

Patients' Experiences, Post-operative Psychosocial and Behavioral Factors Related to Weight Change among Patients who have Undergone Sleeve Gastrectomy in China

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Background: Sleeve gastrectomy (SG) is the most widely used surgical treatment for morbid obesity. Post-operative weight loss is highly variable, and there has been limited research conducted to examine the various factors that contribute to weight loss outcomes following the SG procedure.

Objectives: To describe the psychosocial status and to explore factors that may contribute to weight loss variability among post-SG adults in China, including patient experiences with post-surgical lifestyle change, post-operative psychosocial (disordered eating, depression, self-efficacy, and social problem solving) and behavioral factors (diet and physical activity).

Methods: This study included two phases. First, semi-structured interviews were conducted with 15 post-SG adults in Shanghai Huashan Hospital, China. Interviews explored patient experiences of post-surgical lifestyle changes and their perceived barriers and facilitators to make the required changes. Second, in addition to the 15 participants, we further recruited 52 adults for cross-sectional measurements. Standardized questionnaires were used to measure disordered eating behaviors, depression, self-efficacy, social problem solving and physical activity. One-day paper diary was used to assess dietary behavior. Weight was based on self-report.

Results: Qualitative findings revealed that SG imposed a drastic lifestyle change on participants, they viewed the changes positively and were able to use some of the core behavior change techniques (e.g., self-monitoring) to make appropriate adjustments. Both individual- and community-level barriers existed affecting participants' ability to meet the required lifestyle changes. Participants reported significant post-surgical weight loss with a mean body mass index change of $12.52 \pm 6.12 \text{ kg/m}^2$ in the quantitative phase. They demonstrated a high level of self-efficacy (112.42 ± 40.60) without obvious disordered eating behaviors (43.60 ± 25.61) and depressive symptoms (14.22 ± 11.00). The level of social problem solving skills (89.5 ± 12.87) was relatively low. Reported PA was below the recommended level, and dietary data were poor. Self-efficacy and the subscale of disordered eating behaviors (body dissatisfaction) significantly correlated with weight loss outcome.

Conclusion: Findings suggest that participants had good psychosocial status after SG and were able to use accurate strategies for making post-surgical lifestyle adjustments. Larger longitudinal studies incorporating pre-surgical assessments are needed to further understand the psychosocial and behavioral mechanisms of weight loss in the SG population.

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Preface

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1.0 PROPOSAL

1.1 SPECIFIC AIMS

Obesity is a global concern affecting 13% of adults worldwide.(WHO, 2015b) Since 2014, China has replaced the U.S. as the country with the highest prevalence of adults with obesity. Furthermore, among the 89.6 million adults with obesity, approximately 13.3% have severe obesity (body mass index [BMI] $\geq 35\text{kg}/\text{m}^2$)(Cesare et al., 2016) and consequently are at higher risk for metabolic disease and all-cause mortality compared to their counterparts with moderate obesity.(Flegal, Kit, Orpana, & Graubard, 2013) Bariatric surgery is the only evidence-based, surgical treatment for severe obesity. A relatively new surgical procedure called sleeve gastrectomy (SG), which is conducted by removing approximately 80% of the lateral aspect of the stomach,(Diabetes Prevention Program Research et al., 2009) has been demonstrated to have comparative effects on short-and mid-term weight loss and remission of comorbidities compared to the gold standard and more invasive Roux-en-Y Gastric Bypass (RYGB) surgical procedure.(Kalinowski et al., 2016; J. Li, Lai, & Wu, 2016; Ndumele et al., 2016)

Despite the favorable outcomes (e.g., short- and mid-term weight loss, remission of diabetes, hypertension, and hyperlipidemia(Piwek, Ellis, Andrews, & Joinson, 2016)), weight loss is highly variable in the SG population with a considerable portion of patients experiencing weight regain that reduces the overall benefits of previously achieved weight loss.(F. Li, Liu, Zhu, & Harmer, 2016) In a study conducted in China, only 79.7% and 54.5% of patients successfully achieved the expected weight loss goal (percent of excess weight loss [EWL%] $\geq 50\%$) 2 and 5 years after SG, respectively.(Ndumele et al., 2016) These results were supported by a recently

published systematic review that reported that the percent of people who regained weight ranged from 5.7 % at 2 years to 75.6 % at 6 years after SG.(Lauti, Kularatna, Hill, & MacCormick, 2016) The mechanism of post-surgical weight regain among individuals who have undergone SG is poorly understood due to SG being a relatively new surgical approach. Based on accumulated evidence from studies of gastric bypass and gastric banding procedures, weight loss after surgery is a multifactorial process that is incompletely understood. Although results are conflicting, it is generally acknowledged that besides the anatomic, surgical and genetic factors, how adherent individuals are to the required lifestyle change (e.g., diet and physical activity [PA]) may significantly determine the amount of long-term weight loss achieved following the surgical procedure.(Freire, Borges, Alvarez-Leite, & Toulson Davisson Correia, 2012) Additionally, patients' thoughts and experiences regarding the required post-surgery lifestyle changes, particularly eating and physical activity, and some psychosocial factors (e.g., disordered eating behaviors, depression, self-efficacy and problem-solving skills) may influence post-surgical lifestyle behaviors and contribute to weight regain.(Batsis et al., 2009; Fitzpatrick, Schumann, & Hill-Briggs, 2013; Karmali et al., 2013) The importance of exploring patient experiences and thoughts cannot be ignored given the fact that a person's thinking is an important determinant of psychological and behavioral responses. Indeed, research has shown that a positive modification in patients' thoughts will lead to subsequent improved psychosocial and behavioral functioning and ultimately better weight maintenance.(Bolger & Laurenceau, 2013; A. M. Kriska & Caspersen, 1997) The lack of qualitative evidence about patients' experiences related to lifestyle change after SG suggests a strong need for research in this area.

