuvering the resident and the equipment, and additional staff (Marihart, Brunt, & Geraci, 2015; Zinn, 2003).

Social Costs of Obesity

The psychological effects of obesity are equally significant and include lowered self-esteem, depression, anxiety, social withdrawal, and loneliness (Greenberg, Sullivan, Kaplan, & Perna, 2005; Huberman, 2008). In addition to the physical and psychological effects of obesity on individuals, obesity is also a societal concern because of rising health care and employer costs due to missed days at work for obesity-related issues (Bachman, 2007; Roehling, 1999). The many negative effects of obesity led researchers and healthcare professionals to search for effective weight loss treatments. Most diets and behavioral treatments resulted in initial weight loss, only to be followed by weight regain (Huberman, 2008) leading healthcare providers to turn to surgical treatments for obesity (Karmali et al., 2010).

Reports on the psychological consequences of obesity experienced by certain individuals include lower self-esteem, depression, and anxiety. Obese individuals are three to four times more likely to report depression and anxiety than non-obese individuals (Greenberg et al., 2005). Many obese people experience discrimination, loneliness, and shame resulting from their weight battles (Greenberg et al., 2005). This may lead to social withdrawal and loneliness, which increases negative outcomes related to quality of life. Obese individuals often experience increased psychological issues related to work-related psychosocial stress such as discrimination at work (Greenberg et al., 2005). Roehling (1999) conducted an exhaustive literature review in which numerous work-related stereotypes were identified in obese patients, such as lack of self-discipline, laziness, sloppy appearance, disagreeableness, slower rates of thinking, and reduced conscientiousness. This is not isolated research as other researchers report similar findings (Puhl, Andreyeva, & Brownell, 2008; Schafer & Ferraro, 2011).

From the broader social perspective, obesity is associated with increased health care costs (Bachman, 2007). According to Williams, Barnett and Kumar (2009), obesity costs U.S. employers an estimated $12.7 billion annually, and healthcare costs for obese employees are 36% greater than for normal weight workers. The indirect costs to employers include decreased productivity along with increased absenteeism. Obese employees are twice as likely to be absent two weeks or more per year.

Obesity Discrimination

Many obese individuals suffer discrimination in numerous facets of their daily lives. Obesity discrimination plays a role in everyday life, including work, school, and healthcare settings. It remains a socially acceptable form of prejudice in American society, and is rarely

challenged. In addition, as with other forms of discrimination, obesity discrimination may have consequences for physical health (Muennig, 2008; Schafer & Ferrarro, 2011).

Individuals cope with discriminatory experiences in a number of ways. Growing literature links weight bias with a number of coping behaviors, including problematic eating (Puhl et al., 2008; Manzoni, Castelnuovo, Villa, Pietrabissa, & Molinari, 2013) and avoidance of physical activity (Niego, Kofman, Weiss, & Geliebter, 2007). Adults who believe the negative stereotypes of obesity are true are more likely to refuse to diet and engage in binge eating behaviors (Puhl et al., 2008). Thus, one coping mechanism for individuals who experience weight discrimination is to engage in the behaviors that are conducive to obesity. Weight discrimination, which is often justified because it is thought to help encourage obese individuals to lose weight (Puhl & Heuer, 2010), can actually have the opposite effect, since it is associated with the development and maintenance of obesity. Such discrimination is one social determinant of health that may contribute to numerous inequalities within daily lives.

Obesity Treatment

Obesity is very difficult to treat with lifestyle changes, yet the medical community continues to encourage people to lose weight by traditional diet and exercise methods (Zamosky, 2013). Approaches to weight loss have included self-help groups, drugs, exercise programs, psychotherapy, nutritional counseling, education programs, and surgery (Wadden, Wilson, Stunkard, & Berkowitz, 2011). As a result of these recommendations, overweight and obese people attempt multiple diets, medications, and exercise regiments which tend to have limited long-term results (Dorman & Abraham, et al., 2012; Neff, Olbers, & Le Roux, 2013; Zamosky, 2013). Increasingly, a viable option for obese patients has been surgery as a means to aid weight loss (Han et al., 2011; Mathus-Vliegen, 2012; Zamosky, 2013; Zevin et al., 2012). Bariatric

surgery that either restricts caloric intake or absorption has been found as the most effective method to lose weight and maintain a healthy lifestyle (Mathus-Vliegen et al., 2012; Zamosky, 2013; Zevin et al., 2012).

Types of Bariatric Surgery

There are various bariatric procedures available (Neff et al., 2013) and generally, the more complex the procedure, the greater the weight loss. But more complex/extensive surgery also has greater complications with higher morbidity and mortality rates (Dorman & Abraham, et al., 2012). The order of surgical frequency is: Roux-en-Y gastric bypass (RYGB), laparoscopic adjustable gastric banding (LAGB), and vertical sleeve gastrectomy (VSG). Biliopancreatic diversion with a duodenal switch (BPD-DS) is the least commonly performed surgery type, but is often considered for super, morbidly obese individuals, which is defined as > 50 kg/m2. (Neff et al., 2013).

Roux-en-Y gastric bypass (RYGB)

RYGB is the most common type of weight loss surgery worldwide and is considered permanent (Buchwald & Oien, 2013). The stomach is divided into two sections, the upper part is a small pouch which holds about 1-2 ounces of food initially (Buchwald & Oien, 2013). The pouch is connected to the jejunum using a Y-shaped limb of the small intestine bypassing the duodenum (Smith, Schauer, & Nguyen, 2011). Gastric and pancreatic secretions, as well as bile mix with chime at the juncture of the jejunum and the duodenum (Smith et al., 2011). This procedure permanently changes how food is digested resulting in fewer absorbed calories and micro-nutrients (Perry, Hutter, Smith, Newhouse, & McNeil, 2008). Weight loss is swift and dramatic, usually 50% of excess weight loss (EWL) is in the first six months post-surgery, but may continue for up to two years (Scott & Batterham, 2011). Long-term RYGB results show

many patients keep weight off for 10 years or longer (Sjöström et al., 2012). As an added benefit of the rapid weight loss, health conditions affected by obesity such as diabetes, high blood pressure, high cholesterol, arthritis, sleep apnea, heartburn, and other conditions often improve quickly (Chakravarty et al., 2012; Jáuregui-Lobera, 2013; Perry et al., 2008; Poirier et al., 2011).

Nevertheless, challenges with RYGB include impairment of the body's ability to absorb calories, thus dramatically increasing the risk for nutrient deficiencies (Neovius et al., 2012). The most common nutrient deficiencies after RYGB include the vitamins thiamin, B-12, and D, and the minerals iron, copper, and calcium (Adams et al., 2012). Deficiencies of these nutrients can lead to anemia, fatigue, and osteoporosis; therefore, RYGB patients should plan to take vitamin and mineral supplements the rest of their lives (Jáuregui-Lobera, 2013; Saltzman & Karl, 2013). Thiamin deficiency has occurred after all bariatric procedures and can present within weeks or years after surgery (Saltzman & Karl, 2013). Thiamin deficiencies after bariatric surgery can mimic those symptoms as a result of alcoholism. Wernicke's encephalopathy, usually associated with alcoholism, is related to severe thiamin deficiency resulting in cognitive dysfunction and eye disorders such as nystagmus and ocular palsies (Saltzman & Karl, 2013). Vitamin B-12 deficiency results from an intolerance to animal protein after RYGB and lack of intrinsic factor; therefore, monthly B-12 injections are recommended (Saltzman & Karl, 2013). Vitamin D deficiency is a problem for 25% to 75% of bariatric patients with many having this deficiency pre-operatively. Calcium absorption appears to be diminished possibly due to bypassing the duodenum and lack of vitamin D (Saltzman & Karl, 2013). Resolving an iron deficiency after RYGB can be complicated because oral supplements are not absorbed; therefore, iron must be given intravenously (Saltzman & Karl, 2013). Copper deficiency may also present after RYGB

and secondary to iron deficiency; copper status should be investigated as a source of anemia unresponsiveness to other nutrients (Saltzman & Karl, 2013).

RYGB is associated with other side effects such as an increased risk of dumping syndrome in which food is "dumped" from the stomach into the small intestine too quickly before it has been adequately digested (Adams et al., 2012; Hammer, 2012; Myers et al., 2012). Typically, this occurs when eating too many simple carbohydrates which can lead to diarrhea (Heinlein, 2009). Another long-term complication after RYGB is bone loss, which is generally more severe than with nonsurgical methods of weight loss (Berarducci, 2007; Hammer, 2012). Other potential risks include an increased incidence of hernias and gallstone formations. Both can develop post-surgery and require surgical intervention to repair (Adams et al., 2012). Finally, there is a 1% mortality rate with the RYGB surgery (Benotti et al., 2013). See Figure 1.

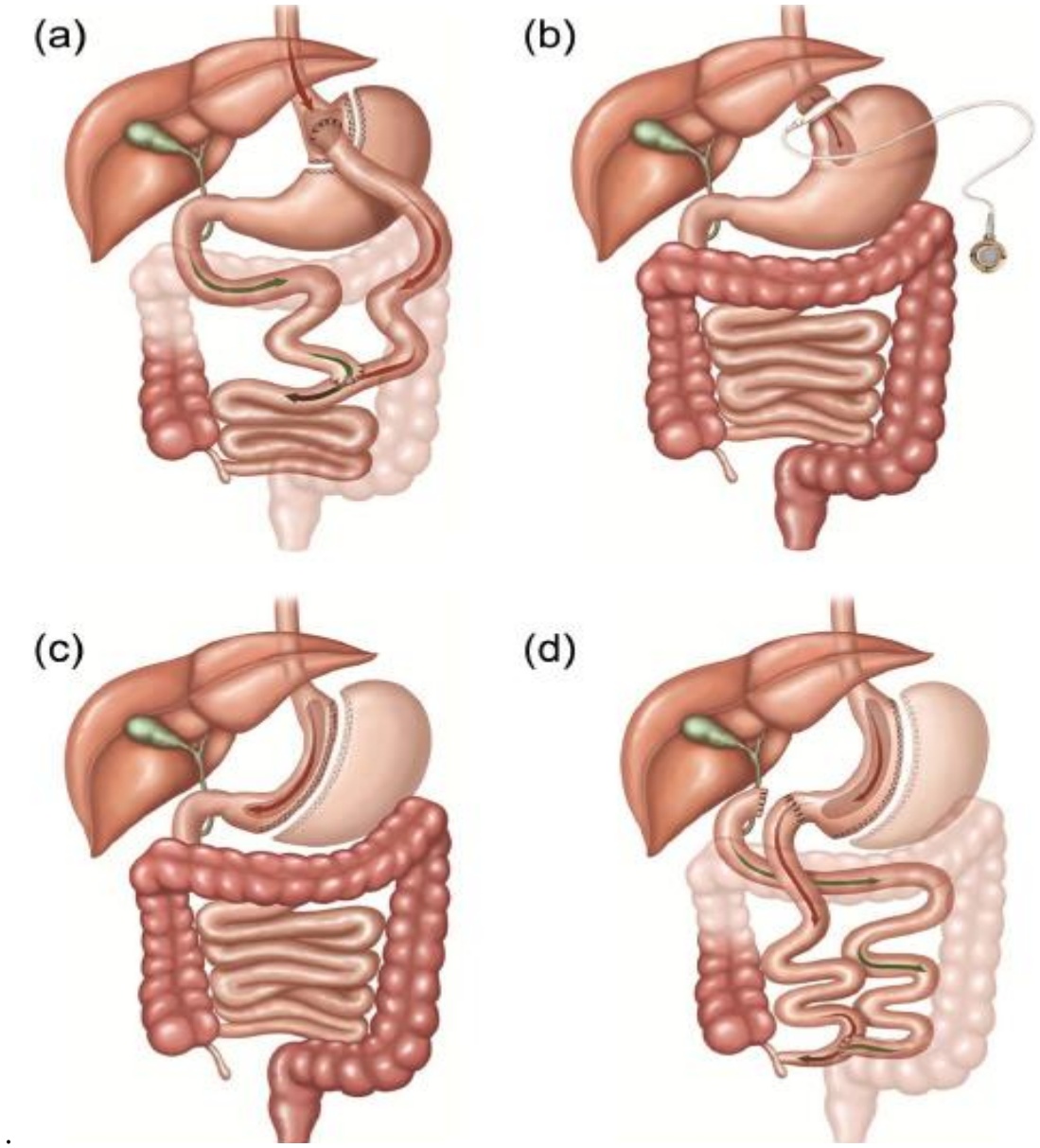

Figure 1.1. Most Common Types of Bariatric Surgery. (Neff et al., 2013)
Note: (a) is Roux-en-Y gastric bypass, (b) is laparoscopic adjustable gastric banding (LAGB), (c) is vertical sleeve gastrectomy (VSG) and (d) is Biliopancreatic diversion, with a duodenal switch.

Vertical sleeve gastrectomy (VSG)

About 75-85% of the stomach is surgically removed in the irreversible VSG procedure, which is generally performed laprascopically (Scott & Batterham, 2011). What remains of the stomach is a narrow tube or sleeve, which provides for the normal process of stomach-emptying

and the pyloric valve remains intact. Not only is the appetite reduced, but also consuming very small amounts of food generate early and lasting satiety (Benaiges et al., 2011). Because the small intestine is unchanged (not shortened), VSG does not usually affect the absorption of food, so nutritional deficiencies are less of a problem compared to RYGB or BPD-DS (Scott & Batterham, 2011). In people with very high body mass index (BMI), VSG, as a stand-alone procedure, results in an average weight loss of greater than 50% of EWL. In patients with very high BMI, the VSG may be followed by a modified RYGB or BPD-DS if significant weight loss is still needed. Since many adults who are morbidly obese have multiple co-morbidities, RYGB or BPD-DS may be too risky as an initial procedure (Benaiges et al., 2011). Usually, 12-18 months post-VSG, once the patient's health has improved and some weight has been lost, a second surgery may be undertaken (Aurora, Khaitan, & Saber, 2012; Benaiges et al., 2011; van Rutte, Smulders, de Zoete, & Nienhuijs, 2013).

Since VSG is a relatively new procedure, long-term benefits and risks are still being evaluated. Typical surgical risks such as infection and blood clots apply; moreover, the sleeve itself can have leakage (van Rutte et al., 2013). Leakage occurs in less than 2.4% of patients for all sleeve procedures which can be successfully treated by operative or percutaneous drainage and endoscopic stenting (Aurora et al., 2012). Sleeve leakage symptoms include fever, pain in chest/shoulder area, heart palpitations, dizziness, nausea and vomiting (Aurora et al., 2012). VSG is associated with greater weight loss than LAGB, but subsequent weight gain has been seen in nearly all studies where follow-up exceeds 5 years (Aurora et al., 2012; Caiazzo & Pattou, 2013).

Biliopancreatic diversion with duodenal switch (BPD-DS)

BPD-DS or more commonly referred to as the "duodenal switch" is a more complicated, invasive version of the RYGB and is performed less frequently (Hedberg & Sundbom, 2012;

Mitchell et al., 2009). Even though as much as 70% of the stomach is removed during the BPD-DS, the remaining pouch is still larger than those formed during RYGB or LAGB (Mitchell et al., 2009; Nilsson, Hedberg, & Ohrvik, 2011). As a result, larger meals can be consumed in a sitting; however, there is also a greater, more serious risk of nutritional deficiencies (Quilliot et al., 2010; Dorman & Rasmus et al., 2012) . Since much of the small intestine is bypassed, digestive enzymes cannot mix with food until it reaches the distal ileum (Nilsson et al., 2011; Prachand, Ward, & Alverdy, 2010). The need for dietary supplements is higher among patients with BPD-DS compared to RYGB (Hedberg & Sundbom, 2012; Quilliot et al., 2009).

This surgery both restricts intake and reduces absorption area thereby resulting in rapid weight loss with an average long-term EWL of 70% to 80% (Dorman & Rasmus, et al., 2012; Hedberg & Sundbom, 2012; Mitchell et al., 2009; Prachand et al., 2010). In addition to the rapid weight loss, remission rate for type II diabetes is impressive at 100% within one year of surgery (Iaconelli et al., 2011). Co-morbidities such as hypertension, hyperlipidemia, and cardiovascular disease were also significantly reduced (Dorman & Rasmus et al., 2012; Iaconelli et al., 2011; Prachand et al., 2010). Even with all these positive outcomes, BPD-DS is not without risks. BPD-DS poses many of the same risks as RYGB, including dumping syndrome, GERD, gallstone formation, and hernias (Prachand et al., 2010). Comparing BPD-DS with RYGB, post-surgery BPD-DS required longer hospital stays and more frequent early reoperation than RYGB (Hedberg & Sundbom, 2012). Nevertheless, overall there were no differences in late reoperation rates between the two groups (Hedberg & Sundbom, 2012; Nilsson et al., 2011). Despite the complications associated with BPD-DS, one study reported better weight and co-morbidity control than with RYGB, with even more pronounced benefits among super-obese patients (Hedberg & Sundbom, 2012; Nelson, Blair, & Martin, 2012; Prachand et al., 2010). Because of

infection, sepsis, and nutrition deficiencies, mortality rates are greater, ranging from 2.5% to 5%, regardless of age (Hedberg & Sundbom, 2012; Prachand et al., 2010).

Bariatric Surgery Candidate Selection

The medical community recommends that surgical treatment of obesity should only be considered after all nonsurgical methods are exhausted (Yermilov, McGory, Shekelle, Ko, & Maggard, 2009). Potential bariatric patients are required to have attempted and failed several traditional diet methods (van Hout, van Oudheusden, Krasuska, & van Heck, 2006). Moreover, in 1991, the National Institute of Health (NIH) first established bariatric patient selection guidelines which included a BMI of 40 or more or a BMI of 35-39 with one or more obesity-related co-morbidity for people ages 18 to 50 (Yermilov et al., 2009). Age restrictions were initially in place because it was believed that the health risks of bariatric surgery surpassed beneficial outcomes for aging patients (Pratt, McLees, & Pories, 2006; Quebbemann, Engstrom, Siegfried, Garner, & Dallal, 2005). In 2006, the NIH recommendations changed, and Medicare reversed its policy to deny bariatric requests based solely on age; therefore, age restrictions were eliminated (Henrickson, Ashton, Windover, & Heinberg, 2009; Yuan et al., 2009).

Statement of the Problem and Purpose of Study

Bariatric surgery can offer patients an effective and long lasting treatment for obesity and its related diseases. There does not appear to be any one bariatric surgical procedure that is recommended for older adults, so individual needs should be taken into consideration when exploring options. Literature is limited concerning long-term outcomes of older adults who choose to have bariatric surgery. This may be due to the short time since the National Institute of Health withdrew age limitations and Medicare inclusion of bariatric surgery in 2006. Although a number of studies have demonstrated that the surgery is safe for the older adult, many research

opportunities remain. Currently, there is insufficient evidence concerning the benefits of bariatric surgery for older adults. Many of the available studies review the immediate response to the surgery while still in the hospital by analyzing events such as the length of the surgical procedure and/or hospitalization. Other research only evaluates a small aspect of the bariatric experience such as reduced medication use or amount of weight lost. The primary purpose of this study is to compare post-operative outcomes including dietary adherence, health impacts such as changes in existing diseases, side effects, surgical complications, quality of life, of those over four adult age groups. The four age groups will be as follows: young adults, age 18-49, midlife adults, age 50-59, older adults, age 60-69 and oldest adults will be age 70 or greater.

Significance of the Study

This study is significant since there is a dearth of published research that examines outcomes of bariatric patients who are past the first year post-procedure. Moreover, there is limited research that investigates the health and psychosocial impacts of bariatric surgery within older adults. The majority of the research on bariatric surgery focuses primarily on physical health-related outcomes. There is limited in-depth research that in addition to health impacts, also examines personal and psychosocial experiences that patients face following the first year post-bariatric surgery. There are no studies that the researchers have found that tie all of these aspects together. As stated above there is limited research which compares outcomes of bariatric surgery based on age groups.

Assumptions

The researchers assume that individuals meeting the criteria for participation will answer questions honestly and accurately when completing the questionnaire.

Potential Limitations

This study included participants from one bariatric center in Minnesota and will be limited to the experiences of those bariatric patients. Since few obese people age 60 and older actually have bariatric surgery, the sample size may be small compared to the larger younger sample. This may result in an inaccurate comparison. In addition, the sample size was limited to a specific geographical group and may not have been representative of the true essence of long-term bariatric outcomes. Thus, the insights gained from this study may be only applicable to individuals who have the same characteristics as the participants in this research study. Another limitation of the study was the researchers' previous experience with weight loss surgery. Moreover, this study used a bariatric questionnaire and self-reported responses which is limited to the perception of the respondents.

