UNDERSTANDING THE EXPERIENCE
OF OSTEOPOROSIS RISK IN
BARIATRIC SURGICAL PATIENTS

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By

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ABSTRACT

Despite what is known about risk factors, preventive treatment, and increased prevalence of fragility fractures in post-bariatric surgical patients, little is known about how patient views of osteoporosis inform their commitment to bone health. The purpose of this research was to examine the lived experience of osteoporosis risk in people who have had bariatric surgery. The specific aims were to understand: 1. What it means to live with the risk of osteoporosis after bariatric surgery 2. The perceptions of osteoporosis risks postoperatively. This study used interpretive phenomenology to explore osteoporosis from the perspective of bariatric surgery patients. Purposive and snowball sampling was used to recruit individuals at risk for osteoporosis and a history of bariatric surgery. Eligibility criteria required participants to be female, over the age of 18 and understand and speak English. The study consisted of in-depth semi-structured interviews with 14 participants. Using open-ended questions, the interviews were audio recorded and transcribed. Study aims were addressed using strategies outlined by Diekelmann, Allen, & Tanner (1989). Findings are described under the relational theme of Looking out for Self, and supported by three subthemes Understanding, Protecting, and Preventing. This research provided an understanding of the risk of osteoporosis from the constructed realities and experiences of those who had bariatric surgery. Osteoporosis risk after bariatric surgery was not well known by participants. Furthermore, participants did not understand that vitamin deficiency can lead to osteoporosis. Participants perceived little to no risk of osteoporosis. Patients need to be aware of the risks of bariatric surgery; without this understanding of awareness about osteoporosis and risk of fracture, uncertainty will remain as to how to enhance osteoporosis prevention efforts in this population.

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CHAPTER 1

BACKGROUND AND SIGNIFICANCE

The prevalence of obesity in the United States (U.S.) over the past 10 years has increased 35% (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). Obesity is defined as a body mass index over 30kg/m²; morbid obesity is defined as 100 pounds over ideal body weight, has a body mass index over 40 kg/m², and experiencing obesity related health conditions. This increase in obesity has contributed to a 761% increase in bariatric surgeries from 1998 to 2008 (Scibora, Ikramuddin, Buchwald, & Petit, 2012). More than 196,000 bariatric surgeries were performed in the U.S. in 2015 (American Society for Metabolic and Bariatric Surgery, 2018b). Bariatric surgery is the treatment of choice for obesity (Ozsoy & Demir, 2018); however, the surgery comes with consequences. Despite calcium and vitamin D supplementation, bariatric surgery is linked to ongoing bone loss (Mahdy, Atia, Farid, & Adulatif, 2008; Nakamura et al., 2014; Valderas et al., 2009; Yu, et al., 2015) and higher risk for fragility fractures (Nakamura et al., 2014). Over 2 million bone fragility fractures occur annually in the U.S., costing nearly 17 billion dollars (Burge et al., 2007). Nakamura and colleagues (2014) reported the incidence of new fractures 15 years after bariatric surgery rose to 58%, a 34% increase compared to the 24% expected incidence of new fractures in the general population. The high incidence of fragility fractures in individuals who have bariatric surgery is of concern. Often, fragility fractures occur before a diagnosis of osteoporosis is established; therefore, prevention may play a significant role for pre-osteoporotic individuals, especially those who have had bariatric surgery (Griffin, 2013).

Bariatric procedures contributing to bone loss are not new concerns, with publications dating back to the 1980s (American Society for Metabolic and Bariatric Surgery, 2018b). Researchers who have conducted studies in those who have had bariatric surgery consistently

report ongoing, accelerated bone loss for years after surgery; yet, this is not listed under patient information as a potential adverse effect for bariatric surgery on several professional websites such as the American Society of Metabolic and Bariatric Surgery, and the National Institutes of Health (Pizzorno, 2016).

Despite what is known about risk factors, preventive treatment, increased prevalence of osteoporosis, and fragility fractures in post-bariatric surgeries, patients who have osteoporosis and bariatric surgery are not compliant with recommendations for bone health. This raises questions about the unique perceptions this population has about osteoporosis risk after bariatric surgery. A review of the literature uncovered scant research about this population living with these experiences or their awareness or understanding of the severity of the adverse outcomes on bone health and the increased incidence of fragility fractures. Research that aims to understand their experiences is crucial for the development of interventions and teaching strategies that address this unique problem.

Bariatric Surgery

There are three different approaches to bariatric surgery, malabsorption or limiting the amount of calories absorbed, (Gletsu-Miller & Wright, 2013), restriction or limiting the amount of food intake by reducing the size of the stomach, or a combination of both malabsorption and restriction (American Society for Metabolic and Bariatric Surgery, 2018a). Bariatric surgery was first performed in the 1960s (E. E. Mason & Ito, 1967), but did not become popular until 30 years later (Sturm & Hattori, 2012). By 2011, bariatric surgery had become so popular, the number of completed procedures rose to more than 340,000 worldwide (Buchwald, H. & Oien, D.M, 2013).

With the alarming rise in obesity and the use of laparoscopic procedures, bariatric surgery has become one of the most effective treatments for substantial weight loss (Martins et al., 2011).

Bariatric surgery is considered the treatment of choice over behavioral approaches, such as counseling or medical treatment because it provides significant and sustainable weight loss, improved comorbidities, and better short and long term outcomes (Franco, Ruiz, Palermo, & Gagner, 2011; Martins et al., 2011). Bariatric surgery contributes to reduced mortality (Adams et al., 2007; S.-H. Chang et al., 2014; Colquitt, Pickett, Loveman, & Frampton, 2014).

Bariatric surgery is considered a viable treatment option for individuals with a body mass index of ≥ 40 or $\geq 35 \text{ kg/m}^2$ and related morbidities such as diabetes, hypertension or sleep apnea (Franco et al., 2011). Diabetic patients who are overweight, but not necessarily obese, have chosen bariatric surgery as an effective means to control blood glucose levels (Bose et al., 2010; S.-H. Chang et al., 2014; Colquitt et al., 2014; National Guideline Clearinghouse (NGC), 2013). According to Libeton et al. (2004), men seek bariatric surgery out of concerns for future health and medical problems, while women seek bariatric surgery primarily to improve their appearance.

The benefits of bariatric surgery in treating obesity and comorbidities are indisputable; however, bariatric surgery and subsequent weight loss have a significant impact on decreased bone health resulting in osteoporosis and increased fracture risk (De Laet et al., 2005; Ensrud et al., 1997; Folli et al., 2012). Compared with a non-surgical group, patients who have had bariatric surgery have higher rates of bone loss in the first year after surgery, as well as persistent bone loss two years after surgery, even after the patients' weights stabilize (E. W. Yu et al., 2015).

Bone health is affected by vitamin deficiencies, malabsorption, decreased oral intake, and weight loss. A common misconception is that obese individuals have adequate nutrition and, therefore, a decreased risk for osteoporosis. To the contrary, individuals who undergo bariatric surgery are frequently malnourished despite consuming more calories (Kimmons, Blanck, Tohill, Zhang, & Khan, 2006). Furthermore, before bariatric surgery they are often deficient in vitamin D

(Damms-Machado et al., 2012; Toh, Zarshenas, & Jorgensen, 2009) and calcium (Chan & Mike, 2014; Isom et al., 2014). In fact, vitamin D deficiencies are seen in 80% of preoperative bariatric surgical patients, further contributing to low calcium levels (Isom et al., 2014). The overall US prevalence rate of vitamin D deficiency is 41.6%, putting bariatric surgical patients at a 38.4% increased risk. Obese individuals who have historically followed intermittent low calorie diets can have low bone mineral content (Nishizawa, Koyama, & Shoji, 1992); subsequent weight loss is an independent risk factor for osteoporosis (Hannan et al., 2010). Other pre-surgery contributors to deficiencies include decreased mobility, lack of sunlight, and lack of bioavailability of fat soluble vitamin D due to isolation in adipose tissue (Stein & Silverberg, 2014).

Dietary restrictions, which impact the quantity and quality of food intake, are associated with vitamin and mineral deficiencies after surgery (Moizé et al., 2013); including rates of vitamin D deficiencies of 39 to 73% (E. O. Aarts, Janssen, & Berends, 2011; Khandalavala, Hibma, & Fang, 2010). Vitamin D is essential for calcium homeostasis (Fleet & Schoch, 2010). Deficiencies can lead to muscular weakness, nonspecific musculoskeletal pain, progressive generalized bone pain, hypocalcemia with subsequent bone loss and fractures, occasionally tetany, pseudo fractures, osteopenia, osteoporosis, and osteomalacia (Liu et al., 2016; Plotnikoff & Quigley, 2003).

Managing complex nutritional deficiencies after bariatric surgery requires daily vitamin supplements; however, compliance rates for post-surgical patients vary (Valderas et al., 2010). Some individuals do not recognize the need for supplementation, some cannot afford the supplements, and others are misled or confused by a myriad of options (Moizé et al., 2013). Many individuals do not follow post-surgical recommendations to seek follow up care for their deficiencies, (Mechanick, Youdim, Jones, Garvey, Hurley, McMahon, Heinberg, Kushner, Adams, Shikora, Dixon, & Brethauer, 2013). Studies show a 33% to 64% noncompliance rate with oral

supplementation contributing to the development of postsurgical nutritional deficiencies (Brolin et al., 1998; Brolin, Gorman, Milgrim, & Kenler, 1991; Gentry, Halverson, & Heisler, 1984). Song & Fernstrom (2008) suggest strict regimens of diet, exercise, and vitamin intake are too demanding for a patient population already facing many comorbidities. Stress of surgery can only add to the difficulties of maintaining these regimens long term. For example, the cost of specialized bariatric vitamins could inhibit compliance for some (Ziegler, Sirveaux, Brunaud, Reibel, & Quilliot, 2009) while others may struggle with mood and personality disorders, eating disorders, depression, risk of suicide, poor body image and addictive behaviors (Ziegler et al., 2009). Emotional stress can contribute to lack of self-management with post bariatric surgery regimens. Vidal and colleagues (2014) found a 17.5% non-adherence rate to follow up visits after bariatric surgery with those less than age 45 showing greater non-adherence. Physician appointments post-surgery are crucial in the management of life long nutritional needs and osteoporosis prevention.

Osteoporosis

Osteoporosis is a condition that weakens the bones, causing them to be more vulnerable to fracture (National Osteoporosis Foundation, 2018). It is a silent, progressive, and irreversible (S. Yu & Huang, 2003) disease that can worsen over many years without detection leading to fragility fractures of the hip, spine, upper arm, and wrist with increased morbidity and mortality (Little & Eccles, 2010; S. Majumdar, 2011; Sujic, Gignac, Cockerill, & Beaton, 2011). Osteoporosis is diagnosed by a T-score, measured by dual energy x-ray absorptiometry (DXA), - 2.5 or lower at the lumbar spine, total hip, and/or femoral neck (World Health Organization, 1994). Osteoporosis can limit a person's mobility, which can lead to isolation and depression. Women are particularly susceptible to osteoporosis as the incidence of osteoporosis exceeds heart attack, stroke and breast cancer combined (National Osteoporosis Foundation, 2018). In the United States, 10.2 million

adults have osteoporosis (Wright et al., 2014), representing 3% of the US population. By 2030, the estimated number of adults with low bone mass is expected to grow to 57.8 million.

The most common form of osteoporosis is primary osteoporosis, osteoporosis that is not caused by some other specific disorder (Mirza & Canalis, 2015). Bone loss caused by specific diseases or medications is referred to as secondary osteoporosis. The more common risk factors associated with primary osteoporosis are age, race, excess tobacco and alcohol use, menopause, genetics, lack of calcium and vitamin D intake, decreased physical activity, and loss of estrogen (National Osteoporosis Foundation, 2013; Riggs, Khosla, & Melton, 2002). Nutrition certainly has an impact on bone health. With insufficient calcium intake, serum calcium begins to decline, causing parathyroid hormone levels to increase by removing calcium from the bone (Office of the Surgeon General (US), 2004). This cascade of events causes an increase in bone resorption.

Those with secondary osteoporosis experience a bone loss that is greater than the expected norm for someone with the same age, gender and race (Office of the Surgeon General (US), 2004). Many diseases, disorders and medications can contribute to the development of secondary osteoporosis. Persons with cystic fibrosis have calcium and vitamin D malabsorption issues along with reduced sex steroid production, delayed puberty and inflammatory cytokines (Mirza & Canalis, 2015). They may also have renal defects decreasing the ability of the kidney to conserve calcium.

Estrogen or testosterone deficiency during adolescence, due to anorexia nervosa, or chronic illness, leads to low peak bone mass (Kuzma & Payer, 2010). Low sex steroid levels also reduce bone density in individuals with an androgen insensitivity or acromegaly. Tumors on the pituitary or adrenal glands, as in Cushing's syndrome, can lead to rapidly progressive and severe

osteoporosis (Mirza & Canalis, 2015). Individuals with primary hyperparathyroidism often present with abnormally high calcium levels in the blood.

Diseases that reduce intestinal absorption of calcium and phosphorus can also lead to secondary osteoporosis. Celiac disease, Crohn's disease ulcerative colitis , and gastric bypass surgery all contribute to secondary osteoporosis (Mirza & Canalis, 2015). Unfortunately, glucocorticoids used to treat Crohn's disease and colitis may also contribute to bone loss. Primary biliary cirrhosis is associated with severe osteoporosis, as well as chronic active hepatitis, cirrhosis due to hepatitis C and alcoholic cirrhosis. Endocrine, nutritional and metabolic factors associated with the human immunodeficiency virus contribute to secondary osteoporosis as well (Office of the Surgeon General (US), 2004).

Autoimmune and allergic disorders, such as lupus and rheumatoid arthritis, lead to immobilization and damage to the bone due to inflammation (Mirza & Canalis, 2015). As with Crohn's and colitis, glucocorticoids used to treat these conditions contribute to further bone loss. Neurologic disorders affects mobility and balance which in turn effects bone and mineral metabolism. Stroke and spinal cord injuries have rapid bone loss in the affected areas (Carey & Raisz, 1985; Go, 2001). Disabling conditions such as cerebral palsy, poliomyelitis and multiple sclerosis can lead to bone loss (Office of the Surgeon General (US), 2004). Epilepsy has a negative effect on bone health leading to an increased risk of developing secondary osteoporosis. Furthermore, medications used to treat epilepsy interfere with vitamin D metabolism (Farhat et al., 2002; Sheth, 2002).

Other conditions associated with secondary osteoporosis include psychiatric disorders such as anorexia nervosa (Mirza & Canalis, 2015), depression, aseptic necrosis, chronic obstructive pulmonary disease including emphysema and chronic bronchitis (Office of the Surgeon

General (US), 2004). The precise cause of osteoporosis in these conditions is unclear but one common factor is immobilization or simply reduction in physical activity. Hematological disorders and malignancies are associated with osteoporosis as well (Mirza & Canalis, 2015).

Other modifiable risk factors include limited calcium intake, limited ambulation, limited physical activity; as well as excess caffeine consumption. Women with first degree relatives (parent, full sibling, or child) diagnosed with osteoporosis are also considered to be at high risk (S.-F. Chang, Hong, & Yang, 2007). In the obese person, bone homeostasis shifts towards resorption, decreasing bone quality (Shapses, Pop, & Wang, 2017). Specific risk factors for osteoporosis associated with bariatric surgery include degree of malabsorption of calcium, vitamin D, and micronutrients, time since surgery, compliance with supplements and health care follow up, and extent of and sustained weight loss (Cook, Khanna, Giordano, Matarese, & Hudson, 2017).

The United States Preventative Services Task Force (2011) and the National Osteoporosis Foundation (2018) recommend bone mineral screenings for women over age 65 years and in younger women with equal fracture risk as a white woman over the age of 65 years and with no additional risk factors. Bone mineral screening and therapy regimens have shown efficacy and effectiveness in reducing fracture risks. However, only 18% of postmenopausal women with one or more risk factors for osteoporosis receive a bone mineral density test (Gallagher, Geling, & Comite, 2002).

Osteoporosis causes fragility fractures; a fracture that results from a fall at standing height or less. Fragility fractures can cause pain and debilitation, leading to loss of independence, quality of life, subsequent nursing home admissions, and death (Adachi et al., 2010; Cosman et al., 2014; Kannegaard, van der Mark, Eiken, & Abrahamsen, 2010; S. Majumdar, 2011). Fifty four million Americans are at risk for fractures due to osteoporosis and low bone mass (National Osteoporosis

Foundation, 2018). In the U.S., one in two women and up to one in four men, over the age of 50, will sustain fragility fractures due to osteoporosis. Yearly, osteoporosis causes two million fractures and costs \$19 billion. Additionally, 22% of the elderly who break a hip will die within one year from complications of fractures or orthopedic surgeries. Most patients require long term stays in nursing homes for rehabilitation, further increasing financial burden.

As with any chronic disease, prevention is key. Self-management of osteoporosis includes adequate calcium and vitamin D intake, fall prevention and exercise (Holman & Lorig, 2004). Knowledge regarding these self-management practices has been well documented in the literature (Bombak & Hanson, 2016), however, there is a paucity of literature regarding those who had bariatric surgery and their perceptions and understandings of osteoporosis, including personal risk, perception of personal risk, and the seriousness of osteoporosis consequences (von Hurst & Wham, 2007)

Long term compliance for taking calcium and vitamin D varies according to a person's beliefs, attitudes, and understanding of multiple options (Yood et al., 2008). A variety of treatment options are available including bisphosphonates, raloxifene, teriparatide and hormone replacement therapy (Sanfelix-Genovés et al., 2009). Osteoporosis can never be cured, but treatment is essential to stop the progression of osteoporosis. Unfortunately, many studies have found adherence to medications is lacking and dependent on beliefs in the effectiveness of the osteoporosis medications (Badamgarav & Fitzpatrick, 2006.; Downey, Foltz, Boccuzzi, Omar, & Kahler, 2006; Silverman, 2006) and distrust of medications (Yood et al., 2008). Of those diagnosed with osteoporosis, less than half regularly take their medications, and of these, only half continue with their medication regimen a year later. Findings regarding non-adherence are varied with evidence suggesting that a person's attitude about osteoporosis is directly related to how they adhere to

osteoporosis treatment (Sanfelix-Genovés et al., 2009). Due to the asymptomatic nature of the disease, individuals often do not realize the significance of taking their medications until an adverse event, such as a fragility fracture, occurs (Solomon, 2005). In other research, non-adherence was found to be related to cost, adverse effects, dosing frequency, disease education, patient follow up and patient involvement in treatment decisions (Gold, Alexander, & Ettinger, 2006). Studies have included high risk groups such as women, postmenopausal women and individuals who suffered from fragility fractures (Beaudoin, Bessette, Jean, Ste-Marie, & Brown, 2014; S. R. Majumdar et al., 2014; Sanfelix-Genovés et al., 2009; Yood et al., 2008), yet no study was found including the high risk group of those who had bariatric surgery.

Summary

Despite the evidence regarding bariatric surgery, osteoporosis risks, diagnosis, and prevention, it remains unknown how osteoporosis is viewed by individuals who have had bariatric surgery. A greater awareness of the link between bariatric surgery and osteoporosis could potentially increase the likelihood that patients will actively engage in osteoporosis prevention strategies. Previous studies have evaluated osteoporosis risk perceptions among peri- and postmenopausal women and other specific groups, however, limited studies were found that assessed osteoporosis perceptions among post bariatric surgical patients (Hsieh, Novielli, Diamond, & Cheruva, 2001; Meadows & A Mrkonjic, 2003). Osteoporosis research is vast and spans decades, across several health disciplines, and types of study designs. However, studies have been primarily quantitative. Individual experiences, perceptions, behaviors and knowledge regarding bariatric surgery and osteoporosis have not been explored. No studies using a qualitative approach were identified, suggesting a significant gap in how the intersection of osteoporosis and bariatric surgery are understood.

During the time leading up to and after bariatric surgery, nurses must gain an understanding of the patient's attitudes, beliefs, perceptions, and motivations regarding osteoporosis prevention in order to tailor pre-operative and post-operative education to a person's individual needs. Studies are needed to provide a theoretical understanding of the patient experience and evaluate interventions to improve osteoporosis prevention and the effectiveness of osteoporosis treatment. Nurses are prime candidates to deliver the message that having bariatric surgery increases the risk of osteoporosis. A comprehensive understanding of the meaning of osteoporosis for individuals who have had bariatric surgery will contribute to an increased awareness of bone health and osteoporosis prevention in a high-risk population. Ultimately, this could lead to evidence-based prevention and intervention activities nurses and other health care practitioners can use to educate patients about awareness and prevention. Because of the need to understand the experience from the patient's point of view, this study used phenomenology to examine the lived experiences of being at risk for osteoporosis in those who have undergone bariatric surgery. By understanding the patient experience from the patient's perspective, researchers will be positioned to develop more effective osteoporosis prevention strategies preoperatively for the patient undergoing bariatric surgery.