SG was first introduced to China in the 1980s, although it has been gaining acceptance, SG remains in its infancy.(X. Li, Zheng, & Rosenthal, 2008) Like anywhere else across the globe,

unsustainable post-surgical weight loss is a challenging issue. However, no study to date has investigated the psychosocial and behavioral factors that may influence weight loss and regain among Chinese patients.(H. Y. Lin et al., 2013) Moreover, it is unclear how the surgery impacts the patients' daily life, from the patient's perspective. The socio-demographic characteristics (e.g., sex, age, social-economic status), lifestyle, and mental health of patients undergoing bariatric procedures in China are dissimilar to patients in other countries.(X. Du et al., 2016) Details related to these factors will be provided later in this paper; therefore, evidence obtained from studies in non-Asian countries may not be applicable to the Chinese population.

Accordingly, we propose a mixed-method study with four specific aims:

Among patients who have undergone SG in China, semi-structured interviews will be conducted with 15 participants,

Aim 1: To describe patients' experiences related to post-surgical lifestyle change. We will explore participants' self-reported feelings and perceptions of how the surgery impacts their daily life.

Aim 2: To explore participants' perceived barriers and facilitators that influence their efforts to make the required post-surgical lifestyle changes.

Among patients who have undergone SG in China, data on psychosocial and behavioral factors will be collected with 120 participants,

Aim 3: To describe patients' psychosocial factors (e.g., disordered eating behaviors, depression, self-efficacy, social problem-solving) and behavioral factors (adherence to prescribed diet, adherence to PA recommendations) self-reported during the post-surgical period and the percent weight change from pre-surgical baseline.

Aim 4: To explore the associations between: 1) psychosocial factors and weight change; 2) behavioral factors and weight change.

1.2 BACKGROUND AND SIGNIFICANCE

1.2.1 Background

1.2.1.1 Obesity prevalence, complications and economic burden in China

Obesity has become a global epidemic affecting more than 650 million (13%) adults aged 18 and older.(WHO, 2015b) Over the past several decades, China has experienced a sweeping shift toward westernized diets and physical activity (PA) patterns that has led to the increased obesity prevalence. Since 2014, China has replaced the U.S. as the country with the highest global prevalence of adults with obesity.(Cesare et al., 2016) Obesity is estimated to afflict nearly 89.6 million adults in China, which translates to afflicting approximately 16.3% of the global male population and 12.4% of the global female population. Based on the World Health Organization (WHO) guidelines, obesity is classified as class I (body mass index [BMI] 30.00 - 34.99 kg/ m²), class II obesity (BMI 35.00 - 39.99 kg/ m²) and class III obesity, which is also called morbid obesity (BMI \geq 40.00 kg/ m²). In China, among the 89.6 million adults who are obese, approximately 13.3% are morbidly obese(Cesare et al., 2016) and consequently, they are at a higher risk of developing metabolic syndromes (e.g., hypertension, type 2 diabetes [T2DM]), cardiovascular disease and all-cause mortality compared to their counterparts with normal-weight or moderate-obesity.(Flegal et al., 2013) Morbid obesity has not only led to an increase in obesity-related morbidity but also has imposed a significant impact on medical care systems and a financial

burden on the obese population in China. Qin et al. reported that 5.29% of the total personal medical expenditure can be attributed to overweight and obesity, which accounts for 2.5% of China's national health care expenditure.(Qin & Pan, 2016)

The first step at all levels of overweight and obesity is modification of diet and PA.(Wing, 1998) Standard behavioral treatment (SBT), which consists of using a cognitive behavioral approach to changing lifestyle behaviors is the most efficacious non-surgical and non-pharmacological treatment.(L. E. Burke et al., 2015; Wing, 1998) Typical weight loss that occurs over several months of SBT is approximately 5-10% of baseline body weight. SBT was developed from social cognitive theory, the primary assumptions underlying this approach are that eating and exercise behaviors can be acquired and modified through the process of observational learning. The centerpiece of SBT focuses on reduced energy intake, increased energy expenditure, and behavioral strategies that facilitate self-regulation; the cornerstone of the behavioral strategies is self-monitoring of diet, PA and more recently body weight.(Turk et al., 2009; Warziski, Sereika, Styn, Music, & Burke, 2008; Wing, 1998) Self-monitoring increases an individual's awareness of his/her behavior and progress made in altering the behaviors targeting caloric restriction and increased PA. Recently published systematic reviews showed that self-monitoring of diet, PA and weight are potential predictors of beneficial weight loss outcomes without causing unwanted adverse effects.(Shieh, Knisely, Clark, & Carpenter, 2016; Teixeira et al., 2015; Zheng et al., 2015) Feedback provided by the self-monitoring and by the interventionist or counselor reinforces the behavior change, and empirical evidence has demonstrated that desired eating and PA behaviors are more likely to occur when the reinforcing feedback messages are delivered immediately after the performed behavior.(Ambeba et al., 2015; L. E. Burke et al., 2017; Lee & Wang, 2005; Shuger et al., 2011)

The Diabetes Prevention Program (DPP) provided an excellent example of the implementation of SBT. DPP is an efficacious weight loss intervention that has been translated into diverse clinical and community settings. Through comparing the effect of lifestyle intervention, metformin and placebo on diabetes prevention, it has provided foundational evidence for the efficacy of lifestyle interventions on decreasing the risk of T2DM and promoting weight loss in individuals at risk for diabetes. The goals for the participants assigned to the intensive lifestyle intervention were to achieve and maintain a weight reduction of at least 7 percent of initial body weight through attending a 16-lesson curriculum covering diet, exercise, and behavior modification. The core curriculum in the DPP was delivered by trained lifestyle coaches and addressed core topics including goal setting (daily calories/fat and weekly PA), dietary modification, self-monitoring fat and/or calorie intake and PA, strategies to enhance adherence to and maintenance intervention, and supervised activity sessions. Although weight loss was not the primary aim of DPP, studies with long-term follow-up have demonstrated that the lifestyle group participants initially lost the most weight (a mean of 7 kg by year 1) still weighing about 2 kg less than they did at randomization, despite the natural process of weight loss and regain.(Diabetes Prevention Program Research, 2015; Diabetes Prevention Program Research et al., 2009) Today, a multi-component behavioral intervention delivered by a multidisciplinary team (including nurses, physiotherapists, exercise specialists, dietitians, and psychologists) is recommended by the U.S Preventive Services Task Force to promote weight loss and to improve cardiovascular risk factor control.(Moyer, 2012) Although cognitive behavioral therapy has been highly successful in achieving weight loss for people with obesity, the biggest challenge today in weight loss treatment is maintaining the achieved weight loss.(Roumans et al., 2016) Considerable research has demonstrated that most people will regain