Dissertation Organization

This dissertation is organized into chapters as follows: Chapter one consists of the introduction to the study including the purpose and significance of the study, assumptions and potential limitations of the study, a list of definition of terms, and a description of how the dissertation is organized. Chapter two yields a review of the literature containing the most recent studies conducted as they pertain to the older adult bariatric population and the bariatric population in general. Chapter three consists of the methods used to conduct the study, including tentative research questions, a description of the sample, recruitment, IRB approval, experimental design, instrumentation, data collection procedure, and method of data analysis. Chapter four consists of the researchers' published review of the literature as it pertains to older bariatric patients. Chapters four and five consist of two manuscripts that present results of the

study. Finally, chapter six is a summary of the overall study, conclusions drawn, limitations of the study, and recommendations for further study.

Definition of Terms

Bariatric surgery: Describes several procedures designed to reduce food intake and effect weight loss for individuals who failed to lose weight through diet and exercise. The most common types of bariatric surgery include: Roux-en-Y Gastric Bypass (RYGB), Laparoscopic Adjustable Banding (LAGB), Vertical Sleeve Gastrectomy (VSG), and Biliopancreatic Diversion with Duodenal Switch (BPD-DS) (Neff et al., 2013).

Binge eating: Recurrent loss of control over eating large amounts of food over a short period of time (Saunders, 2004).

Body mass index (BMI): Body mass index (BMI) can be calculated using an individual's height and weight and is a reliable indicator of body fatness in most people (CDC, 2011). An individual's BMI can be calculated by dividing the weight in kilograms by the height squared in meters (kg/m^2). Based on these numbers, individuals are be placed into BMI categories that include: underweight (>18.5 kg/m^2), healthy weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (>30kg/m^2).The normal amount of body fat (expressed as percentage of body fat) is between 25%- 30% in women and 18%-23% in men (Centers for Disease Control and Prevention (CDC), 2011).

Co-morbidities: Conditions existing simultaneously with and usually independently of another medical condition such as obesity (Adams et al., 2012).

Excess weight loss: (EWL): Weight loss after surgery varies depending on the surgical method chosen and the length of time after surgery. The %EWL can vary depending on the definitions of ideal body weight used by a given surgeon and the preoperative weight of the individual (Lutfi et al., 2006).

Ghrelin: A 28-amino-acid peptide hormone that is secreted primarily by stomach cells and that has been implicated in the stimulation of fat storage and appetite (Pournaras & le Roux, 2010).

Health related Quality of Life: (HRQL): Refers to impact that health conditions have on an individual's general life functioning and well-being (Kolotkin, Meter & Williams, 2001).

Midlife Adult: For purposes of this study, a midlife adult is defined as those aged 50-59.

Morbid obesity: A BMI of over 40 (CDC, 2011).

Obesity: An excess of body fat as expressed by BMI. Women with over 30% body fat and men with over 25% body fat are considered obese (CDC, 2011).

Older Adult: For purposes of this study, an older adult is defined as those aged 60-69. But throughout the text, especially in the literature search an older adult may be assumed to be a larger age group such as those over age 55.

Oldest Adult: For purposes of this study, an oldest adult is defined as those aged 70 or greater.

Psychosocial: Relating to the interrelation of social factors and individual thought, behavior, and mental health (Mamplekou et al., 2005).

Quality of Life (QOL): A broad, multidimensional concept that usually includes subjective evaluations of both positive and negative aspects of life (Folope et al., 2008; van Hout & van Heck, 2009). Examples include an individual's perceived daily overall well-being level or lack thereof and how well-being may be affected by disease, disability, and/or disorder (Folope et al., 2008; van Hout & van Heck, 2009).

Set-point Theory: A weight theory that the body maintains its normal weight and body fat level with internal regulatory controls that dictate how much fat one has. The set point theory

suggests that despite dieting efforts, the body tends to return to its set point weight (Tadross & le Roux, 2009).

Social Cognitive Theory (SCT): Developed in 1986 by Albert Bandura and posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior (Bandura, 2002). Major tenets include:

Expectations: This refers to the anticipated consequences of a person's behavior. Outcome expectations can be health-related or not health-related. People anticipate the consequences of their actions before engaging in the behavior, and these anticipated consequences can influence successful completion of the behavior (Bandura, 2002).

Reciprocal Determinism: This is the central concept of SCT. This refers to the dynamic and reciprocal interaction of person (individual with a set of learned experiences), environment (external social context), and behavior (responses to stimuli to achieve goals) (Bandura, 2002).

Self-efficacy: An individuals' confidence in their ability to change behaviors. Self-efficacy affects the amount of energy that an individual will expend and the extent to which the individual will persist despite adversity (Bandura, 2002).

Super Obesity: A BMI of over 50 (CDC, 2011).

Young Adult: For purposes of this study, a young adult is defined as those aged 18-49.

CHAPTER II. REVIEW OF LITERATURE

This review examines bariatric surgery as a treatment option for obese adults who are ≥ 55 years old. A detailed review of literature search was conducted to retrieve relevant articles on bariatric surgery for older adults using EBSCO, MEDLINE, PROQUEST and WEB of SCIENCE with the forward option. A total of 478 articles were evaluated and 180 were deemed relevant and utilized for this review. Relevant articles described various types of weight loss surgery including benefits and side effects, post-operative changes in co-morbidities and quality of life outcomes, and costs of surgery with related cost savings after surgery.

Costs of Obesity and Bariatric Surgery

Healthcare utilization and healthcare costs for the morbidly obese are 81% above those of the non-obese population (Hensrud & Klein, 2006). Analysis of bariatric surgery costs of 3651 patients showed a strong return on investment up to five years post-procedure (Cremieux et al., 2008). Estimated costs in 2010 of laparoscopic and open gastric bypass were $17,000 and $26,000, respectively (Felix & West, 2013). Even with high surgical expenditures, cost savings started accruing within three months post-procedure (Bradley & Sharma, 2006; Campbell et al., 2010; Crémieux et al., 2008; Klein, Ghosh, Cremieux, Eapen, & McGavock, 2011). The short-term return on investment associated with bariatric surgery is consistent with decreases in multiple co-morbid conditions, including diabetes, coronary artery disease, hypertension, and sleep apnea (Crémieux et al., 2008; Klein et al., 2011). The cost reductions in these diseases take into account prescription drug usage, hospital stays, and physician visits (Cremieux et al., 2008). Type II diabetes is greatly improved by bariatric surgery (Klein et al., 2011) and an estimated annual costs of managing a diabetes patient ($13,243) is five times more than a patient without diabetes ($2,560) (Campbell et al., 2010). People age 65 years and older represent 10.9 million

Americans and approximately 27% of all people in this age group have diabetes, but not all of these older diabetics will necessarily improve with bariatric surgery. An estimated one-third of all Medicare dollars are spent on the cost of care of people with diabetes (Neovius et al., 2012).

Consequences of Bariatric Surgery

Benefits of bariatric surgery include a decrease in co-morbidities, chronic disease risk, and medication-use coupled with improved mobility and quality of life (Bradley & Sharma, 2006; Ewing, Thompson, Wachtel, & Frezza, 2011; Neff et al., 2013). Negative side effects include surgical failure, changes in psychological status, and increased physical and mental stress (Folope et al., 2008; Hensrud & Klein, 2006; Karlsson, Taft, Rydén, Sjöström, & Sullivan, 2007; Sjöström et al., 2012). However, since patients over age 65 have only had bariatric surgery as a viable option since 2006, there is much unknown about future outcomes and complications and long-term costs to Medicare (Cai et al., 2010; Kennedy et al., 2008).

Outcomes of Bariatric Surgery for Older Adults

Bariatric surgery often results in effective and enduring weight loss with complete resolution or significant improvement in obesity-related co-morbidities (Buchwald, 2005; Henrickson et al., 2009). After Medicare authorized approval of bariatric surgery for older adults in 2006, 2.7% of all bariatric operations were performed on patients older than 60 years that year (Varela, Wilson, & Nguyen, 2006). Younger patients may have a greater EWL and have a more complete resolution of their co-morbid conditions, but older people tend to reduce the number of prescribed medications, thus reducing healthcare costs (Adams et al., 2012). Age did not influence the rate of occurrence of post-operative complications and outcomes between older and younger patients (Felix & West, 2013; Sjöström et al., 2012; Sugerman et al., 2004).

Not all medical issues are resolved with bariatric surgery. One of the many studies that looked at medical issues compared obese individuals who had bariatric surgery with obese patients who were treated by conventional methods for hypercholesterolemia over a 10-year period (Sjöström et al., 2004). Sjöström (2004) found that the bariatric surgery group did not have significant improvements in hypercholesterolemia (Sjöström et al., 2004). Many of the studies supporting the benefits of bariatric surgery are short-term studies (Dunkle-Blatter et al., 2007; Folope et al., 2008; Poirier et al., 2011; Saeidi, et al., 2013). For example, (Herron & Tong, 2009) noted that much of the present research identifies bariatric surgery as one of the most effective tools for the treatment of severe obesity and metabolic abnormalities.

Reduction of cardiovascular disease, cancer, and type II diabetes

Physical outcomes of bariatric surgery have shown dramatic improvements over the last decade (Dimick, Nicholas, Ryan, Thumma, & Birkmeyer, 2013), but the greatest benefits to bariatric surgery are the reduction in morbidity and mortality. The most common obesity-related chronic diseases are type II diabetes, hypertension, heart disease, stroke, certain types of cancers, metabolic syndrome, respiratory disease, sleep apnea, fatty liver disease, osteoarthritis, gall bladder disease, pulmonary embolism, GERD, urinary incontinence, chronic renal failure, gout, and depression, all of which can be improved by weight loss from bariatric surgery (Poirier et al., 2011; Zamosky, 2013.).

Individuals who underwent bariatric surgery had a significantly reduced number of total and fatal cardiovascular events compared with matched obese controls that did not undergo surgery (Sjöström et al., 2012; Bray, 2007). Moreover, Vogel and colleagues (2007) found reductions in predicted coronary heart disease risk following significant weight loss after bariatric surgery. Jazet and colleagues (2007) showed that patients who underwent LAGB had

considerable weight loss, which reduced cardiovascular risk factors and a significant decrease in systolic blood pressure.

Further, cancer rates have been reduced by nearly 50% in post-surgical bariatric patients (Sjöström et al., 2012; Bray, 2007). One study of obese patients monitored over a 10-year period compared morbidity and mortality rates of a group that underwent bariatric surgery and a group that did not (Sjöström, 2008). Sjöström (2008) found that the overall mortality of the surgical treatment group was reduced by 23.7%. The most common cause of death in each group was myocardial infarction and cancer. An earlier study conducted by (Sjöström et al., 2007) found that bariatric surgery for the severely obese reduces mortality risks.

Bariatric surgery for older patients has been shown to be safe and effective for EWL and improvement of obesity co-morbidities, especially type II diabetes and blood pressure with trends in greater improvement for older patients than younger patients after RYGB (Dunkle-Blatter et al., 2007). Many obese patients who have type II diabetes experience normalization of blood sugars within days post-surgery (Dunkle-Blatter et al., 2007). Patients can frequently stop taking diabetes medications before leaving the hospital after surgery (Dunkle-Blatter et al., 2007). Being able to reduce or eliminate daily diabetes glucose testing and insulin injections leads to improved quality of life. Currently, research on glucose metabolism is underway to better understand this outcome phenomenon (Dunkle-Blatter et al., 2007; Saeidi et al., 2013).

Quality of life measures and physical mobility

Regardless of age, improved mobility, reduced co-morbidities, pain reduction, and enhanced psychological functioning such as improvements in mood, self-esteem, social functioning, and sexuality led to improved quality of life enrichment in bariatric patients (Folope et al., 2008; van Hout & van Heck, 2009). Burgio, Richter, Clements, Redden, & Goode (2007)

found that chronic health problems which affect quality of life such as urinary and fecal incontinence symptoms improved following bariatric surgery. In addition, bariatric patients had significantly better health perceptions, social interactions, psychosocial functioning, and reduced depression post-procedure (Karlsson et al., 2007). Improved mobility and fewer medications alone led many participants who underwent bariatric surgery to state they had experienced improved mood, regardless of whether all weight loss goals were met, and would opt to have the surgery again (Dunkle-Blatter et al., 2007; Folope et al., 2008; Karlsson et al., 2007; van Hout & van Heck, 2009).

Wheelchair-bound older patients were often fully ambulatory within months post-surgery (Sugerman et al., 2004). Even modest weight loss improved overall physical functioning of older adults (Sugerman et al., 2004). For example, patients with lower extremity arthritis experienced reduced knee and hip pain (McTigue, Hess, & Ziouras, 2006; van Hout & van Heck, 2009). Back pain decreased following bariatric surgery, as well (Khoueir et al., 2008). One study found evidence suggesting significant improvements with musculoskeletal problems in patents following weight loss post bariatric procedure (Hooper, Stellato, Hallowell, Seitz, & Moskowitz, 2007). Patients reported the greatest improvement in cervical and lumbar spine, foot, and fibromyalgia syndrome pain. Lower and upper extremity pain was also significantly improved, resulting in an increase in activity leading to reduced pain levels (Hooper et al., 2007). However, nutrient deficiencies negatively affect quality of life by requiring extra doctor visits, vitamin supplements, iron infusions, B-12 injections, and physical symptoms of lethargy (Jáuregui-Lobera, 2013; Saltzman & Karl, 2013).

Food intolerances

Food intolerance resulting in a lack of vitamin and mineral consumption and absorption can be a problem for all patients after weight loss surgery, regardless of type, and can result in osteoporosis and anemia (Mathus-Vliegen et al., 2012; Ziegler et al., 2009). This can be a more critical concern for the older bariatric patient. Since there is an increased risk of bone fractures for those who developed osteoporosis, recovery from hip fracture can prove to be problematic for aging patients (Dunkle-Blatter et al., 2007). If left untreated, low intake of heme iron foods can increase the risk of lethargy, leading to a decrease physical activity and an increase in muscle mass loss, which can facilitate frailty and malnutrition in older patients (Heuberger, 2011). Patients reported a sense of control over food intake that they never felt before, but certain food intolerances such as meat and coarse vegetables can make consuming nutrient rich foods problematic (Hensrud & Klein, 2006; Ziegler et al., 2009).

Since weight loss post-surgery is initially rapid, losing muscle and bone mass is a valid concern in older patients. As one ages, the loss of muscle mass, known as sarcopenia, usually occurs as part of the aging process (Berarducci, 2007). But losing additional muscle mass through rapid weight loss has the potential to result in more mobility issues for older adults (Berarducci, 2007). Post-operative diet and exercise regimes are recommended for all surgeries and all patients, but certain health challenges may make it more complicated for older adults to adhere to strict programs (Gremeaux et al., 2012). Obesity was once believed to be bone protective, but recent research has introduced evidence of greater risk for metabolic bone disease due to lack of vitamin D (which is stored in fat) resulting in inadequate calcium absorption, sedentary lifestyle, chronic dieting, and underlying diseases (Berarducci, 2007). After bariatric surgery, the risk of bone-related diseases increases due to restrictive intake, malabsorption, and

poor compliance to vitamin and mineral supplement recommendations and dramatic weight loss (Berarducci, 2007; Mathus-Vliegen, 2012; Mathus-Vliegen et al., 2012; Poirier et al., 2011).

Role of Patient Compliance after Surgery

The reported benefits of bariatric surgery may be dependent on the patient's level of compliance after surgery. The level of adherence may be an indicator of the patient's motivation to prevent relapse. A significant number of patients do not follow aftercare recommendations regarding check-ups and follow-up care after the first six months post-procedure (Harper, Madan, Ternovits, & Tichansky, 2007). Even though similar pre-surgical weight existed between patients who adhered to surgical follow-up visits vs. patients who did not, the patients who did not adhere to follow-up care experienced less weight loss post-procedure. However, patients tended to follow-up with their surgeon after prompted by their bariatric clinic (Harper et al., 2007).

Karlsson et al.,(2007) discovered most weight loss occurred during the first year after bariatric procedure. Weight regain occurred between one and six years after bariatric procedure and was observed with a gradual decline in health-related quality of life (Karlsson et al., 2007). Moreover, one of the few long-term studies found that six to ten years after bariatric surgery, patients had fairly stable weight and health-related quality of life (Karlsson et al., 2007). Despite the weight regain, patients still identified with a positive health-related quality of life if 10% of the weight loss was maintained. Further, Karlsson et al. (2007) found a continued need for a long-term study of implementing lifestyle modification techniques and postoperative management of patients.

Weight-Loss Post-Procedure

There are other factors that may impact weight loss following bariatric surgery. One study identified behavior predictors of substantial weight loss following RYGB which included surgeon follow-up, attendance at post-procedure support groups, physical activity, single or divorced marital status, self-esteem, and less binge eating (Livhits et al., 2010). Substantial weight loss was defined as those individuals who lost at least 50% of their excess weight. One hundred eighty patients were evaluated for predictors of success after laparoscopic gastric bypass (Lutfi, Torquati, Sekhar, & Richards, 2006). Of these 180, 147 patients achieved successful weight loss (EWL of 52.8%) one year post-procedure (Lutfi et al., 2006). The results indicated that single patients achieved greater weight loss than married patients (89.9% vs. 77.7%; p = 0.04). Further, patients with a BMI ≤50 had greater weight loss success than those with a BMI > 50 (91.7% vs. 61.6%; p = 0.001). Caucasian patients achieved a higher percentage of EWL than African Americans, but this was not statistically significant (82.9% vs. 60%; p = 0.06) (Lutfi et al., 2006).

Weight loss after surgery varies depending on the surgical method chosen and the length of time after surgery. Cummings Overduin, and Foster-Schubert (2004) found that typical weight loss after two years post- procedure is 35-40% for RYGB, and less for LAGB. According to Sjöström (2008), a sample of Swedish post-bariatric surgery patients had a re-stabilization weight that leveled out after 8 years. Sjöström (2008) also found that 10 years after surgery, EWL was 14% for LAGB and 25% for RYGB patients (Sjöström, 2008).

Unknown physical factors may affect the amount of weight a person loses, such as how the pouch empties and possible changes in the individual's set point weight following surgery. Set point theory suggests that an individual's body has a particular range of weight that it is

comfortable in, usually within a range of 10% (Tadross & le Roux, 2009). For example, patients who have prompt emptying of their pouch following RYGB tend to lose a greater amount of weight than other RYGB patients who have slow or no emptying of the gastric pouch (Akkary et al., 2009). The cause of the difference in the rate of gastric pouch emptying is unknown. The notion of set point theory and the belief that the body is genetically predisposed to a determined weight set point may make it difficult to maintain weight loss (Tadross & le Roux, 2009). The body uses regulatory mechanisms to keep the weight in this set point range. However, individuals who have RYGB surgery seem to have unexplained changes in the energy regulatory system which may appear to establish a lower set point (Tadross & le Roux, 2009).

Another physiological component that may contribute to weight loss with RYGB and VSG respectively is a decreased release of the hormone ghrelin following surgery (Cummings, 2003; Cummings, Bloom, & Rubino, 2012; Roth et al., 2009). Ghrelin is thought to stimulate appetite, and a decrease in ghrelin following RYGB and VSG is thought to be involved in increased satiety leading to weight loss (Roth et al., 2009). However, the position of the staple line and other physiological variations within the procedures during the procedure may produce conflicting results regarding the role of ghrelin hormones (Roth et al., 2009).

A few studies examined patients' long-term weight loss (Bond, Phelan, Leahey, Hill, & Wing, 2009; Kruseman, Golay, Zumbach, & Leimgruber, 2010). For instance, one study in a Swiss university hospital followed 80 women for eight years (± 1.2 years) who had RYGB between 1997 and 2002 (Kruseman et al., 2010). The patients were evaluated on dietary and anthropometric changes, eating patterns, psychological changes, and quality of life at least 5 years post-procedure. Successful long-term weight loss was defined in the Swiss study as EWL of 50%. The results of the study indicated that 50% EWL was achieved by 47 patients (59%).

The researchers found that patients who achieved EWL of 50% were younger and had a greater number of psychological consultations prior to surgery.

Weight Regain Post-Procedure

An understanding of the mechanisms of weight regain from previous failures may contribute to the participant's ability to maintain long-term weight loss (Kiernan et al., 2013). Thus, exploring the mechanisms that may contribute to weight regain is important. Perhaps one of the greatest fears of post-bariatric patients is weight regain following significant weight loss. Nevertheless, preventing weight regain is one of the greatest challenges following massive weight loss (Jeffery et al., 2000; Kiernan et al., 2013). Contributing factors to weight regain may include disinhibition of eating, grazing behavior, food cravings, frequency of weighing, not following aftercare recommendations, and lack of social support. Disinhibition of eating may be an important factor leading to weight regain (Kofman, Lent, & Swencionis, 2010). Susceptibility to cues that trigger overeating may increase the potential for regaining weight regardless if the person lost weight through surgery or nonsurgical means (Bond et al., 2009). In a study, 105 surgical participants were matched with 210 nonsurgical participants from the National Weight Control Registry (NWCR) by gender, entry weight, maximum weight loss, and weight maintenance duration. The participants lost approximately 56 kg (123.5 lbs.) and kept at least 13.6 kg (29.9 lbs.) off for 5.5 to 7.1 years. The weight regain for both groups averaged about 2 kg (4.4 lbs.) per year. The participants were evaluated at entry and one year post-procedure. The results indicated that surgical participants had less physical activity, greater fast food and fat intake, less dietary control, greater depression, and greater stress at both entry and one year post-procedure than the nonsurgical participants (Bond et al., 2009). However, both groups reported higher levels of disinhibition at entry and one year post-procedure with similar weight gain.