The purpose of this research was to examine the lived experiences of being at risk for osteoporosis, in people who have had bariatric surgery. The specific aims were to understand:

1. what it means to live with the risk of osteoporosis after bariatric surgery
2. the perceptions of osteoporosis risks postoperatively

CHAPTER 2

LITERATURE REVIEW

An in-depth review of the literature was conducted to identify sources of current evidence about the phenomenon of osteoporosis in post bariatric surgical patients. Several data bases were searched, including OVID Medline, CINAHL, and EMBASE which included ahead of print articles that had not yet been indexed. Relevant key words were used independently and in combination: “osteoporosis,” “morbid obesity,” and “bariatric surgery.” An initial search identified 457 articles. Inclusion and exclusion criterion were used to narrow the search to relevant articles. Inclusion criteria of key words and English language were used to focus on the most relevant studies. Excluded studies covered topics such as exercise, adolescents, and animals. Other exclusions were duplicates, guidelines, and position statements. A total of 24 quantitative studies and 13 qualitative studies were found. However, no studies examined osteoporosis and bariatric surgery together; therefore, the three key words were searched individually to review qualitative literature on osteoporosis and bariatric surgery. To identify additional relevant qualitative studies, reference lists of included studies were also searched. Due to the limited research related to this study and lack of qualitative studies combining both bariatric surgery and osteoporosis, this review provides an in-depth review of the existing literature that is found when using the keywords bariatrics, obesity, and osteoporosis

Quantitative Research

Twenty-four quantitative studies were identified. Studies were conducted in the United States (n=5), Spain (n=3), and one study each from Norway, Turkey, Brazil, Denmark, Egypt, Greece, Quebec, Taiwan, and Switzerland. Five studies included subjects from a registry or data base. Studies were conducted by researchers in the following categories surgery (n=12),

biomedical (n=2), clinical research (n=9), nutrition (n= 6), endocrinology (n=17), family or internal medicine (n=8), bio statistics (n=2), college faculty (n=5), and rheumatology (n=5). Other researcher categories included public health, internal diseases, bariatrics, osteoporosis, epidemiology, and radiology. No studies were found in nursing.

The primary purposes of the research studies were varied. Twelve studies compared or evaluated bone mineral density (BMD) changes after bariatric surgery (Bredella, Greenblatt, Eajazi, Torriani, & Yu, 2017; Casagrande et al., 2012; Costa, Paganotto, Radominski, Kulak, & Borba, 2015; Fleischer et al., 2008; Frederiksen et al., 2016; Gómez et al., 2009; Shanbhogue et al., 2017; Vage, Gjesdal, Eide, Halse, & Viste, 2004; Vilarrasa et al., 2013, 2009, 2011; E. W. Yu et al., 2015), while eight studies evaluated markers of bone and calcium metabolism after bariatric surgery (Casagrande et al., 2012; Costa et al., 2015; DiGiorgi et al., 2008; Fleischer et al., 2008; Guney et al., 2003; Mahdy, Atia, Farid, & Adulatif, 2008; Olmos, Vázquez, Amado, Hernández, & González Macías, 2008; von Mach et al., 2004). Three studies evaluated the effectiveness of a biochemical intervention to control bone loss (Carlin, Rao, Yager, Parikh, & Kapke, 2009; Sakhaee, Griffith, & Pak, 2012; Tsiftsis, Mylonas, Mead, Kalfarentzos, & Alexandrides, 2009). Four studies assessed fracture incidences post operatively in individuals who had bariatric surgery (Lu et al., 2015; Nakamura et al., 2014; Rousseau et al., 2016; E. W. Yu, Lee, Landon, Lindeman, & Kim, 2017). No study was identified that exclusively examined bariatric surgical patients' perceptions of osteoporosis or their intentions of adhering to osteoporosis preventative measures.

Sample and Setting. The majority of studies used convenience samples of patients receiving care at their local institutions and hospitals (Bredella et al., 2017; Casagrande et al., 2012; Costa et al., 2015; DiGiorgi et al., 2008; Fleischer et al., 2008; Frederiksen et al., 2016; Gómez et al., 2009; Mahdy et al., 2008; Olmos et al., 2008; Sakhaee et al., 2012; Shanbhogue et

al., 2017; Tsiftsis et al., 2009; Vilarrasa et al., 2013, 2009, 2011; von Mach et al., 2004; E. W. Yu et al., 2015). Four research teams used big data from national health research and insured health plans retrieved from United States (n=2), Taiwan (n=1), and Canada (n=1). Nakamura and colleagues (2014) combined data from the Mayo Clinic's bariatric surgery program and the Rochester Epidemiology Project centralized index.

Researchers tended to use homogeneous subjects who were Caucasian (Bredella et al., 2017; Carlin et al., 2009; Casagrande et al., 2012; Costa et al., 2015; Fleischer et al., 2008; Gómez et al., 2009; Nakamura et al., 2014; Sakhaee et al., 2012; Vage et al., 2004; Vilarrasa et al., 2009, 2011), African American (Bredella et al., 2017; Carlin et al., 2009; Costa et al., 2015; Fleischer et al., 2008; Sakhaee et al., 2012), or Hispanic (Bredella et al., 2017; Fleischer et al., 2008), but did not select their subjects to include a representation of race and ethnicity. A few studies did not describe participant ethnicity (DiGiorgi et al., 2008; Frederiksen et al., 2016; Guney et al., 2003; Lu et al., 2015; Mahdy et al., 2008; Olmos et al., 2008; Rousseau et al., 2016; Shanbhogue et al., 2017; Tsiftsis et al., 2009; Vilarrasa et al., 2013; von Mach et al., 2004; E. W. Yu et al., 2015, 2017).

Eight studies exclusively examined female participants (Carlin et al., 2009; Casagrande et al., 2012; Gómez et al., 2009; Tsiftsis et al., 2009; Vage et al., 2004; Vilarrasa et al., 2013, 2009, 2011). Fifteen studies included both males and females (Bredella et al., 2017; Costa et al., 2015; DiGiorgi et al., 2008; Fleischer et al., 2008; Frederiksen et al., 2016; Guney et al., 2003; Lu et al., 2015; Mahdy et al., 2008; Nakamura et al., 2014; Olmos et al., 2008; Rousseau et al., 2016; Sakhaee et al., 2012; Shanbhogue et al., 2017; von Mach et al., 2004; E. W. Yu et al., 2017). One study did not describe the gender of the participants (E. W. Yu et al., 2015).

The majority of studies did not report menopausal status. However, those that did included women who were pre-menopausal (Costa et al., 2015; Fleischer et al., 2008; Guney et al., 2003;

Tsiftsis et al., 2009; E. W. Yu et al., 2015), combined pre- and post-menopausal (Fleischer et al., 2008; E. W. Yu et al., 2015), and combined peri- pre-, and post-menopausal (Olmos et al., 2008). Two studies purposefully excluded peri-menopausal women (Frederiksen et al., 2016; Shanbhogue et al., 2017) and two studies stated their subjects included 25% premenopausal women (Vilarrasa et al., 2011, 2011). Participant ages ranged from 18 to 65 years.

Today, Roux-en Y bypass (RYGB) is the most popular choice for bariatric procedures in the U.S. and worldwide (Buchwald, H. & Oien, D.M, 2013). Ten of 24 studies solely included RYGB surgeries (Bredella et al., 2017; Carlin et al., 2009; Casagrande et al., 2012; Fleischer et al., 2008; Frederiksen et al., 2016; Mahdy et al., 2008; Sakhaee et al., 2012; Shanbhogue et al., 2017; Vilarrasa et al., 2011; E. W. Yu et al., 2015). Other studies included one specific procedure (Costa et al., 2015; Gómez et al., 2009; Guney et al., 2003; Nakamura et al., 2014; Olmos et al., 2008; Tsiftsis et al., 2009; Vage et al., 2004; Vilarrasa et al., 2009); the authors hypothesized that one procedure was more likely to cause bone loss. Those studies included gastric bypass (n=3) (Gómez et al., 2009; Nakamura et al., 2014; Vilarrasa et al., 2009), vertical banded gastroplasty (n=2) (Guney et al., 2003; Olmos et al., 2008) and one each of long limb biliopancreatic diversion (Mahdy et al., 2008), jejunoileal bypass (Vage et al., 2004), and Wittgrove and Clarks Technique (Costa et al., 2015). Six studies included a combination of the above procedures (DiGiorgi et al., 2008; Lu et al., 2015; Rousseau et al., 2016; Vilarrasa et al., 2013; von Mach et al., 2004; E. W. Yu et al., 2017).

Time elapsed since surgery varied across studies from 3 months to 25 years. Some researchers hypothesized the incidence of osteoporosis would be more significant several years after bariatric surgery. The majority of scholars collected baseline data with repeated measures at 12 months (Bredella et al., 2017; Carlin et al., 2009; Casagrande et al., 2012; Fleischer et al., 2008;

Frederiksen et al., 2016; Gómez et al., 2009; Mahdy et al., 2008; Tsiftsis et al., 2009; Vilarrasa et al., 2013, 2009), and 24 months postoperatively (DiGiorgi et al., 2008; Shanbhogue et al., 2017; von Mach et al., 2004; E. W. Yu et al., 2015). Other data collection intervals ranged from three months to 25 years postoperatively (Vage et al., 2004) .

In summary, 24 studies were reviewed for their relevance to the knowledge of osteoporosis risks in individuals who had bariatric surgery. Although a clear understanding of the risk of osteoporosis after bariatric surgery was made based on ethnicity, gender, age, and time since surgery, questions remain as to the individual experiences and perceptions regarding osteoporosis.

Synthesis of Quantitative Findings

Twenty-four quantitative studies were identified in a complete review of the literature. The current trend in bariatric surgical patients regarding osteoporosis is to examine the degree of bone loss based on significant influences including extent of weight loss, years since surgery, type of procedure performed, and subject selection. Other issues included the risk of fracture and interventions to prevent bone loss. Findings were synthesized across studies. A discussion regarding limitations, and gaps found in the literature is discussed at the conclusion of the review of the literature.

Extent of Weight Loss. Rapid weight loss after surgery may adversely affect bone mass due to increased bone reabsorption, vitamin D deficiency, and reduced lean body mass (Costa et al., 2015). Bone mineral density (BMD) is higher in obese women and this protective shielding is typically lost with bariatric surgery (Vilarrasa et al., 2009). Preoperative lean mass is associated with bone mineral density (Costa et al., 2015; DiGiorgi et al., 2008; Gómez et al., 2009; Rousseau et al., 2016; Sakhaee et al., 2012; Vilarrasa et al., 2009). Postoperative lean mass is positively correlated with bone mineral density (Costa et al., 2015; Gómez et al., 2009; Shanbhogue et al.,

2017; Vilarrasa et al., 2013, 2009, 2011) and correlated negatively with age (Vilarrasa et al., 2009). Likewise, weight loss is positively correlated with bone mineral density (Costa et al., 2015; Fleischer et al., 2008; Guney et al., 2003). The mean BMD was found to be significantly lower in subjects who had bariatric surgery when compared to control groups as well as BMD for chronological age (Costa et al., 2015). The main determinants of osteopenia, below normal levels of bone density ("Osteopenia," n.d.), after adjusting for age, one year after surgery included lean mass and menopause. Likewise, change in weight is positively associated with total BMD 12 months after surgery after controlling for gender and age (Frederiksen et al., 2016). Lean body mass and loss of excess weight may be more influential in the loss of bone mass than physical activity, smoking or family history (Costa et al., 2015).

Before surgery, lack of sun light, less mobility, over clothing, and inadequate intake of vitamin D foods put the bariatric population at risk for vitamin D deficiency (Costa et al., 2015). After surgery the risks include reduced caloric intake, reduced gastric volume, and malabsorption (ASBS, 2018a). Mixed results were found with correlations between levels of 25-hydroxyvitamin D (25OHD), a metabolite measured to determine a patient's vitamin D level (Holick et al., 2011), body mass index, and percentage of fat and lean mass. Preoperatively a significant negative linear relationship was found between vitamin D and initial body mass index (DiGiorgi et al., 2008), as well as a significant positive correlation between 25OHD levels and percent of excess weight loss at three months (Olmos et al., 2008) and one and two years after gastric bypass surgery (DiGiorgi et al., 2008). This supports the speculation that vitamin D is sequestered in fat, thus reducing its availability. However, Costa and colleagues (2015) found no correlation between levels of 25OHD, body mass index, and percentage of fat and lean mass after the Wittgrove technique. The mixed results could be due to several factors across studies. Depending on the surgery type, there

are varying degrees of malabsorption. Each study varied in amounts of supplements of calcium and vitamin D that were given. Also, compliance with supplementation seems to be an issue. Despite all these variations, decrease in BMD remains a constant factor.

Time Since Surgery. Correlations between time since surgery and bone loss were mixed. These results could be due to confounding factors such as type of surgery, analysis technique, vitamin supplementation, and site-specific measurements. Not all studies considered these confounding factors. Data was collected preoperatively (n= 15), up to 25 years post operatively (n=1), with most studies ending at 12 months (n= 10) or 24 months (n=4) post surgery. Elevated bone turnover markers, a potential risk factor for osteoporosis, were found as soon as three months postoperatively, (Olmos et al., 2008). Lower BMD was observed at 12 months postoperatively (Bredella et al., 2017; Casagrande et al., 2012; Costa et al., 2015; Fleischer et al., 2008; Frederiksen et al., 2016; Mahdy et al., 2008; Shanbhogue et al., 2017; Tsiftsis et al., 2009; Vilarrasa et al., 2009, 2011). Decreased bone mineral density remained prevalent and sometimes became worse two and three years post surgery, (Shanbhogue et al., 2017; Vilarrasa et al., 2011; E. W. Yu et al., 2015). However, only one researcher conducted a correlation study examining BMD, time after surgery, and biochemical parameters at 12 months after surgery (Costa et al., 2015) and found no correlation. They posited that their findings have been different if they had followed the patients longer postoperatively.

Types of Surgery. Six research studies examined the differences in bone health when comparing one procedure to another. Four studies examined Roux-en-Y gastric bypass (RYGB) versus sleeve gastrectomy (Bredella et al., 2017; Vilarrasa et al., 2013) or adjustable gastric banding (von Mach et al., 2004; E. W. Yu et al., 2017). Another study examined laparoscopic gastric banding compared to gastric bypass (DiGiorgi et al., 2008) and one study compared three

different procedures, biliopancreatic diversion, RYGB, and sleeve gastrectomy (Rousseau et al., 2016). Depending on the type of bariatric surgery, patients who undergo bariatric surgery have a higher incidence of bone loss at specific sites (Bredella et al., 2017; von Mach et al., 2004; E. W. Yu et al., 2017) a higher incidence of fracture (E. W. Yu et al., 2017) and decreases in vitamin D levels. Studies comparing RYGB and sleeve gastrectomy have differential effects on skeletal sites. Femoral bone loss tends to be greater after RYGB than in sleeve gastrectomy (Bredella et al., 2017); however, both RYGB and sleeve gastrectomy are associated with similar BMD at the lumbar spine and femoral neck one year postoperatively (Bredella et al., 2017; Vilarrasa et al., 2013). Studies focusing just on bone loss after RYGB demonstrate a decrease of BMD at the total hip and in the lumbar spine (Carrasco et al., 2009; Coates, Fernstrom, Fernstrom, Schauer, & Greenspan, 2004; Fleischer et al., 2008; Valderas et al., 2009; Vilarrasa et al., 2011). Weight loss and decreased mechanical load could be a main cause of BMD loss at the femoral neck (Vilarrasa et al., 2013).

Roux-en Y gastric bypass, when compared to adjustable gastric banding, was found to have a 43% increased risk of fracture at the hip and wrist (E. W. Yu et al., 2017). Unfortunately, the authors were unable to look at BMD because they used an existing data base. However, the increased incidence of fractures suggests an inverse relationship with BMD. Likewise, von Mach and colleagues (2004) observed a decrease in bone mineral density from 1.26 to 1.22 g/m² in the RYGB group. The estimated bone area remained the same in the adjustable gastric banding group, whereas, the RYGB group had an estimated bone area loss from 2,349 to 2147 cm². Increased bone resorption and increased bone formation was also found. Contradictory to these studies, Rousseau and colleagues (2016) found only biliopancreatic diversion linked with increased fracture risk compared to sleeve gastrectomy and RYGB. The authors noted that the RYGB sample

was underrepresented and limited them from drawing firm conclusions on fracture risk associated with this procedure.

When compared to laparoscopic adjustable gastric banding, patients who have gastric bypass have higher markers of bone loss despite vitamin D supplementation (DiGiorgi et al., 2008). Sixty four percent of subjects were deficient in vitamin D (<20 ng/ml) and 14% had elevated parathyroid levels preoperatively. Postoperatively, a negative relationship was found between 25OHD and parathyroid levels at six months after gastric bypass surgery and one year after laparoscopic adjustable gastric banding. The same inverse correlation was found after the Wittgrove technique (Costa et al., 2015). These results indicate that elevated parathyroid levels are related to vitamin D deficiency even prior to bariatric surgery. Whether the type of bariatric surgery is malabsorptive or restrictive, bone loss is noted.

Sample. Sampling of Caucasian postmenopausal women is typical in osteoporosis studies as this population is at increased risk for osteoporosis (National Osteoporosis Foundation, 2013). Furthermore, women in menopause are nine times more likely to develop osteopenia, low bone density, regardless of age, and have a greater risk for decreased bone mineral densities despite adequate calcium and vitamin D supplementation (Vilarrasa et al., 2009). Studies in this literature review did not always reflect these typical sample characteristics of Caucasian, postmenopausal, women. Subjects with bone disease after bariatric surgery were found to be younger, and premenopausal. Eight studies included solely women (Carlin et al., 2009; Casagrande et al., 2012; Gómez et al., 2009; Tsiftsis et al., 2009; Vage et al., 2004; Vilarrasa et al., 2013, 2009, 2011); in studies that included both men and women, the majority of subjects were still female (Bredella et al., 2017; Costa et al., 2015; DiGiorgi et al., 2008; Fleischer et al., 2008; Frederiksen et al., 2016; Guney et al., 2003; Lu et al., 2015; Mahdy et al., 2008; Nakamura et al., 2014; Olmos et al., 2008;

Rousseau et al., 2016; Sakhaee et al., 2012; Shanbhogue et al., 2017; von Mach et al., 2004; E. W. Yu et al., 2015, 2017). This could be because only 20% of those who have bariatric surgery are male. Results for males were not addressed separately.

Most studies did not report racial demographics, making it difficult to examine racial differences. (DiGiorgi et al., 2008; Frederiksen et al., 2016; Guney et al., 2003; Lu et al., 2015; Mahdy et al., 2008; Olmos et al., 2008; Rousseau et al., 2016; Shanbhogue et al., 2017; Tsiftsis et al., 2009; Vilarrasa et al., 2013; von Mach et al., 2004; E. W. Yu et al., 2015, 2017). Of the four research teams who describe race, all recruited Caucasian women exclusively. (Gómez et al., 2009; Vilarrasa et al., 2009, 2011). Researchers concluded lean mass loss was positively associated with BMD loss (Gómez et al., 2009; Vilarrasa et al., 2009, 2011). Finally, researchers who included multiple races did not report any outcomes of bone loss based on race; therefore, little can be discerned about racial differences (Bredella et al., 2017; Carlin et al., 2009; Casagrande et al., 2012; Costa et al., 2015; Fleischer et al., 2008; Nakamura et al., 2014; Sakhaee et al., 2012).

Although not stated outright, the mean age of study subjects (40.43) supports the assumption that most women were premenopausal. (Tsiftsis et al., 2009) (Tsiftsis et al., 2009). In two studies, perimenopausal women were excluded (Frederiksen et al., 2016; Shanbhogue et al., 2017). Shanbhogue and colleagues (2017) actually dropped two female participants because they entered menopause during the study period. Tsiftsis and colleagues (2009) state they chose premenopausal women because they represent most bariatric surgical patients and created a homogeneous group accounting for confounding variables such as sex and menopause. They found that bone loss occurred due to marked weight loss and diminishing mechanical load on the skeleton. While osteoporosis is more prevalent in postmenopausal women, those who are premenopausal and having bariatric surgery are at an increased risk for osteoporosis. The other

studies only note the number of subjects that were peri, pre, or postmenopausal and included men. There were no studies that included only males. In studies that included both sexes, outcomes were not compared between or within them. For these reasons, studies regarding perception of osteoporosis risk are imperative in this population.

Fracture Risks. The focus of four research studies was the incidence of fracture after bariatric surgery. The findings strongly suggest that bariatric surgery is associated with an increased risk for fracture (Lu et al., 2015; Nakamura et al., 2014; Rousseau et al., 2016; E. W. Yu et al., 2017). Even when compared to non-surgical, obese, and non-obese counterparts, bariatric surgical patient's increased risk of fracture still remains significant (Lu et al., 2015; Nakamura et al., 2014; Rousseau et al., 2016) despite controlling for confounding factors (Nakamura et al., 2014; E. W. Yu et al., 2017). Five topic areas were predominant in this literature, incidence of fracture, fracture sites, type of procedure, age and gender of the subjects, and time elapsed since the surgery.