a third of the lost weight within a year after treatment ends and the rest within 3–5 years.(Dulloo & Schutz, 2015; Evans et al., 2015) The data on the effectiveness of cognitive behavioral therapy in the severely obese population are limited;(Lv et al., 2017) however, a systematic review that examined the efficacy of cognitive behavioral lifestyle interventions for those with moderate and severe obesity concluded that although a clinically significant weight loss can be achieved in the short term period, the long-term effect of SBT is modest. Moreover, the review was unable to find a trend towards significant improvements in other cardiovascular risk factors.(Lv et al., 2017)

Pharmacological therapy is the second line approach to obesity treatment. To date, the Food and Drug Administration (FDA) has approved five drugs for long-term weight control: orlistat (Xenical, Alli), lorcaserin (Belviq), phentermine-topiramate (Qsymia), naltrexone-bupropion (Contrave), and liraglutide (Saxenda). Although supplementing lifestyle modification with pharmacological treatment may lead to greater weight loss, there are limitations to pharmacological therapy, for example, none of these drugs are without potential adverse effects. Moreover, no medication used to stimulate weight loss has shown reduced cardiovascular morbidity or mortality.(Yanovski & Yanovski, 2014) Given the limited long-term weight loss often seen with SBT or pharmacological therapy, bariatric surgery has emerged as the only evidence-based effective treatment for severe obesity that can produce superior benefits for weight loss maintenance, comorbidity remission and long-term survival compared to SBT.(Barzin et al., 2016) Additionally, patients may also experience reduced symptoms associated with certain psychiatric disorders (e.g., depression and anxiety),(Booth et al., 2015; Tae et al., 2014) improved eating behavior,(Pepino, Stein, Eagon, & Klein, 2014) increased

PA,(Vargas, Piccoli, Dani, Padoin, & Mottin, 2013) and better health-related quality of life(Andersen et al., 2015) following bariatric surgery.

1.2.1.2 Bariatric surgery in China

Bariatric surgery was first introduced to China in the 1980s and the number of surgeries performed each year has increased rapidly from 280 in 2009 to 7779 in 2015.(J. Liu, 2015) According to the guidelines issued by the Asia-Pacific Bariatric Surgery Group (APBSG), the surgical indications for the Chinese population include:1) $\text{BMI} \geq 37 \text{ kg/m}^2$, or 2) $\text{BMI} \geq 32 \text{ kg/m}^2$ with at least two obesity-related co-morbidities such as T2DM, hypertension, heart disease, or 3) failed to achieve a sustained weight loss with prior weight loss efforts.(Lee & Wang, 2005) Despite well-recognized benefits and clear guidelines issued for bariatric surgery, it has been underused as demonstrated by the fact that less than 1% of the population that meets the criteria have undergone this treatment option.(Bour, 2015) Possible reasons for this underuse may include lack of financial support via insurance compensation, limited access, high cost and concerns about the possible negative outcomes. Better information to inform potential recipients and improved post-surgical support to patients who could benefit from bariatric surgery is needed to improve their acceptance of this treatment option.

Bariatric surgery in China is still in its infancy. The majority of surgeries performed thus far have used the laparoscopic technique and can be categorized into three categories: malabsorptive procedures (biliopancreatic diversion with or without duodenal switch), restrictive procedures (vertical banded gastroplasty, gastric banding, and SG) and combined procedures (Roux-en-Y Gastric Bypass [RYGB]). RYGB has long been regarded as the gold standard, however, it has been gradually replaced by SG, which has become the predominant global bariatric

procedure performed today with an increase from 9.3% in 2010 to 58.2% in 2014.(Khorgami et al., 2017)

SG achieves weight loss by removing approximately 80% of the lateral aspect of the stomach and as a relatively new surgical technique has been performed as a stand-alone procedure only since 2008.(Diabetes Prevention Program Research et al., 2009) The SG has been demonstrated to be equally effective for short-and mid-term weight loss and remission of comorbidities compared to the RYGB.(Kalinowski et al., 2016; J. Li et al., 2016; Ndumele et al., 2016) SG also has other advantages, such as a short learning curve for the surgeon, the absence of introducing foreign objects, and short hospital stay. SG has gained a wide acceptance among bariatric surgeons since it was first introduced to China in 2011. It is estimated that approximately 7700 cases of bariatric surgery were performed in 2015 with SG accounting for half of them.(S. Lin, Guan, Hans, & Liang, 2017)

1.2.1.3 Health outcomes of sleeve gastrectomy

Weight loss

SG has proven to be very effective in initiating weight loss for patients with morbid obesity, at least in the early to midterm postoperative period. Emile et al.(Emile, Elfeki, Elalfy, & Abdallah, 2017) reviewed short-term weight loss data after SG from the previous 5 years and found a significant reduction in BMI, which dropped from a mean of 43.8 ± 4.9 at baseline to a mean of 30.7 ± 3.9 at 1 year, 28.6 ± 4 at 18 months and 28.7 ± 3.1 at 24 months after SG ($P < .0001$). Mean percent excess weight loss (%EWL) is a common metric for measuring post-surgical weight loss outcomes which can be calculated as $[(\text{Initial Weight}) - (\text{Post-operative Weight})] / [(\text{Initial Weight}) - (\text{Ideal Weight})]$ (in which ideal weight is defined by the weight with a BMI of 25 kg/m^2).