Disinhibition of eating in response to internal cues is associated with weaker long-term weight loss outcomes (Niemeier, Phelan, Fava, & Wing, 2007).

Internal disinhibition predicts weight regain after weight loss and weight loss maintenance; however, several factors may be involved (Niemeier et al., 2007). In one study, 268 participants in a behavioral weight loss trial and 3345 participants from the NWCR were evaluated on two factors of the disinhibition scale: eating in response to feelings and thoughts (internal factors) and eating in response to social events (external cues). The results suggested that external cues did not predict weight loss; however, internal disinhibition predicted weight change in both groups. Difficulty with disinhibition may have been an underlying factor contributing to grazing behavior. Grazing behavior may be a significant component of weight regain. The bariatric patient may stumble into the behavior of grazing simply because it allows them to feel mentally satisfied without feeling overly full or dumping (Niemeier et al., 2007). The behavior of eating frequent high caloric small meals throughout the day may contribute to weight regain and grazing may correlate to lack of successful of weight loss (Engstrom & Quebbemann, 2005; Quebbemann et al., 2005).

Some researchers also believe that many patients exhibited the pre-surgery eating pattern of binge eating, but with the post-surgery patient, binge eating may appear as grazing because the physiological changes in the body due to surgery only allow for small portions of food to be continually consumed throughout the day (Saunders, 2004). Further, Crowley, Budak, Karl Byrne, and Thomas (2011) found evidence that patients who demonstrated greater binge eating behaviors prior to RYGB surgery had less weight loss at six months post-procedure than those patients who exhibited less binge eating behavior.

There are contradictions in the literature. For instance, some studies report a connection between pre-surgery binge eating and less weight loss to weight regain within 2 years after RYGB (Dymek, le Grange, Neven, & Alverdy, 2001; Kalarchian et al., 2002; Sallet et al., 2007). Other studies have not found a significant relationship between binge eating prior to surgery and weight loss up to six years post-surgery (Alger-Mayer, Rosati, Polimeni, & Malone, 2009; Bocchieri-Ricciardi et al., 2006; Burgmer et al., 2005). It seems difficulties with post-procedure weight gain or difficulty with weight loss were related to post-procedure eating behavior of grazing and not connected to prior binge eating behavior. Crowley et al. (2011) suggested that differences in these finding may be related to the pre-operative binge eating dynamics. Some binge eating may be related to difficulty with recognizing fullness cues, whereas other binge eating episodes may be related to difficulty with environmental or internal triggers. Patients who struggle with fullness cues would benefit from RYGB because of the physiological nature of the surgery (Crowley et al., 2011). However, it was hypothesized that those who struggled post-operatively with environmental or internal triggers would not benefit from RYGB, as the triggers have a psychosocial drive to the binge eating patterns. Crowley and colleagues found evidence that those patients who had more cognitive triggers based on scores of the instrument, Inventory of Binge Eating Situations scores. They found that prior to RYGB these patients had less weight loss at six months post-surgery (Crowley et al., 2011).

Food craving may be another underlying factor that contributes to weight gain. The initial suppression of food cravings that occurs following the surgery may give patients a false sense of security. Weight regain may begin to occur when individuals struggle with the return of these food cravings (Crowley et al., 2011). A study which combined cognitive-behavioral therapy and motivational interviewing to address weight regain was conducted with 14 female patients who

were at least 18 months post- surgery from RYGB (Stewart, Olbrisch, & Bean, 2010). The participants engaged in an eight-week pilot therapy intervention program. Participants reported difficulty coping with the return of food cravings that led to challenging eating behaviors, which had initially subsided following the surgery. The group intervention appeared to help with increasing motivation and confidence, along with the return to healthier eating behaviors.

The group reported peer support as an essential component (Stewart et al., 2010). Individuals who decrease their weighing frequency from baseline weighing to one year gain more weight than individuals who keep their frequency of weighing the same or increase weighing frequency (Butryn, Phelan, Hill, & Wing, 2007; Wing et al., 2007). Further, patients who decrease their weighing frequency tend to increase daily calories consumed from fat and disinhibition, and exhibit a decrease in cognitive restraint. Frequent weighing may increase individual accountability. Many patients begin to regain weight once they stray from the recommendations of the post-operative plan (Wing et al., 2007). Another study indicated 47 to 50% of participants report not following post-surgery diet recommendations and decreased physical activity despite typically participating in an intensive pre-operative educational program and having access to educational resources as part of the continuing post-operative plan. Post-surgery diet habits that should not be followed may include continuing to eat small, but more frequent meals throughout the day (grazing) and eating high-calorie dense foods (Tejirian, Jensen, Lewis, Dutson, & Mehran, 2008).

Pre-surgery bariatric patients may have years of unhealthy physiological and psychological eating patterns ingrained that may include rapid eating, binge eating, continuous snacking, and emotional eating. Initially, the surgery may help reduce these maladaptive eating patterns by the sheer physical and anatomical mechanism of the surgery. However, one must

consider the often life-long eating patterns that must be changed with the altered physiological components. Without addressing possible psychological issues, the patient may override the biological mechanism and regain the weight. Weight regain is a concern because patients may return to having health issues that were previously resolved with the surgery and immediate weight loss (Shah, Simha, & Garg, 2006). Weight regain is a complex issue with many mechanisms at work. The process in post-bariatric patients to maintain long-term weight loss following bariatric surgery can be difficult.

Maintenance of Weight Loss

Outcomes of bariatric surgery should not be assessed by weight loss alone. Improvement of both overall quality of life and co-morbidities must be included in assessment outcomes. Long-term weight maintenance is an area that likely is enhanced by behavioral intervention (Greenberg et al., 2005; Hsu et al., 1997). Understanding the factors that lead to weight maintenance following a significant weight loss is perhaps one of the most important components for a person struggling with obesity. The bariatric individual may have experienced years of weight loss, followed by weight regain. While bariatric surgery is the most effective long-term weight loss method to date, weight maintenance after surgery is essential. Strategies to prevent relapse and maintain weight loss are very important. Exploring weight maintenance strategies provides insight into techniques employed by participants of some research studies. The frequency that individuals weigh themselves may influence the amount of weight lost along with the vigilance of adhering to their diet and related behavior changes. For instance, frequent weighing is helpful for identifying weight regain before it escalates (Butryn et al., 2007; Wing et al., 2007). Further, individuals who maintain a weight loss typically weigh themselves from once

daily to once weekly. Individuals who weighed themselves daily for 18 months reported having fewer than four binge episodes per month and a decrease in disinhibition (Wing et al., 2007).

The National Weight Control Registry (NWCR) is a longitudinal study of individuals who have been successful at maintaining significant weight-loss (Klem et al., 2000). Klem and colleagues examined a sample of 134 members of the NWCR. Half had undergone bariatric surgery, while half reported losing weight with the help of a commercial program, a self-help group, or a health professional. Each was then computer-matched to a control that had lost weight without surgery. The behaviors used by bariatric participants to maintain their weight losses were very different from the weight maintenance behaviors used by participants who had not had surgery. Bariatric participants reported eating a diet considerably higher in fat and lower in carbohydrates and protein than the group who forwent surgery. Bariatric participants reported lower levels of physical activity than non-bariatric patients. The reported differences may be related to physiological differences between the groups. Bariatric participants may have developed dumping syndrome in which carbohydrate rich foods cause nausea and other unpleasant side effects, leading to an aversion to such foods. Despite differences in diet and physical activity, the majority of participants in both groups indicated weight-loss maintenance had been accompanied by significant improvements in general mood, self-confidence, quality of life, job performance, and interactions with friends and family (Klem et al., 2000).

Furthermore, individuals who participated in a weight maintenance intervention program (WMIP) after participating in a behavioral weight loss program not only maintained their weight loss, but also had greater weight loss overall compared to individuals who only completed a behavioral weight loss program without the follow-up WMIP (Carels et al., 2008). Individuals who participated in the additional WMIP also reported increases in physical activity. In addition,

fitness improved dietary habits, suggesting that a 6-month maintenance program may assist individuals with reducing behaviors or cues to maintain weight loss. Ninety-four bariatric patients who were required by their insurance company to participate in a pre-surgery weight loss regime and 59 patients who were not required to do so were examined pre-surgery and post-surgery. The study found that patients who were not required to follow the weight loss regime pre-surgery gained more weight prior to receiving bariatric surgery, but lost more weight post-surgery than those who were required to engage in the pre-surgery weight loss program (Ochner, Puma, Raevuori, Teixeira, & Geliebter, 2010). While controlling for the initial weight, the findings suggested that the common requirement of insurance companies to have patients complete a medically supervised weight loss program before receiving surgery were ineffective with determining weight loss estimates post-operative (Ochner et al., 2010).

Another factor that may contribute to weight loss maintenance is the notion of mindfulness. Mindfulness is being aware of one's thoughts and actions in the present moment. Mindful eating is defined as being present in the moment with each meal, which eliminates the internal cues (i.e., emotional eating, reward eating, or excessive satisfaction eating) and external cues (i.e. social triggers to eat, being in the presence of food, grazing, snacking, or fast eating) (Engstrom, 2007). Mindfulness may also be effective when combined with cognitive behavioral techniques. In a case study report, Engstrom (2007) examined a 41-year old married female patient who struggled with weight loss following RYGB. After and major psychiatric issues were ruled out; the patient participated in a behavioral and mindful intervention treatment. The treatment focused on behavioral techniques, such as self-monitoring, stimulus control, behavioral pacing, stress management, and mindfulness techniques to develop strategies for changing the participant's attentiveness toward eating. Pre-surgical psychological testing results indicated the

personality profile was basically normal, with slight non-significant elevations in depression and anxiety, a high level of emotional eating and occasional binge eating. The participant had a high level of social support and motivation for the surgery. Prior to the surgery, she read several books on bariatric surgery and attended online chat groups. She lost 28 pounds during the 8 weeks post-surgery, but by 12 weeks post-surgery she was regaining weight. She admitted to increased snacking (three to eight snacks a day) of rich foods between meals when feeling hungry, eating more than she thought she should, and feeling too full after her meals. She identified that most of her eating was related to non-mindful eating triggered by internal cues. The course of her treatment included increasing awareness of and reducing mindless eating, developing mindfulness skills, and increasing "satisfaction" after each meal. She was instructed on timing of meals and stimulus behavior techniques to avoid grazing. She was provided with techniques on self-monitoring of hunger. At the end of her 9 weeks of mindfulness training treatment, there was a significant decrease with both grazing and emotional eating and a significant increase in mindful eating. At the end of her treatment she had lost 95 pounds (Engstrom, 2007).

Self-monitoring aids in maintaining weight loss following RYGB (Odom et al., 2010). Leahey, Crowther, and Irwin (2008) implemented a 10-week cognitive-behavioral mindfulness-based group therapy intervention to address binge eating in bariatric surgery patients. The results of the study demonstrated a decrease in binge eating symptoms, a decrease in depressive symptoms, along with an increase in emotion regulation skills and increased motivation to change negative eating behavior.

Weight loss from bariatric surgery varies from study to study. Overall, the average weight loss for RYGB surgery is 60% to 61.6% of excess body weight during the first 2 to 3

years post-op (Buchwald, 2005; Shah et al., 2006). However, after 18 months to 2 years following the bariatric procedure, as many as 30% of patients begin to regain weight (Shah et al., 2006). In addition, many researchers define success as 50% EWL maintained (Deitel & Greenstein, 2003; Kruseman et al., 2010; Livhits et al., 2010).

Social Support Post Procedure

Questions still arise on long-term bariatric surgery success and its effect on weight loss maintenance and the return of lifestyle diseases such as type II diabetes, hypertension, and high cholesterol (Buchenwald et al., 2005; Manzoni et al., 2012). Past research indicated that about a year and a half to two years after surgery, weight loss from surgery stops, and a significant number of individuals begin to regain the weight they had lost (Niego et al., 2007). This is when support is needed most; nevertheless, many longitudinal follow-up bariatric surgery studies are short-term and incomplete when evaluating weight loss maintenance and social support (Buchenwald et al., 2005).

Social support can develop from both organic and formal support systems. Organic support includes both family and friendship networks (Hogan, Linden, & Najarian, 2002). Formal support is provided by professionals (such as bariatric support groups through a patient's surgery center) and through social or community bonds such as online weight-loss surgery forums (Hogan et al., 2002). Organic support is generally viewed as a more enduring source of support, while other forms of support may be more transient (Hogan et al., 2002). Though whether one or the other is the "gold standard" of support is not clear. Research indicates that participation and attendance at formal bariatric support groups post-surgery is associated with greater excess weight loss, though it remains unclear what role organic support plays (Klem et al., 2011; Leahey et al., 2008; Livhits et al., 2011).

Attending support groups with others who are losing weight provides peer support and opportunity for guided discussions about changes in body image, meal preparation, relationship issues, and stress management (Macias et al., 2009; McMahon et al., 2006; Orth et al., 2008; Song et al., 2008). Attendance at bariatric support group meetings after weight loss surgery is a valuable component of continuing follow-up care. Evidence shows that one year after surgery, there are significant differences in EWL between patients who attend support groups and those who do not (Livhits et al., 2011; McMahon et al., 2006; Song et al., 2008). Support groups can be held in a variety of formats such as structured meetings or online bariatric surgery forums.

However, there may be a gap in how support groups should be utilized. For instance, many support groups offered by surgical programs may only focus on the pre-surgical and post-surgical needs of the patient only within the first year post-operative (Stewart et al., 2010). There is a need for a greater focus on cognitive-behavioral therapy groups that address the interrelation among thoughts, feelings, and behaviors that lead to weight regain (Stewart et al., 2010). Furthermore, there is no common standard to which all bariatric clinics are mandated to follow, only sets of recommendations by the American Society for Metabolic and Bariatric Surgery (ASMBS) (ASMBS, 2013). This means that not all support groups are created equal; and each clinic may subscribe to different post-surgery recommendations for their patients to follow. Many formal bariatric support groups cater to newer post-ops (usually during the first year post-surgery) (Livhitis et al., 2010; McMahon et al., 2006). Because the experiences of newer post-ops and longer-term post-ops usually differ, long-term post-ops may feel alienated by the topics and discussions at their surgical support group. Other barriers to formal support group attendance included far away locations, difficult group attendance times, and work and family commitments.

Personal Relationships Post Procedure

Meana and Ricciardi (2008) found that most relationships in the lives of bariatric patients are not immune to change once the weight starts coming off and that relationships are interconnected. A person cannot alter one substantial aspect of life (such as with bariatric surgery) and then expect the change to not have a significant effect on other parts of one's life (Meana & Ricciardi, 2008). Relationships are most prone to change post-surgery, both positively and negatively (Meana & Ricciardi, 2008). Learning new skills in key areas where change creates tension (such as post-surgery dietary and lifestyle overhaul) is essential for reaping the full benefits of surgical weight loss.

Individuals with higher levels of support tend to do better in weight management (Klem et al., 2011). Sarwer, Wadden, and Fabricatore, (2005) found that many marital relationships improved dramatically post-surgery and that issues regarding divorce were generally tied to poor pre-surgical relationships. Another study found that rates of divorce and separation appear to be higher in relationships that include one bariatric post-operative member than divorce and separation rates are among non-bariatric couples, especially during the first year after surgery (McAlpine et al., 2010).

Relationship issues appear to emerge six to eight months after surgery (McAlpine et al., 2010). As significant weight loss becomes visible, family, friends, and co-workers may make observations and comments about the patient and their body (Bagdade & Grothe, 2012). Even complimentary remarks may be seen as intrusive or judgmental to the bariatric patient (McAlpine et al., 2010). Increased social attention after weight loss can produce anxiety (Bagdade & Grothe, 2012). Most patients find others to be supportive, but negative responses related to jealousy can occur (Bagdade & Grothe, 2012). Strong healthy relationships seem to

weather the experience of one member's bariatric surgery, but there is often an adjustment period (McAlpine et al., 2010).

The post-operative period may be quite difficult for some because of the necessary change in eating and lifestyle habits (Sogg & Gorman, 2008; McMahon, 2006). This may be associated with emotional discomfort, so a personal support system of family and friends should be in place (Sogg & Gorman, 2008; McMahon et al., 2006). Peer and family support is important in helping individuals learn greater self- acceptance, develop new norms for interpersonal relationships, and manage stressful work or family-related situations (McMahon et al., 2006). Social support along with strong family support is of great importance to an individual who has undergone bariatric surgery.

Depression and Suicide

A minority of patients may experience an increase in psychological distress after surgery due to life stressors such as severe restriction of food intake, malabsorption of vitamins and minerals, or psychotropic medications (Bagdade & Grothe, 2012). Lack of medication for depressive symptoms can lead to an increase of depressive episodes and emotional distress (Bagdade & Grothe, 2012). There is little research that compares the psychological outcomes between older adults and younger or middle-aged counterparts (Heinberg, Ashton, Windover, & Merrell, 2012).

Though some bariatric patients report an increase of psychological symptoms, yet others report improvements. In one study, 59 bariatric patients were assessed on psychological conditions and quality of life following bariatric surgery (Mamplekou, Komesidou, Bissias, Papastantinou, & Melissas, 2005). Prior to surgery, participants were asked to complete a questionnaire evaluating not only their quality of life, but also their social, professional, sexual,

and other activities of daily living. Results of the study revealed female participants had a greater degree of depression from obesity than male participants pre-surgery (Mamplekou et al., 2005). Females had significant self-reported post-operative emotional improvement at two years post-surgery and their quality of life (physical, professional, social, and sexual) significantly improved (Mamplekou et al., 2005).

Another seldom researched post-bariatric issue is suicide. Compared to non-bariatric procedure suicides, Tindel (2011) found a substantial number of suicides among all bariatric patients, regardless of surgery type. Tindal (2011) reviewed suicides among all patients who had bariatric surgery in Pennsylvania during a ten year period. Reports of 31 suicides from 16, 683 bariatric surgeries for an overall rate of 6.6 suicides per 10,000 population; 13.7% per 10,000 among men and 5.2 per 10,000 for women. Approximately 30% of suicides occurred within 2 years after surgery and almost 70% occurred within 3 years after surgery. This compared to an age and sex related suicide rate among 35 to 64 years of age of 2.4 per 10,000 men and 0.7 per 10,000 for women (Tindel, 2011). Some studies suggest that severe obesity is also associated with high risk of lifetime suicide ideation (Chen, Fettich & McCloskey, 2012). One study found that 9.1% of 121 bariatric surgery seeking severely obese patients reported having made one or more suicide attempts in the lifetime (N = 1,020) as compared with the national U.S. sample of 0.5% for suicide attempts (Windover, Merrell, Ashton & Heinberg, 2010).

Social Cognitive Theory (SCT)

The SCT is frequently used to help promote health behavior change in areas regarding obesity (Baranowski et al., 2003) and food choices (Kaufman, 2007). SCT explains how people acquire and maintain certain behavioral patterns, while also providing the basis for intervention strategies. Human behavior is explained in terms of a triadic, dynamic and reciprocal model in

which behavior, personal factors, and environmental influences all interact. An individual's behavior is uniquely determined by these interactions. The triad concept of SCT cannot be pieced out as one faction depends on another in a fluid give and take. Instead, all three constructs influence each other and bariatric health professionals need to understand the individual, their families, and their environmental interactions in order to meet the needs of the patient in relation to food choices and weight management (Kaufman, 2007). According to Bandura (2002, p. 144), the main determinants of SCT include:

> …knowledge of health risks and benefits of different health practices, perceived self-efficacy that one can exercise control over one's health habits, outcome expectations about the expected costs and benefits for different health habits, the health goals people set for themselves and the concrete plans and strategies for realizing them, and the perceived facilitators and social and structural impediments to the changes they seek.

The construct of self-efficacy has been studied in regards to nutrition and physical activity. For example, one Internet-based intervention used SCT constructs to gain a better understanding of the demographic, behavioral, and psychosocial influences of participants involved in an online intervention addressing nutrition and physical activity (Anderson-Bill, Winett, & Wojcik, 2011). Results of the study showed that participants' high self-efficacy and outcome expectation levels did not lead to health behavior change, which may involve low levels of perceived social support (Anderson-Bill et al., 2011). The study determined even though high self-efficacy may be connected to healthier lifestyles, low levels of social support may very well serve as a barrier to behavior change that many people find difficult to work through (Anderson-Bill et al., 2011).