Incidence of fracture. The incidence of fracture rates varied between studies, yet still painted an alarming picture. Obese individuals undergoing bariatric surgery are more likely to fracture even prior to surgery than their obese or non-obese counterparts and this risk continues to be high after surgery (Rousseau et al., 2016). After surgery, the estimated incidence rate of non-vertebral fractures per 1000 person years is 9.7 in RYGB patients and 6.8 in those who had adjusted gastric banding (AGB)(E. W. Yu et al., 2017). In a similar study, Lu et al. (2015) found 12 years following bariatric surgery, there were a total of 183, 1.84 cases per 1000 person years, and 374 fractures in a matched control group, 1.50 cases per 1000 person years. Overall, this equated to a 1.22-fold significantly increased risk of fractures in the surgical group compared to the control group. Nakamura and colleagues (2014) found that a small population (n=258) of mostly RYGB

(94%) had a markedly increased risk of fractures over community based men and women controls during an average 8 year follow up period. The study group had a standardized incidence ratio of 5.5 for hip fracture. In an average of 7.7 years, 79 subjects experienced 132 fractures, increasing the elevated risk for fracture 2.3-fold. This study was similar to Yu and colleagues (2017) study; however, it did not control for the confounding factor obesity due to not using an obese control group. Rousseau and colleagues (2016) found that varied bariatric surgical procedures had a 38% increased fracture risk compared with obese and non-obese controls with a mean of 4.4 years after surgery.

Fracture site. Fractures after surgery changed from resembling obesity patterns to that of osteoporosis (Rousseau et al., 2016). There is a two fold increase in fractures at the traditional osteoporotic sites of hip spine, and wrist after surgery (Nakamura et al., 2014). Other increased risk sites included the upper limb, pelvis, and lower limb (Nakamura et al., 2014; Rousseau et al., 2016; E. W. Yu et al., 2017). Roux-en-Y patients have a higher risk of fracture at the hip and wrist than AGB patients (E. W. Yu et al., 2017). In the Lu et al (2015) study, the surgical group had increased risk of fracture compared with controls both in osteoporotic fracture and non-osteoporotic fracture sites.

Procedure. Some studies suggest that fracture risk varies depending on procedure type. Malabsorptive procedures were found to result in a significantly higher fracture risk whereas restrictive procedures did not (Lu et al., 2015). Rousseau and colleagues (2016) found biliopancreatic diversion to be associated with the greatest fracture risk; AGB patients did not have a higher fracture rate when compared to obese controls. Likewise, Yu and colleagues (2017) found a 43% increased risk for non-vertebral fracture in patients who had RYGB when compared to AGB two years after surgery.

Age and gender. Predominant risk factors for osteoporosis include aging and the female gender (National Osteoporosis Foundation, 2013). Rousseau and colleagues' (2016) subjects were 72.3% women with a mean age of 42 ± 11 . They discovered surgical patients were more likely to have fractures than were obese or non-obese controls. Nakamura and colleagues' (2014) subjects had an average age of 44 ± 10 years and 82% were females; when compared to the expected incidence rates of community men and women, the overall fracture rate was increased more than two fold. In the general population, the incidence rate of non-vertebral fracture is low in adults younger than 45 years. Lu and colleagues' (2015) study subjects had a mean age of 31.8 years; 63.7% were women with a comparative matched control group. Despite the young age and predominance of female gender of these subjects, a significant increased risk for fracture was found in the surgical groups compared with the matched control groups. One study did not match these similar results; Yu et al.(2017) found no statistically significant effect of RYGB associated fracture risk by age

Time since surgery. Scholars have identified a trend toward an increased fracture risk five or more years following surgery (Lu et al., 2015; Nakamura et al., 2014; E. W. Yu et al., 2017). Increased bone turnover is evident by the third postoperative month and even more predominant by the sixth month (Tsiftsis et al., 2009). Lu and colleagues (2015) found fracture rates 2.37% after two years and 2.06% after five years for surgical patients, compared to matched controls, 1.65% and 1.42% respectively. Interestingly, the matched control group risk for fracture declined as years increased, whereas, for surgical patients the risk for fracture increased respectively. Roux-en-Y gastric bypass fracture risk occurred after two years with the highest risk for fracture occurring in the fifth year following surgery (E. W. Yu et al., 2017). Rousseau and colleagues (2016) found bariatric surgical patients to be more susceptible to fracture four years post

operatively. The continued bone loss suggests that skeletal homeostasis is not yet achieved by two years after bariatric surgery. However after 25 years, no significant reduction in bone mineral density was found when compared to matched age controls (Vage et al., 2004). Bariatric surgery impacts bone loss and fracture risk immediately and several years after surgery.

Interventional Studies. Bone loss, leading to osteoporosis, could be the result of impaired intestinal calcium absorption, fast peristalsis, and vitamin D deficiency (Valderas et al., 2009). Calcium and vitamin D supplements are considered the standard of care after surgery; however, their effects are unclear. Only three interventional studies were found during this review of the literature; all of the studies used an experimental design to examine the use of a biochemical intervention to control bone loss in patients who had RYGB (Carlin et al., 2009; Sakhaee et al., 2012) and long limb biliopancreatic diversion (Tsiftsis et al., 2009). The subjects were morbidly obese patients who underwent bariatric surgery. Inconsistencies between the studies included gender, pre or post-menopausal, age, geographical area, and sunlight exposure.

Sakhaee, Griffith, & Pak (2012) conducted a crossover study. Subjects were randomly assigned to a group that received either an effervescent formulation of potassium calcium citrate or placebo. Each phase was 13 days in duration with a period of 1 week when the subjects did not receive the calcium or placebo. The investigators found potassium calcium citrate supplementation repressed bone resorption by providing bioavailable calcium in RYGB subjects; however, its bioavailability was substantially less than that of healthy subjects. They also found parathyroid hormone levels to be greater than the upper normal limit in both phases of the study. However, the potassium calcium citrate effervescent did not have a significant impact on 25OHD. Confounding variables were not considered and patients who were taking supplemental calcium and vitamin D were not excluded.

Tsiftsis and colleagues (2009) found no improvement in BMD despite subjects receiving 2 grams of supplemental calcium and hypothesized that weight loss was the main culprit for increased bone turnover and decreased BMDs. The subjects were all premenopausal women who postoperatively followed a high protein, high calcium diet. Subjects were randomly divided into two groups, one group receiving an additional 2 grams of calcium carbonate. All subjects were evaluated preoperatively, and at 1, 3, 6 and 12 months postoperatively. In the intervention group, 25OHD levels were low in seven (26.9%) of the subjects. The most reliable index of vitamin D nutrition is the 25OHD level (Carlin et al., 2009) and a significant contributor to cortical bone loss is secondary hyperparathyroidism and vitamin D deficiency (Sakhaee et al., 2012), which subsequently increases the risk for fracture (Carlin et al., 2009). The authors noted that a limitation to their study was that vitamin D supplementation was not given to raise the concentration to a sufficient level of 25-OHD. Five subjects (19.2%) had elevated parathyroid levels one year postoperatively. Subjects who had a known preexisting bone, liver, or renal disease or were taking medications known to affect bone and mineral metabolism were excluded (Tsiftsis et al., 2009).

Carlin et al. (2009) recruited women who had preoperative vitamin D depletion and randomly assigned them to receive 50,000 IU of vitamin D weekly (group 1; n=30) or no additional vitamin D (group 2; n=30) after RYGB. Subjects were then evaluated preoperatively, 3, 6 and 12 months postoperatively by serum analyses and questionnaires. Interestingly, 3 of the 21 subjects were noncompliant with the supplementation resulting in continued vitamin D depletion. The investigators found the mean serum 25OHD was significantly greater in 71% of the intervention group than the control group one year postoperatively; yet, 36% still had secondary hyperparathyroidism with elevated parathyroid hormone levels, most likely due to calcium malabsorption. Their analysis showed that 50,000 IU of vitamin D weekly after RYGB safely

corrects vitamin D depletion in most women and reduces cortical bone loss. Questionnaires were used to understand if there were any differences between the groups in factors that may slow the progression of bone disease such as menopause status, sunlight exposure, and consumption of milk or orange juice, and oily fish. No significant differences were found.

Qualitative Research

Fifteen qualitative studies were identified. Studies were conducted in Norway (n=4), Brazil (n=2), Denmark (n=3), Canada (n=3) with one study each from the U.S., France, and England. All studies were conducted by interdisciplinary researchers, which combined teams from clinical research (n=7), medicine (n=3), public health (n=4), psychology (n= 4), primary care (n=3), surgery (n=3), and nursing (n=2). Other author affiliations included departments of endocrinology, radiology, patient safety and quality, physical education, and mobility research

Primary purpose. The primary purposes of the qualitative studies varied between and within topics. However, a common theme among many studies was to explore the daily experiences of osteoporosis, post fragility fracture, or post bariatric surgery. The aims of the studies included identifying beliefs norms, opinions and perceptions of osteoporosis, and perceptions of an osteoporosis diagnosis and treatment (Besser, Anderson, & Weinman, 2012a). Two research teams examined how both males and females navigate their everyday lives after receiving a diagnosis of osteoporosis (Hansen, Abrahamsen, Konradsen, & Pedersen, 2017; Nielsen, Huniche, Brixen, Sahota, & Masud, 2013). In addition, perspectives and experiences on screening for osteoporosis was examined (Rothmann et al., 2014) as well as follow up care once diagnosed with osteoporosis (Beaton et al., 2012).

Researchers investigating bariatric surgery examined post-bariatric surgery from both male (Lier, Aastrom, & Rørtveit, 2016; Natvik, Gjengedal, Moltu, & Råheim, 2015) and female

perspectives (Lier et al., 2016). To optimize long term outcomes, follow up care (M.-A. Aarts et al., 2017), chronic side effects, complications (Groven, Råheim, & Engelsrud, 2010) and therapeutic successes (Magdaleno, Chaim, & Turato, 2010) were explored. Several researchers examined the meaning of bariatric surgery in both males and females (Magdaleno, Chaim, Pareja, & Turato, 2011; Magdaleno et al., 2010; Natvik, Gjengedal, & Råheim, 2013) and one author examined substance abuse post bariatric surgery (Natvik et al., 2013).

Sample. The majority of studies used purposive and convenience sampling to recruit participants from the authors' local institutions (M.-A. Aarts et al., 2017; Alami, Hervouet, Poiraudau, Briot, & Roux, 2016; Besser et al., 2012; Lier et al., 2016; Magdaleno et al., 2011, 2010; Meadows & A Mrkonjic, 2003; Natvik et al., 2015, 2013; Rothmann et al., 2014). Other studies did not describe the sampling method (Beaton et al., 2012; Hansen et al., 2017; Ivezaj, Saules, & Wiedemann, 2012; Nielsen et al., 2013). Race and ethnicity were not reported in most of the studies, but those that did were Caucasian (Ivezaj et al., 2012) and Norwegian (Groven et al., 2010; Natvik et al., 2013). Participant characteristics for bariatric surgical research included those with substance abuse (Ivezaj et al., 2012), status post duodenal switch procedure (Natvik et al., 2015, 2013), bariatric surgery within the last six years (Groven et al., 2010), or any past history of bariatric surgery (M.-A. Aarts et al., 2017; Lier et al., 2016; Magdaleno et al., 2011, 2010). Inclusion criteria were a diagnosis of osteoporosis (Nielsen et al., 2013; Rothmann et al., 2014), osteoporosis or osteopenia (Besser et al., 2012a), fragility fracture (Beaton et al., 2012; Meadows & A Mrkonjic, 2003), physicians caring for post- menopausal osteoporotic women, (Alami et al., 2016) and women greater than age 65 (Hansen et al., 2017). Nine studies exclusively examined female participants (Alami et al., 2016; Besser et al., 2012a; Groven et al., 2010; Hansen et al., 2017; Ivezaj et al., 2012; Magdaleno et al., 2011, 2010; Rothmann et al., 2014) . Unlike the

quantitative studies, the qualitative researchers were less likely to report if female participants were pre-, peri-, or post-menopausal. One exception was a study by Alami et al., (2016) which included only women with post-menopausal osteoporosis.

Four studies recruited both male and female participants (M.-A. Aarts et al., 2017; Lier et al., 2016; Natvik et al., 2013; Nielsen et al., 2013), while Natvik et al., (2015) recruited only males. Participant ages ranged from 20-87.

Setting. Interviews were conducted face-to-face (n=13) or by telephone (n=2)). Face-to-face interviews were conducted in participant homes (Alami et al., 2016; Hansen et al., 2017; Natvik et al., 2013; Rothmann et al., 2014), medical offices or clinics (Alami et al., 2016; Besser et al., 2012a), hospitals (Hansen et al., 2017; Lier et al., 2016; Nielsen et al., 2013), participants choice (Groven et al., 2010; Natvik et al., 2015), a library (Rothmann et al., 2014), a quiet meeting place (Natvik et al., 2013). Five studies did not describe the setting for interviews (Beaton et al., 2012; Ivezaj et al., 2012; Magdaleno et al., 2011, 2010; Meadows & A Mrkonjic, 2003)

Research Design. Research teams used grounded theory (Alami et al., 2016; Beaton et al., 2012; Ivezaj et al., 2012) and phenomenological designs (Besser et al., 2012a; Groven et al., 2010; Hansen et al., 2017; Natvik et al., 2015, 2013; Nielsen et al., 2013). Other research teams did not provide enough details to determine the qualitative method (M.-A. Aarts et al., 2017; Lier et al., 2016; Magdaleno et al., 2011, 2010; Rothmann et al., 2014) . Researchers used semi-structured interviews (Besser et al., 2012a; Hansen et al., 2017; Ivezaj et al., 2012; Lier et al., 2016; Magdaleno et al., 2011, 2010; Natvik et al., 2015; Rothmann et al., 2014), focus groups (Rothmann et al., 2014), and telephone interviews (M.-A. Aarts et al., 2017). One study used solely focus groups because the researchers felt the interactions between the participants would guide and inform varying experiences of osteoporosis care after a fracture (Beaton et al., 2012). Besser et al.,

(2012a) asked participants to draw their perceptions of a bone with and without osteoporosis and a person with and without osteoporosis on paper. Three research teams did not describe the data collection method (Groven et al., 2010; Natvik et al., 2013; Nielsen et al., 2013)

Synthesis of Qualitative Findings

Life After Bariatric Surgery. Eight qualitative studies focusing on post bariatric surgery were reviewed. Overwhelmingly, the studies were concerned with how participants experienced life after surgery. Lingering issues with physical, psychological, and social concerns were predominantly reported. Two recurrent themes were identified across the qualitative research that were especially relevant to this study, including ambivalence and pre-occupied, two reasons why osteoporosis may not be considered significant to the individual who had bariatric surgery. A global discussion regarding limitations, and gaps found in the literature is discussed at the conclusion of the entire review of findings.

Physical. New and unexpected physical limitations lead to worry and vulnerability, two key concepts noted throughout many qualitative studies examining life after bariatric surgery. These concepts were frequently mentioned with regard to physical appearance (Lier et al., 2016), lack of education or follow up (M.-A. Aarts et al., 2017), thoughts and feelings, altering bodies, encountering others (Natvik et al., 2015), and loose or hanging skin was often associated with attractiveness and sexuality. One woman described her constant struggle with infections between the folds due to sweating and the constant swaying of the loose skin (Groven et al., 2010). Many women considered plastic surgery to remove the skin; however, for many this required additional weight loss.

Patients related feeling of uncertainty back to the lack of continuity of care. Frustration was expressed as feeling “used” to capture data, lack of personalized care, or sense of being one of

many patients moving through the system. Aarts and colleagues (2017) go on to state the lack of clinicians and staff to support follow up appointments could be a potential contributor to these feelings. Overburdened bariatric programs may overlook the benefits of personalized care. Patients found the pre-surgery program thorough, however, the post-surgery care was sporadic and lacking personalized information. This implies osteoporosis information may be missing as well. One patient stated “the ideal program would be one that is patient specific, not program specific” (M.-A. Aarts et al., 2017); other literature supports this notion (Natvik et al., 2013). Topics patients thought were missing were exercise and body contouring after bariatric surgery. Additionally, they noted their needs changed as more time passed after their surgery. Patients faced issues such as regaining weight, psychosocial issues and eating patterns two and three years postoperatively (M.-A. Aarts et al., 2017). Optimal post-operative care was described as seeing one provider, additional counseling on physical appearance, and convenient around the clock access via e-mail or phone as needed.

Prior to surgery, participants described their physical lifestyle as active and involved, however, only a short few months after surgery they began to have less energy and feel fatigued (Groven et al., 2010). This profound change included fatigue, tiredness, pain and loss of strength. Patients stated their energy and emotional highs after surgery lasted only a few short months, followed by a loss of energy and mental and emotional strength (Groven et al., 2010; Natvik et al., 2015). Daily routine tasks such as holding a simple conversation with others became a struggle (Groven et al., 2010). Exhaustion and fatigue lead to inactivity and days off from work. Some women stated they began to experience a gradual onset of whole body pain and aches (Groven et al., 2010). Any type of physical activity would intensify the pain and fatigue, sometimes leading

to physical illness. Women stated they were unprepared for these experiences and worried something went wrong with their surgery.

Bariatric surgery is known to help with chronic illnesses, however, there is a paucity of research regarding long term effects (Colquitt et al., 2014). Some patients have experienced side effects or complications from their surgery while others have experienced being a new onset of chronic conditions which demanded their attention. Patients would discuss their constant struggle with abnormal blood values and vitamin deficiencies and how they were dependent on vitamins and medications. Some patients noted iron deficiencies, low hemoglobin, vitamin B12; however calcium or vitamin D was never mentioned. One gentleman described his bone pain as his “heaviest burden,” stating, “I can feel my bones bruise easily. Ribs fractures and the like have happened to me many times. I can’t do what I used to” (Natvik et al., 2015). He stated he was diagnosed with osteoporosis and now worries about what his future may hold. Bariatric surgical patients also describe ongoing pain that is exacerbated by any physical activity and requires great effort to manage (Groven et al., 2010).

Psychological. Bariatric surgery caused sudden and unforeseen changes which affected participants’ entire life. Abrupt changes included eating patterns, weight loss or gain, loss of energy, chronic illness, and pain. These overwhelming and ongoing experiences became preoccupations that often made patients feel trapped (Groven et al., 2010).

Many patients expressed concerns with obsessive behavior regarding weight loss or weight gain (M.-A. Aarts et al., 2017; Lier et al., 2016; Natvik et al., 2013). Patients feared gaining weight so much their eating habits became the focus of their lives. Others feared losing more weight because they were unhappy with the drastic changes to their body. In addition to the psychological

fears, all patients needed extended periods of time to become familiar with what they could and could not eat. Many patients' days were spent planning frequent, small meals, calculating amounts of food that could be eaten (Lier et al., 2016) or frequent trips to the scales (Natvik et al., 2013). This overwhelming fear of weight gain lead to stress, which for some, lead to stress eating (Natvik et al., 2013); others turned to addictive behaviors (Ivezaj et al., 2012). Patients found themselves losing control and relapsing into consuming large amounts of food (Natvik et al., 2013). One woman reported having a panic attack due to gaining weight after she quit smoking. Some patients found it hard to cope with this inner stress and obsessive behavior.

For some, exhaustion ensued from a daily struggle of being preoccupied with emotional thoughts and physical appearances. A constant worry of losing control over food and obsessive eating lead to exhaustion (Natvik et al., 2013). Routine behaviors included a constant awareness of the body (Natvik et al., 2013) and looking in the mirror for changes (Natvik et al., 2015, 2013). Preoccupations included how they looked now and how they felt they should look. For many, they did not see themselves as 'thin' (Ivezaj et al., 2012; Natvik et al., 2015), while others were confused about the discomfort they felt with their new 'thin' body (Natvik et al., 2013). Some were deeply exhausted by the ongoing learning process of how their body would react to food (Natvik et al., 2013). One patient described his exhaustion as "Suddenly, I had to cope with so much. I couldn't find peace" (Natvik et al., 2013).

Social. Reengaging in social activity was easy for some and difficult for others. Anticipation of becoming part of society again was empowering, yet others feared how their position in society would change as a result of their weight loss (Magdaleno et al., 2011). Extensive weight loss after surgery triggered a new way of thinking and defining oneself and their existence in the world (Lier et al., 2016).

Weight loss meant fitting into the norms of society, which lead some participants to feel normal and able to participate in new social activities (Lier et al., 2016; Magdaleno et al., 2010) and freed from isolation (Natvik et al., 2013). Many metaphors were used by participants to describe the initial period after surgery such as ‘a high’ (Lier et al., 2016), ‘honeymoon’ or ‘hallelujah-wave’ (Groven et al., 2010). Initially after surgery, some reported a sense of a new start to their lives (Groven et al., 2010; Natvik et al., 2015). With this new beginning came a renewed self-confidence, impulsiveness, and, at times, irresponsible behavior (Lier et al., 2016). One participant stated initially after weight loss he moved, made new relationships, and went out to numerous events. Others described this new beginning as feelings of being attractive and wearing extra make-up, enjoying positive comments from others, and simply being more sociable (Groven et al., 2010). “Now I nearly feel restless if I don’t leave the house on a daily basis” (Natvik et al., 2013). Natvik and colleagues (2015) found connecting with others to be essential for successful long term weight loss and change after surgery.