In a short term weight loss review, %EWL at 1 year, 18 months and 24 months were 67.3 ± 11.2 , 67.5 ± 6.9 , and 70.9 ± 10.4 respectively. Although long-term weight loss data following SG is rare, some studies have pointed out that weight regain may be a significant issue both for Chinese and western populations. Liu et al.(Ndumele et al., 2016) followed 150 Chinese patients who underwent SG for 5 years and reported that the mean %EWL decreased gradually from 70.5 % at 1 year to 57.2% at 5 years. Felsenreich et al.(Warziski et al., 2008) followed patients who underwent SG for 10 years and reported that 59% regained more than 10 kg and 30% regained more than 20 kg from the nadir weight. A recently published systematic review that included findings of 9 studies conducted in different countries reported that the percent of people who regained weight ranged from 5.7% at 2 years to 75.6% at 6 years.(M. Lauti, M. Kularatna, et al., 2016) The failure to achieve the desired post-surgical weight may attenuate the surgery-induced benefits of comorbidity remission and possibly revisional bariatric surgery,("Overview: Behavioral Risk Factor Surveillance System 2017," 2017) which will create additional economic and emotional burden.(Saunders, 2004) An example of loss of post-surgery benefit is the recurrence of T2DM after initial remission, which occurred in 19% of patients in Janse Van Vuuren et al.'s study; reduced weight loss and weight regain are the two major predictors for the re-emergence of T2DM.(Brethauer et al., 2013) Attempting to correct this recidivism, approximately 10-20% of patients undergo revisional surgery to induce better weight loss for the long-term.(Kowalewski et al., 2018; Noel, Nedelcu, Eddbali, Manos, & Gagner, 2017)

Comorbidity remission

One of the reasons why SG is gaining greater acceptance lies in its ability to improve multiple obesity-related comorbidities, such as T2DM, hypertension, and hyperlipidemia. It is repeatedly shown that SG is highly effective in the treatment of T2DM with a 60.8% resolution 5

years after surgery.(Switzer et al., 2016) Even though a certain level of T2DM recurrence can be expected in some patients who initially achieved remission, a significant improvement in glycemic control, reduced number of diabetes-related medications including insulin, and improved levels of HDL cholesterol were still observed for the long-term.(Aminian et al., 2016) Recent research has shown that SG is equally safe and effective for patients whose BMI is less than 35 kg/m². (Horwitz et al., 2016) The American Diabetes Association has recognized bariatric surgery as a standard treatment option for T2DM and suggests that patients who have a BMI between 30 and 34.9 kg/m² consider the surgery if hyperglycemia is poorly controlled.(Rubino et al., 2016) The existing evidence shows that SG has a significant effect on hypertension.(Garg, Priyadarshini, Aggarwal, Agarwal, & Chaudhary, 2017; Nocca et al., 2017) A recent published meta-analysis, which included 33 studies examining the effects of SG on hypertension, concluded that at 1 year after SG, 58% of patients had complete hypertension resolution and, on average, 75% of patients experienced resolution or improvement.(Sarkhosh, Birch, Shi, Gill, & Karmali, 2012) Moreover, SG has also been shown to have a positive effect on obstructive sleep apnea syndrome,(Garg, Aggarwal, et al., 2017; Nocca et al., 2017) hyperlipidemia,(Altun et al., 2016; Gray et al., 2017) and gastro-esophageal reflux disease (GERD).(Garg, Priyadarshini, et al., 2017; Gray et al., 2017)

Risks and complications

SG is considered a safe surgery in China and elsewhere globally with a 30-day mortality rate of less than 1%(Emile et al., 2017; Garg, Aggarwal, et al., 2017; Garofalo et al., 2017; Hans, Guan, Lin, & Liang, 2017) and near zero treatment-related mortality 5 years after surgery.(Hoyuela, 2017; Salminen et al., 2018) Early complications reported in the literature include nausea and vomiting, pulmonary embolism, staple line leak, bleeding, infection, and deep vein thrombosis. Later complications include stricture formation, nutritional deficiencies and new

onset GERD. While bariatric surgery will lead to decreased bone mineral density and accelerate the process of bone loss,(Ko et al., 2016) a paucity of research has examined post-surgical fracture risk, which is a crucial area for additional research. Chia-Wen et al.(Lu et al., 2015) matched 2064 patients who underwent bariatric surgery (SG included) to 5027 patients with obesity who did not receive surgery and found that the surgical group was at a significant higher risk of fracture after 12 years. However, another study that had a shorter follow-up time of 2.2 years suggested there was no relationship between bariatric surgery and fracture risk.(Lalmohamed et al., 2012) While bariatric surgery may have positive effects on psychological disorders, the likelihood of other mental illness may increase post-surgery, more specifically, SG patients are at a higher risk to develop alcohol and other substance abuse.(Malik, Mitchell, Engel, Crosby, & Wonderlich, 2014a) The underlying mechanism of this phenomena is poorly understood, some researchers have raised a hypothesis called “addiction transfer” which means that an addiction switched from food to other substances.(Qiu, Ren, Liu, Yin, & Ren, 2019) Other negative health outcomes reported in the literature included hair loss(Ruiz-Tovar et al., 2014) and excess skin that often requires corrective cosmetic surgery.(Wakefield, Rubin, & Guseenoff, 2014)