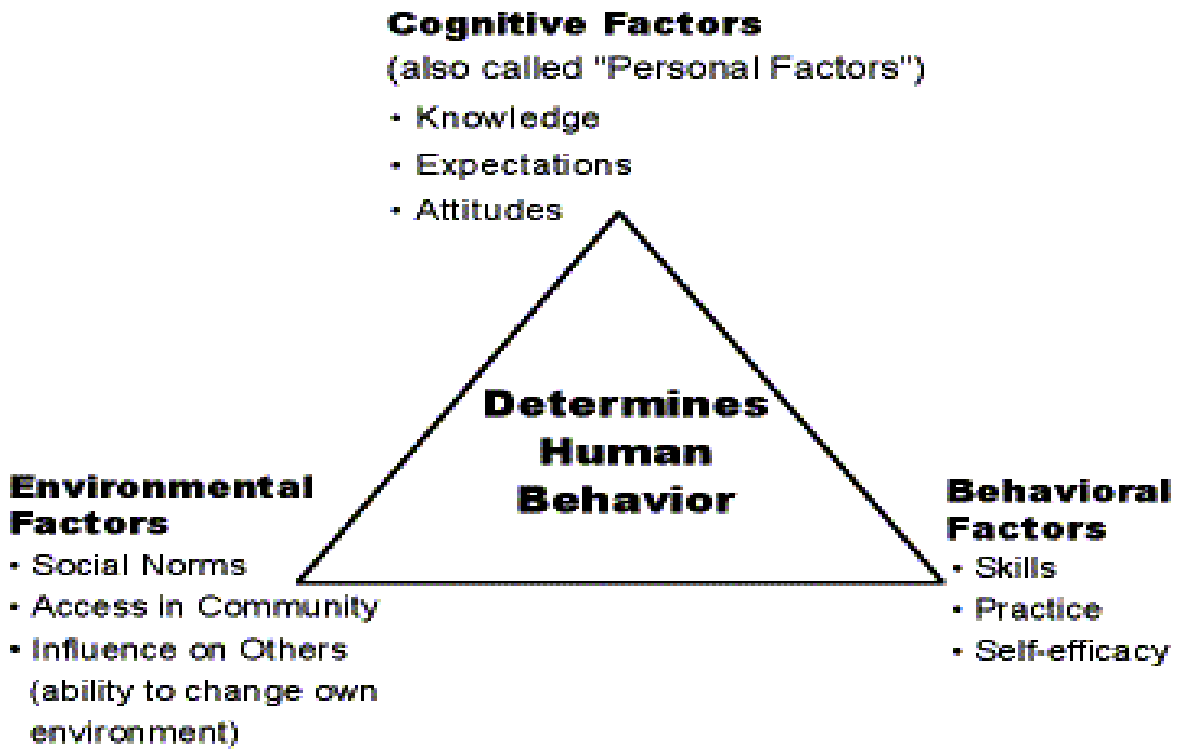

Figure 2.1. Social Cognitive Theory. (Denler et al., 2012)

Theories such as the SCT are designed to assist individuals with making psychological, personal, and environmental behavior adjustments necessary to be successful in weight loss endeavors post-bariatric surgery. Weight loss does not happen in a vacuum, it is fluid with setbacks and miss-steps occurring along the way. Long-term changes in health behavior, like making the life-changing decision to have bariatric surgery involve multiple actions and adaptations over time. In some cases, evaluating the downside of bariatric surgery can propel a person to have greater conviction with eating a healthier diet and exercising more and losing weight without surgery.

Depending on type of surgery, bariatric surgery is generally a permanent commitment, and it should only be considered after all other alternatives to achieve weight loss are exhausted. Moreover, having bariatric surgery is a lifelong decision that requires follow-up care. Applying

the SCT theory posits that a person's environment can help or hinder their lifestyle and weight changes. These patients face environmental factors such as medical and psychosocial challenges (for example, social support) that require continuing care for years after surgery, and the hard work only begins post-surgery (Elliott, 2004). A basic premise of SCT is that people learn not only through their own experiences, but also by observing the actions of those around them and the results of those actions.

Public health intervention strategies aiming at the individual level include goal setting, behavioral contracting, and tailored health communication (Painter, Borba, Hynes, Mays, & Glanz, 2008). SCT explains human behavior in terms of a dynamic, reciprocal model in which personal factors, environmental influences, and behavior continually interact. Constructs that are relevant to using the SCT in behavior change include observational learning, reinforcement, self-control, and self-efficacy (Painter et al., 2008). Increasing and maintaining a bariatric patient's self-efficacy is an important part to successful post-procedure outcomes. Bariatric clinics can build a patient's self-efficacy by continued and relevant social support groups, setting incremental goals that are achievable, and monitoring and reinforcing the patient not just in the first year post-surgery, but for at least five years post-operative.

In addition, not much has been written on the topic of follow-up care, but rather the focus has been on who is a good candidate for bariatric surgery rather than what patients go through after the procedure (Elliott, 2004). While obesity threatens to explode into a reverberating pandemic, there is a need to understand and support those individuals who have made the decision to have bariatric surgery. Using health behavior theories can offer health care professionals needed insight and information to be supportive and provide the care necessary to this vulnerable population. Likewise, bariatric programs address significant public health

problems such as obesity and chronic diseases and should strive to complement individual interventions with strategies to develop healthier environments.

Summary

Bariatric surgery can offer patients an effective and long lasting treatment for obesity and its related diseases. There does not appear to be any one bariatric surgical procedure that is recommended for older adults, so individual needs should be taken into consideration when exploring options. Literature is scarce on the long-term success of older adults and bariatric surgery. This may be due in part to the recently removed age cap that the NIH imposed and 2006 Medicare inclusion of bariatric surgery. A number of studies that have demonstrated that the surgery is safe for the aging population; additionally, co-morbidities improve.

Most of the studies reviewed focused on specific health outcomes such as the amount of weight loss, number of days in the hospital, reductions in prescriptions, changes in morbidity and mortality and safety of procedures for older adults. There is a need for more research on how attitudes and beliefs from their organic support system of family and friends assist or the failure to support one's weight loss. In addition, there is a lack recent research on how formal support systems (medical and psychological professionals) can influence outcomes for older adults. Is their role different with older adults than with their younger counterparts?

CHAPTER III. METHODS

Many of the existing studies review the immediate response to the surgery while still in hospital analyzing such things as length of time of procedure and/or hospitalization. Other research only reviews a small aspect of the bariatric experience such as number of medications reduced or amount of weight lost. The current research intends to ask questions about a person who chooses to have bariatric surgery and their experiences at least 18 months post-surgery.

The goal of this research is to evaluate the success of bariatric surgery for older adults and to compare their benefits, side effects, and outcomes with that of their younger counterparts. The following questions will be addressed:

1. Do older adults experience greater overall health benefits after surgery than younger adults?
2. Do older adults experience more side effects after surgery than younger adults?
3. After surgery, do outcomes regarding weight loss (reduction in BMI) differ between older adults and younger adults?
4. How does quality of life and physical mobility differ after the surgery for older adults than younger adults?
5. Do older adults experience greater satisfaction and/or happiness with the surgery and weight loss than younger adults?
6. Do older adults experience the same psychological issues related to losing weight as younger adults? Specifically does self-concept, overall sense of well-being, outlook on their future and general happiness differ between age groups?
7. Are older adults more likely to have the surgery again if they had to do it all over again compared to their younger counterparts?

Research Design

The research design for this study used a survey method. A cross-sectional, self-reported questionnaire was utilized. The primary purpose of this study is to compare post-procedures outcomes including dietary adherence, health impacts, surgical complications, quality of life, surgery satisfaction and happiness with weight loss and impact on their futures with four adult age groups. There are three goals this study aims to reach which include: 1) The purpose of this research was to compare milestone BMI changes of bariatric patients at least 18 months post-surgery among four age groups: young adult – ages 18-49, midlife adult – ages 50-59, older adult – ages 60-69 and oldest adult ages 70 and greater. A comparison of perceived improvement of existing chronic diseases and health symptoms (side-effects) post-surgery was also determined. 2) Another purpose of this study is to assess differences in health related quality of life (HRQL) concerns including energy level, mobility, sleep, and overall health of bariatric patients post-surgery compared among age groups. 3) Further, to study any substantial findings in the responses to specific areas of the questionnaire.

IRB Approval

Institutional Review Board approval was given by North Dakota State University prior starting the study (See Appendix A). It was deemed by Center for Weight Management at St. Joseph's Health Services that sole IRB approval by NDSU would be honored and IRB approval from the Center for Weight Management was not necessary for this research project. A letter of support stating this is provided (See Appendix B). The researchers were not able to offer incentive for participation in the project. Information collected via questionnaires was anonymous and questionnaires were sent to the NDSU researchers for analysis. NDSU researchers were not aware of any personal information for participants. Informed consent was

provided to potential participants upon invitation to participate in the questionnaire. An IRB signature waiver addendum was approved to further protect the anonymity of participants (See Appendix A).

Populations of Interest

The target population for the study included all bariatric patients (regardless of surgery type) over the age of 18 who had their bariatric procedure at least 18 months ago at the Center for Weight Management at St. Joseph's Health Services. Due to HIPAA restrictions, the researchers could only construct the sampling unit as it was described during a meeting with the bariatric center's liaison and physician's assistant. The sampling unit was a list of a bariatric patients' names and addresses from the Center for Weight Management's database who had surgery at least 18 months ago, and up to 15 years ago at the time the survey was mailed out. The content of the sampling unit consists of one element (the bariatric patient).

An estimated 220,000 procedures were performed in 2008 according to the American Society for Bariatric and Metabolic Surgery (ASBMS, 2013). Due to the relatively small nature of the bariatric surgery population in the United States, two groups that were excluded in this survey population were those bariatric patients under 18 years of age and bariatric patients who were less than 18-months post-operative at the time the surveys were mailed out.

Sampling Frame and Enumeration

The researchers were not privy to the exact procedures the Center for Weight Management staff used when selecting potential participants, nor how the sampling frame was structured. The researchers knew that the center administrative staff would identify those patients who meet inclusion criteria from their patient database and create address labels from those patients for the envelopes in which the surveys were sent.

Potential frame problems

Many of these problems were not within the researchers' control, as the surveys were sent out by the center's administrative staff in order to meet HIPPA regulations. The researchers were unable to take preventative action in regards to these potential problems due to the lack knowledge of the mailing lists and control of the sampling frame.

Non-coverage and missing elements

Potential survey participants who meet inclusion criteria may have been left off of the Center's mailing list of patients or the Center may not have had the correct information for inclusion on a patient who should have been put on the mailing list.

Foreign elements

Patients who never had bariatric surgery could incorrectly be on the mailing list. Moreover, patients could have been potentially be put on the mailing list and were less than 18 months post-procedure and under the age of 18.

Duplicates

The survey may have been mailed to the same person more than once. This may potentially happen due to the high rate of bariatric revision surgeries. For example, if a patient had the laparoscopic adjustable gastric banding (LAGB) five years ago and then revised to the vertical sleeve gastrectomy three years ago, they may be put on the mailing list twice because for all intents and purposes, they meet inclusion criteria, even though this would be the same person.

Clusters

A potential cluster could have happened if one potential participant on the mailing list is linked to more than one address or surname. This may have occurred if the same patient (as in

the case of a snowbird) has both a winter home and a permanent address. In addition, this scenario may occur if the patient had a name change in the past year and a half (as with marriage/divorce) and two surveys may have possibly be sent to the same person.

Sample Selection Methods

This study employed purposive convenience sampling due to the relatively small population of bariatric patients in the area. Upon the initial meeting with the center's representatives, an estimated 4,000 bariatric patients are listed in their database that were at least one year out from bariatric procedure. Due to the researchers' decision to only survey patients at least 18 months post-procedure and budget constraints, surveys were mailed to 2520 patients.

Selection Procedure

Purposeful convenience sampling was employed for this study since we used only one Midwestern weight management center which may be a non-representative subset of the larger U.S. bariatric population. Because the bariatric population is a very specific group, access to the larger population would have been very difficult.

Data Collection

The particular method of data collection for this study was a survey questionnaire, which was mailed out by administrative staff at the center's bariatric unit. The researchers developed a bariatric questionnaire addressing the needs of participants who are at least 18-month post-procedure. The questionnaire included demographic information and 5-point Likert-questions (which focus on changes in body weight, body mass index, nutrition, physical activity, quality of life changes, health status, side effects and various psychosocial factors such as self-esteem and happiness) and open-ended questions to elicit more detailed responses. The data collection for this questionnaire commenced with questionnaire mailings on or around June 1, 2014. The

length of time completing the survey instrument was estimated to take approximately 20 minutes. The study was closed after approximately 12 weeks.

Instrument

After an exhaustive search, the researchers found no existing bariatric questionnaire that met the needs of the research. Therefore, the researchers developed a bariatric questionnaire addressing the needs of participants who are at least 18-month post-bariatric procedure. The questionnaire included 12 demographic questions including height and four milestone weights; these questions also included birth year, gender, education level, marital status, employment status, bariatric surgical type, date of surgery. Next, there were 26-item Likert-style questions (which focus on diet adherence, nutrition, physical activity, quality of life changes, health status, side effects and various psychosocial factors such as self-confidence and happiness) and 2 open-ended questions to elicit more detailed responses for a total of 40 questions. A copy of the questionnaire is located Appendix C.

The constructs the researchers wanted to delve into involve multiple questions (5-8 for each construct section) on a 5-point Likert scale with the hope of obtaining clear feedback on diet/exercise adherence and food intolerances. The number of questions was limited to four double-sided regular size sheets of paper as the researchers have a finite timeline that must be met. The questionnaire was primarily compiled of closed-ended quantitative questions rather than qualitative ones due to the sheer size of the sample that was utilized.

Pilot Testing

Because reliability and validity had not been established on the developed questionnaire, the researchers conducted a pilot test of a sample of 10 bariatric patients to test the validity. In addition, 12 experts were contacted (various academic experts, as well as professionals from the

weight management center) to help confirm the content validity and readability of the questionnaire. Based on the results of the pilot study, the final questionnaire was modified and mailed to potential participants through the Center for Weight Management.

Data Analysis

The data was analyzed using SAS (Statistical Analysis Software, Cary, NC, version 10.3). Analyses included frequency and ANOVA and probability values. Body mass index (BMI) was calculated using the four milestone weights and height. The diseases and symptoms/side effects and quality of life outcomes were collapsed from a 5 point comparison scale to 3 points. The main groups that the researchers were interested in are bariatric age groups, which were divided into four groups for young adults, aged18-49, midlife adults, age 50-59, older adults, age 60-69 and "oldest adults, age ≥ 70. Descriptive statistics will be used to evaluate participants' characteristics and anthropometric data.

CHAPTER IV. OLDER ADULTS FIGHTING OBESITY WITH BARIATRIC SURGERY: BENEFITS, SIDE EFFECTS AND OUTCOMES[1]

Abstract

The aging population is growing exponentially worldwide. Associated with this greater life expectancy is the increased burden of chronic health conditions, many of which are exacerbated by the continued rise in obesity. In the United States, the prevalence of obesity in adults aged 60 years and older increased 23.6% to 37% in 2010. Objectives: This review examines bariatric surgery as a treatment option for obese adults > 60 years old. The most common types of weight-loss surgery are laparoscopic adjustable gastric banding, vertical sleeve gastrectomy, Roux-en-Y gastric by-pass, and the duodenal switch. Methods: A comprehensive literature search found 349 articles that referred to bariatric surgery in older adults. Of these, 70 relevant articles on bariatric surgery for older adults were utilized for this article. Results: Weight-loss surgery procedures were found equally safe for both older adults and their younger counterparts. Pre-surgical psychological assessment is critical for positive outcomes for older adults. Benefits of bariatric surgery include a decrease in comorbidities, chronic disease risk, and medication use coupled with improved mobility and quality of life outcomes. Side effects include surgical failure, changes in psychological status, and increased physical and mental stress. Conclusions: Bariatric surgery can offer patients an effective and long-lasting treatment for obesity and related diseases. There does not appear to be any one bariatric procedure that is recommended for older adults, so individual needs should be taken into consideration when

[1] This work previously appeared: 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.The material in this chapter was co-authored by Cindy Marihart (CM), Angela Geraci (AG) and Ardith Brunt (AB). CM and AG identified the pool of articles used for the review.CM wrote the article and created the table, AG created an outline and assisted with revisions. AB served as final proofreader.

exploring options. Costs range from US$17,000 for laparoscopic procedures to US$26,000 for open gastric surgeries. Estimated savings on healthcare costs start accruing within three months of surgery making bariatric surgery a serious cost saving consideration.

Introduction

This review examines bariatric surgery as a treatment option for obese adults ≥ 60 years old. The prevalence of obesity in older adults is rapidly expanding due to the aging of the baby boomer generation. Estimates of obesity in older Americans, increased from 9.9 million (24%) in 1990 to 14.6 million (32%) in 2000 to 22.2 million (37%) in 2010 (Salihu, Bonnema, & Alio, 2009). Since the baby boomers, those born between 1946-1964, are reaching their sixth decade heavier than previous generations, there is a public health concern that these overweight adults will become obese leading to greater risk of chronic disease (Leveille, Wee, & Iezzoni, 2005). The baby boomers weighed more and became obese at younger ages than previous generations (Zevin, Aggarwal, & Grantcharov, 2012). When the silent generation members, those born between 1926-1945, were aged 35-44 years, 14 to 18% were obese, but when the baby boomers were that age, those percentages doubled to 28-32% (Zevin et al., 2012)

Given the increased obesity rates for older adults, increased life expectancy does not necessarily mean an increase in healthy years (Han, Tajar, & Lean, 2011; Mathus-Vliegen, 2012). Instead, obese elderly may be facing additional years of discomfort, lack of mobility, and chronic ill health (Mathus-Vliegen, 2012; Mathus-Vliegen et al., 2012). The most common obesity related chronic diseases are type II diabetes, hypertension, heart disease, stroke, certain types of cancers, metabolic syndrome, respiratory disease, sleep apnea, fatty liver disease, osteoarthritis, gall bladder disease, pulmonary embolism, gastro-esophageal reflux disease (GERD), urinary incontinence, chronic renal failure, gout, and depression (Zamosky, 2013).

A literature search was conducted to retrieve relevant articles on bariatric surgery for older adults using EBSCO, MEDLINE, PROQUEST and WEB of SCIENCE with the forward option. A total of 349 articles were evaluated and 72 were deemed relevant and utilized for this review. Relevant articles described various types of weight loss surgery with the benefits and side effects, postoperative changes in co-morbidities and quality of life outcomes, and costs of surgery with related cost savings after surgery. See Table 4.1.

Types of Bariatric Surgery

Even though obesity is very difficult to treat with lifestyle changes, the medical community continues to encourage people to lose weight by diet and exercise (Zamosky, 2013). As a result of these recommendations, overweight and obese people attempt multiple diets, medications, and exercise regiments resulting in limited success over the long-term (Dorman, Abraham, et al., 2012; Neff, Olbers, & Le Roux, 2013; Zamosky, 2013). Increasingly, a viable option for obese patients has been surgery as a means to aid weight loss (Han et al., 2011; Mathus-Vliegen, 2012; Mathus-Vliegen et al., 2012; Zamosky, 2013; Zevin et al., 2012). Bariatric surgery that either restricts caloric intake or absorption has been found as the most effective method to lose weight and maintain a healthy lifestyle (Adams et al., 2007;Mathus-Vliegen et al., 2012; Zamosky, 2013; Zevin et al., 2012). There are various bariatric procedures available (Neff et al., 2013) and generally, the more complex the procedure, the greater the weight loss. But more complex/extensive surgery also has greater complications with higher morbidity and mortality rates (Dorman, Abraham, et al., 2012). In the order of frequency performed, are the Roux-en-Y gastric bypass (RYGB), laparoscopic adjustable gastric banding (LAGB), and vertical sleeve gastrectomy (VSG) (Figure 4.1). Biliopancreatic diversion, with a

duodenal switch (BPD-DS)] is least commonly performed but is often a consideration for extremely obese individuals (Neff et al., 2013).

RYGB

RYGB is the most common type of weight loss surgery worldwide and is considered permanent (Buchwald & Oien, 2013). The stomach is divided into two sections, the upper part is a small pouch which holds about 1-2 ounces of food initially (Buchwald & Oien, 2013). The pouch is connected to the jejunum using a Y-shaped limb of the small intestine bypassing the duodenum (Smith, Schauer, & Nguyen, 2011). Gastric and pancreatic secretions as well as bile mix with chime at the juncture of the jejunum and the duodenum (Smith et al., 2011). This procedure permanently changes how food is digesting resulting in fewer calories and nutrients being absorbed (Perry, Hutter, Smith, Newhouse, & McNeil, 2008). Weight loss is swift and dramatic, usually 50% of excess weight loss (EWL) in the first six months post-surgery, but may continue for up to two years (Scott & Batterham, 2011). Long term RYGB results show many patients keep weight off for 10 years or longer (Sjöström et al., 2012). As an added benefit of the rapid weight loss, health conditions affected by obesity such as diabetes, high blood pressure, high cholesterol, arthritis, sleep apnea, heartburn and other conditions often improve quickly (Chakravarty et al., 2012; Jáuregui-Lobera, 2013; Perry et al., 2008; Poirier et al., 2011).