Social media, or intranet, provided a sense of belonging by connecting with others who had bariatric surgery or were considering surgery and creating new friendships (Groven et al., 2010). However, others who were not experiencing this “high” did not find social media to be supportive. Whereas initially some found social media to be supportive, over time they found expressing their concerns and challenges of weight loss and weight gain to be unwanted and unsupported (Groven et al., 2010). Patients who experienced weight gain after surgery stated they would compare themselves to others and have feelings of failure, embarrassment and shame. These feelings would typically lead to withdraw from social media discussions.

These new social interactions triggered an increase in self-esteem and self- acceptance (Natvik et al., 2013), however, the transition from social nonexistence to socially accepted was not

always easy. The realization of how their weight impacted their social lives was at times hurtful. The above mentioned “high” appeared to be connected with weight loss, but once weight loss ended or simply stalled, so was the “high.”

For some, they never experienced this sense of a “high.” Many participants were unsure how to cope or deal with new and unfamiliar social situations regarding their new social status (Magdaleno et al., 2011), jealousy from partners (Lier et al., 2016; Magdaleno et al., 2011, 2010), and new and unfamiliar reactions from friends and family (Groven et al., 2010; Magdaleno et al., 2011). Comments from others such as “you cheated” to get to a thinner body, lowered self-esteem and belief in one self (Groven et al., 2010; Lier et al., 2016; Natvik et al., 2013). Others were surprised by offensive comments regarding their changing bodies, weight, and eating habits (Natvik et al., 2013). At social events or meals, patients were concerned about other’s reactions over their own to the point where they would withhold gas causing abdominal pain and prefer only to use their own toilet.

Ambivalence and pre-occupations after bariatric surgery consume patient’s entire lives physically, psychologically, and socially, thus, leaving little time to consider osteoporosis prevention.

Life With Osteoporosis. Five osteoporosis qualitative studies were identified to be relevant to this study. Whereas, qualitative research about bariatric surgery tended to focus on how participants lived after bariatric surgery, qualitative studies about osteoporosis described how participants live with the disease. Specifically, knowledge, prevention, and risk perceptions; however, findings under each of these subthemes were confounding. Participants in these studies believed they understood osteoporosis but, their knowledge was inconsistent and at times

incorrect. Findings were synthesized across studies. A discussion regarding limitations and gaps found in the literature are discussed at the conclusion of the entire review of findings.

Knowledge. Participants in osteoporosis research often describe osteoporosis as an inevitable disease due to the aging process (Alami et al., 2016; Rothmann et al., 2014). Some participants acknowledged they were diagnosed yet they still believed they did not have osteoporosis because osteoporosis was an older person's disease (Beaton et al., 2012), they "can't see it," or they are not "the type" to have fragile bones (Meadows & A Mrkonjic, 2003). Others denied a diagnosis of osteoporosis because they stated this was reflective of aging and being old. Due to this disbelief, despite being diagnosed, often patients believe their fragility fracture was due to the fall and not osteoporosis (Alami et al., 2016; Beaton et al., 2012; Besser et al., 2012a; Rothmann et al., 2014). Fractures did not consistently trigger a follow up for bone health (Meadows & A Mrkonjic, 2003), thus the connection between fracture and future fracture risk prevention seems poorly understood. Patients stated osteoporosis could be prevented by not falling or limiting their activity (Besser et al., 2012a). Rothmann and colleagues (2014) found the women in their study to have limited knowledge regarding osteoporosis as they were unsure if osteoporosis caused pain, reduced height, is heritable, or is related to lack of estrogen. These women stated they were aware of the risk and implications for osteoporosis, however, they asked the researchers if osteoporosis was treatable and if they could prevent osteoporosis. Others stated they were never instructed on changing the way they eat in regards to osteoporosis so they believed there was no connection to osteoporosis (Besser et al., 2012a). Across studies, participant's understanding and knowledge of osteoporosis differed. This suggest the need for personalized information for bariatric surgical patients that addresses their individual levels of understanding and needs to address osteoporosis.

Contrary to these beliefs are others who describe osteoporosis as bones that are weak, brittle or thin (Besser et al., 2012a). A few women described osteoporosis as a disease that is asymptomatic, hidden, and causes fractures (Alami et al., 2016; Rothmann et al., 2014) and is a serious condition that warrants preventative measures (Besser et al., 2012a; Hansen et al., 2017). Yet, despite this knowledge, women were unsure how serious their osteoporosis was (Besser et al., 2012a) or even believed that they were still at low risk for osteoporosis (Rothmann et al., 2014).

Prevention. There is ambiguity about osteoporosis prevention amongst study participants. Many were unaware of their risks, how osteoporosis is diagnosed, and benefits of taking preventative medications (Besser et al., 2012a; Hansen et al., 2017; Rothmann et al., 2014). Initiation of medication is difficult, but even those who are on medications may stop because there are no outward signs of the disease progressing. Others have poor medication adherence due to unwanted side effects (Besser et al., 2012a), therefore, individualized education is warranted to improve compliance. When diet (dairy consumption) and physical activity was discussed, it was mentioned in regards to maintaining health, not osteoporosis prevention (Alami et al., 2016). Patients waited for the physician to discuss osteoporosis; if it was not discussed, patients perceived osteoporosis prevention as not important (Beaton et al., 2012). It was also mentioned that osteoporosis could be prevented by being more careful and not falling (Besser et al., 2012a). A participant in the Hansen and colleagues (2017) study stated “I do not know what to do about it, so I don’t do anything. I missed instructions. I hardly know what osteoporosis is. That’s probably why it does not make as much impression on me” (Hansen et al., 2017).

For some, bone mineral density tests were never discussed with their health care professional (Alami et al., 2016; Beaton et al., 2012). Others who underwent a bone mineral density scan found the scan to be reassuring since there was no symptoms of osteoporosis (Hansen

et al., 2017; Rothmann et al., 2014). These women saw it as a chance to prevent osteoporosis. In contrast, some declined a bone mineral density screening due to their perception of their body being healthy as they were physically active, followed a healthy diet, with no fractures, and no family history. Besser and colleagues (2012a) found drawings of osteoporosis evoked emotions; thus, visual images may aid in education on risk prevention.

Risk perceptions. Risk perceptions varied among participants. Once diagnosed, some participants believed their symptoms correlated to their bone health. Other study participants believed their symptoms were not related to osteoporosis. Despite a diagnosis of osteoporosis, participants commonly stated they had no emotion related to osteoporosis because it didn't have much effect on their daily lives (Besser et al., 2012a). Women denied screening due to their perceived low risk for osteoporosis (Rothmann et al., 2014), which indicates a limited knowledge about osteoporosis and its risk factors. Osteoporosis was not taken seriously, even after a fracture; participants stated their healed fracture indicated strong bones (Rothmann et al., 2014). Even more alarming, participants were more likely to focus on other health concerns especially if they had no symptoms of osteoporosis (Hansen et al., 2017; Nielsen et al., 2013). In general, osteoporosis is not considered life threatening or as serious a diagnosis as cancer (Alami et al., 2016; Rothmann et al., 2014). One woman stated "One would think more about it (osteoporosis) if it was a different disease... if it was cancer, then I would think more" (Rothmann et al., 2014).

Physical appearance and history of falls also played a role in risk perception, as some described their appearance as healthy, youthful, and they were able to fulfill their professional and family roles so they perceived very little risk of osteoporosis (Alami et al., 2016; Rothmann et al., 2014). Participants expressed an underlying belief that risk for osteoporosis was mitigated due to physical activity and eating healthy calcium rich foods. Participants from Rothmann and

colleague's study (2014) stated "I do have a straight back" (p. 192) and another referred to a fall she had taken without breaking her hand, "I must be made of something solid.." (p. 192). Despite the lack of perceived risks, fears of being wheelchair bound, fracture, falling, and of a curved spine were all grave concerns (Besser et al., 2012a).

To the extreme opposite, some perceived their risk of osteoporosis and future fractures to be so great that they were fearful, especially of falling, and stayed in their homes where they felt safe (Beaton et al., 2012). Participants described their diagnosis of osteoporosis after a fracture to be a shock that led to anger, sadness and fear; fear that led some to seek out treatment. These participants hoped for success in the treatment they were receiving, but also feared the unpredictable consequences of osteoporosis such as losing mobility, being reliant on others, and falls that cause fractures (Nielsen et al., 2013). Others feared their physical appearances and how they would look due to osteoporosis (Beaton et al., 2012). Those who expressed fear regarding osteoporosis sought out sources of information in health professionals, written material, friends, family, and others who had a diagnosis of osteoporosis. Others sought out screening for reassurance (Rothmann et al., 2014).

Quantitative and Qualitative Limitations

Methodological limitations included issues with sampling, design, data collection and measurement, and confounding variables. Studies used convenience sampling (Bredella et al., 2017) or data bases (DiGiorgi et al., 2008; Lu et al., 2015; Nakamura et al., 2014; Rousseau et al., 2016; E. W. Yu et al., 2017), and observational designs (Bredella et al., 2017; Casagrande et al., 2012; Costa et al., 2015; Gómez et al., 2009, 2009; Guney et al., 2003; Mahdy et al., 2008; Olmos et al., 2008; Vage et al., 2004; Vilarrasa et al., 2013, 2011). These limitations compromise the

reliability of the study, making reproducibility of findings difficult (Anderson, 2010)(Anderson 2010).

The studies reflect only the population of those mostly having the surgery (Alami et al., 2016; Besser et al., 2012a; Carlin et al., 2009; Casagrande et al., 2012; Gómez et al., 2009, 2009; Groven et al., 2010; Hansen et al., 2017; Ivezaj et al., 2012; Magdaleno et al., 2011, 2010; Natvik et al., 2015; Rothmann et al., 2014; Tsiftsis et al., 2009; Vage et al., 2004; Vilarrasa et al., 2013, 2011) and included only Caucasian (Gómez et al., 2009; Groven et al., 2010; Natvik et al., 2013; Vage et al., 2004; Vilarrasa et al., 2009, 2011). A few studies sampled only urban communities, (Nielsen et al., 2013) and used non- randomized groups (Fleischer et al., 2008) all of which limit transferability (Trochim & Donnelly, 2008).

Several other sampling problems emerged. None of the authors reported power analysis, but several did state that their sample size was small and more studies were needed with larger sample sizes (Bredella et al., 2017; Casagrande et al., 2012; Fleischer et al., 2008; Frederiksen et al., 2016; Olmos et al., 2008; Shanbhogue et al., 2017; Vilarrasa et al., 2013, 2009, 2011; von Mach et al., 2004). Rothmann and colleagues (2014) noted a small sample of participants with an actual diagnosis of osteoporosis. Small sample sizes resulted in low statistical power; however, large sample sizes would be difficult due to cost of lab and DXA testing. Retrospective designs (DiGiorgi et al., 2008; Rousseau et al., 2016; E. W. Yu et al., 2015), or lack of data (Shanbhogue et al., 2017; Vilarrasa et al., 2013, 2009, 2011) lead to incomplete information that would have provided a more complete picture of bone health. For example, absence of data on osteoporosis prevention activities, may have played a role in the observed bone changes, or lack of identifying clinical spine fractures may have caused an under estimation of fractures. Several important

confounders, such as perceptions of osteoporosis risk, medication compliance, or dietary intake of calcium and vitamin D, may affect bone health or risk for fractures or falls.

Compliance was not addressed in every study. Two studies used questionnaires for dietary recall and activity (Carlin et al., 2009; Casagrande et al., 2012), however, this relied on the patient's memory which has the potential for inaccurate information based on memory, or under or over reporting of information. Information on how these questionnaires were conducted was not available. Studies noted noncompliance with oral intake of vitamin D (Carlin et al., 2009) or incomplete follow up (Carlin et al., 2009) which would also lead to inaccurate information. Attrition was also an issue for one study (Casagrande et al., 2012).

Data analysis and measurement was noted to be a limitation in some studies. A few authors mentioned the discrepancies between DXA measurements for bone densities versus use of QCT, in that DXA measurements may have not been the most accurate in obese individuals (Casagrande et al., 2012; Fleischer et al., 2008; Vilarrasa et al., 2013, 2009, 2011). Other limitations to analysis include not recording and transcribing interviews (Ivezaj et al., 2012) and translating interviews from Norwegian to English (Lier et al., 2016), jeopardizing credibility (Lincoln & Guba, 1985).

Cofounding variables was a major limitation found in these studies. Researchers failed to control or eliminate confounding variables, which damage the internal validity of the study (Burns & Grove, 2009). Although limiting all confounding variables would be difficult, a few authors did express this to be a limitation to their study (Frederiksen et al., 2016; Lu et al., 2015; Rousseau et al., 2016; Vilarrasa et al., 2013).

Quantitative and Qualitative Gaps in Knowledge

The literature review revealed that the current body of knowledge related to osteoporosis in those who had bariatric surgery is limited to quantitative data. Despite the knowledge of

deteriorating bone health and increased risk of fractures after bariatric surgery, the literature is silent on how those who have experienced bariatric surgery perceive the risk of osteoporosis or attitudes and beliefs towards preventative measures. Separate reviews of bariatric surgery and osteoporosis give some insight, but a complete understanding of osteoporosis from those who have experienced bariatric surgery needs to be explored. This literature review identified multiple misunderstandings about osteoporosis, indicating that, patient specific information to address individual needs is warranted, especially after bariatric surgery. Research in the field of osteoporosis needs to focus on bariatric surgical patients' own perceptions. This type of research calls for the use of a qualitative research method to give voice to this population.

As mentioned previously, calcium and vitamin D deficiency is prevalent even before surgery. Regardless of supplementation, patients are still found to be deficient postoperatively (Vilarrasa et al., 2013) which suggests adequate doses should be individualized (Flores et al., 2015), or perhaps the compliance and barriers to taking calcium and vitamin D should be examined to clarify. Digiori and colleagues (2008) stated compliance with supplementation of calcium and vitamin was assessed during patient's interviews, however, nothing was reported. Likewise, Rousseau and colleagues (2016) stated they were unable to assess compliance with supplementation and physical activity. Carlin and colleagues (2009) reported a 14.3% non-compliance rate. Of the patients in the study group, 39% did not achieve an optimal 25OHD serum level of 30ng/ml. Three of the 21 patients were noncompliant with the high dose therapy during the final six months of the study.

Nurses need to assist bariatric surgical patients regain control of their health post operatively. Even those not going through bariatric surgery and being diagnosed with osteoporosis, had incorrect or conflicting knowledge and understanding of osteoporosis. The literature review

proposes that those with a diagnosis of osteoporosis deal with this chronic condition in diverse ways based on their knowledge, which suggests bariatric surgical patients would deal with osteoporosis in a unique way as well. This study contributes to the current body of knowledge by describing bone health perceptions, maintenance, or lack thereof those behaviors in individuals who had bariatric surgery, which to date has not been done.

In a most recent study, Yu et al. (2017) stated less than 4% of their subjects had a preoperative bone density test, 11% of RYGB subjects, and only 9% of adjustable gastric banding subjects. For some of those diagnosed with osteoporosis, a bone density was found to be reassuring and seen as a preventative measure (Hansen et al., 2017; Rothmann et al., 2014). This validates a need to understand from the patient's perspective why a bone density test is not being done. This study describes the intent to become aware of and improve osteoporosis from those who have experienced bariatric surgery.

To date, no qualitative studies exist describing the lived experience of osteoporosis in individuals who had bariatric surgery. This study, using phenomenology methods, contributes to the current understanding of bone health perceptions in individuals who had bariatric surgery by giving this understudied population an opportunity to describe their experiences in their own words. This study brings to light unknown features regarding their lived experiences and builds on our understanding of how prevention programs can better serve and enhance osteoporosis prevention efforts at an individual level.

CHAPTER 3

METHODOLOGY

The purpose of this research was to examine the lived experiences of being at risk for osteoporosis, in people who have had bariatric surgery. The specific aims were to understand:

1. what it means to live with the risk of osteoporosis after bariatric surgery
2. the perceptions of osteoporosis risks postoperatively

Interpretative Phenomenology

Interpretive phenomenology or hermeneutics is based on the philosophy of Martin Heidegger and is useful for understanding the meaning of a phenomenon from the perspective of those living it (Cohen, Kahn, & Steeves, 2000; McCaslin & Scott, 2003). Heidegger believed the lived experience is an interpretive and shared process for understanding. Within this philosophy, an emphasis is placed on the ability of the individual to construct meaning around their experiences. Thus, researchers attempt to get a better understanding what an experience is like for those living it. Interpretive phenomenology is an active process in which the meaning of a lived experience is elicited from participants through the stories they tell, so researchers can understand what it is like to live with the phenomenon (Pietkiewicz & Smith, 2014).

This study used interpretive phenomenology to investigate the perceptions of osteoporosis from a bariatric surgical patient. Interpretative phenomenology provides a deeper understanding of individuals who had bariatric surgery, which can lead to the development of future interventions regarding osteoporosis awareness and prevention. Understanding the individual experiences of people at risk for osteoporosis after bariatric surgery may impact how nurses interact with patients and deliver care.

Method

Sample. This research used purposive and snowball sampling to recruit individuals who were at risk for osteoporosis and had bariatric surgery. Purposive sampling is useful because it targets individuals living with the phenomenon (J. W. Creswell, 2013). Snowball sampling allows participants to invite other eligible individuals they know to contact the researcher (Munhall, 2007). Eligible participants were women over the age of 18 who understood and spoke English and had bariatric surgery, putting them at increased risk for osteoporosis (Nakamura et al., 2014; Rousseau et al., 2016). Individuals who were cognitively impaired or had a known diagnosis of osteoporosis were not eligible for this study.

Phenomenology uses in-depth interviews to collect extensive detail about the phenomenon of interest from the perspective of those living with the phenomenon. The final sample size for phenomenological research can only be estimated a priori; small sample sizes are common with recommendations ranging between 3 to 25 participants (J. Creswell, 1998; J. W. Creswell, 2013; Morse, 1994). Sample size in qualitative research is influenced by how many interviews are necessary to meet the study's aims (Baker & Edwards, 2012). Also, estimated sample size depends on the homo- or heterogeneity of the sample (with a heterogeneous samples requiring a slightly larger samples to draw out differences), and the ability to achieve data saturation. Data saturation occurs when no new information about the phenomenon is uncovered during data analysis (M. Mason, 2010). For this research, fourteen heterogeneous post-bariatric surgical patients participated in one individual face to face interview; four of these participants were interviewed a second time to clarify their comments and enhance the richness of the data.

Participants in this study were female adults between the ages of 29 and 72. The majority of the participants were Caucasian (n= 13). Annual family incomes were reported as low as

\$10,000 and as high as \$ 149,000 with most participants reporting incomes between \$ \$35,000 and \$39,000. The highest level of education achieved by the sample was 14% (n=2) master's degree, 28% (n=4) earning a bachelor's degree, 21% (n=3) earning an Associate's degree. Other levels of education included 14% (n=2) having some college credit but no degree, 14% (n=2) earning high school graduate, diploma, or equivalent and only 10% (n=1) completing trade/technical/vocational training. Most of the participants were married (71%; n=10), while 21% (n=3) were single and 7% (n=1) were widowed. Years since surgery varied from less than 1 year to 5 years. Four participants (29%) reported having a bone scan either before or after surgery. Participant demographics are summarized in Table 1.

Recruitment

Recruitment took place at a bariatric center in Northeast Ohio. Two recruitment sites, one rural and one urban, were selected to achieve better representation of the population; however, only the patients at the bariatric center consented to participate. Flyers were hung at both locations and at both offices staff were educated about the study. However, at the orthopaedic center, there was a limited number of patients that had bariatric surgery and they were not interested in participating in the study. The bariatric center sees approximately 500 bariatric surgical candidates annually and performs approximately 10 surgeries per week. Letters of support for the study were provided by two surgeons. (APPENDIX A & B).

Approval was obtained from the Kent State University Institutional Review Boards (IRB) prior to initiating the study. Recruitment was done via flyers (Appendix C), nursing staff, and word of mouth. Flyers described the study purpose, eligibility criteria, and participant incentives. A telephone number was provided so potential participants could contact the investigator. Flyers were hung in key locations where potential participants would see them, such as bariatric centers,

orthopaedic clinics, and hospitals. The investigator met with staff at the bariatric center to describe the purpose of the study, answer questions, and ask for their help in recruiting participants who meet study criteria. A recruitment script was provided to staff to assure that patients receive consistent and standardized information (Appendix D). The investigator was available at the centers one day a week to recruit eligible patients and answer questions. However, on days when the investigator was not at the surgery center, the staff notified the investigator of potential participants and conveyed participant contact information. The investigator contacted eligible patients by telephone, answered their questions, and verified they meet the inclusion criteria (Appendix E). Eligible patients were invited to participate in the study and an appointment to meet for interviews was scheduled at a time that was convenient to the patient and investigator.

Prior to beginning the interviews, the investigator discussed informed consent (Appendix F) with potential participants, including the risks and benefits of participation, the right to abstain or withdraw from the interview at any time, and the right to refuse to answer any questions without risk to their healthcare services. Once all questions were answered, written consent was obtained. Participants received a copy of the consent.

The participants completed a brief demographic questionnaire (Appendix G) including the person's age, gender, marital status, surgical procedure, years since procedure, ethnicity, education level, household income, occupation and if they have had a bone scan. Finally, a questionnaire asking if participants would like a copy of the findings was completed (Appendix H).