1.2.1.4 Factors related to weight loss after SG

As noted previously, there is great variability in weight loss after SG with some patients at risk of regaining most or part of the lost weight. Although research addressing the mechanism of post-surgical weight loss variance of SG is emerging, it is still very limited due to SG being a relatively new surgical approach that was not performed as a stand-alone procedure until 2008. Based on accumulated evidence from studies of gastric bypass and gastric banding procedures, weight loss after surgery is a complex combination of technical, physiological, behavioral and psychosocial factors (e.g., pouch dilation, hormonal imbalance, disordered eating

behaviors).(Maleckas, Gudaityte, Petereit, Venclauskas, & Velickiene, 2016) SG is a restrictive surgical technique that is performed by a removal of most of the fundus, body and antrum guided by a bougie. Bougie size is assumed to be an influencing factor for weight loss effect after SG. Balla et al.(Balla et al., 2017) divided 127 patients into 3 groups based on bougie size and other surgical techniques, the bougie diameter for groups A, B and C were 48F, 42F and 36F, respectively. Results showed that among 7 patients who experienced weight regain, 6 of them came from group A and the seventh patient was in group B, supporting the premise that a larger bougie size may be a risk factor for weight loss failure. Similarly, through analyzing data from 1395 patients who underwent SG, Ellatif et al.(Abd Ellatif et al., 2014) reported that a smaller bougie size (\leq 36F) was significantly and positively associated with weight loss after a mean follow-up period of 76 months. Besides bougie size, research has targeted the volume of residual stomach as a predictor of weight loss after SG. Obeidat et al.(F. Obeidat, Shanti, Mismar, Albsoul, & Al-Qudah, 2015) compared the surgical outcomes between two groups, group A consisted of 54 patients who had a 6-cm antral resection and group B comprised 56 patients with 2-cm antral resection. After 2 years, the rate of weight regain was 12% and 2% for groups A and B, respectively, (P=.003) which proved that a more radical antral resection may be a protective factor against weight regain. For studies with a longer follow-up period, Weiner et al.(Weiner et al., 2007) demonstrated that a removal of less than 500cc gastric volume may result in early weight loss failure after SG. However, one study from the Chinese experience reported no relationship between resected gastric volume and weight loss at one year after SG.(Xiao Du et al., 2018) Other factors that have an influence on the volume of gastric remnant, such as the shorter distance between the pylorus and the beginning of the staple line, were also reported to be related to the post-surgical weight loss success.(Abd Ellatif et al., 2014)

Although physiological and surgical factors play a critical role in influencing the weight loss effect, we cannot ignore the importance of behavioral domains, e.g., modifying dietary habits and encouraging PA, to support weight loss and maintenance. Based on the literature of studies conducted in western countries, a failure to sustain weight loss after SG can be partly attributed to noncompliance to the comprehensive lifestyle changes recommended to support weight loss.(Alvarez et al., 2016; Fahmy et al., 2016) Although SG removes a substantial part of the stomach and reduces the volume of food that can be consumed,(Alhalel, Schueller, & O'Brien, 2018) it does not necessarily guarantee an improvement in food quality. Studies have shown that patients' adherence to dietary recommendations declined over time(Ferreira, Dantas, & Valente, 2018; Schiavo et al., 2017) and was demonstrated to be negatively associated with weight loss.(Moize et al., 2013) Patients' adherence to PA presents a similar pattern with a lower levels of PA in the long-term(Goldenshluger et al., 2017; Magnoni et al., 2012) and reported to significantly contribute to the weight regain.(C. Mitchell, Ridgway, & Sheeran, 2018) Keren et al.(C. Mitchell et al., 2018) examined the reasons for weight regain among 114 patients by asking them whether or not they had significantly changed their eating or PA behaviors since undergoing SG. By comparing the regain and non-regain groups, results revealed that poor dietary and exercise patterns contributed to weight regain. Long-term multidisciplinary care after bariatric surgery is important for weight maintenance and management of co-morbidities. Despite knowing the importance of close follow-up and support following surgery, the rate of attendance to follow-up appointments is universally low. Regular attendances to follow-up appointments and support groups have been shown to be significant predictors of weight loss outcome.(de Hollanda et al., 2015; Martin, Lee, Rigas, & Tam, 2015) Other behaviors associated with weight loss include preoperative weight loss,(Pekkarinen et al., 2016a, 2016b; Steinbeisser, McCracken, & Kharbutli,

2017) and early post-surgical weight loss.(Firas Obeidat & Shanti, 2016) Besides the behavioral factors, several socio-demographic predictors have been reported to be associated with post-operative weight loss, such as older age, gender,(Perrone et al., 2016) higher baseline BMI, taking more medications(Goldenshluger et al., 2017), and lower level of education.(Dilektasli et al., 2017)

Behavioral outcomes post bariatric surgery have not been systematically studied in China. Chinese patients are different from their counterparts in other countries in several ways, which may influence their adherence to the new lifestyle. Unlike in the U.S. where most patients choose bariatric surgery with the intention of losing weight,(Faccio, Nardin, & Cipolletta, 2016) in China, the majority of bariatric procedures are performed to facilitate diabetes remission, rather than for weight loss which may influence the patient's engagement in postsurgical lifestyle change.(X. Du et al., 2016) A second factor to consider is China's unique diet culture. In one respect, Chinese cuisine relies heavily on grains and vegetables, and steaming and boiling are the primary cooking methods that may be beneficial in terms of reducing energy intake. In another respect, the grouped dining system(Ma, 2015) may hamper patients' dietary adherence by limiting available food choices and pressuring patients to eat the same foods their family members are eating. A third factor is that being physically active is not heavily emphasized in China where occupational, household, and transport domains are the most common types of PA, whereas leisure-time activity is the main contributor to total PA in high-income countries.(AE et al., 2012; Macniven, Bauman, & Abouzeid, 2012) Additionally, patients may encounter more obstacles to adhere to the PA guidelines due to a lack of exercise facilities.(Pearson, 2012)

1.2.1.5 Psychosocial factors related to behavior change

Postoperative compliance to lifestyle change may be affected by psychosocial factors. Self-efficacy and social problem-solving are two key constructs that may influence postoperative adherence.(Bandura, 1986; Koharchik & Redding, 2016) The concept of self-efficacy comes from Bandura's social cognitive theory, which refers to a person's confidence in his or her capability to perform a behavior and has been regarded as the single most powerful construct in explaining behavior change.(Bandura, 1986) Research has repeatedly demonstrated that people with a higher level of self-efficacy for changing their lifestyle behaviors are more likely to engage in weight management behaviors such as healthy eating and regular PA,(Nezami et al., 2016; Strachan & Brawley, 2009) and they have a higher chance of achieving weight loss and weight loss maintenance as well.(Faghri & Buden, 2015; Nezami et al., 2016; Shin et al., 2011; Warziski et al., 2008)