Table 4.1. *Bariatric Key Findings for Patients Age 60 and Over*

Author/Year	Number of participants >60	Key findings
Adams et al. (2007)	7925 surgery group vs 7925 control group, 3 age ranges 33-44, 45-54 & ≥ 55	No significant difference in age groups. Indicated that patients who have RYGB had decreased long-term mortality from any causes and from disease specific causes but have increased mortality from non-disease causes as compared with control subjects.
Dorman et al. (2012)	43,378 N with 1994 > 65	Patients > 65 did not experience major complications for either open or laparoscopic procedures but likely to have a longer length of hospital stay for either procedure.
Dunkler-Blatter et al. (2007)	76 > 60 and 989 < 60	Same length of stay of 2.9 days in hospital. Significant improvement for diabetes and hypertension after RYBG. Weight loss was less but greater reductions in medications.
Hallowell et al. (2007)	46 > 60 31 Medicare	No difference was found in the occurrence of complications in Medicare patients and patients > 60 years old. Results indicate that bariatric surgery should not be denied based on age or Medicare status.
O'Keefe et al. (2010)	197 > 65	Weight loss surgery is effective in patients > 65 years of age, producing EWL, reduction in daily medication use and morbidities.
Perry et al. (2008)	476 > 65	Bariatric surgery appears to increase survival even in high risk Medicare population. Diagnosed prevalence of weight-related co-morbid conditions declined after bariatric surgery.
Quebbemann et al. (2005)	27 > 65-73	Bariatric surgery van be performed safely in patients > 65. RYGB procedure is significantly more effective than LAGB.
Sugerman et al. (2004)	83 > 60	Bariatric surgery was effective for older patients with low morbidity and mortality. Older patients had more pre and post-operative co-morbidities and lost less weight than younger patients. But weight loss & improvement in co-morbidities in older patients were clinically significant.
Van Rutte et al. (2013)	73 for 55-59 50 for 60-64 12 for ≥65	Laparoscopic sleeve gastrectomy (LSG) as a primary treatment for older morbidly obese is an effective and relatively safe procedures in terms of weight loss and remission of co-morbidities with an acceptable low complication rate.
Varela et al. (2006)	1339 > 60	Older adults had longer lengths of stays in hospitals but bariatric surgery is considered as safe as other gastrointestinal procedure. Mortality is better than expected.
Wool et al. (2009)	47 > 50-59 males 13 > 60 males	Despite a higher early morbidity rate, obese males > 60 years perform as well as male patients 50-59 years with respect to excess weight loss, mortality. Length of hospital stay and improvement of diabetes at 1 year postoperatively.
Yuan et al. (2009)	27 > 65 males	Weight loss and mortality similar to younger males. Older males had slightly better resolution of both hypertension and diabetes.

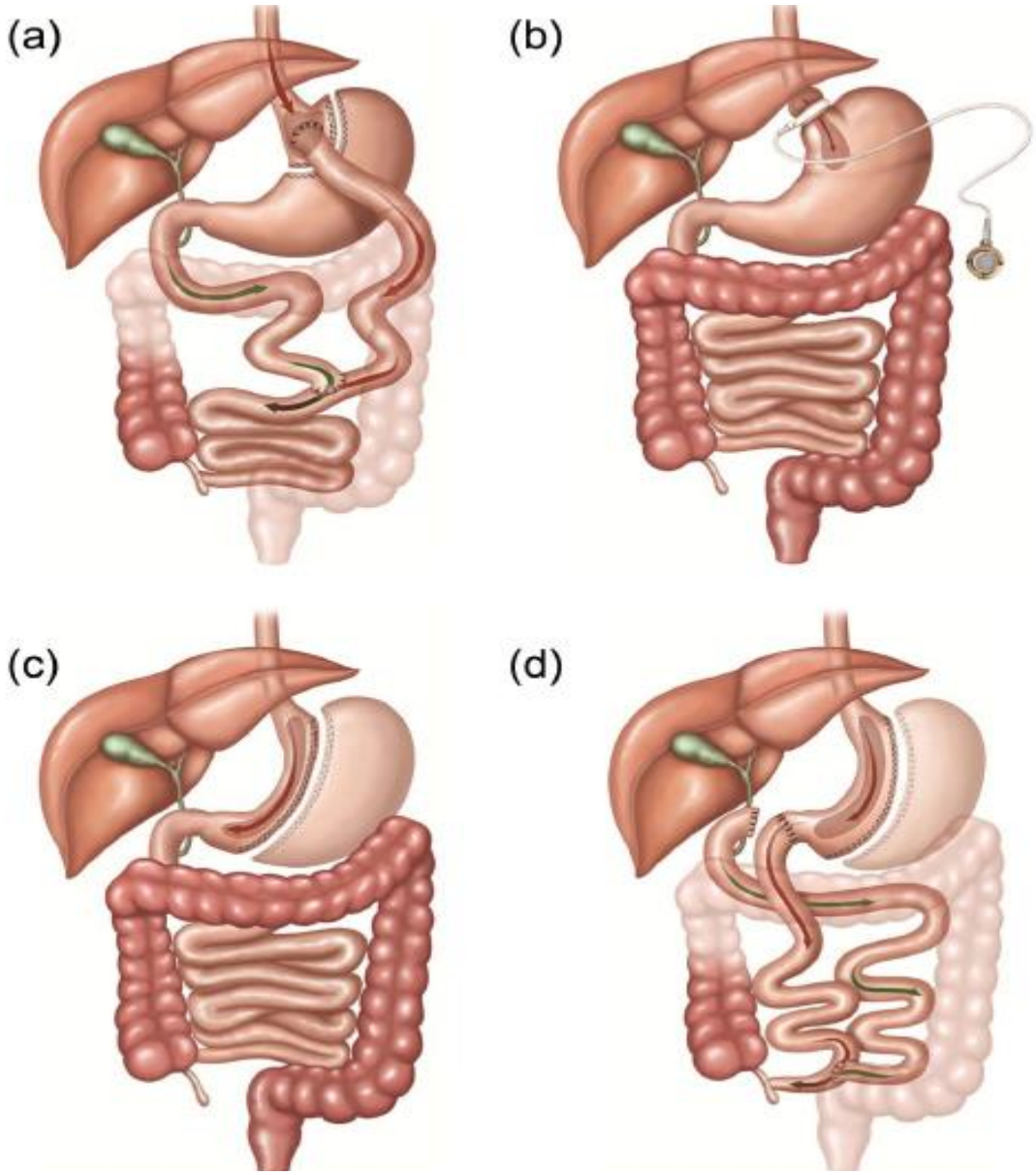

Figure 4.1. Most Common Types of Bariatric Surgery. (Neff et al., 2013)
Note: (a) is Roux-en-Y gastric bypass, (b) is laparoscopic adjustable gastric banding (LAGB), (c) is vertical sleeve gastrectomy (VSG) and (d) is Biliopancreatic diversion, with a duodenal switch.

Nevertheless, all is not necessarily without challenges. RYGB impairs the body's ability to absorb calories, dramatically increasing the risk for nutrient deficiencies (Neovius et al., 2012). The most common nutrient deficiencies after RYGB include the vitamins thiamin, vitamin B-12 and D, and the minerals iron, copper, and calcium (Adams et al., 2012).

Deficiencies of these nutrients can lead to anemia, fatigue, and osteoporosis; therefore, RYGB patients should plan to take vitamin and mineral supplements the rest of their lives (Jáuregui-Lobera, 2013; Saltzman & Karl, 2013). Thiamin deficiency has occurred after all bariatric procedures and can be present within weeks or years after surgery (Saltzman & Karl, 2013). Wernicke's encephalopathy is related to severe thiamin deficiency resulting in cognitive dysfunction and eye disorders such as nystagmus and ocular palsies (Saltzman & Karl, 2013). Vitamin B-12 deficiency results from an intolerance to animal protein after RYGB and lack of intrinsic factor; therefore, monthly B-12 injections are recommended (Saltzman & Karl, 2013). Vitamin D deficiency is a problem for 25% to 75% of bariatric patients with many having this deficiency preoperatively. Calcium absorption appears to be diminished possibly due to bypassing the duodenum and lack of Vitamin D (Saltzman & Karl, 2013). Resolving iron deficiency after RYGB can be a complicated issue because oral supplements are not absorbed; therefore, iron must be given intravenously (Saltzman & Karl, 2013). Copper deficiency is also present after RYGB, secondary to iron deficiency; copper status should be investigated as a source of anemia unresponsiveness to other nutrients (Saltzman & Karl, 2013).

RYGB is associated with other side effects such as an increased risk of dumping syndrome in which food is "dumped" from the stomach into the small intestine too quickly before it has been adequately digested (Adams et al., 2012; Hammer, 2012; Myers et al., 2012). Typically, this occurs when eating too many simple carbohydrates which can lead to diarrhea (Heinlein, 2009). Another long-term complication after RYGB is bone loss which has been greater than with nonsurgical methods of weight loss (Berarducci, 2007; Hammer, 2012). Other potential risks include an increased incidence of hernias and gallstone formations, which can

develop post-surgery and require surgical intervention to repair (Adams et al., 2012). Finally, there is a 1% mortality rate with the RYGB surgery (Benotti et al., 2013).

LAGB

LAGB is considered the least invasive and safer than the gastric bypass (Angrisani, Lorenzo, & Borrelli, 2007). Benefits of using LAGB are that recovery is quicker, hospital stays are shorter, and the surgery can be reversed (Angrisani et al., 2007; Chakravarty et al., 2012; Neff et al., 2013; Tice, Karliner, Walsh, Petersen, & Feldman, 2008). LAGB uses an inflatable silicone elastic band to squeeze the stomach into two sections: a smaller upper pouch and a larger lower section. The two sections are still connected, however, the channel or "bottleneck" between them is very small which slows down the emptying of the upper pouch (Tice et al., 2008). Because LAGB physically restricts the amount of food consumed, it is a successful method in losing weight. However, weight loss is less dramatic and furthermore, weight is more likely regained over time (Thornton, Rozen, So, Kaplan, & Wilkinson, 2009). A common side effect of LAGB is vomiting which is often a result of eating too much too quickly (Chakravarty et al., 2012). If the band is too tight, acid reflux can result (Scott & Batterham, 2011; Spivak, Abdelmelek, Beltran, Ng, & Kitahama, 2012). Complications with the band itself include slipping out of place, becoming loose, or leaking (Thornton et al., 2009). Sometimes further laparoscopic surgeries are necessary to re-position the band or repair a band leak. Follow-up visits are also required in order to "tighten or loosen" the band to fine-tune how fast food empties from the upper pouch into the residual stomach (Allen, 2007). The process can result in weight fluctuations. LAGB has a 50% failure rate in the long term, as defined by poor weight loss and percentage of band removal (Spivak et al., 2012). Reasons for band removal ranged from

inadequate weight loss (76%), gastric pouch dilation (64%), intolerance (21%), and band slippage (12%) (Spivak et al., 2012).

VSG

About 75% of the stomach is surgically removed in the irreversible VSG procedure (Adams et al., 2007), usually laparscopically (Scott & Batterham, 2011). What remains of the stomach is a narrow tube or sleeve which provides for the normal process of stomach emptying and the pyloric valve remains intact. Not only is the appetite reduced, but also consuming very small amounts of food generate early and lasting satiety (Benaiges et al., 2011). Because the small intestine is unchanged (not shortened), VSG does not usually affect the absorption of food, so nutritional deficiencies are less of a problem compared to RYGB or BPD-DS (Scott & Batterham, 2011). In people with very high body mass index (BMI), VSG as a stand-alone procedure results in an average weight loss of greater than 50% of EWL. In patients with very high BMI, the VSG may be followed by a modified RYGB or BPD-DS if significant weight loss is still needed. Since many adults who are morbidly obese have multiple co-morbidities, RYGB or BPD-DS may be too risky as an initial procedure (Benaiges et al., 2011). Usually, 12-18 months post-VSG, once the patient's health has improved and some weight has been lost, a second surgery may be undertaken (Aurora, Khaitan, & Saber, 2012; Benaiges et al., 2011; van Rutte, Smulders, de Zoete, & Nienhuijs, 2013).

Since VSG is a relatively new procedure, long term benefits and risks are still being evaluated. Typical surgical risks such as infection and blood clots apply; moreover, the sleeve itself can have leakage (van Rutte et al., 2013). Leakage occurs in less than 2.4% of patients for all sleeve procedures which can be successfully treated by operative or percutaneous drainage and endoscopic stenting (Aurora et al., 2012). Sleeve leakage symptoms include fever, pain in

chest/shoulder area, heart palpitations, dizziness, nausea and vomiting (Aurora et al., 2012). VSG is associated with greater weight loss than LAGB but subsequent weight gain has been seen in nearly all studies where follow-up exceeds 5 years (Aurora et al., 2012; Caiazzo & Pattou, 2013).

BPD-DS

BPD-DS or more commonly referred to as the "duodenal switch" is a more complicated, invasive version of the RYGB and is performed less frequently (Hedberg & Sundbom, 2012; Mitchell et al., 2009). Even though as much as 70% of the stomach is removed during the BPD-DS, the remaining pouch is still larger than those formed during RYGB or LAGB (Mitchell et al., 2009; Nilsson, Hedberg, & Ohrvik, 2011). As a result, larger meals can be consumed in a sitting; however, there is also a greater, more serious risk of nutritional deficiencies (Dorman, Rasmus, et al., 2012; Ziegler, Sirveaux, Brunaud, Reibel, & Quilliot, 2009). Since much of the small intestine is bypassed, digestive enzymes cannot mix with food until it reaches the distal ileum (Nilsson et al., 2011; Prachand, Ward, & Alverdy, 2010). The need for dietary supplements is higher among patients with BPD-DS compared to RYGB (Hedberg & Sundbom, 2012; Ziegler et al., 2009).

This surgery both restricts intake and reduces absorption area thereby resulting in rapid weight loss with an average long-term EWL of 70% to 80% (Dorman, Rasmus, et al., 2012; Hedberg & Sundbom, 2012; Mitchell et al., 2009; Prachand et al., 2010). In addition to the rapid weight loss, remission rate for type II diabetes is impressive at 100% within one year of surgery (Iaconelli et al., 2011). Co-morbidities such as hypertension, hyperlipidemia, and cardiovascular disease were also significantly reduced (Dorman, Rasmus, et al., 2012; Iaconelli et al., 2011; Prachand et al., 2010). Even with all these positive outcomes, BPD-DS is not without risks. BPD-DS poses many of the same risks as RYGB, including dumping syndrome, GERD,

gallstone formation and hernias (Prachand et al., 2010). Comparing BPD-DS with RYGB, post-surgery BPD-DS required longer hospital stays and more frequent early reoperation than RYGB (Hedberg & Sundbom, 2012). Nevertheless, overall there were no differences in late reoperation rates between the two groups (Hedberg & Sundbom, 2012; Nilsson et al., 2011). Despite the complications associated with BPD-DS, one study reported better weight and co-morbidity control than RYGB, with even more pronounced benefits among super-obese patients (Hedberg & Sundbom, 2012; Nelson, Blair, & Martin, 2012; Prachand et al., 2010). Because of infection, sepsis, and nutrition deficiencies, mortality rates are greater, ranging from 2.5% to 5% regardless of age (Hedberg & Sundbom, 2012; Prachand et al., 2010).

Bariatric Surgery Candidate Selection

The medical community recommends that surgical treatment of obesity should only be considered after all nonsurgical methods are exhausted (Yermilov, McGory, Shekelle, Ko, & Maggard, 2009). Potential bariatric patients are required to have attempted and failed several traditional diet methods (van Hout, van Oudheusden, Krasuska, & van Heck, 2006). In 1991, the National Institute of Health (NIH) first established bariatric patient selection guidelines which included a BMI of 40 or more or a BMI of 35-39 with one or more obesity related co-morbidities for people ages 18 to 50 (Yermilov et al., 2009). Age restrictions were initially in place because it was believed that the health risks of bariatric surgeries surpassed beneficial outcomes for aging patients (Pratt, McLees, & Pories, 2006; Quebbemann, Engstrom, Siegfried, Garner, & Dallal, 2005). In 2006, the NIH recommendations changed and Medicare reversed their policy to deny bariatric requests based solely on age and age restrictions were eliminated (Henrickson, Ashton, Windover, & Heinberg, 2009; Yuan et al., 2009).

Outcomes of Bariatric Surgery for Older Persons

Bariatric surgery often results in effective and enduring weight loss with complete resolution or significant improvement in obesity-related co-morbidities (Buchwald, 2005; Wool et al. 2004). After the Medicare authorized approval of bariatric surgery for older adults in 2006, 2.7% of all bariatric operations were performed on patients older than 60 years old in that year (Varela, Wilson, & Nguyen, 2006). Younger patients may have a greater EWL and have a more complete resolution of their co-morbid conditions, but older people reduced the number of prescribed medications that they took (Adams et al., 2012: O'Keefe et al., 2010). Age did not influence the rate of occurrence of postoperative complications and outcomes between older and younger patients (Felix & West, 2013; Hallowell et al., 2007;Sjöström et al., 2012; Sugerman et al., 2004).

Physical outcomes of bariatric surgery have steadily improved during the past decade (Dimick, Nicholas, Ryan, Thumma, & Birkmeyer, 2013). The most common obesity related chronic diseases are type II diabetes, hypertension, heart disease, stroke, certain types of cancers, metabolic syndrome, respiratory disease, sleep apnea, fatty liver disease, osteoarthritis, gall bladder disease, pulmonary embolism, GERD, urinary incontinence, chronic renal failure, gout, and depression which can all be improved by weight loss from bariatric surgery (Poirier et al., 2011). Bariatric surgery for older patients has been shown to be safe and effective for EWL and in improvement of obesity co-morbidities especially type II diabetes and blood pressure with trends in greater improvement for older patients than younger patients after RYGB (Dunkle-Blatter et al., 2007). Individuals who underwent bariatric surgery had a significantly reduced number of total and fatal cardiovascular events compared with matched obese controls who did

not undergo surgery (Sjöström et al., 2012). Further, cancer rates have been reduced to nearly 50% in post surgical bariatric patients (Sjöström et al., 2012).

Quality of life measures and physical mobility

Regardless of age, improved mobility, reduced co-morbidities, pain reduction, and enhanced psychological functioning such as improvements in mood, self-esteem, social functioning, and sexuality led to improved quality of life enrichment in bariatric patients (Folope et al., 2008; G. van Hout & van Heck, 2009). Ten years after weight loss surgery, patients had significantly better health perceptions, social interactions, psychosocial functioning, and reduced depression (Karlsson, Taft, Rydén, Sjöström, & Sullivan, 2007). Improved mobility and less medications alone led many participants who underwent bariatric surgery to state they had experienced improved mood, regardless of whether all weight-loss goals were met, and would opt to have the surgery again (Dunkle-Blatter et al., 2007; Folope et al., 2008; Karlsson et al., 2007; G. van Hout & van Heck, 2009).

Wheelchair-bound older patients were often fully ambulatory within months post-surgery (Sugerman et al., 2004). Even modest weight-loss improved overall physical functioning of older adults (Sugerman et al., 2004). For example, patients with lower extremity arthritis experienced reduced knee and hip pain (McTigue, Hess, & Ziouras, 2006; G. van Hout & van Heck, 2009). Many obese patients who have type II diabetes experience normalization of blood sugars within days post-surgery (Dunkle-Blatter et al., 2007). Patients can frequently stop taking diabetes medications before leaving the hospital after surgery (Dunkle-Blatter et al., 2007). Being able to reduce or eliminate daily diabetes glucose testing and insulin injections leads to improved quality of life. Currently, research on glucose metabolism is underway to better understand this outcome phenomenon (Dunkle-Blatter et al., 2007; Saeidi et al., 2013). However, nutrient deficiencies

negatively affect quality of life by requiring extra doctor visits, vitamin supplements, iron infusions, B-12 injections and physical symptoms of lower energy (Jáuregui-Lobera, 2013; Saltzman & Karl, 2013).

Food intolerances and physical mobility challenges

Food intolerance and lack of vitamin and mineral absorption can be a problem for all patients after weight loss surgery, regardless of type and can result in osteoporosis and anemia (Mathus-Vliegen et al., 2012; Ziegler et al., 2009). This can be a more critical concern for the elderly. Since there is an increased risk of bone fractures for those who developed osteoporosis, recovery from hip fracture can prove to be problematic for aging patients (Dunkle-Blatter et al., 2007). If left untreated, low intake of heme iron foods can increase the risk of anemia which can lead to frailty and malnutrition in older patients (Heuberger, 2011). Patients report that they have a sense of control of food intake that they never had before but certain food intolerances such as meat and coarse vegetables can make choosing foods difficult (Hensrud & Klein, 2006; Ziegler et al., 2009).