Although the investigator has clinical experience with osteoporosis patients, she does not have experience conducting qualitative interviews with bariatric patients. Therefore, prior to conducting the first interview, the investigator conducted a mock interview with the dissertation chair.

Setting

The investigator conducted individual interviews in person in private rooms at the bariatric center. Participants were attending their follow up appointments and were asked at the end of the appointment if they would like to participate in the study. Before the interviews took place, the women signed consent forms agreeing to be interviewed and audio taped. The interviews were conducted between January 31 and May 14, 2019 and lasted from 15 to 55 minutes. The duration of the interviews was decided primarily by the participants and what they had to say. The interviews were conducted using open-ended questions that asked the participant about their perceptions of osteoporosis, awareness of risks, and attitudes and beliefs toward prevention. The participant's narrative guided the interviews, further funneling the interviews down to more specific questions based on the participants' previous responses. All participants provided rich descriptions of their day-to-day lives after bariatric surgery and living with the risk of osteoporosis. Many articulated an in-depth understanding of their perceived osteoporosis risks post-operatively. An interview guide that was evidence-based and addressed the study aims was developed for this study (Appendix I). However, the need existed to remain flexible and responsive to each participant's experiences. Nudging (e.g., "can you tell me more...") and reflective probes (e.g., "how did you feel when....") was used to maintain focus, gain clarity, and deepen the meaning of participant's stories (Minichiello, Aroni, & Hays, 2008). Interviews were digitally recorded and transcribed verbatim by the interviewer. At the conclusion of each interview, the investigator asked each participant if she experienced any distress. If distress occurred, a counseling resource sheet was available (Appendix J) and participants would be referred to the practitioner at the bariatric center. None of the participants reported experiencing distress. Participants were asked for permission to contact them for follow up questions and were thanked for their time. After the

participant left, the researcher created field notes of observations made about the interaction such as facial expressions, hand gestures, and other non-verbal communication. Field notes are useful for creating a holistic picture of the phenomenon (Munhall, 2007). The interviews were digitally audio recorded and transcribed verbatim by the investigator.

Human Subjects Concerns

Compliance and adherence to professional ethical standards was maintained during the study. The protection of the welfare of human subjects recruited to participate was addressed by assuring confidentiality, assessing and managing emotional distress, and understanding the risks and benefits from participating in the study.

Confidentiality. Individual's contact information was kept in a locked file cabinet in the dissertation chair's office at Kent State University, College of Nursing. Confidential electronic information was stored exclusively on an encrypted password protected Blackboard site. Participants were informed that confidentiality would be maintained, although individual anonymous quotes might be used as exemplars and the findings would be presented in aggregate.

Emotional distress. At the conclusion of the interview, the investigator asked participants if they experienced any distress. For distress, a counseling resource sheet was available (Appendix D) and participants would be referred to the practitioner at the bariatric center. Participants would be instructed to contact their health provider if they became distressed after the interview as well. Participants' questions were answered, and appropriate referrals could be made. None of the participants reported distress at the end of the interviews.

Risks vs benefits. Education regarding the risks versus benefits of participating in the study was provided to each participant. There were no anticipated risks beyond those encountered in everyday life. Participants were assured that participating or not participating in the study would

not affect their care at the bariatric clinic. Benefits of participating in the study included catharsis, or being able to express one's feelings and thoughts, sense of purpose in sharing information that increased the awareness of osteoporosis, and a sense of empowerment which encouraged them to speak in their own voice regarding osteoporosis (Hutchinson, Wilson, & Wilson, 1994).

Data Management and Analysis

Each participant was assigned a participant number which was included on all written materials. Transcripts were de-identified by replacing any identifying names or details with pseudonyms. Consent forms were separated from the data and stored in a locked file cabinet located in the dissertation chair's private office at the Kent State University's College of Nursing. Data will be stored for five years per university policy. Audio files were destroyed after the transcripts were verified for accuracy. All other data, including transcripts and demographics, were stored electronically on a dedicated and password protected Blackboard site accessible to only the investigator and her dissertation chair and committee. The investigator printed hard copies of the de-identified transcripts and an aggregate of all participant demographics for analysis.

Each of the study aims was addressed using strategies outlined by Diekelmann, Allen & Tanner (1989). This included a process that examined data for meanings that emerge implicitly or explicitly in the participants' stories. Data was compared to explain and identify categories, relational themes, and constitutive patterns. This process guided the research team back and forth through the data to highlight meanings and interpretations, while providing a systematic structure to uncover unsupported meanings and inaccurate interpretations. In alignment with Diekelman's stages of analysis, the researchers followed a specific stepwise procedure to meet the study aims:

Aim 1: to understand what it means to live with the risk of osteoporosis after bariatric surgery.

Aim 2: to understand the perceptions of osteoporosis risks postoperatively.

Step 1. Each researcher individually examined all transcripts to gain an overarching understanding of what was being said and wrote a summary and title for each transcript.

Step 2. Each researcher identified categories and supported those categories and interpretations with excerpts from the transcripts. During this stage, the research team met, shared, and discussed identified common and differing meanings and categories. Unique findings were discussed until consensus was reached.

Step 3. The categories were further investigated by each team member checking, for similarities and differences amongst interpretations. Each team member was responsible to explain inconsistencies by returning to the raw data for clarification.

Step 4. Researchers identified relational themes, which are key themes repeated across transcripts. These themes emerged as the researchers read through all text created in previous stages, highlighting similarities and differences of meaning and redefining categories. If contradictory meanings were noted within the text, the research team provided support for why the relational theme was chosen.

Step 5. Researchers compared and interpreted the relational themes and connected them into constitutive patterns, the highest level of analysis, and highlighted associations between relational themes.

Step 6. Finally, excerpts from the participants was used as exemplars to provide further validation of the findings.

Evaluation Framework

The scientific rigor of this study was assessed using Lincoln and Guba's (1985) criteria for trustworthiness. Ensuring trustworthiness is additive to the overall integrity of qualitative research

and consists of four components: (1) credibility, (2) dependability, (3) confirmability, and (4) transferability.

Credibility refers to the truthfulness and accuracy of the data. Strategies to ensure credibility for this study included the researchers' prolonged immersion in the data and peer debriefing. Data immersion is achieved by conducting an adequate number of interviews and spending ample time reading and reflecting on the data. Peer debriefing occurs when researchers ask questions of peers to uncover biases or assumptions that may have occurred during analysis (Lincoln & Guba, 1985). Peer debriefing was an ongoing process during data analysis meetings with the research team. Peer debriefing provided opportunities to talk through the interpretations with the research team to verify conclusions and explore aspects of the findings that might otherwise have not been clearly expressed (Lincoln & Guba, 1985). Through peer debriefing bias was minimized, new ideas developed, and discussions provided opportunities for more in depth reflections on the findings. Denzin and Lincoln (1994) attest that peer debriefing enhances the credibility of the findings.

Dependability refers to the reliability of the data or its applicability to the phenomenon over time and in different contexts and conditions. To assure dependability, a detailed report of the methodology as well as a reflexive journal of analytic decisions was kept. This accounted for any changes to the research design as the research study progresses, allowing other researchers to decide if proper research methods were followed and for replicating another study.

Confirmability is the degree to which researchers agree upon the findings and ensures that the findings are grounded in the data. A detailed audit trail consisting of field notes, memos, and reflexive journaling was kept along with a comprehensive record of the data analysis process to support the study findings and claims. An audit trail records all research decisions and activities

throughout the research process (Koch, 2006). Audit trails help the reader to evaluate the events, influences and actions of the researcher. NVivo 12 was used to manage the data. Also, the dissertation chair, who has many years of experience in qualitative research, assisted the investigator in the interpretation of the data.

Transferability is the ability of the findings to be applied to other groups and settings. Transferability lies in the hands of the reader and the decision of applicability. The researcher's job is to present ample descriptive data to allow for comparison. The results of this study have applicability only to women who have had bariatric surgery. Demographic details describing the participant characteristics were collected and can be used to assess the applicability to other groups or clinical settings. An adequate number of participants as well as a diversified cohort were interviewed to increase transferability.

In summary, this study aimed to investigate and describe the phenomenon of living with the risk of osteoporosis in those who had bariatric surgery. A qualitative method was chosen to explore the patients' perspective of osteoporosis, and to highlight where improvements in osteoporosis prevention could be made. With a better understanding from the patient's perspective, researchers will be well positioned to develop more effective osteoporosis prevention strategies preoperatively to support and educate those undergoing bariatric surgery.

CHAPTER 4

FINDINGS

Participants in this study described a lived experience of looking out for self in regard to their bariatric surgery, but not in regard to osteoporosis prevention. Participants described their knowledge for needing help to lose weight, their research leading up to their surgery, and the lack of understanding about osteoporosis. Participants went on to describe how they were engaged in protective behaviors from unwanted judgmental comments, the challenges they faced preoperatively and monitoring themselves after surgery. Finally, in preventing osteoporosis, participants described their medication regimen, why they engaged in exercise and the barriers they had to prevention. Barriers included a high focus on protein intake, dealing with internal emotions and the myths behind osteoporosis. Creating an urgency about osteoporosis may come from further education regarding the “why” behind taking vitamins and the risks of surgery.

Findings are described under the relational theme of Looking out for Self, and supported by three subthemes, Understanding, Protecting, and Preventing.

Looking out for Self

A relational theme cuts across all texts (Diekelmann et al., 1989) and represents the overall picture of the lived experience of the participants. Looking out for Self was clearly noted through all transcripts and can be depicted by how the participants asked for help with their weight loss, how they made a lifelong commitment to their health, and how they chose self first. Some participants were looking out for self more than others; however, every participant engaged in looking out for self behaviors to some degree.

Looking out for self began with asking for help. Many participants described a “yoyo” effect with success followed by failed attempts with diets prior to surgery. Over time participants

realized they needed help with weight loss and couldn't manage weight loss on their own without the proper "tools". For many of the participants, surgery wasn't seen as the "cure" or a quick fix but rather a means to help them. Many stated after failed attempts on their own to lose weight they needed help. Sandra describes her need for help,

"I need help, yeah so it was a tool that I needed, so I chose it. I just felt like I need help. I couldn't do it on my own. I needed, even though I lost the 40 pounds, like I needed something. It was just so out of control that I needed help. I needed help to do it, 250 that's a lot of weight and I felt that I needed help."

Abby described how important it is to look out for self to a friend who was preparing for bariatric surgery. She told her to "make it easy on yourself" and "take as much work as you can off just so you can think about yourself." Many participants reiterated these same words wishing they would have looked out for self sooner. All participants were glad they chose to have the surgery but wished they would have made the decision earlier in life, realizing after surgery they deserved to have a better quality of life.

After surgery, participants made a lifelong commitment to change how they lived and cared for themselves.

"You know if you're sticking with your vitamins and go to your follow-ups and you know it's a lifelong commitment and I just made that decision I'm going to lifelong commit to this and making myself healthy which includes getting blood work and taking vitamins" (Pam).

When asked what advice they would give someone who is preparing for bariatric surgery Sandra said they need to look at bariatric surgery as a complete lifestyle change. Really stressing the surgery was the "tool" or steppingstone they needed to change their diet, exercise and mindset.

She continued saying before surgery, individuals have to be willing and seriously commit to changing their lives, otherwise the surgery will not be successful. Pam spoke about her lifestyle change as a “job”, something that she really has to “focus” on. However, Abby described how she has made lifestyle changes and can maintain her new behaviors for the rest of her life.

Sue and Abby both made the commitment to transform their lifestyle by investing their own money into the procedure. Both spoke about how much of the expense of surgery was paid out of their own pocket and when “investing that much into it, you want it to work” (Abby). Tamara also had trouble getting insurance coverage and decided to take drastic measures. She described herself at being over 400 pounds and so desperate for the surgery that she cut back her hours to part time thereby reducing her income by more than half, making her eligible for Medicaid to cover her surgery.

All participants described their experiences after bariatric surgery as life changing. Participants chose to make lifelong commitments for themselves, changing the way they ate, exercised and looked out for self. The changes were challenging. Many of the commitments meant they had to make difficult choices which were different than their old lifestyle or what their family or friends would choose. Regina remembers struggling with the diet even prior to surgery. She chose to have her surgery right after New Year’s, which meant no holiday food with family. She recalls family members staring at her plate with a minimally amount of food compared to their large plates of food. She stated at one point she just sat in the living room while everyone else ate. Abby described how she chose to go outside and walk instead of sitting with her co-workers at lunch. This decision was challenging at times because sitting and talking would have been much more enjoyable and sometimes she had to walk in undesirable weather. Looking out for self was

not easy, but the participants in this study illustrated how they were looking out for self by understanding, protecting and preventing osteoporosis.

Understanding

Knowledge and understanding of their bariatric procedure proved to be valuable in the success of each participant's outcome. Understanding bariatric surgery was developed through self-initiated research into the process as well as the educational classes offered by their bariatric centers. Understanding was sought in order to make informed decisions regarding their surgery. Despite the thorough education process, an understanding of osteoporosis risk after surgery was lacking.

Self-initiated research. Despite receiving monthly and ongoing education from their surgeon's office, participants chose to do their own research looking into the various types of bariatric surgery, risk factors, and required lifestyle changes to further their understanding of the procedure and commitment. For some of the participants, research into bariatric surgery started well before seeking out a physician. Katie investigated bariatric surgery three years prior to making the commitment and Tamara stated she initially began looking into the surgery 14 years ago when her mother had bariatric surgery. The decision to have bariatric surgery was not made hastily. The majority (71%) of participants looked for understanding online, however, some looked to others who had a bariatric surgery either online or in person.

Thirteen of the 14 participants did their own research online. "I'm a big internet person myself, I do, do my own research. The doctors definitely explain the procedure. I did watch a couple of videos that I can see on YouTube" (Regina). Others used online media to follow people who already had the surgeries. When asked what kinds of things they were looking to understand, Sandra said she wanted a clear understanding of what to expect during the surgery, how long the

surgery would take, and how she was going to feel after the surgery. She wanted to know what foods she could eat and how they would taste. She even went as far as to research how menstruation would change for her. Jessica who described herself as a person who researches everything stated she used the medical literature to investigate which facilities had the highest success rates and which hospitals had dedicated bariatric units. She also wanted to have a clear understanding of which physicians specialized in bariatric surgery and whether they used a team approach that included a dietitian and psychologist.

Online forums and support groups also seemed to be popular when seeking out understanding both before and after surgery. Dawn, Pam and Sandra all joined online support groups, and Edna joined two groups. Edna stated the groups she belongs to discuss diet specifically and one is more supportive. Sandra, who is 3 years post-surgery, is still in contact with members from her online support group. The support groups included people who just recently had surgery and those who were much further out. Pam found the experience and knowledge from some of the group members to be positive and reassuring. Tamara joined bariatric Facebook groups, however, she found the groups to be more for “entertainment value” than supportive. She questioned the truthfulness of many of the posts. Abby joined Facebook and Instagram, looking for success stories and why they were successful. Two participants researched YouTube for answers. Regina watched two videos and Sue went through YouTube looking for advice from people who shared what they did right or wrong with their bariatric surgery.

Although many participants kept the decision to have bariatric surgery to themselves, others found it valuable to ask others for advice as a way to seek understanding. Heather felt comfortable talking with a couple of friends who had bariatric surgery. Cassie found it easier to talk with someone she didn’t know. Cassie’s close friend and support person introduced Cassie to

a girl he knew in New York who had the procedure done. Cassie spent time texting back and forth asking her questions regarding the surgery.

Understanding osteoporosis. During the participants' extensive journey to increase their understanding of bariatric surgery, either on their own or through the required education classes, most did not read or hear about an increased risk for osteoporosis after surgery. Sue and Heather both only five and six months out post operatively, don't remember hearing the word osteoporosis.

"We were told we were going to have to take it for the rest of our lives, calcium and multivitamins, yeah, but I don't remember actually the word osteoporosis. I remember them mentioning that if you don't have enough calcium it starts taking [calcium] out of your bones" (Sue).

Abby when referring to the required education classes stated, "maybe was one of the conditions that was mentioned but it didn't stand out" and about Facebook blogs, "no one ever talked about that kind of stuff."

There was a general knowledge of the potential for deficiencies in calcium and vitamin D if supplements were not taken, but no understanding of the consequences of those deficiencies. Most participants were unaware of the risk for osteoporosis after bariatric surgery, except the participants who were nurses. Pam read about osteoporosis to further her understanding of the risk.

"I just researched which [procedure] would be better sleeve or the bypass. I really want to make that choice as to which one would be a better benefit for me and then I researched all the complications trying to decide, you know, is this something that I really want to take a chance on, but when I looked at it, I looked at the osteoporosis. I knew that was a thing, but really once I educated myself, as long as you do your lab work and follow up with your vitamins, and stay on top of it, you know, I felt pretty secure with that going forward"

Another nurse, Regina, when asked about her education regarding the risk for osteoporosis, she stated that she received none. She received education on taking calcium citrate every day and the importance of taking vitamins daily. She understood that there is an increased risk of vitamin deficiency after bariatric surgery, so she understood that a depletion in calcium meant a decrease in bone mass.

Most participants had a general understanding of osteoporosis, however, their knowledge was limited to “weakening of bones,” “fragile bones,” and “bones that break easy.” Abby had a little more in-depth understanding.

“It’s like more common in women as we get older our bone density I guess breaks down and if we don’t get enough calcium then it can lead to that guess that deficiency and I guess that’s why women lose height sometimes I don’t know like has to do with getting the hunchback but that’s all I know about it.”

When asked about osteoporosis, six participants used the same exact words “it’s something that I never thought about.” Jessica stated, “Frankly it never crossed my mind before. It’s something I never thought about. I’ve been taking my vitamins and then going on my merry way and not really worrying about my bones.” Dawn stated she learned about osteoporosis when she was younger and in school, but really hadn’t thought about it since. For some participants, other health issues or concerns preoccupied their thoughts. Cassie described how she constantly worried about her health and that she wouldn’t have time to worry about anything else.

Lack of an understanding about osteoporosis was evident throughout the interviews.

“You know I’m not [concerned] I’m really not. I don’t know why, but I’m not. Well you know, I think it’s because that same doctor told me years ago that heavier people don’t have

to worry as much about osteoporosis as a thinner person would have to worry about it and so that kind of stuck in my head. Hey, I'm a fatty, so I don't have to worry about it" (Edna). Interestingly, however, as the interviews progressed and an understanding of the risk of osteoporosis developed, participants began to have some heightened awareness and sense of concern. Regina stated "it's [osteoporosis] on the radar, like a little concerning." Tamara described osteoporosis as "scary". She was concerned that if she developed osteoporosis, her new found physical freedom from losing the weight would be cut short. Pam concurred describing bariatric surgery as a means to get healthier, but if they don't consider osteoporosis, their overall health will not improve. Participants stated they were glad they had been faithful with their vitamin regimens and seemed to show some interest in broadening their understanding of osteoporosis. A few participants left the interview stating they wanted to research symptoms and causes of osteoporosis and how it might be prevented.

Protecting

Protecting oneself from challenges and negative comments was a common theme among all participants. Protecting included shielding themselves from social mishaps, embarrassments, and negative comments associated with not only obesity, but weight loss and bariatric surgery. For some, the act of protecting started in early childhood and continued even after bariatric surgery.

Pre-operative challenges. Participants faced many challenges prior to surgery and made considerable efforts to protect themselves. Some discussed challenges with food and abuse that started in early childhood. The issue of weight was brought to Abby's attention as early as age 4. She began suffering from eating disorders, such as binge eating, in her early teens. Abby described how she would sneak food when she was around her parents. She would try fad diets but then struggled with the limited amount of food choices. At times she felt so overwhelmed with food

restriction and hunger that she would binge eat. She stated her eating eventually “spiraled out of control.” Tamara describes how her father was verbally abusive, commenting on how her pretty face did not match her large body, prompting her to start dieting at a young age. Participants described “yo-yo” diets, losing weight and then gaining it back, starting in early childhood and continuing into adulthood.

Surprisingly, only three participants talked about struggling with weight loss. Katie only referred to being overweight and unable to lose a “significant” amount of weight. Sandra stated she had tried many diets, losing weight just to gain it all back, plus some. Regina also tried many different diets believing she could lose the weight on her own. She would commit to the special diet, such as Adkins, and exercise, only to lose a minimal amount and then gain it back.

Jessica discussed her challenges and the frustrations she had every time she went to her primary care physician, stating that physician assumed every health issue she had was related to her obesity. She gave this example,

“but every time I went into the doctor, [and stated] my arm hurts [the physician would reply] ‘okay we’re going to check you for diabetes’. [I would state] I have a cavity [the physician would reply] ‘ok, were going to check you for diabetes.’ Like every single thing...it's not related, but thank you for being concerned. I’m fat, I’m aware.”

Participants described protecting of self as an ongoing, daily issue that was a constant and relenting challenge. Katie recalled a new physician appointment and where the very first thing that the physician asked about was her weight.

Pre-operative challenges were not just verbal: some experienced physical challenges that were difficult to overcome. Some challenges lead to embarrassment where they felt they needed to protect themselves from public ridicule. “I didn't really want to have to go through almost trauma

associated with trying to find a wedding dress” (Jessica). Tamara had a constant worry about body odor.