Social problem-solving is a cognitive-affective-behavioral process by which people attempt to discover effective or adaptive solutions to problems they experience in everyday life(Nezu & D'Zurilla, 2007) and it has been demonstrated to be a key component in relapse prevention therapies and has a significant influence on weight maintenance.(Mary E. Murawski et al., 2009; Perri et al., 2001) Evidence also has shown that effective problem-solving may increase active coping strategies. Based on Marlatt's cognitive-behavioral model of relapse, individual's ability to utilize effective coping skills is the most critical predictor of relapse.(Larimer, Palmer, & Marlatt, 1999) Compared to weight regainers, successful weight maintainers are more likely to adopt positive coping behavior (e.g., trying to build weight maintenance behaviors to be a normal part of their lifestyle) when facing high risk situations.(Chambers & Swanson, 2012) Self-efficacy and problem-solving have been largely ignored in studies of individuals who have had bariatric

surgery; however, from the limited published studies, there have been reports of a positive relationship between self-efficacy and post-surgical lifestyle adherence and self-efficacy and weight loss.(Batsis et al., 2009; Boeka, Prentice-Dunn, & Lokken, 2010) One study reported that SG patients with high %EWL reported significantly more "active coping" behavior than patients with moderate and low %EWL.(Figura et al., 2015)

Post-surgical eating disorder is a well-recognized predictor of poorer weight loss in the literature on gastric banding and gastric bypass,(Fitzpatrick et al., 2013; Heppner & Petersen, 1982; Kalarchian et al., 2016) but little is known about disordered eating behaviors among patients after undergoing SG. Individuals with disordered eating behaviors are less likely to achieve weight loss success. Sioka et al.(Pagoto et al., 2018) reported that binge eating disorder is associated with worse post-SG weight loss, and Ivezaj et al.(Rafiei & Gill, 2018) reported a significant association between loss of control eating and poorer weight loss outcome after SG.

Apart from eating disorders, depression is one of the most commonly diagnosed mental health conditions among patients who have undergone SG.(Burgmer et al., 2014) Negative mood was found to negatively affect self-regulation behaviors while individuals with negative mood have more difficulty controlling their eating or exercising behaviors.(Lazarus, 2016; Rodriguez-Garcia, Medina-Moya, Gonzalez-Pascual, & Cardenete-Reyes, 2018) In the bariatric surgery population, significant negative associations were found between depression and postsurgical dietary adherence.(Phillips, Duke, & Weerasuriya, 2017; Schuelke & Barnason, 2017) Research findings related to the relationship between depression and weight loss effect are inconsistent. Although some studies report a negative association(Odom et al., 2010) or no association,(Strain et al., 2014) most of the studies conducted among patients who have undergone gastric bypass or

gastric banding reported support for depression as a predictor of poorer weight loss outcomes, and this finding has been repeated in SG patients.(Burgmer et al., 2014)

Psychosocial research on bariatric surgery remains underdeveloped in China. Unlike the findings reported in western countries, there is an inverse relationship between depressive symptoms and weight in Chinese populations, which is known as the “jolly fat” phenomenon. That is, individuals who are obese are significantly less likely to report depressive symptoms compared to their normal weight counterparts.(Dong et al., 2013; Yu, Chen, Liu, Chau, & Chang, 2011) It is unclear what the psychological status of patients who have undergone bariatric surgery is as well as how it relates to their post-surgical adherence to lifestyle change, suggesting another area in need of further study.

1.2.1.6 Patient experiences in lifestyle change after bariatric surgery

To the best of our knowledge, there has been no study in the literature that has conducted qualitative investigations of the patient experiences related to post-operative lifestyle changes specifically focused on SG technique. Overall, a large portion of bariatric surgery patients have an unrealistic expectation of bariatric surgery and are not well-prepared for the lifestyle change needed after surgery.^(Homer, Tod, Thompson, Allmark, & Goyder, 2016) Several negative thoughts have been identified to impede patients to adopt and maintain post-surgical changes, such as regarding behavioral change as a huge sacrifice,(da Silva & da Costa Maia, 2012) lack of information and resources,(K. L. Edward, Hii, Giandinoto, Hennessy, & Thompson, 2018) seeing oneself as a passive spectator without personal commitment,(A. M. Kriska et al., 1990) having no intention to make change,(Bond et al., 2013) feeling lack of social support,(Liebl, Barnason, & Brage Hudson, 2016) feelings of shame and failure, perceiving a sense of loss,(Liebl et al., 2016) experiencing feelings of defeat and failure with weight regain,(Jr, ER, EA, & Jr, 2014) worrying about the unmet

expectations(Pereira et al., 1997) and frustrated about the physical changes that occur post-surgery (e.g., hair loss, surplus skin, chronic pain, fatigue).(K.-L. Edward, W, Giandinoto, Hennessy, & Thompson, 2016; Gribsholt, Pedersen, Svensson, Thomsen, & Richelsen, 2016; Mayor, 2016) A successful identification and modification of those negative thoughts was reported to be positively related to an improvement in anxiety, psychological distress,(A. M. Kriska & Caspersen, 1997) depression, disordered eating(Bolger & Laurenceau, 2013) and better weight loss outcome.(Abiles et al., 2013)

The experience of Chinese patients post-bariatric surgery may be quite different from that reported in other countries for the following reasons, first, the majority of surgery has been conducted for diabetes treatment rather than for obesity, so the unique context may influence patients' expectation and perception of the postsurgical lifestyle change;(X. Du et al., 2016) second, the number of male and female patients has been almost equal(X. Du et al., 2016) which is different from western countries where the majority of patients are female, the gender-related differences may lead to new insights on postsurgical change; third, due to the diet and PA culture (e.g., grouped dining system,(Ma, 2015) lack of facilities for exercising), patients may encounter more obstacles to adhere to the postsurgical lifestyle modification.(Magnoni et al., 2016)

1.2.1.7 Current interventions and frameworks

Several theories and constructs have been used to guide research conducted among individuals who have undergone bariatric surgery, which will be discussed below. Although this proposed study is descriptive in nature, data collected will definitely facilitate the future design of theory-based intervention studies. In addition, a review of the theories and constructs that have been applied in the bariatric field would be informative to us in selecting the most appropriate theory for the proposed study.