Since weight loss post-surgery is initially rapid, losing muscle and fat mass is a valid concern in older patients. As one ages, the loss of muscle mass, known as sarcopenia, usually happens as part of the aging process (Berarducci, 2007). But losing additional muscle mass through rapid weight loss has the potential to result in more mobility issues for older adults (Berarducci, 2007). Post-op diet and exercise regimes are recommended for all surgeries and all patients, but certain health challenges may make it difficult for older adults to adhere to strict programs (Gremeaux et al., 2012). Obesity was once believed to be bone protective, but more recent research has introduced evidence of greater risk for metabolic bone disease due to lack of vitamin D and inadequate calcium intake, sedentary lifestyle, chronic dieting, and underlying

diseases (Berarducci, 2007). After bariatric surgery, the risk of bone-related diseases increases due to restrictive intake, malabsorption, and poor compliance to vitamin and mineral supplements and dramatic weight loss (Berarducci, 2007; Mathus-Vliegen, 2012; Mathus-Vliegen et al., 2012; Poirier et al., 2011).

Costs of Bariatric Surgery

Healthcare utilization and healthcare costs for the morbidly obese are 81% above those of the nonobese population (Hensrud & Klein, 2006). Analysis of bariatric surgery cost of 3651 patients showed a strong return on investment up to five years post operatively (Cremieux et al., 2008). Estimated costs in 2010 of laparoscopic and open gastric bypass are $17,000 and $26,000, respectively (Felix & West, 2013). Even with these high surgical expenditures, cost savings start accruing by the third post-operative month (Bradley & Sharma, 2006). The short term return on investment associated with bariatric surgery is consistent with decrease in multiple co-morbid conditions, including diabetes, coronary artery disease, hypertension and sleep apnea (Crémieux et al., 2008; Klein, Ghosh, Cremieux, Eapen, & McGavock, 2011). The cost reductions in these diseases take into account prescription drug usage, hospital stays, and physician visits (Cremieux et al., 2008). Type II diabetes is greatly improved by bariatric surgery (Klein et al., 2011) and estimated annual costs of managing a diabetes patient ($13,243) are five times more than a patient without diabetes ($2,560) (Campbell et al., 2010). People age 65 years and older represent 10.9 million Americans. Approximately 27% of all people in this age group have diabetes but not all of these older dietetics will necessarily improve with bariatric surgery. It is estimated that one third of all Medicare dollars are spent on the cost of care of people with diabetes (Neovius et al., 2012).

Conclusion

Bariatric surgery can offer patients an effective and long lasting treatment for obesity and its related diseases. There does not appear to be any one bariatric surgical procedure that is recommended for older adults, so individual needs should be taken into consideration when exploring options. Literature is scarce on the long-term success of older adults and bariatric surgery. This may be due to the NIH removal of age limitations and Medicare inclusion of bariatric surgery since 2006. A number of studies that have demonstrated that the surgery is safe for the aging population; additionally, comorbidities improve. Many other research opportunities remain. Research questions should delve into motivating older adults and their younger counterparts to choose bariatric surgery and the effects of that surgery on their relationships. Questions remain concerning bariatric surgery side effects on social relationships, the role of social support, quality of life issues post-surgery, and predictor differences for bariatric success in older versus younger adult patients. Other questions might include the effect of retirement as a help or hindrance on bariatric surgery recovery, older patients and diet adherence, the effect of nutritional deficiency complications, or weight regain concerns. Specific for older adults, research questions may include the effects of muscle and bone loss as a result of bariatric surgery and the long- term outcome for mobility for older adults.

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CHAPTER V. WHAT'S AGE GOT TO DO WITH IT? A COMPARISON OF BARIATRIC SURGICAL OUTCOMES AMONG YOUNG, MIDLIFE, OLDER AND OLDEST ADULTS

Abstract

Bariatric surgery has become an accepted method to treat obesity and its related diseases in adults; nevertheless, few studies compare changes in body mass index (BMI), disease outcomes, and side effects among age groups. This study compares long-term bariatric surgery outcomes across four adult age groups by comparing changes in milestone BMIs, existing disease outcomes, and symptoms or side effects after surgery. Data was obtained using a 40-item questionnaire that was mailed to 2520 patients of a Midwestern weight management center who were at least 18 months post-procedure. The 534 respondents were divided into four age groups in years: 18-49 (n=171), 50-59 (n=148), 60-69 (n=138) and ≥ 70 (n=77). The older and oldest age groups were as successful at losing weight and keeping it off as young and midlife groups. Significant improvement in eight chronic diseases occurred across all age groups. Compared to the young and midlife groups, the older and oldest age groups had similar or better outcomes for most diseases and reported fewer side effects. Bariatric surgery should be considered an option for weight loss and disease management for older adults as much as it is for younger.

Keywords: Older adults, bariatric surgery, age groups, disease outcomes, BMI.

Introduction

The prevalence of obesity in the older adult population (age 60 and older) is one of the greatest public health concerns (Salihu, Bonnema, & Alio, 2009). Obesity in older Americans was estimated to increase from 24% in 1990 to 37% in 2010 (Salihu, et al., 2009). Overweight adults are more likely to become obese which leads to increased risk of chronic disease (Leveille,

Wee, & Iezzoni, 2005). The baby boomer generation, those born between 1946-1964, weighed more and became obese at younger ages than any previous generation (Zevin, Aggarwal, & Grantcharov, 2012). As a result, chronic diseases associated with obesity are on the rise. The chronic diseases that are most commonly associated with obesity include asthma or respiratory disease, hypertension, type II diabetes, renal failure, heart disease, fatty liver disease, arthritis, gall bladder disease, and depression (Zamosky, 2013). As individuals live longer, chronic health concerns greatly impact their quality of life. So instead of enjoying greater longevity, obese older adults may be struggling with years of pain, discomfort, and poorer quality of life due to chronic diseases (Han, Tajar, & Lean, 2011). However, surgical side effects can also have an effect on a person's life satisfaction.

Bariatric surgery has become an accepted method to treat obesity and its related diseases (Puzziferri, Roshek, Mayo, Gallagher, Belle, & Livingston, 2014). In fact, bariatric surgery is now the leading form of treatment for overall long-term weight loss (Grimaldi & Van Etten, 2010). Historically, the older adult population has few reports of bariatric surgery outcomes, since the National Institute of Health's previous recommendation was to exclude bariatric surgery for patients 60 years of age and older (Marihart, Brunt, & Geraci, 2014). In 2006, the National Institute of Health removed age restrictions from their recommendations for bariatric surgery. Medicare also opted to include bariatric surgery as a covered procedure for Medicare participants (Hendrickson, Ashton, Windover, & Heinberg, 2009; Yuan et al., 2009). Age restrictions were initially in place because it was believed that the health risks associated with bariatric surgery exceeded beneficial outcomes for aging patients (Pratt, McLees, & Pories, 2006; Quebbemann, Engstrom, Siegfried, Garner, & Dallal, 2005). A number of studies have demonstrated that bariatric surgery is safe for older adults (Ewing, Thompson, Wachtel, &

Frezza, 2011). Bariatric surgery can offer patients of all ages an effective and long lasting treatment for obesity and its related diseases (Neff, Olbers, & Le Roux, 2013).

A basic definition of overweight and obesity is having too much body fat that ultimately presents a risk to health (World Health Organization, 2006). One way to determine whether a person has too much body fat is to calculate the ratio of weight in kilograms to height in meters squared, known as body mass index (BMI). This method is inexpensive, very easy to measure, and accounts for differences between taller and shorter people. Research has shown that BMI is highly correlated with under-water weighing which is the gold-standard method for measuring body fat (Gallagher, Visser, Sepulveda, Pierson, Harris, & Heymsfield, 1996). According to the World Health Organization (2006), a healthy BMI range for adults is between 18.5 and 24.9 kg/m^2; overweight is defined as a BMI of 25 to 29. 9 kg/m^2, and obesity is defined as a BMI of 30 kg/m^2 or higher (Ezzali, Lopez, Rodgers, & Murray, 2004; Kelly, Yang, Chen, Reynolds, & He, 2008). The risk of developing chronic diseases such as heart disease and diabetes rises progressively as BMI increases and so does the risk of dying at an earlier age (Adams, et al., 2006; Hardy & Kuh, 2006; Roger, Go, Lloyd-Jones, Adams, et al., 2012). It is noteworthy that an increase of 28 pounds in body weight will increase a BMI from 24.9 kg/m^2 to 30 kg/m^2.

There are gaps in the literature; there is limited published research that examines the outcomes of bariatric patients who are past the first year post-surgery. Much of the research on bariatric surgery focuses on immediate health-related outcomes. For example, bariatric patients can frequently stop taking diabetes medications before leaving the hospital (Dunkle-Blatter et al., 2007; Saeidi et al., 2013). There is very limited research that investigates the health impacts of bariatric surgery with older adults compared to younger age groups (Huberman, 2008; Algul et al, 2009).

The purpose of this research was to compare milestone BMI changes of bariatric patients at least 18 months post-surgery among four age groups: young adult – ages 18-49, midlife adult – ages 50-59, older adult – ages 60-69 and oldest adult ages 70 and greater. A comparison of perceived improvement of existing chronic diseases and health symptoms (side-effects) post-surgery was also completed.

Methods

The study design was a survey method, using a cross-sectional, self-reported questionnaire. Institutional review board (IRB) approval was given by North Dakota State University for this research.

After an exhaustive search, the researchers found no existing bariatric questionnaire that met their needs. Therefore, they developed a bariatric questionnaire addressing the surgical outcomes of patients who were at least 18 month post-bariatric surgery. The questionnaire included demographic information such as age, height, 4 milestone weights and type of surgery. The 4 milestone weights were highest weight before surgery, weight on surgery day, lowest weight after surgery, and current weight. Likert-style questions were designed which focused on disease and side effect outcomes. The questionnaire was reviewed by education and health professionals for content and readability. The instrument was revised and pilot tested with a sample of 12 bariatric patients to test clarity. No further revisions were made.

Bariatric patients who were at least 18 months post-surgery were recruited from a Midwestern weight management center in the United States which specializes in bariatric surgery. Additional criteria included being over the age of 18 years. To ensure privacy, hospital personnel mailed paper questionnaires with the option to complete the questionnaire online. The questionnaires were returned with no identifying information to researchers. The questionnaires

were then coded and entered into Qualtrics (Survey Software, Provo, UT, version 60,114). Approximately 12 weeks after the questionnaires were mailed, the data collection was stopped.

The data was analyzed using SAS (Statistical Analysis Software, Cary, NC, version 10.3) Analyses included frequency and ANOVA. Body mass index (BMI) was calculated using the four milestone weights and height. The diseases and symptoms were collapsed from a 5 point comparison scale to 3 points.

Results

Of the 2520 mailed questionnaires, 534 were completed and 178 returned as undeliverable. This was a 22.8% response rate. As seen in Table 5.1, the 534 respondents were divided into four age groups: 18-49 years (n=171), 50-59 years (n=148), 60-69 years (n=138) and ≥ 70 years (n=77). The majority were female (n=442; 82.8%), and married (n=350; 65.7%). Employment status varied with part-time work (n=254; 47.7%), and full-time work (n=66; 12.4%), and a large number of retired participants (n=160; 30.1%). The majority had some college (n=252; 47.3%) or a college degree (n=142; 26.4%), and the majority of all participants underwent gastric bypass surgery (n=511; 96.2%) rather than the gastric sleeve, gastric band, or another alternative.

Table 5.1. *Demographic Characteristics Overall and by Age Group*

Characteristic	Overall N=534 Number (%)	Young n=171 Number (%)	Midlife n=148 Number (%)	Older n=138 Number (%)	Oldest n=77 Number (%)
Gender					
Woman	442 (82.8)	153 (89.4)	123 (83.1)	103 (74.6)	63 (81.8)
Man	92 (17.2)	18 (10.5)	25 (16.9)	35 (25.4)	14 (18.2)
Education					
< High School	8* (1.5)	0	2 (1.4)	3 (2.2)	3 (3.9)
High School/GED	131 (24.6)	30 (17.5)	32 (21.8)	38 (27.5)	31 (40.3)
Some College	252 (47.3)	91 (53.2)	64 (43.5)	63 (45.7)	34 (44.2)
College Degree	142 (26.4)	50 (29.2)	49 (33.3)	34 (24.6)	9 (11.7)
Marital Status					
Single / Never Married	48 (9.0)	30 (17.5)	13 (8.8)	4 (2.9)	1 (1.3)
Married	350 (65.7)	100 (58.5)	105 (71.0)	92 (67.2)	53 (68.8)
Domestic Partnership	5 (0.9)	2 (1.2)	1 (0.7)	1 (0.7)	1 (1.3)
Separated	6 (1.1)	5 (2.9)	0	0	1 (1.3)
Divorced	86 (16.1)	32 (18.7)	27 (18.2)	24 (17.5)	3 (3.9)
Widowed	38 (7.1)	2 (1.2)	2 (1.4)	16 (11.7)	18 (23.4)
Employment Status					
Caregiver at Home	22 (4.1)	13 (7.7)	7 (4.8)	1 (0.7)	1 (1.3)
Work Part-Time	254 (47.7)	119 (70.0)	94 (63.5)	40 (29.0)	1 (1.3)
Work Full-Time	66 (12.4)	22 (12.9)	17 (11.5)	22 (15.9)	5 (6.6)
Retired	160 (30.1)	1 (0.6)	19 (12.8)	72 (52.2)	68 (89.5)
Other	30 (5.6)	15 (8.8)	11 (7.4)	3 (2.2)	1 (1.3)
Surgery Type					
Gastric By-Pass	511 (96.2)	162 (94.7)	143 (98.0	132 (96.4)	74 (96.1)
Gastric Sleeve	4 (0.8)	3 (1.8)	0	1 (0.7)	0
Gastric Band	15 (2.8)	6 (3.5)	2 (1.4)	4 (2.92)	3 (3.9)
Biliopancreatric Diversion	1 (<0.01)	0	1 (0.7)	0	0

*Some characteristics may not add to total sample size due to non-response by some participants.

As seen in Table 5.2, participants lost weight as expected, and most experienced some weight regain regardless of age. The young adults had a larger mean highest BMI of > 50 kg/m^2 compared to a mean BMI of 46.3 kg/m^2 for the oldest group (p=0.03). Although not significant, overall each mean milestone BMI was larger for the young group and progressed in chronological order with the oldest age group having the lowest milestone BMIs in all four areas.

Table 5.2. *Mean BMI Milestones Overall and by Age*

BMI Milestone	Overall N=534 Mean ± SD*	Young n=171 Mean ± SD	Midlife n=148 Mean ± SD	Older n=138 Mean ± SD	Oldest n=77 Mean ± SD	P value
Highest	48.4 ± 8.2	50.5 ± 8.7	49.1 ± 8.5	47.8 ± 7.5	46.3 ± 8.0	0.03
Surgery Day	46.9 ± 7.7	48.7 ± 7.4	47.5 ± 8.3	46.3 ± 7.0	44.9 ± 8.0	0.28
Lowest	26.5 ± 5.1	26.9 ± 5.4	26.8 ± 5.5	26.6 ± 5.1	25.8 ± 4.2	0.93
Current	30.2 ± 6.1	31.2 ± 6.2	30.7 ± 6.1	30.2 ± 6.1	28.8 ± 5.8	0.51

* Standard Deviation

Nevertheless, there were differences between some of the milestone BMIs and various age groups. There were significant differences for the highest BMI between the oldest and midlife groups (p=0.05) as well as the oldest and young (p = 0.005). Moreover there were differences between the older and young group for highest BMI (p = 0.015). For surgery day BMI, there were significant differences between the oldest and midlife (p = 0.046) and oldest and youngest (p = 0.006). There were also differences between the older and young (p = 0.026). There were no significant differences between the age groups at lowest BMI; however, at current BMI, there are significant differences between young and oldest (p = 0.026).

Participant perceptions regarding their current control of chronic diseases compared to pre-procedure status are found on Table 5.3. There were significant improvements in diagnosed diseases across all age groups. The older and oldest age groups reported similar outcomes as did the young and midlife age groups for most conditions. Arthritis, depression, diabetes type II,

hypertension and sleep apnea were reported by over 40% of the participants whereas fewer than 40% reported fatty liver disease, asthma/respiratory disease, and heart disease.

Approximately 88 % reported arthritis as a health concern. Almost two-thirds of these participants (64.5%) reported reductions in joint pain and arthritis; however, as age increased the percentage of those who reported improvement in their conditions steadily declined (p= 0.01).

Approximately 60% of all participants reported depression as a health problem. Depression was improved in over half of these participants (54.8%) whereas only 15.0% perceived that depression was worse than before surgery; Although there were no significant differences between age groups for changes in depression (p =0.52), the most improved age group was the oldest group at 60% feeling better.

Overall, 321 of the respondents (60.1%) reported diabetes type II. Compared to the chronic conditions that were assessed, diabetes type II showed the largest improvement for all ages at 87.4% with the older group at the high rate of 93.3% compared to the midlife group at 81.5%; however, these levels were not significant (p=0.10).

Overall, hypertension was reported to be better or much better by 81.1 % of those who reported hypertension (65.0%). Hypertension was most improved in the oldest group at 89.3% compared to the young group at 78.8% (p=0.02).

Overall, sleep apnea was reported to have improved in 72.8% of those who reported sleep apnea (41.9%) Sleep apnea was most improved in the oldest group showing an 80.7% improvement compared to the least improved which was the midlife group showing a 66.7% improvement (p=0.05).

Table 5.3. *Percentage of Participants Reporting Changes in Existing Chronic Diseases Overall and by Age Group*

	Overall Percent	Young Percent	Midlife Percent	Older Percent	Oldest Percent	p-value
Arthritis/ Joint Pain	N= 468	n = 98	n = 120	n=104	n = 52	0.01
Worse/much worse	12.4	19.4	11.7	19.2	9.6	
About the same	23.1	18.4	28.3	29.8	48.1	
Better/much better	64.5	62.2	60	51	42.3	
Depression	N =321	n = 117	n = 96	n = 68	n = 40	0.52
Worse/much worse	15	18.8	14.6	14.7	5	
About the same	30.2	28.2	28.1	33.8	35	
Better/much better	54.8	53	57.3	51.5	60	
Diabetes Type II	N= 321	n = 117	n = 96	n = 60	n = 34	0.10
Worse/much worse	2.7	2.9	1.9	0	8.8	
About the same	9.8	8.6	16.7	6.7	5.8	
Better/much better	87.4	88.6	81.5	93.3	85.3	
Hypertension	N = 347	n = 80	n = 103	n = 99	n = 65	0.02
Worse/much worse	3.8	10	1.9	2	1.5	
About the same	14.4	11.3	15.5	19.2	9.2	
Better/much better	81.4	78.8	82.5	78.8	89.3	
Sleep Apnea	N =224	n = 55	n = 69	n = 69	n = 31	0.05
Worse/much worse	6.2	9.1	1.5	10.1	3.2	
About the same	21	12.7	31.9	18.9	16.1	
Better/much better	72.8	78.2	66.7	71	80.7	
Asthma/ Respiratory Disease	N = 140	n = 36	n =51	n = 32	n = 21	0.88
Worse/much worse	5.7	8.3	3.9	6.3	4.8	
About the same	35	36.1	29.4	40.6	38.1	
Better/much better	59.3	55.6	66.7	53.1	57.1	
Fatty Liver Disease	N = 99	n = 29	n = 43	n = 18	n = 9	0.02
Worse/much worse	8	24.1	0	5.6	0	
About the same	30.3	20.7	37.2	27.8	33.3	
Better/much better	61.6	55.2	62.7	66.7	66.7	
Heart Disease	N = 97	n = 13	n = 29	n = 35	n = 22	0.42
Worse/much worse	8.3	15.4	3.5	8.6	9.1	
About the same	37.1	46.2	51.7	22.6	31.8	
Better/much better	54.6	58.5	44.8	62.9	59.1	

* p values are chi-square values and are comparisons of age groups for all three responses.

Even though fewer individuals reported the remaining chronic conditions, the perceived improvement was high among those who reported those conditions. The older and oldest age groups reported marked improvement with fatty liver disease, heart disease, compared to the young and midlife age groups. Although not significantly different among the age groups

(p=0.88), asthma was most improved by the midlife group at 66.7% with least improvement of 53.1% for the older group. In regard to fatty liver disease the older and oldest groups improved by 66.7% as compared to the least improved which was the young group at 55.2% (p=0.02). Although not significantly different among the age groups (p=0.42), heart disease was most improved with the older group by 62.9%, and then the oldest group at 59.1% with the least improved being the midlife group at only 44.8%.

As seen in Table 5.4, the overall results reflected high percentages for improvements in symptoms and/or side effects after bariatric surgery for all age groups. Overall, a low percentage of the participants reported high level of frequency of bladder problems/incontinence (6.8%), gallbladder/gallstones (5.1%), heartburn (4.9%), indigestion (6.4%), nausea over the past year (6.8%), and vomiting (5.2%). Gas belching/flatulence (37.2%) were the most commonly identified negative side effect. Although not reported by about half of the participants, hair loss and diarrhea were reported by 17.8% and 15.3% respectively.