“I had to start using aids, mechanical aids to wipe myself, to shower myself, to put my socks on and I didn't even care. I'd stick that wand in my purse and take it with me everywhere I went cuz if I had to go to the bathroom I didn't want to smell, but I couldn't reach to wipe my own butt. I would shower twice a day cuz I've always thought I smelled, but I had to use things to help me wash myself.”

Tamara also talked about other physical challenges such as making it to the bathroom in time. At her heaviest weight, she described not being able to control her bladder or physically be able run up the stairs to make it to the bathroom. Her only choice was to wear an adult brief. She described how difficult it was to be physically intimate.

Other physical challenges included just walking. Edna chose not to leave her house for fear of public ridicule. Edna found it difficult to walk short distances and described a low self-esteem regarding her body image. Kathy struggled with ambulation, using a walker and eventually ending up in a wheelchair. Despite Cassie's young age of 35, she was also challenged by walking, due to profuse sweating and back pain. Many of the participants identified these challenges as what lead them to bariatric surgery.

The easy way out/the real way. Once the decision was made to proceed with bariatric surgery, all participants stated they did not tell everyone about their decision. Participants described the public perception of bariatric surgery as the “easy way out” or not “the real way” to lose weight. Participants described a stigma associated with bariatric surgery that surgery does not take hard work or that surgery somehow makes it easy to lose weight when in fact participants stated weight loss after surgery takes a constant physical and mental effort. “I still, even though I

would tell patients no, there was still a stigma that you couldn't accomplish it on your own or people perceive it as being the easy way out, which is absolutely not so” (Regina, registered nurse). Dawn also supported this notion, “that it's [surgery] not like the easy way, cuz it was very hard decision and a hard process to go through. It wasn't easy”. Abby added “Everyone thinks they're a weight loss expert and just then once you do lose weight people are judging you, oh it's just cuz you had the surgery and they haven't looked at all the hard work you've done.” Katie stated she too initially thought bariatric surgery was “the easy way out” until her primary care physician discussed the benefits of surgery. .

Don't tell everyone. Interestingly, participants knew about the stigmas and negativity associated with bariatric surgery even prior to making the decision to move forward. For fear of having to defend oneself against the comments, participants carefully chose who they told. Sue stated she decided not to tell anyone she knew who would have derogatory comments after her surgery. Dawn didn't want the negativity that she knew surrounded weight loss surgery. Dawn described how weight loss is a mental challenge as well as physical, rebutting the public perception that weight loss can be done with just hard work.

Even family and friends were considered in the decision of who to tell and not tell. “I didn't even tell my sisters, I still haven't” (Jessica). Likewise, Tamara didn't discuss bariatric surgery with her sister until sometime after surgery. Cassie decided not to tell her family right away for fear they would try to talk her out of proceeding with surgery. Abby chose not to tell anyone, even her husband, until shortly before the surgery.

“Actually, didn't tell anyone. I was going to go through the process just because, even though my husband knew I was overweight he didn't know I was 300 pounds and I

don't think he knew the extent of like my internal struggle of how I felt about myself. And

I didn't kind of want to bring it up to him and just kind of admit that I'm this fat.”

Even after surgery, participants are still choosing to protect themselves from negative comments.

“I still haven't told many people. I mean I'm telling more and more especially when they see me, you know” (Edna).

Preventing

When asked specifically about osteoporosis prevention measures, very few purposefully engaged in preventive behaviors for the purpose of preventing osteoporosis. The majority of participants (79%) described engaging in prevention behaviors in terms of exercise, vitamin regimens and diet for weight loss, following bariatric surgery guidelines, and for overall health reasons, but not to prevent osteoporosis. By engaging in these behaviors participants describe how they were protecting themselves from weight gain and unwanted side effects of surgery, but made no reference to osteoporosis prevention. Although still looking out for self, participants did not have any sense of urgency regarding bone health. Participants stated osteoporosis prevention was more of a “reactive” approach as opposed to “proactive.” Reasons for not being concerned with osteoporosis included no family history, consumer of dairy, taking calcium, and young age. With osteoporosis, there is no feedback loop, making it difficult to initiate and maintain preventative measures.

Challenges with vitamins. Participants stated they take supplemental vitamins after surgery because of absorption issues and to prevent deficiencies, however, only two participants (14%) really knew that calcium and vitamin D deficiencies would lead to osteoporosis. Pam and Lori both nurses, understood the importance of calcium and vitamin D. However, Dawn’s

understanding of taking vitamins after surgery was due to not consuming or absorbing enough calcium and vitamin D through food.

Participants discussed many challenges with taking the vitamins, such as forgetting to take all of them, certain vitamins making them sick, cost of the bariatric vitamins, and not taking certain vitamins at the same time. Regina described a time five years after surgery when she would forget and not worry about taking her vitamins. She perceived herself as healthy because she was eating well, and felt good, therefore she didn't believe she needed to take her vitamins. At a follow up visit, her labs came back low and she was anemic, which prompted her to start taking the vitamins again. Regina stated she hasn't missed a vitamin since. Tamara stop taking her calcium because she assumed it was making her ill. After talking with her provider, they concluded it was the iron causing her symptoms, so she promptly started taking her calcium again. Tamara explained that now she is diligent about taking her calcium and other vitamins.

When talking about vitamins designed specifically for bariatric surgery, Kathy stated she purchased them initially after surgery, but then stopped because they were too expensive. Kathy now takes vitamins that she buys at a local store. Eighty-eight percent of participants with an annual income of less than \$40,000 continued to take their vitamins daily. Cassie discussed how initially after surgery taking vitamins was challenging, "it was difficult when I was taking the other medication... you had to be two hours from this, an hour from that. That was a little more difficult." She stated she has found a routine now and is faithful with taking her vitamins. Edna had no trouble remembering to take her vitamins, but she did find timing and routine challenging. "Well I don't take them at the same time every day, but I take lots of medicine."

Four participants stated a pill box was helpful in keeping their daily vitamin regimen. "I have a pill box, I take them every day. I don't miss. I'm very loyal" (Sandra). "It's habit, I have a

little pack that I bring with me. That's my Sunday night routine, is I fill up my little vitamin pack and it just stays in my purse" (Jessica). Abby found her phone alarm to be the most helpful in terms of remembering to take her vitamins. Abby stated during the day she would forget to take her calcium because it was out of sight inside her desk. Now, Abby sets her phone alarm, so she doesn't forget.

Why exercise. Participants said they exercise to lose weight and maintain health. "Burn calories and stuff like that and keep your muscles active and stuff like that" (Sandra). "Keep me active, well it just helps you feel better, keep your body, you know, lubricated. I guess keeps you going and for the weight loss" (Sue). Pam stated her overall goal with exercise is to be healthy, but described weight loss as an added bonus. Pam said later in a subsequent interview, "I really do focus on a lot of walking, I do a lot of walking, so I'm trying to maintain an exercise regimen not only to help with this [healthy lifestyle] but to keep my bones strong." Lori does not like exercise but enjoys walking. She stated she wants to like exercise because, "I know it impacts a person's risk for osteoporosis." For many participants, walking was their main form of exercise. Regina stated she found walking was easier than aerobics initially after surgery. From walking she progressed to a recumbent bike and biking around her neighborhood. Tamara who struggled with walking before surgery, now feels accomplished to walk, even if it's only a mile. For Tamara, and others, walking any length of time is a new accomplishment.

Two participants did not engage in exercise at all. Edna recalls her surgeon stressing the importance of exercising and walking, however, she doesn't. She understands that if she exercised, she would lose a "little more weight," "keeps your blood flowing," and "makes you a healthier person" but she has trouble finding the motivation. Edna stated she would be likely to engage in walking if her husband and dogs would join her. Of the participants who were single or widowed,

3 of the 4 (75%) did not engage in weight bearing exercise. Kathy exercised prior to surgery to lose the needed pounds required to have surgery, but since her surgery she has not exercised. When asked what keeps her from exercising, she states, “being lazy.” Kathy does clean and do housework.

Two participants were engaged in weight bearing exercises with an impetus for muscle tone, not knowing it contributed to their overall bone health. Dawn originally joined a gym for fear of extra hanging skin, but now she lifts weights to maintain muscle tone. Abby also joined a gym to start building muscle. She too had loose skin and is considering skin removal surgery.

Barriers to osteoporosis prevention. Participants described a strong focus on self in regard to diet and emotional health, but a focus on osteoporosis prevention was hindered by a lack of education. “It was really, the emphasis was really on you have to be on vitamin supplementation and you have to be on it for the rest of your life, not necessarily the reason why” (Katie).

“Well honestly, I'm thinking back because, we used to do the packets for pre-op teaching and I'm kinda going over things and I don't know that we ever included that [osteoporosis], which is a major deal if your teaching people from the get-go and I don't know even at the information sessions. Honestly, I feel kinda not educated as well on osteoporosis” (Regina, registered nurse).

When the participants were asked if they consider or think about osteoporosis prevention in their daily lives, they describe being more concerned about other health issues. “No, I don't really think about it. No, it's just something I've not thought about it, I worry about every little tiny thing in my life and that maybe something it just slips by” (Cassie). Additionally, Cassie describes her constant worry of trying to lose weight. “trying to get my weight off.” A side by side comparison of participants and their osteoporosis preventative behaviors is shown in Table 2. Most of

participants (86%) did not view vitamin intake and weight bearing exercise as preventing osteoporosis.

Besides education, other barriers to prevention include perceptions on the effectiveness of medications, cooking challenges, and injuries. Katie questioned the effectiveness of her husband's osteoporosis treatment because his laboratory reports were not improving. Ankle and back injuries prevented two participants from engaging in exercise. A few participants discussed the challenges of cooking for just one or two people and convenient meals would be an easier option than planning healthy meals. In addition, all participants met barriers to osteoporosis prevention with an extreme focus on a protein rich diet, post-operative emotions, and myths of osteoporosis.

Protein helps the body maintain and build muscle mass. For those who had bariatric surgery and are on a low-calorie diet, protein is essential to maintain muscle mass during rapid weight loss. Protein also helps the body heal from surgery wounds, increases satiety, and enhances weight loss (Faria, Faria, Buffington, de Almeida Cardeal, & Ito, 2011). Patients have a thorough understanding of these concepts from their pre-operative education classes. Typical protein consumption recommendation is 60 grams daily and up to 1.5 grams/kilogram ideal body weight per day (Mechanick, Youdim, Jones, Garvey, Hurley, McMahon, Heinberg, Kushner, Adams, Shikora, Dixon, & Brethauer, 2013). In this study, fourteen out of 14 participants stated their dietary focus was protein. When asked about their dietary regimen protein was the first thing they mentioned, and oftentimes stated protein was their sole focus.

“I focus on protein. I do get fruits and vegetables in, but after I get the protein. So, I eat like chicken, broccoli, and blueberries. So, I'll eat all the chicken first just to make sure I have that and then start the vegetable and the fruit” (Dawn).

Dawn lifts weights and drinks protein shakes to build muscle. The participants were so knowledgeable on protein intake that they went to the extent of even counting their daily consumption of protein.

“I'll have a protein yogurt that has 15 grams, the Oikos for lunch. A pretty common thing, a Lean Cuisine that has like chicken and vegetables and maybe like it has some noodles or rice or something like so it's more balanced. And, I always look at the protein as my main thing and it has probably like 20 grams of protein in it. Basically, I try to make sure I get my protein in. I try to make sure I have 70-100 grams of protein everyday” (Abby, 38).

Pam starts her day with a 30 gram protein shake to ensure 70 grams of protein is consumed daily. Giving such an immense attention to protein overpowered thinking about calcium intake for osteoporosis prevention.

“So, I'm not actively thinking about it, [calcium intake] but I do definitely have a hearty amount of dairy going in. No, I really don't, a lot of my diet is dairy-based so, I mean like, I have two glass of milk usually with dinner. I always been a milk drinker (Jessica).

Many participants eat yogurt or vegetables daily, not for calcium reasons, but for the protein. Regina tries to incorporate protein rich vegetables into her diet. Pam and Regina both like the triple protein yogurts for a snack or breakfast. Income did not appear to have any bearing on calcium consumption.

Pam goes on to describe how her dietary focus almost consumes her.

“I'm like oh my gosh, I need to get on this. So, I feel like the challenge is there, where I'm always thinking about, I need to eat cuz sometimes I don't even think about eating. I have to remind myself it's like a job. You know, you have to really focus.”

At first, the diet was challenging for Abby. She, like other participants, were concerned with what they could eat, what their stomach would tolerate, and how much they could eat. Abby didn't experiment with different foods, such as sweets, for fear her stomach would not tolerate them or worse, she would start craving them. Katie also tried to limit her sugar for fear of dumping syndrome. Jessica stated she is very particular about what foods she chooses to eat. Her rationale was limited space for the nutrients that fuel her body. All participants described how their relationship with food has changed and how they now eat for a different purpose.

Dealing with personal anger, empathy, and happiness postoperatively was not something most participants expected to experience and found themselves focusing on self to deal with those new emotions. Jessica reported she was treated differently after surgery, even though she was the same person after bariatric surgery and weight loss.

"I started resenting people so much because I was angry at them cuz like particularly at work in a professional environment. I felt so much, a lot of things got so much better. Like I felt so much more professionally respected. I felt like people took me more seriously. I started getting pats on the back that I wasn't getting before. I was getting people actually recognizing me and it made me so mad because I was the same person, same person inside that I was all the time. I was always their same teacher, same education, same background, and same everything. Everything is the same and now all the sudden they're so proud of you. They are so much nicer to you than before, babies are nicer to you. So, that was definitely something interesting that was not anticipated, that I had to work through that resentment and anger that I felt towards people. It's not something that ever crossed my mind, that I would start hating people all of a sudden. And, it felt so so disingenuous on their part, like all of a sudden now you're nice to me because I'm physically

attractive, now so all of a sudden I have social worth. It's interesting to see the change is social currency that you hold when you are a conventionally attractive person.”

Other participants describe a renewed self-confidence, describing themselves as “happier,” “feel better,” “healthier,” and “accomplished.”

“Mentally, because I feel more caring of myself. You know, when I was heavier I just got disgusted because I couldn't do anything. I couldn't get out cuz I was in a wheelchair, oh and I had knee surgery too. That [knee surgery] helped after I had the gastric bypass. I just felt a lot better” (Kathy).

Tamara describes her self-confidence “Makes me feel good, it's [weight loss] a boost to my ego most definitely. I also carry myself with a lot more confidence. I feel better in my own skin; I have a lot of it, and I don't show anybody. I mean there is a lot of laying skin under here. I have to bind everything up, push everything up because everything is deflated. But, I feel comfortable. I feel I can walk and hold my head up high and I don't really care. I know, I know that I'm pretty. I'm not conceited.” Regina however struggled with her self-confidence and self-image. She describes herself as obese and struggles with her weight or body mass index (BMI). However, described herself as healthy with minimized co-morbidities. Regina has gone from a pre-surgery BMI in the 50s to a BMI of 32 post surgery. She has a personal goal to lose 20 more pounds. She describes being shy when going to the gym, and when she runs on the treadmill, she likes to run in the lady's locker room versus the main gym where everyone can see her. Initially after surgery she did celebrate accomplishments like participating in a 5k, not believing she could do it. Since then she is involved in more intense activities like paddle boarding, biking, yet; she still struggles with her self-confidence.

For most, there wasn't much enjoyment in going out to eat as they had to find a table close to the bathroom for fear they would need to use it in a hurry. Participants described having to skip alcoholic beverages so they would be able to eat protein. Many women mentioned concerns of embarrassment if they ate too much or left a plate full of food. Dawn who was only six months out from surgery found the procedure a success because it changed the way she viewed food and her "attachment" to it. Now, she has more of an awareness of food that is going into her body and does not just eat for "leisure or entertainment." She went on to say food isn't for comfort anymore, but rather for health. Overall, participants embraced their decision to have bariatric surgery, describing a happier, more caring self after surgery. Edna stated, "I'm happier. I'll go places now. I'll do more. I feel better about myself."

Myths regarding osteoporosis stand as barriers to osteoporosis prevention. Myths ranged from no genetic history, believing that no pain meant no osteoporosis, and osteoporosis is something only old, thin women get. Many participants did not have a complete understanding of osteoporosis and the causes. Most thought osteoporosis was "thinning" or "brittle" bones, but some did not know "really what it is or much about it." Sue believed an individual had osteoporosis when their physical appearance changed such as kyphosis. Dawn remembers hearing about osteoporosis in school. Sandra stated going to a chiropractor regularly would be one way to prevent osteoporosis. "I make sure I go to the chiropractor once a month and get crunched and realigned and stuff like that. So, yeah I am concerned about my bones, so I make sure that I'm aligned." Sue believed an individual had osteoporosis when their physical appearance changed, such as kyphosis. Dawn remembers hearing about osteoporosis in school. Sandra stated going to a chiropractor regularly would be one way to prevent osteoporosis. "I make sure I go to the chiropractor once a month and get crunched and realigned and stuff like that. So, yeah I am concerned about my bones,

so I make sure that I'm aligned.” Sue was not aware of what a bone scan was, thinking that it required a health care diagnosis. She explained that it was not needed for bariatric surgery so there was no reason for her to have one.

When talking about family history, many participants stated osteoporosis was something “older women” get. Jessica suggested osteoporosis only affects older women. The participants spoke in a manner that osteoporosis would be something they would have to worry about in the future, again suggesting osteoporosis is something only older women get. “I thought it was something older women get. I didn't know, I don't really know where it comes from. I know the calcium thing in the brittle bones, but other than that I don't know anything else” (Dawn). For those women who were already older, they believed they were not at risk. Kathy stated she was not concerned about her risk for osteoporosis due to the fact that she has fallen twice since her surgery and has not broken a bone yet. Regina compared herself to her mom at age 60 and stated she was much healthier in regard to osteoporosis. She described her mom as “much worse off”, struggling with pain and immobility, and in need of a joint replacement. Regina stated she had much better bone health than her mom at the same age. Edna was told that obese women did not have to worry about osteoporosis. She stated,

“doctor told me years ago that heavier people don't have to worry as much about osteoporosis as a thinner person would have to worry about it and so, that kind of stuck in my head, hey I'm a fatty so I don't have to worry about it.”

Three participants talked about how osteoporosis was genetic and stated that due to their family history they would have osteoporosis or would not.

“I never really, I don't have any adult female blood relatives that have issues with osteoporosis. I've always been a big consumer of dairy. Mom, which we tend to line up

medically, she hasn't had any issues with it. I take four big old horse tablets of calcium every day and so I'm not that worried about it, plus I'm 29 so it's not something that I don't think I'm going to have to think about for a couple decades” (Jessica).

Regina also spoke about her genetic relationship with her mother. Regina stated she was at risk for osteoporosis because her mom had osteoarthritis. She went on to describe “good genes” in her father because he lived long and was relatively active despite his age. Sandra stated she would be at more of a risk for osteoporosis if she was diagnosed with rheumatoid arthritis since her mother had rheumatoid arthritis. These participants further validated the lack of understanding about osteoporosis, confusing osteoporosis with osteoarthritis and rheumatoid arthritis.

Regina had a partial understanding of risk factors for osteoporosis. She acknowledged her increased risk for osteoporosis by proton pump inhibitor medications, her genetic history, obesity, and inactivity prior to surgery. However, she suggested pain would indicate osteoporosis. Regina, like many of the other participants, spoke about joint pain and mobility issues prior to surgery. After surgery she described her physical mobility.

“I don’t have like a lot of joint type pain. I don’t have a lot of aches pains anymore. I used to when I was heavier, so I guess that’s the thing you feel like you’re exercising, your diet, and your supplements are kind of keeping it at bay.”

Creating Urgency

For many of the participants, a sense of urgency to prevent osteoporosis was lacking. Bariatric surgery was the consuming focus; there was not a big enough risk factor for them to be concerned about osteoporosis. Reasons for not being concerned about osteoporosis included lack of knowledge, misunderstandings or myths, and the overwhelming sense to look out for self-regarding bariatric surgery. For example, participants were knowledgeable of their post surgery

laboratory results and were confident their levels were normal. They stated normal calcium levels indicated no concerns for osteoporosis, thus, decreasing their sense of urgency about engaging in preventative measures.

For many, osteoporosis did not sound as threatening as “cancer,” describing the concern of cancer being far greater than osteoporosis. Katie describes the lack of concern as this, “it’s much more long-term result issue, like if it was something like cancer, that obviously creates urgency cuz you’re going to die eventually if you don’t take care of it.” Participants described their approach to osteoporosis prevention as more retrospective than proactive. Katie states osteoporosis is “it’s like one of those things that once you get older and something happens you think gosh, I wish I would have paid more attention to that when I was younger.” Lori stated osteoporosis is similar to diabetes, there is no motivation to prevent until diagnosed and by then, in most instances, physical damage has already occurred. Jessica stated osteoporosis is probably best thought about sooner rather than later.