The study of behavioral interventions in patients post bariatric-surgery is in its infancy and has mainly focused on cognitive behavioral therapy (CBT) an approach that is similar to what has been described earlier in this document in SBT weight loss in individuals not seeking to undergo surgical intervention. CBT is one of the most widely used intervention strategies in the bariatric field and emphasizes the key constructs of irrational beliefs, unconditional self-acceptance, dysfunctional cognitions, experiential avoidance and psychological inflexibility. CBT focuses on the thoughts, cognitive schema, beliefs, attitudes, and attributions that influence one's feelings and mediate the relationship between antecedents and behavior. Although there is no specific theory attached to CBT, some of the constructs originated from classic behavior change theories. For example, the concept of belief is a key component in the theory of planned behavior (TPB) which adopts a cognitive approach to explaining behavior that centers on individuals' attitudes and beliefs. Individuals' beliefs significantly influence attitudes and subjective norm about the positive or negative outcomes from performing behavior. Those factors combined to influence a person's behavioral intention which is regarded as a strong predictor of behavior. The foundation of CBT is based on the assumption that most emotional and behavioral reactions are learned, which comes from social learning theory that evolved to social cognitive theory (SCT). People learn through observing others' behavior, attitudes, and outcomes of those behaviors.

Motivational interviewing (MI) is an intervention strategy used in many behavioral treatment for weight loss studies (e.g., LOOK Ahead) and subsequently introduced to the field of weight management post-bariatric surgery. MI is an effective strategy that uses a patient-centered and goal-directed approach to enhance autonomous motivation and facilitate change(Miller & Rollnick, 2002) which is derived from self-determination theory (SDT). SDT is well proved and widely used in the field of behavior change. Motivation has two dimensions: autonomous

motivation and controlled motivation. Autonomous motivation includes intrinsic motivation (individuals' experience, volition and satisfaction of the behavior itself), integrated regulation (the behavior is consistent with one's identity), and identified regulation (individuals have identified with the personal importance of a behavior for their own self-selected goals, values, or aspirations). Controlled motivation includes introjected regulation (the pursuit of a behavior is partially internalized and is motivated by the need to maintain self-esteem, gain approval from others, or to avoid shame) and external regulation (based on rewards or punishment that' has poor maintenance and transfer). A wealth of research regarding behavior change has proved that, compared to controlled motivations, autonomous reasons tend to yield fewer relapse episodes and lead to greater long-term persistence.(Deci & Ryan, 2008; Teixeira et al., 2015; Trief, Cibula, Delahanty, & Weinstock, 2017)

Protection motivation theory (PMT) is a popular social cognitive model to predict health behavior, it emphasizes how four core cognitive processes (perceived vulnerability, perceived severity, perceived self-efficacy and perceived response efficacy) lead to healthy behavior changes. Boeka et al.(Boeka et al., 2010) used PMT as the theoretical framework to develop a pilot intervention that focused on increasing adherence to post-surgical dietary guidelines. The control group received regular education provided by the bariatric surgeon, and the PMT group received several sessions targeting cognitive reconstruction. While there was no statistically significant difference between the PMT group and control group on dietary adherence, further analysis showed that two components of the PMT intervention, perceived self-efficacy and perceived threat of not following the guidelines, did predict the patients' intentions of complying with the dietary protocol.

1.2.2 Theoretical/conceptual framework

From these theories, SCT is the most appropriate to guide our research.(Bandura, 1986)

This is one of the most widely used behavioral change theories that offers logical connections between personal thoughts and psychosocial and behavioral components to explain behavior change, and it has been successfully applied numerous times in a weight loss context.(Courtney, Moler, Osborne, Whitney, & Conard, 2015; Dunn & Conard, 2018) The basic structure of SCT lies in the triadic reciprocal determinism among personal, environmental and behavioral factors,(Bandura, 1986) and individuals' behavior is regarded as a result of the bidirectional influence of one's affect, thoughts and beliefs as well as the surrounding physical and social environment.

In this proposed study, behavior is operationalized as adherence to the diet and PA goals. Personal factors refer to patient experiences and individual psychosocial components, including disordered eating behavior, depression, self-efficacy, and social problem-solving as well as demographic characteristics (i.e., age, gender, marital status, education and socioeconomic status). Chinese culture serves as the environmental factor that we do not measure but based on the literature assume it influences the personal and behavioral factors.(Painter et al., 2017)