The older and oldest age groups seemed to have fewer symptoms and/or side effects after surgery than the young and midlife age groups. Upon reviewing the above table, there is less occurrence of constipation, lower frequency of diarrhea, gall bladder or gallstone problems, and gas, for older and oldest age groups but is only significant for constipation ($p<0.000$) and nausea within the past year (p=0.02).

Table 5.4. *Percentage of Participants Reporting Symptoms/Side Effects by Age Groups*

	Overall Percent	Young Percent	Midlife Percent	Older Percent	Oldest Percent	p-value
Bladder Problems/ Incontinence	N = 527	n = 171	n = 146	n = 134	n = 76	0.65
Never/rarely	76.5	77.8	79.5	73.1	73.7	
Sometimes	16.7	14.0	14.4	20.9	19.7	
Most of the time/always	6.8	8.2	6.2	6.0	6.6	
Constipation	N = 532	n = 171	n = 147	n = 137	n = 77	0.000
Never/rarely	60.2	45.6	62.6	65.0	79.2	
Sometimes	28.6	39.2	23.1	28.5	15.6	
Most of the time/always	11.3	15.2	14.3	6.6	5.2	
Diarrhea	N = 531	n = 171	n - 147	n - 136	n = 77	0.22
Never/rarely	46.9	41.5	46.9	47.8	57.1	
Sometimes	37.9	38.6	37.4	39.7	33.8	
Most of the time/always	15.3	19.9	15.7	12.5	9.1	
Gallbladder Problems/ gallstones	N = 531	n = 171	n = 148	n - 137	n = 75	0.07
Never/rarely	91.9	87.1	92.6	94.9	96.0	
Sometimes	3.0	3.5	4.1	2.2	1.3	
Most of the time/always	5.1	9.4	3.4	2.9	2.7	
Gas/Belching/Flatulence	N = 530	n = 169	n = 148	n = 136	n = 77	0.46
Never/rarely	21.3	17.8	22.3	22.8	24.7	
Sometimes	41.5	38.5	42.6	41.9	45.5	
Most of the time/always	37.2	43.8	35.1	35.3	29.9	
Hair Loss	N = 529	n = 170	n = 147	n = 136	n = 76	0.12
Never/rarely	54.1	47.7	58.5	61.0	47.4	
Sometimes	28.2	29.4	27.2	25.7	31.6	
Most of the time/always	17.8	22.9	14.3	13.2	21.1	
Heartburn	N = 532	n = 171	n = 148	n = 136	n = 77	0.73
Never/rarely	81.4	79.5	82.4	82.4	81.8	
Sometimes	13.7	13.5	14.9	12.5	14.3	
Most of the time/always	4.9	7.0	2.7	5.2	3.9	
Indigestion	N = 530	n = 170	n = 147	136	n = 77	0.22
Never/rarely	67.4	67.7	64.6	69.9	67.5	
Sometimes	26.2	22.4	31.3	25.7	26.0	
Most of the time/always	6.4	10.0	4.1	4.4	6.5	
Nausea in the Last Year	n = 532	n = 171	n = 148	n = 136	n = 77	0.02
Never/rarely	59.4	53.2	63.5	63.2	58.4	
Sometimes	33.8	34.5	31.1	33.8	37.7	
Most of the time/always	6.8	12.3	5.4	2.9	3.9	
Vomiting	N = 531	n = 170	n = 148	n = 136	n = 77	0.84
Never/rarely	70.2	68.8	73.0	69.9	68.8	
Sometimes	24.5	24.7	23.7	23.5	27.3	
Most of the time/always	5.27	6.47	3.38	6.62	3.9	

* The p values are chi-square values and are comparisons of age groups for all three responses.

Discussion

All age groups lost weight after bariatric surgery. All groups experienced some weight regain as indicated by current BMI being higher than lowest BMI. This agrees with previous research (Clough, Layani, Shah, Wheatley, & Taylor, 2011) who found excess BMI loss was

44.1% after 5 years for patients age 60 and over with limited major complications . The older and oldest age groups were as successful at losing weight and keeping it off as the young and midlife age groups.

There were significant improvements in chronic diseases across all age groups. The older and oldest age groups had comparable or better outcomes as did the young and midlife age groups on most chronic diseases like arthritis, hypertension, sleep apnea, and fatty liver disease. This coincides with Adams et al. (2012) who found high rates of diabetes remission and lower risks of cardiovascular problems continued six years after gastric bypass in patients over age 60. Similarly, others have found that bariatric patients over 55 years of age had weight loss and health gains comparable to the general bariatric population (Lynch & Belgaumkar, 2012; Fatima et al., 2006).

The overall low frequency of side effects or symptomatology for all age groups after bariatric surgery is a positive finding in this quantitative study. For adults over 60 years to show that they had fewer overall side effects is encouraging to many who feared the possibilities of dealing with negative consequences of bariatric surgery procedures. O'Keefe, Kemmerer and Kemmeter (2010) also found significant weight loss and low complication rates for patients 65 years old and older.

The researchers of this study strongly recommend that anyone considering bariatric surgery learn about the potential risks and side effects that can happen following surgery. They should also consider the consequences if they choose to do nothing. That being said, since there are such great disease improvements with apparent limited long term side effects, bariatric surgery should be considered when all other traditional methods have been exhausted.

Of significant concern is that at all four of the weight milestones, the young and midlife adults were more overweight than the older and oldest adults. This research is a compelling wake-up call that early intervention and ongoing remedies are necessary to avoid the onset of many chronic diseases. One limitation is the sample was from only one Midwestern weight management center in the United States so there is limited diversity within the population sample so generalizability could be affected. Another limitation is that the participant responses were self-reported and while the response rate was good, it is unclear if their outcomes are accurately reported and may not represent the entire sample. Perhaps participants who did not have as good of outcomes failed to return the survey which could have led to selection error. Not everyone answered the disease questions which may limit the results, perhaps because the question was unclear or the participants did not have the condition before surgery, so no improvement was needed. It should be noted however that almost everyone answered the symptoms/side effects question.

In conclusion, 'What's Age Got to Do with It?" the answer seems to be that age does not negatively affect weight loss/BMI changes, weight regain, existing disease improvement or symptomology. These results indicate that age should not be a consideration when deciding to have bariatric surgery. Outcomes for weight loss, reduction of co-morbidities and negative side effects for older and oldest adults compared to young or midlife adults are similar or better. There are many positive outcomes in this study which indicates adults of all ages benefit from the weight loss that accompanies bariatric surgery. Bariatric surgery should be considered for older adults for disease management as much as it is for younger adults, along with other health criteria. A patient must be healthy enough to sustain such a surgical procedure and have exhausted all other non-surgical measures such as diet modification and exercise programs first.

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CHAPTER VI. WITHOUT A DOUBT I WOULD DO IT AGAIN: A STUDY OF QUALITY OF LIFE IN BARIATRIC SURGERY ADULTS

Abstract

The prevalence of obesity is one of the fastest growing diseases in the older adult population. The quality of life may be compromised for obese older adults who live longer. Obese older adults may be facing years of discomfort, lack of mobility, and chronic ill health. This study compares bariatric surgery outcomes across four adult age groups, specifically comparing changes in quality of life including energy level, mobility, sleep and overall health. Using a survey research design, data was obtained from a 40-item questionnaire that was mailed to 2520 patients of a Midwestern weight management center who were at least 18 months post-procedure. The 534 respondents were divided into four age groups in years: 18-49 (n=171), 50-59 (n=148), 60-69 (n=138) and ≥ 70 (n=77). All age groups lost weight after bariatric surgery, and all groups experienced some weight regain. Over 79% of all the age groups reported being satisfied with weight loss since surgery. There were significant improvements in quality of life among all age groups and asked if they would have the surgery again, if they had to do it over, most (86.7%) said, "Without a doubt I would do it again!" This study indicates adults of all ages benefit from the weight loss after bariatric surgery. Besides the decrease in BMI across all age groups, there is a significant improvement in quality of life.

Keywords: Older adults, bariatric surgery, age groups, quality of life, BMI.

Introduction

The prevalence of obesity is one of the fastest growing diseases in older adults (Salihu, Bonnema, & Alio, 2009). Between 2011 and 2012, the National Center for Health Statistics (2014) has estimated, more than one-third of adults (34.9%) were obese and another one-third of

the US population is overweight (Mattar, 2008; Ogden, Carroll, Kit, & Flegal, 2014). Young adults with morbid obesity (100 pounds over normal weight) may lose 20 years of life expectancy if they do not lose weight (Fontaine, Redden, & Wang 2003). On the other hand, if an obese older adult lives longer, their quality of life may be compromised (Han, Tajar, & Lean, 2011). Obese older adults may be facing years of discomfort, lack of mobility, and chronic ill health (Mathus-Vliegen, 2012; Mathus-Vliegen et al., 2012). The increased prevalence of obesity is a public health threat which can be associated with related chronic diseases such as type II diabetes, hypertension, heart disease, certain types of cancers, metabolic syndrome, respiratory disease, sleep apnea, fatty liver disease, osteoarthritis, gall bladder disease, pulmonary embolism, gastro-esophageal reflux disease, urinary incontinence, chronic renal failure, gout, and depression (Zamosky, 2013). These chronic diseases all contribute to a poorer quality of life.

Quality of life concerns due to obesity go beyond the medical and disease challenges. Many adults face physical, psychological, social, and economic chronic co-morbidities, and disabilities which decrease their quality of life (Wang, 2007). Health-related quality of life (HRQL) refers to the impact that health conditions have on an individual's general life functioning and well-being. HRQL reflects the way that patients perceive and react to their health status, and the effect their health has on other aspects of their lives such as work, leisure time activities, and social relationships (Kolotkin, Meter, & Williams 2001). HRQL is a particularly relevant construct in obesity and weight-loss research, because obesity has shown to exert significant negative consequences on HRQL, which seem to resolve with adequate weight loss (Karlsson, Taft, Ryden, Sjostrom, & Sullivan, 2007). Obesity creates many problems, not only for the obese person, but also for family members and society as a whole. For individuals, obesity increases psychological problems, reduces sleep quality, and reduces quality of life

(Algul et al., 2009; Hopman et al., 2007; Wee et al., 2008). Obesity is also associated with increased mortality and reduced life expectancy as a result of increased medical risks (de Beer et al., 2007; Maggard et al., 2005; Padwal, 2005; Sach et al., 2007). Many obese people may struggle with physical immobility as a result of their weight; these limitations may lead to increased psychological problems or reduced quality of life. These effects of obesity led researchers and healthcare professionals to search for effective weight loss treatments. Many diets and behavioral treatments resulted in initial weight loss, only to be followed by weight regain (Huberman, 2008). Healthcare providers turned to surgical treatments for obesity (Karmali et al., 2010).

Quality of Life after Bariatric Surgery

Regardless of age, improved mobility, reduced co-morbidities, reduced pain, and improved functioning led to improved quality of life enrichment in bariatric patients (Folope et al., 2008; van Hout & van Heck, 2009). Burgio, Richter, Clements, Redden, & Goode (2007) found a decrease in urinary and fecal incontinence symptoms following bariatric surgery. Ten years after weight loss surgery, patients reported significantly better health perceptions and social interactions (Karlsson et al., 2007). Fewer medications and improved mobility alone led many participants to experience improved quality of life. Regardless of whether all weight-loss goals were met, many would opt to have the surgery again (Dunkle-Blatter et al., 2007; Folope et al., 2008; Karlsson et al., 2007; van Hout & van Heck, 2009).

Older patients who were wheelchair-bound were often fully ambulatory within months post-surgery (Sugerman et al., 2004). Even modest weight-loss improved overall physical functioning of older adults (Sugerman et al., 2004). For example, patients with lower extremity arthritis experienced reduced knee and hip pain (McTigue, Hess, & Ziouras, 2006; van Hout &

van Heck, 2009). Back pain symptoms decreased following bariatric surgery (Khoueir et al., 2008). Patients reported the greatest improvement in cervical and lumbar spine, foot, and fibromyalgia syndrome pain. Lower and upper extremity pain was also significantly improved (Hooper, Stellato, Hallowell, Seitz, & Moskowitz, 2007). Significant improvements in musculoskeletal concerns were reported following weight loss after bariatric surgery (Hooper et al., 2007).

In general, a person's quality of life comes from a sense of well–being (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009). In the healthcare field, quality of life is often negatively affected, by having a debilitating weakness due to disease (Wang, 2007). Dymek, leGrange, Neven, and Alverdy (2002) measured health related quality of life after gastric bypass surgery and found positive changes in only six months after surgery. Being obese can affect every aspect of a person's quality of life, from embarrassing situations of not fitting in standard size airplane seats to being passed over for job promotions to dealing with chronic diseases that frequently come with obesity.

Purpose of Research

Literature is scarce on the long term success of older adults and bariatric surgery. Moreover, there is a dearth of published research that examines the outcomes of older bariatric patients and their satisfaction with the surgery. Generally speaking, patients who have had bariatric surgery report improvements such as reductions in medication, better blood pressure, and other co-morbidities and mobility. Nevertheless, no studies have addressed the differences in HRQL among age groups. Therefore the purpose of this study is to assess differences in HRQL concerns including energy level, mobility, sleep, and overall health.

Methods

The research design for this study was a survey method, using a cross-sectional, self-reported questionnaire. This study was approved by the university's Institutional Review Board (IRB). After an exhaustive search, the researchers found no existing bariatric questionnaire that met their needs. The researchers therefore, developed a bariatric questionnaire addressing the needs of participants and their possible HRQL concerns for those who were at least 18 months post-bariatric procedure. The questionnaire included demographic information such as age, height, four milestone weights, date, and type of surgery. The 4 milestone weights were highest weight before surgery, weight on surgery day, lowest weight after surgery, and current weight. The questions were designed using a 5-point Likert scale, which focused on satisfaction with surgery and quality of life outcomes. The questionnaire was reviewed by education and health professionals for content and readability. The instrument was revised and pilot tested with a sample of 12 bariatric patients to test clarity with no further changes made.

Bariatric patients were recruited from a Midwestern weight management center in the US which specializes in bariatric surgery. Inclusion criteria included patients who were 18 years of age and older and were at least 18 months post-procedure. The weight management center personnel mailed the paper questionnaires which were returned anonymously to the researchers. The questionnaires were then coded and entered into Qualtrics (Survey software, Provo, UT, version 60,114). Approximately 12 weeks after the questionnaires were mailed, the data collection stopped.

The data was analyzed using SAS (Statistical Analysis Software, Cary, NC, version 10.3). Analyses included frequency, ANOVA, and probability values. BMI was calculated using the 4 milestone weights and height.

Results

A total of 2520 surveys were mailed, and 178 were returned as undeliverable. Overall, 534 surveys were completed and returned which was a 22.8% response rate. The respondents were divided into four age groups in years: 18-49 (n=171), 50-59 (n=148), 60-69 (n=138) and ≥ 70 (n=77). The majority were female (n=442; 82.8%), and the majority of all participants were married (n=350; 65.7%). Employment status varied with part-time work (n=254; 47.7%), and full-time work (n=66; 12.4%), with a large number of retired participants (n=160; 30.1%). The majority had some college (n=252; 47.3%) or a college degree (n=142; 26.4%), and the majority of all participants underwent gastric bypass surgery (n=511; 96.2%) rather than the gastric sleeve or gastric band or another alternative. See Table 6.1 for more details on demographics.

Body mass index (BMI)

All age groups lost weight after bariatric surgery and all groups experienced some weight regain. The older and oldest age categories were as successful at losing weight and keeping off as the young and midlife age groups. The young adults had a significantly larger highest BMI with a mean > 50 kg/m^2 compared to a mean BMI of 46.3 kg/m^2 for the oldest group (p=0.03). Although not significant, each mean milestone BMI was larger for the young group and progressed in chronological order with the oldest age group having the lowest milestone BMIs in all four areas. Table 6.2 details mean BMI milestones overall and age groups.

Table 6.1. *Demographic Characteristics Overall and by Age Group*

Characteristic	Overall N=534 Number (%)	Young n=171 Number (%)	Midlife n=148 Number (%)	Older n=138 Number (%)	Oldest n=77 Number (%)
Gender					
Woman	442 (82.8)	153 (89.4)	123 (83.1)	103 (74.6)	63 (81.8)
Man	92 (17.2)	18 (10.5)	25 (16.9)	35 (25.4)	14 (18.2)
Education					
< High School	8* (1.5)	0	2 (1.4)	3 (2.2)	3 (3.9)
High School/GED	131 (24.6)	30 (17.5)	32 (21.8)	38 (27.5)	31 (40.3)
Some College	252 (47.3)	91 (53.2)	64 (43.5)	63 (45.7)	34 (44.2)
College Degree	142 (26.4)	50 (29.2)	49 (33.3)	34 (24.6)	9 (11.7)
Marital Status					
Single / Never Married	48 (9.0)	30 (17.5)	13 (8.8)	4 (2.9)	1 (1.3)
Married	350 (65.7)	100 (58.5)	105 (71.0)	92 (67.2)	53 (68.8)
Domestic Partnership	5 (0.9)	2 (1.2)	1 (0.7)	1 (0.7)	1 (1.3)
Separated	6 (1.1)	5 (2.9)	0	0	1 (1.3)
Divorced	86 (16.1)	32 (18.7)	27 (18.2)	24 (17.5)	3 (3.9)
Widowed	38 (7.1)	2 (1.2)	2 (1.4)	16 (11.7)	18 (23.4)
Employment Status					
Caregiver at Home	22 (4.1)	13 (7.7)	7 (4.8)	1 (0.7)	1 (1.3)
Work Part-Time	254 (47.7)	119 (70.0)	94 (63.5)	40 (29.0)	1 (1.3)
Work Full-Time	66 (12.4)	22 (12.9)	17 (11.5)	22 (15.9)	5 (6.6)
Retired	160 (30.1)	1 (0.6)	19 (12.8)	72 (52.2)	68 (89.5)
Other	30 (5.6)	15 (8.8)	11 (7.4)	3 (2.2)	1 (1.3)
Surgery Type					
Gastric By-Pass	511 (96.2)	162 (94.7)	143 (98.0	132 (96.4)	74 (96.1)
Gastric Sleeve	4 (0.8)	3 (1.8)	0	1 (0.7)	0
Gastric Band	15 (2.8)	6 (3.5)	2 (1.4)	4 (2.92)	3 (3.9)
Biliopancreatric Diversion	1 (<0.01)	0	1 (0.7)	0	0

*Some characteristics may not add to total sample size due to non-response by some participants.

Table 6.2. *Mean BMI Milestones Overall and by Age*

BMI Milestone	Overall N=534 Mean ± SD*	Young n=171 Mean ± SD	Midlife n=148 Mean ± SD	Older n=138 Mean ± SD	Oldest n=77 Mean ± SD	p value
Highest	48.4 ± 8.2	50.5 ± 8.7	49.1 ± 8.5	47.8 ± 7.5	46.3 ± 8.0	0.03
Surgery Day	46.9 ± 7.7	48.7 ± 7.4	47.5 ± 8.3	46.3 ± 7.0	44.9 ± 8.0	0.28
Lowest	26.5 ± 5.1	26.9 ± 5.4	26.8 ± 5.5	26.6 ± 5.1	25.8 ± 4.2	0.93
Current	30.2 ± 6.1	31.2 ± 6.2	30.7 ± 6.1	30.2 ± 6.1	28.8 ± 5.8	0.51

* Standard Deviation

Bariatric surgery satisfaction

Participant perceptions regarding their current level of satisfaction with bariatric surgery are found on Table 6.3. Overall 79% of participants reported being satisfied with weight loss since surgery, with no significant differences between age groups. But when it comes to the question, "If you had to do it over again, would you still have bariatric surgery?" over 75% of all participants said they would likely/very likely have the surgery again. The oldest group were very much in support of the surgery (92.2%) with the older group being a close second (90.4%), and the midlife group (89.2%) strongly agreeing as well with the young group (78.9%) being 10.3% lower than the midlife group.

Table 6.3. *Satisfaction with Bariatric Surgery*

	Overall Percent	Young Percent	Midlife Percent	Older Percent	Oldest Percent	p value*
Satisfied with weight loss since surgery?	N = 516	n = 167	n = 144	n = 132	n = 73	0.143
Very dissatisfied/dissatisfied	12.4	10.8	10.4	14.4	16.4	
Neutral	7.8	11.4	8.3	6.1	1.4	
Satisfied/very satisfied	79.8	77.8	81.3	79.5	82.2	
Do you feel healthier?	N = 531	n = 173	n - 152	n = 146	n = 75	0.015
Never/rarely	5.5	8.7	7.2	8.2	8.0	
Sometimes	18.1	24.9	13.2	15.1	14.7	
Often /all the time	76.5	66.5	79.6	76.7	77.3	
Still have bariatric surgery?	N = 532	n = 171	n = 148	n = 136	n = 77	0.024
Very unlikely/unlikely	7.1	12.3	5.4	5.1	2.6	
Undecided	6.2	8.8	5.4	4.4	5.2	
Likely/very likely	86.7	78.9	89.2	90.4	92.2	

*The p values are chi-square values and are comparisons of age groups for all three responses.