When asked what would cause a sense of urgency, Lori a nurse and aware of her risk for osteoporosis, described how she was persistent with her family care physician about getting a bone scan several years after surgery. Unfortunately, it wasn’t until she met with another provider that she was able to get a bone scan ordered. Her bone scan did not reveal decreased bone mass, but she believed that if it did, she would be more concerned. Despite having bariatric surgery and the knowledge of the risk for osteoporosis, Lori did not have any urgency to prevent osteoporosis. Katie also stated a positive bone scan would cause a sense of alarm. Katie had broken a bone shortly after surgery and received an order for a bone scan, but delayed scheduling it. The referral for a bone scan was made as part of the treatment to fix her broken bone, and also because Katie’s bones were found in surgery to be soft. She stated the order was sitting on her desk but no

appointment had been made. Katie described her concern regarding whether the broken bone was due to reduced bone mass or if the reduced bone mass was due to bariatric surgery. Katie stated she had some fear, acknowledging she was ordered a bone scan at a much younger age than the standard 65 years old, however, at the time of the initial interview there was little sense of urgency to have the scan done. Several months later, at a follow up interview, Katie still did not have her bone scan scheduled. Similar to Katie, Sandra previously broke a bone, but stated she would not be concerned about osteoporosis unless she broke another bone. Regina had a specific concern about a broken hip due to a physician telling her she would not regain her quality of life. For these participants, a positive bone scan or two broken bones would create motivation or urgency to prevent osteoporosis. There is a lack of understanding that a positive bone scan or broken bones signifies decreased bone mass has already occurred.

More education seemed to be key in causing a sense of urgency or “red flag” regarding the risk for osteoporosis. All participants do not recall any osteoporosis education, but state if they had received that education, they would be more diligent about preventing osteoporosis. Pam recalls a notebook full of education on how to prevent hair loss, not to chew gum, and avoid sugar. She remembers right where to find the information in her notebook, therefore, she stated believes if osteoporosis education was in her notebook, she would be aware of that information. Regina would like to know “statistics” on the risk of osteoporosis and the percentage of people who develop vitamin and mineral deficiencies. Regina stated osteoporosis education would have been helpful in creating motivation to prevent osteoporosis.

Summary of Findings

(Aim 1: to understand what it means to be at risk for osteoporosis after bariatric surgery)

The women in this study had little to no understanding of their risk for osteoporosis after surgery. There was no recollection of education regarding osteoporosis risk prior to surgery or after. Participants were aware they needed to take vitamin D and calcium postoperatively to prevent deficiencies. However, they were not aware deficiencies in these nutrients could cause bone loss.

Participants had a naive understanding of what osteoporosis is and how it is monitored. Participants would describe osteoporosis as a condition only older, thin women get. They thought osteoporosis would be painful and that is how they would know they had the condition. Some women also believed osteoporosis would be shown in physical ways such as shortened height or hunched back, and one woman stated she really didn't know anything about osteoporosis.

The nurse participants in this study had a much better understanding of osteoporosis. These women knew about osteoporosis, however, only two were aware of their risk prior to surgery. They were only aware because of their own research, both stating osteoporosis information was not presented to them prior to surgery. Despite the increased risk, they chose to proceed with surgery, knowing they would have to manage their risks postoperatively. Only one participant is purposefully engaged in osteoporosis prevention with a calcium rich diet and weight bearing exercises; while the other nurses exercise and take calcium and vitamin D but not necessarily for the purpose of osteoporosis prevention.

The current study provides insight into how much women understand about osteoporosis risks after bariatric surgery. The extent of literature regarding bone loss after bariatric surgery is vast, yet women in this study, prior to and after surgery, have no knowledge of their risk. Educational information regarding the risk of osteoporosis after surgery, if any, was not clear or impactful in these participants' lives.

(Aim 2: to understand how bariatric surgical patients perceive osteoporosis risk post operatively)

After a discussion of what osteoporosis is and the inherent risks after surgery, the majority of the participants had little to no concern about the risk for osteoporosis post operatively. These women described their osteoporosis prevention measures as following their high protein diet, taking their prescribed vitamins, and at least walking regarding exercise. Participants perceived little to no risk due to not having any symptoms of osteoporosis or pain. Some described how painful or difficult it was to exercise before surgery, but now postoperatively they can exercise with few limitations. Many thought since their calcium levels came back normal, and the provider told them their calcium level was normal, they were not at risk for osteoporosis, not understanding that blood levels are not always reflective of bone health. However, as the interviews progressed, three participants began to have some heightened awareness and sense of concern about osteoporosis. These participants used adjectives such as “concerning,” and “scary.” Two participants left the interview stating they wanted to research symptoms and causes of osteoporosis.

The current study expands on the idea that there is little to no urgency for osteoporosis prevention. The mention of osteoporosis risk during the interviews did not have a concerning effect with most participants. Falls without broken bones, misunderstanding of information from primary care physicians, and normal results on bone scans all provide reassurance and contributed too little to no perceived risk for osteoporosis. Without education about the risk and physical warning signs or symptoms of bone loss, it was difficult for the participants to perceive any risk.

Chapter 5

Discussion

At the time this dissertation was written, it is the first qualitative study to explore the lived experience of being at risk for osteoporosis in bariatric surgical patients. This study draws attention to several aspects of the participants' lived experiences. The findings support and extend the current body of knowledge on osteoporosis in bariatric surgical patients.

Looking out for Self

In an earlier study, the primary reason participants sought out bariatric surgery was because of "health issues" (Roberson, Neil, Pories, & Rose, 2016). Similar findings were noted in the current study with 10 out of 14 (71%) of the participants affirming that health issues influenced their decision to have surgery. Participants were concerned with worsening co-morbidities such as hypertension and diabetes. Other reasons included wanting more energy and the ability to play with their children on the floor or at the park. In both the current study and Roberson and colleague's (2016) study participants talked about setting a good example for their children in regard to health and eating habits.

Participants feared being refused by surgeons for, what they stated to be, a life changing surgery; therefore, they were determined to show the commitment required (Homer, Tod, Thompson, Allmark, & Goyder, 2016). Similarly, participants in this study spoke about bariatric surgery as a lifelong commitment, stating changes in weight will only occur or be sustained if a commitment is made to following the diet, vitamin, and exercise regimens. Those who had bariatric surgery stated diet, and physical activity are essential to successful outcomes (Homer et al., 2016). Participants varied on their level of commitment, some taking more control over their diet and exercise regimens. Participants from the current study described bariatric surgery as a

‘tool’ required to make lifelong changes, however, participants from the Homer and colleagues (2016) study described bariatric surgery as a ‘tool’ to control eating, as opposed to taking responsibility for the commitment to changing their eating behaviors. Participants in the current study described beneficial eating and exercising habits but found it difficult to fully commit. One participant in the current study described her commitment to exercise while at work, stating sometimes it is a difficult decision to seclude herself from coworkers and go outside when the weather conditions are less than ideal. In the Durand-Moreau et al.(2015) study, those who worked were less likely to maintain 30 minutes of exercise a day compared to those who didn’t work. Practicing any type of physical activity was difficult for 75% of the single participants and 41% of those who were employed.

Understanding

Participants described how they initiated their own research on bariatric surgery by looking for information on websites, YouTube, Facebook, journal articles and from those they knew who had the surgery. The participants found their additional inquiry to be helpful in their decision to commit to surgery and for the surgery itself. Some of the participants in the Homer and colleagues’ (2016) study were given trusted websites with the expectation that they would explore additional information on bariatric surgery on their own. When asked about osteoporosis, participants in the current study stated they did not read anything about osteoporosis risk after surgery.

Protecting

Participants in both studies described how dealing with obesity their entire life lead them to having bariatric surgery (Homer et al, 2016). In the current study, participants described an unhealthy relationship with food that started as early as age 4. They described efforts made by themselves and their parents to restrict or even deny food. Several participants started dieting at a

young age. According to Sinton & Birch (2005), dieting and weight related behaviors are common in obese adolescents. However, such behaviors contribute to low bone densities later in life (Zuckerman-Levin, Hochberg, & Latzer, 2014). More recently, Hohman and colleagues (2018) found preadolescents had a reduced bone mineral accrual associated with dieting behaviors.

In this study and in many others, participants described being negatively judged about their decision to have bariatric surgery by friends, family and co-workers. The overall perception was bariatric surgery was the “easy way out” or that surgery wasn’t the “real way” to lose weight (Griauzde et al., 2018; Groven et al., 2010). In the Lier, Aastrom and Rortveit (2016) study one participant stated his brother told him after surgery that he “cheated to get a better body.”

One participant from the current study described the judgmental remarks she received from her physician any time she had an appointment for an issue not related to her weight. The participant believed she was constantly being judged because of her excess weight. Similarly, in the Homer et al. (2016) study participants identified healthcare professionals as being judgmental regarding their weight. Participants described feelings of increased marginalization from those they thought should be providing support. Others felt blamed and stigmatized by health care professionals because of their weight (Homer et al., 2016).

Preventing

The current study expands the idea that risks to and prevention of osteoporosis are not well known or considered by patients. Participants had a vague understanding of osteoporosis and an even more limited understanding of prevention. For example, one participant stated that since she fell and didn’t break any bones she was not at risk, similar to the findings of Merle and colleagues (2019) that despite being exposed to osteoporosis, history of fracture, pharmacological treatment or medical follow up concerning osteoporosis, there still were no concerns about osteoporosis. In

the current study, participants underestimated their personal risk of osteoporosis. Even those who were diagnosed with osteoporosis did not appear concerned. Many participants stated that osteoporosis was not considered as serious as cancer. Similar findings included osteoporosis not being as serious as cancer or cardiovascular disease due to osteoporosis not having pain or symptoms associated with it (Barker & Toye, n.d.; Merle et al., 2019). Lack of symptoms makes osteoporosis difficult to understand and equate to fracture risk (Ravn Jakobsen et al., 2018).

In the current study a participant stated that going to a chiropractor was preventing osteoporosis. Study participants were unfamiliar with osteoporosis and thought of osteoporosis as part of the normal aging process, however, they did state they didn't want to end up like family members with "hunched backs" or looking frail. Women in the Ravn Jakobsen and colleagues (2018) study were more likely to have a concern about osteoporosis if osteoporosis was present in a family member.

Barriers to exercise post operatively have been noted throughout the bariatric literature. This study highlighted motivation to exercise without an exercise partner was difficult. Other barriers included self-consciousness concerns regarding physical appearance and the term "lazy" was used when one participant described why she didn't exercise. Zabatiero and colleagues (2018) noted the same issues with participants reporting appearance or size when engaging in physical activity. Many participants from the current study also described lack of motivation or laziness and lack of social support or company to engage in physical activity. Participants stated family and friends were facilitators in engaging in physical activity, whereas 70% of those who were married engaged in exercise. Dikareva et al. (2016) reported similar findings, participants lack of social support deterred them from engaging in physical activity. They also went on to describe reluctance to engage in physical activity due to reduced exercise self-efficacy, lack of motivation, and

negative attitudes towards physical activity. They described exercise as “taxing,” a “chore,” and a “waste of time.”

Preoccupation with diet, vitamins and maintaining health limits the focus on osteoporosis prevention (Nielsen et al., 2013). In the current study participants were extremely focused on eating enough protein. Such intense focus on protein overshadowed thoughts to include calcium in their diet. One woman described it as being her job each and every day to make sure she was consuming enough protein. Similar findings were found in Lier, Aastrom and Rortveit’s (2016) study where participants reported their “whole day” was spent planning and implementing meals.

In the current study, participants dealt with many emotions after surgery including anger, happiness and empathy. Other studies revealed jealousy, helplessness, (Magdaleno et al., 2010) mistrust, fear, and envy were other emotions that women faced post operatively (Magdaleno et al., 2011). Participants from the current study particularly mentioned emotions when dealing with others who were judgmental about their decision to have surgery, or treating them differently because they had lost weight. Similarly, Griauzde and colleagues’ (2018) participants described dissatisfaction with how they were perceived by others and their comments about how good they looked. Likewise, participants in the current study were upset by the way they were professionally and socially treated. Resentment was described by participants for not being treated the same as they were before they lost weight. The women in a study by Natvik, Gjengedal, and Raheim (2013) had mixed emotions about others’ comments and actions. They described feeling pleased to now be included in social circles and relationships but were also hurt to realize that the contour of their body made such a difference in how others viewed them.

Without a complete and thorough understanding of osteoporosis, motivation to prevent the disease is stalled. In the current study, as well as other studies, participants believe osteoporosis is

an old woman's disease (Beaton et al., 2012; Minns Lowe, Toye, & Barker, 2019) and something they don't need to think about until much later in life. Participants in the current study stated osteoporosis was not something they really thought about. These findings extend the findings of Besser, Anderson, and Weinman (2012b) where participants stated osteoporosis really didn't impact them, so osteoporosis wasn't something they really thought about daily. One participant stated she was never given any dietary information relating to osteoporosis, therefore she didn't believe there was a connection between osteoporosis and diet (Besser et al., 2012a). In the same study and despite having a diagnosis of osteoporosis or osteopenia, 50% of the participants reported osteoporosis had little impact on their lives, therefore they felt no emotion related to osteoporosis. Many of these women believed they had caught their osteoporosis early and that their osteoporosis diagnosis was not severe. In the current study, a college degree did not seem to have an impact on awareness of risk; only 20% stated they were at risk.

Participants in the current study all had bariatric surgery, putting them at higher risk for osteoporosis. Some participants had either a diagnosis of osteoporosis, sustained a fracture, had relatives whose physical appearance had changed due to osteoporosis, or currently had family on osteoporosis medication however, none of these red flags caused the participants to have any urgency about osteoporosis prevention. When participants were asked directly, "what would cause you to have urgency regarding osteoporosis," most stated more education from their providers. Understanding the link between bariatric surgery and osteoporosis risk would be pivotal in creating an urgency for osteoporosis prevention.

Strengths and Limitations

At the time of publication, this is the first qualitative study to look at osteoporosis and female bariatric surgical patients. The purposive and snowball sampling technique used in this

study achieved a sample of women of varying ages, education levels and length of time since surgery. Various characteristics including race and socioeconomic status was included to provide a diverse sample. The participants in this study had experiences in five different bariatric surgery centers. None of them remembered receiving osteoporosis education prior to or after surgery.

There were several limitations in this study. First, the degree to which the sample is representative of the larger population is limited. Two recruitment sites, one rural and one urban, were selected in hopes of achieving a better representation of the population, however, all the participants came from the urban site. Despite the urban location of the bariatric clinic, several participants lived in rural locations. The participants in this study represent healthy African American and Caucasian women. Findings reflect the experiences of a limited number of participants from one clinic and may not be transferable to other bariatric settings. A larger more diverse sample would be generalizable to women in nonurban areas or to other racial or ethnic groups. A second limitation is that participants were asked to reflect on their experiences which ranged from 3 months to 14 years ago. While this may have introduced some retrospective recall bias, the participants stories were quite detailed and thoughtful. Given that bariatric surgery was such a big event in their lives, the participants were able to vividly recall minute details about the education they received prior to surgery and emotional details of their experiences leading up to and after surgery. Third, it is possible that participants with more favorable surgical outcomes participated in this voluntary study. Thus, the findings may not represent all the negative impacts of bariatric surgery which would influence engagement and concern for osteoporosis prevention measures. However, at the time of recruitment only two patients refused participation, suggesting that all participants were interested in the study regardless of surgical outcome. Finally, most participants were interviewed once. More interviews over a period of time would have provided a

more complete picture of the participants' perspectives on osteoporosis risks as well as changes in perspectives occurring over time. More interviews could also allow the researcher to follow up on questions that arose following the first interview. Due to the time limitation, follow up interviews were not possible in the current study.

Implications for Clinical Practice

This research has both immediate and future implications for orthopaedic nursing. Through these findings, practicing nurses will immediately have a better understanding of osteoporosis and osteoporosis risk perceptions among people receiving bariatric surgery, which will facilitate better nurse-patient understanding and interaction. These findings will also influence future intervention research aimed at development of effective osteoporosis prevention preoperative strategies tailored to bariatric surgical patients

Participants were unaware of their increased risk; therefore, they did not perceive any concern or urgency to prevent osteoporosis. For most participants, their osteoporosis knowledge was basic. After discussing osteoporosis and how it effects the bones, participants began to have some heightened awareness and sense of concern. Participants just needed the knowledge to begin to take preventative action. It is important for healthcare providers to understand the knowledge and perceptions of their patients concerning osteoporosis in order to provide them with patient centered care and impactful knowledge to improve adherence to prevention measures. This study identified misunderstandings of osteoporosis that ranged from not entirely accurate to completely misunderstood. This suggests the need for tailored osteoporosis education that could be addressed by nurses pre and post operatively. Personalized education would aid in more accurate understanding.

The findings of this study indicate that education was often lacking in healthcare encounters, public websites, and social media platforms. Osteoporosis has no warning signs or feedback loop of bone loss; however, this loop can be closed with education and osteoporosis prevention. It was apparent the participants in this study sought out and yearned for education regarding surgery and self-care after surgery; therefore, osteoporosis education is ideal for individuals seeking bariatric surgery. Participants stated their recommendation for healthcare providers regarding osteoporosis risks was specific osteoporosis education. The teach back method may be one intervention that might be helpful in assuring understanding. The teach back method is an effective teaching and assessment of patients' comprehension and recall of the material being taught (Dinh, Clark, Bonner, & Hines, 2013) Teach back has been shown to enhance patient's knowledge and understanding regarding chronic conditions and makes them more accountable for their own health. Key aspects to implementing teach back include plan the approach, start slowly and use consistency, practice, use handouts along with teach back, and always clarify and explain again.

Osteoporosis education should be presented before and after surgery, by nurses and physicians and through social media platforms. Osteoporosis education should begin with the first surgical visit and continued throughout the patient's education journey leading up to surgery. Reiteration of osteoporosis risk and prevention strategies should continue after the surgery in the hospital as well as follow up visits with the provider. Social media platforms could include education as well. American Society for Metabolic and Bariatric Surgery (2018c) website has a section titled Life After Bariatric Surgery, Common Questions. This section addresses issues such as the side effects of not enough protein or why fluid is important. The website also addresses

vitamin D and calcium. Additionally, there could be information on the side effects of vitamin deficiency and a definition of osteoporosis and prevention strategies.

The findings of the study also suggest the approach and communication between healthcare providers and patients who are obese could be improved. Participants' health care concerns were often dismissed due to their weight. They were often told their health concern would be resolved if they lost weight. Medical concerns from patients who are obese should be addressed first, regardless of patient's weight. Hildegard Peplau (2002) suggests the need to understand one's own behavior or bias before helping others. Patients should not be judged, nor should assumptions be made regarding a patient's weight.

Participants in this study also encountered healthcare providers who had a lack of knowledge regarding bariatric surgery restrictions. For example, someone who has Roux-en-Y cannot take Non-steroidal anti-inflammatory drugs (NSAIDs) as they can cause marginal ulcers or stomach irritation (American Society for Metabolic and Bariatric Surgery, 2018c) . Knowledge of restrictions for patients who had bariatric surgery is imperative for all care providers.

The pillars to osteoporosis prevention in bariatric surgical patients include a calcium rich diet, weight bearing exercise, bone scan, and vitamin supplementation. Some participants engaged in these behaviors but not necessarily for osteoporosis prevention. As noted, many participants are waiting for a broken bone before they engage in preventive practices. In order to create a sense of urgency for osteoporosis prevention, providers need to ensure patients are informed and aware why they take calcium and vitamin D postoperatively, the consequences of deficiencies, and the importance of prevention. Empowering patients with knowledge and skills regarding vitamin intake will help them engage successfully in prevention measures. This research indicated that people had limited knowledge of vitamin deficiency and their risks but were interested in more

information. Bariatric surgical patients should be made aware of the increased risk for osteoporosis and thus fracture; furthermore providers must stress the importance of adhering to the guidelines of supplemental vitamins and exercise (Fashandi, Mehaffey, Hawkins, Schirmer, & Hallowell, 2018). Weight bearing exercise can be explained as having a dual benefit of weight loss and osteoporosis prevention. In addition, a referral for a dual energy x-ray absorptiometry (DXA) should be coordinated to occur with the two year follow up visit after bariatric surgery to monitor for osteoporosis and treatment if indicated (Mechanick, Youdim, Jones, Garvey, Hurley, McMahon, Heinberg, Kushner, Adams, Shikora, Dixon, Brethauer, et al., 2013).

Recommendations for Future Research

This qualitative study is foundational to future research targeting the needs of an increasing population at risk for osteoporosis after bariatric surgery. Empirical studies exploring the factors identified in this study with men would extend the findings to the population. There needs to be a greater awareness that men, especially those at a higher risk due to bariatric surgery, acquire this condition. A descriptive, exploratory study with patients and providers would shed more light on the knowledge and understanding of osteoporosis risk and preventative measures. The National guidelines make several recommendations regarding osteoporosis prevention; however, it is unclear if providers or patients are aware of these recommendations. The findings raise the question regarding why a bone scan is not being conducted 2 years after surgery. A further research study on physician practices and perceptions of osteoporosis risk may be warranted. An observational study of actual teaching sessions would further illuminate the gaps in osteoporosis education. The impact of osteoporosis education given pre and post operatively on osteoporosis urgency and prevention could be explored with a longitudinal study.