Table 6.4. *Quality of Life after Bariatric Surgery*

	Overall Percent	Young Percent	Midlife Percent	Older Percent	Oldest Percent	p-value*
Energy level	N=529	n = 171	n = 147	n = 137	n = 74	0.21
Worse/much worse	6.4	9.4	6.8	4.4	2.7	
About the same	12.5	15.8	10.9	10.9	10.8	
Better/much better	81.1	74.9	82.3	84.7	86.5	
Mobility	N = 526	n = 170	n = 146	n = 136	n = 74	0.81
Worse/much worse	2.1	2.9	1.4	1.5	2.7	
About the same	8.0	10.0	6.8	6.6	8.1	
Better/much better	89.9	87.1	91.8	91.9	89.2	
Sleep	N = 532	n = 171	n = 148	n = 136	n = 77	0.89
Worse/much worse	10.2	11.1	8.1	11.0	10.4	
About the same	44.9	47.4	45.9	41.2	44.2	
Better/much better	44.9	41.5	45.9	47.8	45.5	
Overall Health	N = 430	n = 171	n = 147	n = 137	n = 75	0.45
Worse/much worse	5.3	7.0	4.1	2.2	2.7	
About the same	9.5	8.8	7.5	6.6	8.0	
Better/much better	85.1	84.2	88.4	91.2	89.3	

*The p values are chi-square values and are comparisons of age groups for all three responses.

Discussion

All age groups lost weight after bariatric surgery and all groups experienced some weight regain as indicated by increased current BMI. The older and oldest age groups were as successful at losing weight and keeping off as the young and midlife age groups. There were significant improvements in perceived quality of life among all age groups. While all the age groups improved greatly, the young age group (ages 18-49) perceptions seemed less positive than the other three age groups which were all 50 years old and older. It was interesting to note that the oldest age group, those ages 70 or greater were the most satisfied with the weight loss (82.2%). The midlife (ages 50-59) and older (ages 60-69) groups were very similar on most questions and were either closely ahead or behind the oldest age group. But the young group seemed to be to report lower levels of HRQL for each of the questions. There were significant improvements in quality of life among all age groups and asked if they would have the surgery again, if they had to do it over, most (86.7%) said, "Without a doubt I would do it again!"

Limitations

One limitation is the sample was limited from only one Midwestern weight management center in the United States so there will not be a large diversity of ethnicity within the group so generalizability could be affected; nevertheless, this limitation reduced possible statistical error within this population. Moreover, the questionnaire was self-reported and while the response rate was good, it is unclear if their outcomes necessarily represent the entire sample. Perhaps participants who did not have as good of outcomes as those reported here failed to return the survey which could have led to selection bias.

Conclusion

Bariatric patients of all age groups reported many positive outcomes in this study. Obese adults of all ages seemed to benefit from the weight loss that accompanies bariatric surgery. Besides the obvious decrease in BMI across all age groups, there were significant improvements in quality of life. Improved energy level, mobility, and sleep all add up to improvements in overall health. There does not appear to be any worse outcomes for weight loss or quality of life for older and oldest adults compared to midlife and young age groups. Bariatric surgery should be considered for older adults for disease management and for improvement in of quality of life as much as it is for younger adults.

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CHAPTER VII. SUMMARY AND CONCLUSIONS

Summary

All age groups lost weight after bariatric surgery. All groups experienced some weight regain as indicated by current BMI being higher than lowest BMI. This agrees with previous research Clough, Layani, Shah, Wheatley, & Taylor (2011) who found excess BMI loss was 44.1% after 5 years for patients age 60 and over with limited major complications . The older and oldest age groups were as successful at losing weight and keeping off as the young and midlife age groups.

There were significant improvements in chronic diseases across all age groups. The older and oldest age groups had comparable or better outcomes as did the young and midlife age groups on most chronic diseases like arthritis, hypertension, sleep apnea, and fatty liver disease. This coincides with Adams et al. (2012) who found high rates of diabetes remission and lower risks of cardiovascular problems continued six years after gastric bypass in patients over age 60. Similarly, others have found that bariatric patients over 55 years of age had weight loss and health gains comparable to the general bariatric population (Lynch & Belgaumkar, 2012; Fatima et al., 2006).

The overall low frequency of side effects or symptomatology for all age groups after bariatric surgery is a positive finding in this quantitative study. For adults over 60 years to show that they had fewer overall side effects is encouraging to many who feared the possibilities of dealing with negative consequences of bariatric surgery procedures. O'Keefe, Kemmeter and Kemmeter (2010) also found significant weight loss and low complication rates for patients 65 years old and older.

There were also significant improvements in perceived quality of life as previously reported by Buchwald (2004) and Karlsson et al (2007). While all the age groups improved greatly, the young age group (ages 18-49) perceptions seemed less positive than the other three age groups which were all ≥50 years old. It was interesting to note that the oldest age group, those ages ≥70 were the most satisfied with the weight loss (82.2%). The midlife (ages 50-59) and older (ages 60-69) groups were very similar on most questions and were either closely ahead or behind the oldest age group. But the young adult age group seemed to be to report lower levels of HRQL in each of the questions. There were significant improvements in quality of life among all age groups and asked if they would have the surgery again, if they had to do it over, most (86.7%) said, "Without a doubt I would do it again!"

In conclusion, to the question of the relevance of advanced age and bariatric surgery, the answer seems to be that age does not negatively affect weight loss/BMI changes, weight regain, existing disease improvement or symptomology. These results indicate that age should not be a consideration when deciding to have bariatric surgery. Outcomes for weight loss, reduction of co-morbidities and negative side effects for older and oldest adults compared to young or midlife adults are similar or better. There are many positive outcomes in this study which indicates adults of all ages benefit from the weight loss that accompanies bariatric surgery. Bariatric surgery should be considered for older adults for disease management as much as it is for younger adults, along with other health considerations. There is always a risk to any surgery and a patient must meet pre-surgery criteria of being able to sustain such a surgerical procedure.

The researchers of this study strongly recommend that anyone considering bariatric surgery learn about the potential risks and side effects that can happen following surgery. They should also consider the consequences if they choose to do nothing. That being said, since there

are such great disease improvements with apparent limited long term side effects, bariatric surgery should be considered when all other traditional methods have been exhausted.

However, we would be remiss if we failed to mention a significant concern which is that at all four of the weight milestones, the young and midlife adults were more overweight than the older and oldest adults. This research is a compelling wake-up call that early intervention and ongoing remedies are necessary to avoid the onset of many chronic diseases.

Limitations

One limitation is the sample was from only one Midwestern weight management center in the United States is limited diversity within the population sample which could reduce generalizability could be affected. Another limitation is that participant responses were self-reported and while the response rate was good, it is unclear if their outcomes may or may not represent the entire sample. Perhaps participants that did not have as good of outcomes failed to return the survey which could lead to selection bias. To explore selection bias more thoroughly, participants who did not answer the survey could have been simply too busy or moved on from this health concern. So not returning the survey does not necessarily mean they were unhappy or dissatisfied on one hand, but on the other maybe it does. Not everyone answered the disease questions which may limit the results, perhaps because the question was unclear or the participants did not have the condition before surgery, so no improvement was needed. It should be noted however that almost everyone answered the symptoms/side effects question.

Conclusion

Bariatric patients of all age groups reported many positive outcomes in this study. Obese adults of all ages seemed to benefit from the weight loss that accompanies bariatric surgery. Besides the obvious decrease in BMI across all age groups, there were significant improvements

in quality of life. Improved energy level, mobility, and sleep all add up to improvements in overall health. There does not appear to be any worse outcomes for weight loss or quality of life for older and oldest adults compared to midlife and young age groups. Bariatric surgery should be considered for older adults for disease management and for improvement in of quality of life as much as it is for younger adults. Further, there does seem to be a difference between the age groups with the young age adults being somewhat less satisfied with their weight loss, and their overall quality of life issues as compared to older adults. Perhaps more research could be done to determine why there is a difference. One could hypothesize that the older and oldest adult population are more easily pleased by the changes because they have more life experience and have a better grasp on reasonable expectations. Whereas the younger adults' expectations may have been too high, they may have thought all aspects of their life would improve by leaps and bounds.

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APPENDIX A. IRB APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

April 2, 2014 FederalWide Assurance FWA00002439

Dr. Ardith Brunt
HNES

Re: IRB Certification of Exempt Human Subjects Research:
Protocol **#HE14235 , "Older adults fighting obesity with bariatric surgery: Benefits, side effects and outcomes"**

Co-investigator(s) and research team: **Cindy Marihart, Angela Geraci, Brent Hill, Mark Strand, Chris Ray**

Certification Date: 4/2/14 Expiration Date: 4/1/17
Study site(s): **varied**
Funding: **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 original protocol submission with revised consent (received 4/2/14).

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.
- Conduct the study as described in the approved protocol. If you wish to make changes, obtain approval from the IRB 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

Kristy Shirley, CIP, Research Compliance Administrator

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

APPENDIX B. LETTER OF SUPPORT FROM THE CENTER FOR WEIGHT MANAGEMENT

CATHOLIC HEALTH INITIATIVES

The Center for Weight Management

A Service of St. Joseph's Area Health Services

600 Pleasant Ave. Park Rapids, MN 56470

Phone: (218) 732-3311 Fax: (218) 732-1368

www.sjahs.org

Leah Walters, RD, LD, CDE

leahwalters@catholichealth.net

(218) 616-3375

4/14/14

Dr. Ardith Brunt, PhD., RD, Associate Professor

North Dakota State University

Health, Nutrition and Exercise Science

College of Human Development

351 EML, P.O. 6050

Fargo, ND 58108-6050

Dear Dr. Brunt,

The purpose of this letter is to show our support in working with Cindy Marihart and Angela Geraci on their dissertation research through North Dakota State University on, "Older adults fighting obesity with bariatric surgery: Benefits, side effects and outcomes." We have agreed to send out surveys to approximately 3,600 patients who have had bariatric surgery and are at least 18 months post-operative. The survey will be studying differences between our patients based on their age, specifically focused on weight loss, diet/exercise/vitamin adherence. Quality of life issues on comorbidities after surgery will also be compared by age groups. Additionally, personal relationships and bariatric support groups will be compared based on age.

We have chosen to partner with these students in the interest of furthering research on these very important questions. We have been part of the planning process and will continue to participate in survey question selection. We have agreed to honor the North Dakota State University Institutional Review Board (NDSU IRB) approval for the survey and the study. Our volunteers will place mailing labels on all correspondence to protect all HIPPA and data privacy of our patients and the results of the survey will be anonymous.

In an effort to assist with this worthwhile study, we will contribute financially by assisting with the cost of postage by off-setting staff costs with labeling and handling this mailed-out survey.

Sincerely,

Leah Walters

APPENDIX C. MATERIALS SENT TO POTENTIAL PARTICPANTS

NDSU NORTH DAKOTA STATE UNIVERSITY

Dear Survey Participant,

You are invited to participate in a study on the experiences of patients who have had bariatric surgery at least 18 months previously. We are two doctoral students, in the College of Human Development and Education at North Dakota State University who have both had bariatric surgery and teamed up together to research bariatric surgery. We are working in cooperation with the Center for Weight Management in Park Rapids. We would like to learn more about your weight loss surgery and your post-surgical outcomes. The purpose of our research project is to gain more insight into the individual and personal experiences that only people who have had weight loss surgery undergo.

The criteria for participating in the study is that you must have had weight loss surgery at least 18 months ago and are over the age of 18. Your participation is entirely voluntary, and you may change your mind or quit participating at any time, with no penalty. However, your assistance would be greatly appreciated in making this a meaningful study. The responses to this survey study are completely anonymous so, you are free to answer candidly and openly. For this reason, we will not be asking you to sign a separate consent form to participate in this study, and your completion of the survey implies your consent. You may not receive direct benefit for participation in this study, but will be able to contribute your thoughts and opinions about your bariatric surgery experience so that society may also benefit from your knowledge. We have taken reasonable safeguards to minimize any known risks. These known risks include: you may feel slightly uncomfortable answering some questions.

When writing the study results, your information will be combined with information from other participants taking part in the study and you will not be identified in these written materials. We intend to publish the results of the study. For questions about the rights of human participants in research, or to report a complaint about the research, please contact the NDSU Human Research Protection Program, at ndsu.irb@ndsu.edu or call (701) 231.8908. You may also contact our advisor, Ardith Brunt, PhD at (701) 231.7475 or Ardith.Brunt@ndsu.edu.

We greatly appreciate your participation in this study and we thank you for your time and effort. We also thank the Center for Weight Management in Park Rapids for making this study possible. If you wish to receive a copy of the research results, please email either Cindy or Angela at cindy.marihart@my.ndsu.edu or angela.geraci@my.ndsu.edu.
If you would prefer to take the survey online, you may complete it at:
http://tinyurl.com/bariatric-survey

Best regards,
Cindy Marihart and Angela Geraci

DEPARTMENT OF HEALTH, NUTRITION, AND EXERCISE SCIENCES
NDSU Dept 2620 | PO Box 6050 | Fargo ND 58108-6050 | 701.231.7487 | Fax 701.231.6347 | www.ndsu.edu

Post-Bariatric Survey

Background Information

Please write in or circle your answer:

1) What is your age? _____

2) What is your gender?

_____Woman

_____Man

_____Decline to answer

3) What is your highest level of education completed?

_____Less than high school

_____High school diploma / GED

_____Some college or degree (AA, AS)

_____College degree (BA, BS) or above

4) What is your marital status?

_____Single, never married

_____Married

_____Domestic partnership

_____Separated

_____Divorced

_____Widowed

5) What is your employment status?

- ❍ Caregiver at home
- ❍ Work Part-time
- ❍ Work Full-time
- ❍ Retired
- ❍ Other

6) When was your bariatric surgery? (month/year) _____/_____

7) What type of surgery did you have? (most recent surgery)

- ❍ Gastric Bypass
- ❍ Gastric Sleeve
- ❍ Laparoscopic Gastric Band
- ❍ Biliopancreatic diversion with duodenal switch
- ❍ Other (please specify): _____

8) What is your height (in feet/inches)?

_____

9) What is your current weight? _____

10) What was your weight at the time of your surgery? _____

11) What was your highest weight before surgery? _____

12) What was your lowest weight achieved after surgery? _____

Mark an ‘X’ in the box indicating your answer for the following chronic conditions

1. Have you seen changes in any of the following since surgery?

:	Much Worse	Worse	About the Same	Better	Much Better	Not Applicable
Arthritis / joint pain						
Asthma / respiratory disease						
Chronic renal failure						
Depression						
Diabetes, type II						
Fatty liver disease						
Gall bladder disease						
Heart disease						
High blood pressure / hypertension (even if treated)						
Sleep apnea						
Other:						

2) Are you satisfied with your weight loss since your surgery?

- ❍ Very Dissatisfied
- ❍ Dissatisfied
- ❍ Neutral
- ❍ Satisfied
- ❍ Very Satisfied

3) How did your overall health change after surgery?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

4) How has your ability to move around changed after surgery?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

5) How is your energy level since surgery?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

6) How has your sleep changed since surgery?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

7) Over the past week, how many minutes of moderate to vigorous activity (exercise) have you participated?

- ❍ 0
- ❍ Less than 30
- ❍ 31 - 60
- ❍ 61 - 90
- ❍ 91 - 120
- ❍ More than 120

8) How happy are you with your bariatric surgery?

- ❍ Very Unhappy
- ❍ Unhappy
- ❍ Neither Happy nor Unhappy
- ❍ Happy
- ❍ Very Happy

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

- ❍ Very Unlikely
- ❍ Unlikely
- ❍ Undecided
- ❍ Likely
- ❍ Very Likely

10) Over the past month, how often do you follow your bariatric eating plan?

Never

- ❍ Rarely
- ❍ Sometimes
- ❍ Often
- ❍ Almost Always

11) Over the past month, how many 8-ounce cups of liquid did you drink daily?

- ❍ 0 - 2 cups
- ❍ 3 - 4 cups
- ❍ 5 - 6 cups
- ❍ 7 - 8 cups
- ❍ more than 8 cups

12) Over the past month, how often do you take the recommended vitamin and mineral supplements after surgery?

- ❍ Never
- ❍ Rarely
- ❍ Sometimes
- ❍ Quite Often
- ❍ Very Often

13) Over the past month, how many grams of protein did you eat daily?

- ❍ Less than 50
- ❍ 50 - 60
- ❍ 61 - 80
- ❍ 81 - 100
- ❍ More than 100

14) Over the past month, how often do you eat the foods listed below?

Mark an ‘X’ in the box indicating your answer for the following foods:

	Never	Less than Once a Month	2-3 Times a Month	Once a Week	2-3 Times a Week	Daily
Fruits						
Vegetables						
Milk and dairy foods						
Breads, pasta, rice						
Meat						
Fish						

15) Since your surgery, have you had any of the following symptoms?

Mark an ‘X’ in the box indicating your answer for the following symptoms:

	Never	Rarely	Sometimes	Most of the Time	Always
Nausea (In last year)					
Indigestion					
Heartburn					
Vomiting					
Constipation					
Diarrhea					
Gas/belching/ flatulence					
Bladder problems / urinary incontinence					
Gallstones (or gallbladder removed)					
Hair loss					
Other:					

16) How would you rate the support you have received from your personal relationships since your surgery? Mark an ‘X’ in the box indicating your answer for the following relationships:

	Much Weaker	Somewhat Weaker	No Change	Somewhat Stronger	Much Stronger	Not Applicable
Spouse/ Significant other						
Parents						
Siblings						
Children						
Other Family						
Grandparents						
Friends						
Co-workers						
Employer						

17) How has your self-esteem changed since you've lost weight?

- ❍ Much Lower
- ❍ Slightly Lower
- ❍ About the Same
- ❍ Higher
- ❍ Much Higher

18) In regards to the way you look and feel since your surgery, how happy are you?

- ❍ Very Unhappy
- ❍ Unhappy
- ❍ Neither Happy nor Unhappy
- ❍ Happy
- ❍ Very Happy

19) How would you rate your overall sense of well-being in the last month?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

20) How would you rate your satisfaction with leisure time activities since you have lost weight?

- ❍ Very Dissatisfied
- ❍ Dissatisfied
- ❍ Neutral
- ❍ Satisfied
- ❍ Very Satisfied

21) Since your surgery, do you feel healthier?

- ❍ Never
- ❍ Rarely
- ❍ Sometimes
- ❍ Often
- ❍ All of the Time

22) Since your surgery, do you feel you have a better outlook on life in general?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

23) Since your surgery, do you feel better

about your future as you age?

- ❍ Much Worse
- ❍ Worse
- ❍ About the Same
- ❍ Better
- ❍ Much Better

24) Since your surgery, how would you rate

your confidence in yourself?

- ❍ Much Worse
- ❍ Worse
- ❍ Somewhat Worse
- ❍ About the Same
- ❍ Somewhat Better

25) How often do you go to face-to-face

bariatric support groups?

- ❍ Weekly
- ❍ Once a Month
- ❍ Every Few Months
- ❍ Couple times per year
- ❍ Never

26) How often do you participate in an

online bariatric support group?

- ❍ Daily
- ❍ Weekly
- ❍ Once a Month
- ❍ Every Few Months
- ❍ Never

27) Is there anything else you would like to share about your bariatric surgery experience?

_____

_____

_____

_____

28) Would you like a bariatric professional to contact you about any concerns? If so, please list your name and phone number below and tell us the best time to contact you.

_____

_____

_____

_____

APPENDIX D. SOCIAL COGNITIVE THEORY CONSTRUCTS OF THE SURVEY

Construct	Definition	Application to Survey Question
Environment	Factors physically external to a person	Questions: 26, 27, 30, 31
Expectations	Anticipated outcomes of a behavior	Questions: 1, 4, 5, 7, 8, 9, 10, 19, 20, 21
Expectancies	Values placed on a given outcome	Questions: 2, 3, 6, 15, 22, 23, 24, 25
Self-Control	Self-regulation of a behavior	Questions: 12, 14, 16, 17, 18, 28
Emotional Coping Responses	Strategies used to manage emotional stimuli	Questions: 36, 37
Reinforcement	Responses to behavior that will increase or decrease likelihood of behavior's occurrence	Questions: 32, 33, 34, 35
Self-Efficacy	Confidence in the ability to perform the behavior	Questions: 11, 13, 29

Note. Adapted from Glanz, K., Rimer, B. K., & Lewis, F. M. (2008). *Health behavior and health education: Theory, research, and practice*. San Francisco: Wiley & Sons.