In conclusion this research provided an understanding of the risk of osteoporosis from the constructed realities and experiences of those who had bariatric surgery. Osteoporosis risk after bariatric surgery was not well known by participants. Furthermore, participants did not correlate vitamin deficiency and osteoporosis. Barriers to osteoporosis prevention included preoccupations with diet, vitamin intake and exercise. Participants perceived little to no risk of osteoporosis due to not having any symptoms of osteoporosis, not having pain, or normal laboratory results. Patients need to be aware of the risks of bariatric surgery; without this understanding of awareness about osteoporosis and risk of fracture; uncertainty will remain as to how to enhance osteoporosis prevention efforts in this population. Creating a link between bariatric surgery and the risk for osteoporosis is an important first step in osteoporosis prevention.

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Appendix A

Letter of Support: Unity Health Network Bariatric Center

Walter J. Chylsta, MD, FACS, FASMB | Tonya Thomas, CNP, CBN

May 8, 2018

Candy Mori, RN, MSN, APRN, ACNS-BC, ONC
Ph.D Nursing candidate Kent State University
210 Skyview Circle Dalton, Ohio 44618

Dear Mrs. Mori,

We would be happy to collaborate with you and your dissertation chair, Dr. Pamela Stephenson of the College of Nursing at Kent State University, in your research study on osteoporosis in bariatric surgical patients. Learning how bariatric surgical patients perceive their osteoporosis risks and their awareness of prevention activities will enhance our care delivery for pre and post-surgical education.

The Unity Health Network Bariatric Center provides minimally invasive bariatric surgery to Northeast Ohio. Our patient specific treatment options has allowed for successful outcomes helping patients return to a more active lifestyle they want to live. We see approximately 500 patients per year, and perform approximately 10 bariatric surgeries per month. To support your study, we will provide access to our professional staff to assist you. Furthermore, I will work with you and our staff to help identify and recruit potential participants.

I strongly support this innovative study and appreciate the opportunity to contribute to its success.

Sincerely,

Dr. Walter J. Chylsta
General Surgery
Unity Health Network

1800 23rd Street, Suite 403, Cuyahoga Falls, OH 44223
P: (330) 926-3443 F: (330) 255-5022

Appendix B

Letter of Support: Wooster Community Hospital Orthopaedic Center

May 3, 2018

Candy Mori, RN, MSN, APRN, ACNS-BC, ONC
Ph.D candidate Kent State University
210 Skyview Circle Dalton, Ohio 44618

Dear Mrs. Mori,

We would be happy to collaborate with you and your dissertation chair, Dr. Pamela Stephenson of the College of Nursing at Kent State University, in your research study on osteoporosis in bariatric surgical patients. Learning how bariatric surgical patients perceive their osteoporosis risks and their awareness of prevention activities will enhance our care delivery in post fracture care.

The Wooster Community Hospital Orthopaedic Center provides advanced, patient specific treatment options for orthopaedic conditions caused by pain and or discomfort. Our goal is to help patients return to the active lifestyle they want to live. We see approximately 2500 patients per year, with 10% of those having a diagnosis of osteoporosis and 2% having a history of bariatric surgery. To support your study, we will provide access to our professional staff to assist you. Furthermore, I will work with you and our staff to help identify and recruit potential participants.

I strongly support this innovative study and appreciate the opportunity to contribute to its success.

Sincerely,

Dr. Anne Marie Chicorelli
Orthopaedic Surgeon
Wooster Community Hospital Orthopaedic Center

Osteoporosis and Bariatric Surgery Research Study

I am looking for volunteers to assess osteoporosis risks after bariatric surgery. I'm looking to understand what it means to live with the risk of osteoporosis after bariatric surgery and the perceptions of osteoporosis risks.

Have you had bariatric surgery?

If you answered yes, I would like to hear your story.

- To determine if you are eligible to participate in this research or if you have more questions, please call me at the number below.
- If you are eligible, an appointment will be scheduled for you to be interviewed about your experiences with osteoporosis and bariatric surgery.
- The research includes a confidential, one on one interview that will take place in a convenient location
- You will receive \$30 for your participation
- Your participation will help healthcare providers understand what it is like to be at risk for osteoporosis with bariatric surgery.

Tell your nurse if you would like to participate.

This is a research study conducted by Candy Mori, Ph.D. (c), RN and has been approved by the Kent State University Human Subjects Review Board: (330) 672-2704

[illegible]

Appendix D
Recruitment Script

I want to let you know about an opportunity to participate in a research study about osteoporosis in persons who had bariatric surgery. The care that nurses provide to patients is an important part of helping them achieve wellness. Candy Mori, a doctoral student in Nursing at Kent State University, is conducting research to learn how osteoporosis effects persons who have had bariatric surgery. You may be eligible to participate in her study because you had bariatric surgery and are at risk for osteoporosis. Does this research sound like something you would like to be a part of, or would you like to talk to Candy? If so:

Is it alright for Candy Mori to call you? ____Yes ____No (stop questionnaire here if patient says no. Thank them for their time. If yes, continue).

What is the best way to reach you? _____

Do you have a cell phone number or home phone? _____

Would you prefer she text? _____

What time is best to call? _____

May she leave you a message? ____ Yes ____ No

Participant's name _____

Recruiter's name _____

Recruiter's agency _____

Recruiter's phone _____

Appendix E
Telephone Script

Hello, my name is Candy. I'm calling from Kent State University about a research study. Am I speaking to _____ (name)?

If "no," wait for the person to pick up or ask for a time to call back. You should only share the research topic with the potential participant or when permissible the person's representative.

If "yes": Is this a good time to talk? I expect this phone call will take about 10 minutes.

Arrange to call at another time, if appropriate.

I'm calling about a research study of osteoporosis called Osteoporosis and Bariatric Surgery Research Study. The purpose of this research study is to learn more about what it means to live with the risk of osteoporosis after bariatric surgery and the perceptions of osteoporosis risks.

I'm calling to (see if you are interested/to determine if you are eligible/because you signed up to be contacted). If you agree, I will ask you some questions to see if you can be in the study. If it looks like you might be eligible, we will schedule a time for you to be interviewed about your experiences with osteoporosis and bariatric surgery.

Before we go on to the questions, let me tell you a little bit about your rights as a research subject.

You don't have to answer any questions that you don't want to, and you can choose to stop at any time without penalty. The main risk of answering my questions today is emotional distress. If distress occurs, a counseling resource sheet will be provided to you.

If you have questions about the study, you can call us at _____ (phone number). If you have questions about your rights as a research subject or research-related injuries, you can call the OHSU Research Integrity Office at 503-494-7887.

May I go ahead with the eligibility questions?

If no, thank the individual and end the call. If yes start the questions:

- **Potential first question that helps preserve privacy** - I'm going to give a list of things that would PROHIBIT you (exclusion criteria) from being in the study. Please do not indicate if these things apply to you until the end of the list. *Cognitively impaired and known diagnosis of osteoporosis. End the call if someone answers in the affirmative. ...OR... List inclusion criteria. Bariatric Surgery, over age 18, understand and speak English End the call if someone answers in the negative.*

If eligible move forward (*add any remaining information to this script*), if not thank them for their time.

Appendix F
Informed Consent to Participate in a Research Study

Study Title: Understanding the Experience of Osteoporosis Risk in Bariatric Surgical Patients

Principal Investigator: Denice Sheehan, Principal Investigator; Candy Mori, Co-Investigator

You are being invited to participate in a research study. This consent form will provide you with information on the research project, what you will need to do, and the associated risks and benefits of the research. Your participation is voluntary. Please read this form carefully. It is important that you ask questions and fully understand the research in order to make an informed decision. You will receive a copy of this document to take with you.

The purpose of this study is to explore the experiences of being at risk for osteoporosis in bariatric surgical patients. This study will address the following research aims: (a) to understand what it means to be at risk for osteoporosis after bariatric surgery; and (b) to understand how you perceive osteoporosis risks post-operatively.

Procedures

In order to participate in this study, you must have had bariatric surgery which puts you at risk for osteoporosis. Also, you must speak and understand English. The interview will last approximately 60 minutes. You will be asked several general questions about bariatric surgery and osteoporosis. Candy Mori will interview you. She may contact you sometime after the interview to ask you to help her better understand your thoughts. Candy may also ask you about any other thoughts you might have had, or to read a summary of this study.

Audio and Video Recording and Photography

The interview will be digitally recorded. Later, the words on the recording will be transcribed, and the recording will be destroyed.

Benefits

This research will not benefit the care you receive directly. However, your participation in this study will help us to better understand osteoporosis prevention and provide better care in the future.

Risks and Discomforts

There are no anticipated risks beyond those encountered in everyday life. If you find any questions, we ask upsetting, or you feel uncomfortable answering them, you may skip them and go on to the next question.

Privacy and Confidentiality

Any identifying information you disclose during your interview (e.g., names and places) will be substituted with false names in the transcript to reduce the chance that you can be identified by the story you tell. Your signed consent form will be kept separate from your study data, and responses will not be linked to you.

Your study-related information will be kept confidential within the limits of the law. Any identifying information will be kept in a secure location, and only the researchers will have access to the data. Research participants will not be identified in any publication or presentation of research results; only aggregate data will be used.

Your research information may, in certain circumstances, be disclosed to the Institutional Review Board (IRB), which oversees research at Kent State University, or to certain federal agencies. Confidentiality may not be maintained if you indicate that you may do harm to yourself or others.

Compensation

When you complete the interview, you will be compensated for your time by receiving \$30.

Voluntary Participation

Taking part in this research study is entirely up to you. You may choose not to participate, or you may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. You will be informed of any new, relevant information that may affect your health, welfare, or willingness to continue your study participation.

Contact Information

If you have any questions or concerns about this research, you may contact Candy Mori at 330-201-1751 or Denise Sheehan at 330-672-8845. This project has been approved by the Kent State University Institutional Review Board. If you have any questions about your rights as a research participant or complaints about the research, you may call the IRB at 330-672-2704.

Consent Statement and Signature

I have read this consent form and have had the opportunity to have my questions answered to my satisfaction. I voluntarily agree to participate in this study. I understand that a copy of this consent will be provided to me for future reference.

Participant Signature

Date

Witness Signature

Date

Demographics

Participant # _____

Age: _____

Gender: MALE / FEMALE/ TRANSGENDER/ NON-BINARY

Which of the following BEST describes how you see yourself?

- ☐ American Indian or Alaska Native
☐ Asian
☐ Native Hawaiian or Other Pacific Islander
☐ Black or African American
☐ White
☐ More than one race
☐ Other

Are you:

- ☐ Employed
 Occupation _____
☐ Unemployed
☐ Student
☐ Other

Marital status:

- ☐ Married
☐ Single
☐ Widowed
☐ Divorced

What type of bariatric surgical procedure did you have?

- ☐ Roux-en-Y Gastric Bypass
☐ Laparoscopic Adjusted Band
☐ Laparoscopic Sleeve Gastrectomy
☐ Other

When did you have your surgery? _____

Your current annual income: ENTER LETTER _____

- A. Less than \$10,000/year

- B. \$10,000 \$14,999/year
- C. \$15,000 \$19,999/year
- D. \$20,000 \$24,999/year
- E. \$25,000 \$29,999/year
- F. \$30,000 \$34,999/year
- G. \$35,000 \$29,999/year
- H. \$40,000 \$44,999/year
- I. \$45,000 \$49,999/year
- J. \$50,000 \$59,999/year
- K. \$60,000 \$99,999/year
- L. \$100,000 \$124,999/year
- M. \$125,000 \$149,999/year
- N. \$150,000 \$199,999/year
- O. \$200,000 or more/year

Highest level of education achieved

- ☐ No schooling completed
- ☐ Nursery school to 8th grade
- ☐ Some high school, no diploma
- ☐ High school graduate, diploma or the equivalent (for example: GED)
- ☐ Some college credit, no degree
- ☐ Trade/technical/vocational training
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional degree
- ☐ Doctorate degree

Have you had a bone scan? ☐ YES ☐ NO

If YES, what year?

Appendix H
Summary of Findings

1. Would you like to receive a summary of the findings? Yes or No
2. Would you like to be notified of other research that you might be eligible for? Yes or No

If you responded yes to either of these, how would you like to be contacted?

Name _____

_____ Email _____

_____ Address _____

Appendix I
Interview Questions

Participant # _____

1. Tell me about your decision to have bariatric surgery.
2. What challenges have you experienced as a bariatric surgical patient?
3. What do you know about osteoporosis?
4. Have you ever been told that you were at risk for osteoporosis? If so, how did you find out?
 - a. How has osteoporosis risk impacted your life so far?
5. What does osteoporosis mean to you?
6. Did you receive any education about the risk for osteoporosis before surgery?
 - a. Tell me about the osteoporosis education you received.
 - b. What information was included?
 - c. What was helpful; what was not helpful?
7. How do you see your risk for osteoporosis after having bariatric surgery?
8. Have you done anything differently to manage your osteoporosis risk? If so, what have you done?
9. How do you make the decision to engage in a preventative measure?
10. You mentioned (exercise, medications, diet, and smoking cessation). Please tell me more about your routines, types, reminders...?
11. Tell me how or by whom you are supported in these behaviors?
12. What do you feel health care professionals need to know about helping bariatric surgical patients make the decision to engage in osteoporosis prevention?
13. Is there anything you would like to say about osteoporosis risk to someone who is considering bariatric surgery?
14. How has this interview been for you?

Appendix J
Counseling Resource Sheet

Counseling Resources for Wayne and Holmes Counties

1. **Counseling Center of Wayne and Holmes Counties:**

Provides comprehensive mental health services to the residents of Wayne and Holmes Counties. This certified mental health provider offers the following areas of service: psychiatry, psychology, counseling, social work, psychiatric nursing, counseling to children and adults, crisis intervention, community support, case management, specialized services to the Amish community, BRIDGES (self- help for people recovering from mental illness, suicide prevention and depression help)

- a. 2285 Benden Drive, Wooster, 330-264-9029
- b. 212 N. Washington, Millersburg, 330-674-6697
- c. 345 Crownhill, Orrville, 330-683-5106
- d. 8 N. Main, Rittman, 330-925-5466

2. **Crisis Intervention Team**

- a. 330-264-9029

3. **Springhaven Counseling Center**

- a. 9693 Benner Rd., Rittman, 330-927-2020
- b. 15550 Durstine Rd., Dundee, 330-359-5100

4. **Catholic Charities**

Catholic Charities provides individual, marital, group, and family counseling to children, adults, and families. Parent education and group therapy offered.

- a. 4419 Cleveland Rd., Wooster, 330-345-8450

5. **Your Human Resource Center**

Certified mental health and substance abuse treatment, intervention, and prevention agency. Outpatient substance abuse and mental health assessment and counseling services. The agency offers substance abuse and mental health preventions services, family and marital counseling, and urinalysis for drugs of abuse.

- a. 2587 Back Orrville Rd., Wooster, 330-264-9597
- b. Millersburg, 330-674-4608
- c. 51 N. Main, Rittman, 330-927-2244

- d. 119 E. Market, Orrville, 330-682-4800
- 6. Behavioral Health Services at Wooster Community Hospital**
Wooster Community Hospital's Behavioral Health Services are designed to help those who struggle with depression, anxiety, post-traumatic stress disorder, panic disorder, or any other mental health issues.
 - a. 1761 Beall Ave., Wooster, 330-263-8710
- 7. Professional Counseling Associates**
 - a. 2200 Benden Dr., Wooster, 330-262-1228
- 8. Bowden & Associates**
 - a. 365 Riffle Rd., Wooster, 330-345-3461
- 9. Cornerstone Counseling of Ashland**
 - a. 259 Sandusky St., Ashland, 419-289-1876

Counseling Resources for Cuyahoga Falls

- 1. Portage Path Behavioral Health**
 - a. North Summit Clinic, 792 Graham Rd., Cuyahoga Falls, 330-928-2324
 - b. Main Office, 340 South Broadway Street, Akron, 330-253-3100
 - c. Barberton Outpatient Clinic, 105 5th St. Southeast, Suite 6, Barberton, 330-745-0081
- 2. Coleman Behavioral Health**
 - a. Saint Thomas Hospital, 444 North Main Street, Akron, 877-796-3555
 - b. Akron City Hospital, 525 East Market Street, Akron, 877-796-3555
 - c. Barberton Office, 169 5th St Southeast, Suite B, Barberton, 330-296-3555
 - d. 5982 Rhodes Rd., Kent, 330-673-1347
- 3. Pastoral Counseling Service**
 - a. 611 West Market Street, Akron, 330-996-4600
- 4. Summit Psychological Associates**
 - a. 37 North Broadway Street, Akron, 833-240-8206
- 5. Vantage Aging- Behavioral Health Solutions**
 - a. 2279 Romig Rd., Akron, 234-334-6256
- 6. Emerge Counseling Services**
General counseling services for the Christian community
 - a. 900 Mull Avenue, Akron, 330-867-5603
- 7. University of Akron-Department of Counseling, Clinic for Individual and Family Counseling**
 - a. 27 South Forge Street, 2nd floor, Akron, 330-972-6822

8. Minority Behavioral Health Group

- a. 1293 Copley Rd., Akron, 330-374-1199

9. Community Health Center

- a. Adult Treatment Center, 725 East Market Street, Akron, 330-434-4141

10. Jewish Family Service

Outreach to the LGBT Community

- a. 750 White Pond Drive, Akron, 330-867-3388

11. Catholic Charities Community Services of Summit County

- a. 812 Biruta Street, Akron, 330-762-7481

12. Common Ground Family Services

- a. 12 Southwest Avenue, Tallmadge, 330-630-1868

13. Greenleaf Family Center

- a. 580 Grant Street, Akron, 800-277-9494

14. Heart to Heart Family Support Center

- a. 1035 Rosemary Boulevard, Akron, 330-724-1950

15. United States Department of Veterans Affairs

- a. Akron Multispecialty Outpatient Clinic, 330-724-7715
- b. Louis Stokes Cleveland VA Medical Center-Wade Park Campus, 10701 East Boulevard, Cleveland, 216-791-3800

16. Kent State University

- a. Psychological Clinic, 176 Kent Hall, Kent, 330-672-2372

17. Beech Brook

- a. Summit County Office, 888 Jonathan Avenue, YMCA, Akron, 877-546-1225

18. Family and Community Services

- a. 143 Gougler Avenue, Kent, 330-677-4124

19. The Village Network

- a. Akron/Canton Network, 5399 Lauby Road, Suite 130, North Canton, 330-497-7726

20. Circle Health Services

- a. 12201 Euclid Avenue, Cleveland, 216-707-3500

Appendix K

Mind Map

Table 1

Participant Demographics

<u>Participant ID</u>	<u>Age</u>	<u>Gender</u>	<u>When did you have surgery</u>	<u>Race</u>	<u>Zip Code</u>	<u>Occupation</u>	<u>Partner Status</u>	<u>Bone Scan</u>	<u>Education Completed</u>	<u>Income</u>
#1	46	F	2004	White	44254	Clinical Education Staff Instructor-college	Married	Yes-2017	Bachelor's degree	\$40,000 - \$44,999
#2	46	F	2013	White	44691	Revenue Cycle Director	Married	No-has one scheduled	Master's Degree	\$125,000 - \$149,999
#3	55	F	Nov. 2018	White	44223	HR	Married	NO-didn't know what this was	High School graduate, diploma or the equivalent	\$10,000 - \$14,999
#4	46	F	Feb. 2019	White	44223	other	Single	Yes-1990's after motor cycle accident	Some college credit-no degree	\$15,000 - \$19,999
#5	29	F	2016	White	44223	Teacher	Married	NO	Master's degree	\$45,000 - \$49,999
#6	40	F	2018	White	44805	RN-Instructor	Married	NO	Bachelor's Degree	\$50,000 - \$59,999

#7	38	F	Feb. 2018	White	44223	Case worker	Married	No	Bachelor's Degree	\$35,000 - \$39,999
#8	49	F	Feb. 2018	White	44223	LPN	Single	NO	Associate degree	\$35,000 - \$39,999
#9	71	F	August 2018	White	44223	Retired	Married	Yes	Some college credit, no degree	\$40,000 - \$44,999
#10	72	F	2011	White	44223	Retired	Widowed	Yes	High School graduate, diploma or the equivalent	\$10,000 - \$14,999
#11	35	F	May 2018	White	44223	Employed-Medical Biller/Coder	Single	No	Associate degree	\$30,000 - \$34,999
#12	35	F	October 2018	Black or African American	44223	Employed-Teacher	Married	NO	Associate degree	\$60,000 - \$99,999
#13	47	F	April 18 2016	White	44223	Employed	Married	No	Trade/technical/vocational training	\$30,000 - \$34,999
#14	60	F	January 2014	White	44223	Employed-RN	Married	NO	Bachelor's Degree	\$35,000 - \$39,999

Table 2

Osteoporosis Preventative Measures

Participant	Diet focus on Calcium	Exercise-weight bearing	Bone Scan	Vitamins-Calcium & Vit D	Years Since Surgery
1	X		Done after BS, stated at risk before BS, but not after the scan	X	14
2				X	6
3	X	X		X	5 MONTHS
4			Done before BS, stated at risk for osteoporosis	X	3 MONTHS
5	X	X		X	3
6	X	X		X	1
7		X		X	1
8	X	X		X	1
9			Before BS; stated not at risk for osteoporosis	X	1
10			Before BS; stated not at risk for osteoporosis		8
11				X	1
12		X		X	6 MONTHS
13		X		X	3
14		X		X	5