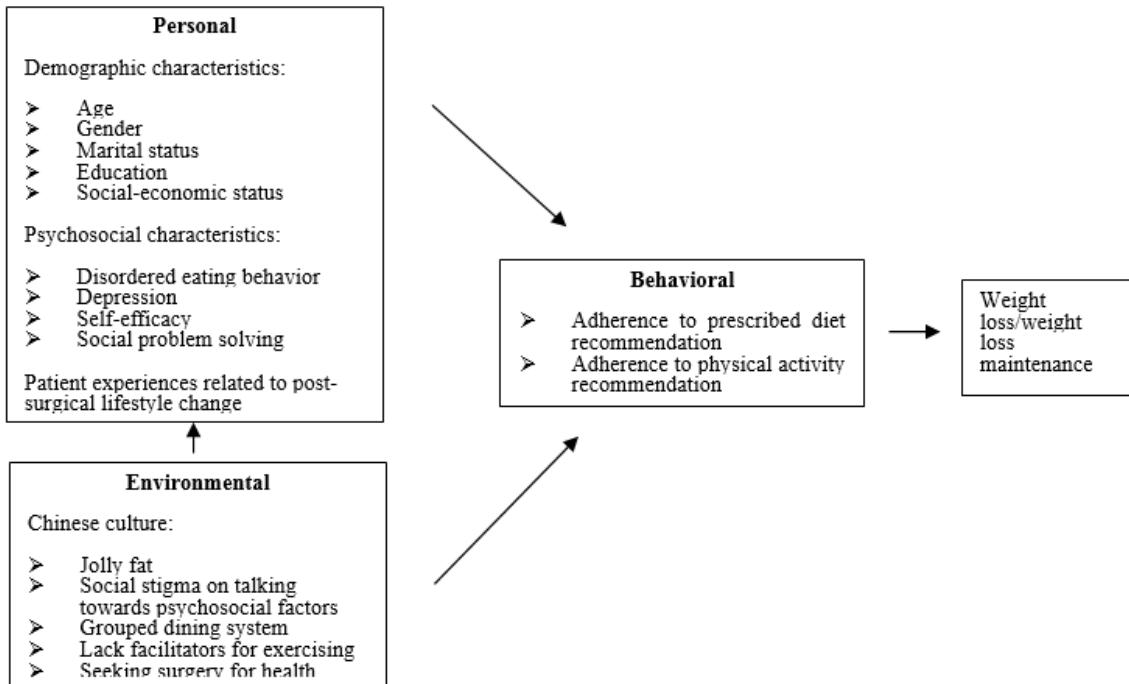


Figure 1 Social Cognitive Theory

1.2.3 Significance and Innovations

1.2.3.1 Significance

In an area where limited evidence exists, understanding how patients think and feel is of vital importance to serve as the foundation for further research. Additionally, given a dramatic lifestyle modification requirement, such as changing dietary patterns and eating habits and increasing exercise after surgery, it is critical to understand how patients adjust to and cope with the requirements that will significantly influence his/her emotional and behavioral reactions and therefore will finally influence the weight loss effect. The limited available research examining patients' post-surgical life experience focuses primarily on western populations whose personal characteristics are very different from that of Chinese. Exploring this culture-specific experience will offer insight into the potential contributors of post-surgical weight loss variance and will also

inform future interventions or patient counseling strategies to facilitate lifestyle change and obtain a successful outcome after surgery.

The two main goals of the SG procedure are to induce weight loss and to reduce the individual's obesity-related comorbidities,(Wimmelmann, Dela, & Mortensen, 2014) neither of which can be sustained if post-surgical weight regain occurs. Current evidence on factors contributing to successful post-surgical weight loss maintenance is conflicting and mainly retrieved from the literature on gastric bypass or gastric banding. SG differentiates itself from other surgical procedures for its purely restrictive modes of action that eliminate the possibility of malabsorption. The hormone changes resulting from the SG procedure may lead to an alteration of appetite and food preference. Thus, the lifestyle habits, especially the dietary intake and eating behaviors, are potentially unique for SG.(Magnoni et al., 2012; Melero, Ferrer, Sanahuja, Amador, & Hernando, 2014; Primeaux et al., 2015) In addition, research has reported that during the post-SG phases patients are at a higher risk for long-term weight loss failure compared to malabsorptive surgical techniques, which support the importance of this study to identify potential factors influencing the post-operative phase.(Johnson Stoklossa & Atwal, 2013)

Sustained weight loss requires sustained changes in diet and PA. Several constructs, such as self-efficacy and social problem-solving have been well-recognized as key mediators for behavior change in theoretical(Bandura, 1986) and empirical research,(Clark, Abrams, Niaura, Eaton, & Rossi, 1991) but have rarely been examined in the bariatric surgery arena. SCT is used predominantly in behavioral weight loss studies.(Peterson et al., 2014; Turner-McGrievy et al., 2013) Through identifying the theory-based psychosocial and behavioral factors that may be linked to weight change after SG, tailored interventions that target the modifiable contributors can be developed to improve post-surgical weight loss maintenance and sustain comorbidity remission.

Additionally, exploring the associations between psychosocial and behavioral factors and post-surgical weight loss will provide a better understanding of the post-surgical weight change processes.

Weight regain is as common in Chinese populations undergoing the SG procedure as that in other populations.(Han, Chen, Zhuge, Zhang, & Zou, 2013; Ndumele et al., 2016) However, the factors contributing to weight loss variability in this population have not been examined. Although researchers in western countries have studied the psychosocial and behavioral aspects of bariatric surgery, there are few studies among Chinese patients reported in the literature. Given the distinct cultural as well as lifestyle differences between Chinese and western cultures and health care, this study will attempt to address the gap and to provide evidence to better inform the development of interventions to improve post-surgical weight outcomes. Researchers and clinicians can benefit from our proposed examination of disordered eating behaviors and depression among patients who have undergone SG. Moreover, our findings for self-efficacy, social problem-solving and post-surgical adherence may inform the development of interventions to improve patients' post-surgical lifestyle adherence and ultimately to help them optimize post-surgical weight loss.

1.2.3.2 Innovation

This study is innovative because it will be the first study:

- To incorporate qualitative methods to explore patients' experiences in changing lifestyle behaviors after SG, which will build evidence for better design and delivery of post-surgical interventions in the future.
- To apply constructs from SCT to the post-SG context among patients in China where the behavioral mechanism of weight change is poorly understood.
- To examine the psychosocial and behavioral aspects among patients in China who have

undergone SG, thus it will help to identify factors that contribute to post-surgical weight change among adult patients in China.

- This study is pioneering from the perspective of global health, it facilitates cross-cultural comparison of these factors pertaining to the psychological and behavioral aspects of bariatric surgery among Chinese patients through addressing the deficit of evidence.

1.3 RESEARCH DESIGN AND METHODS

1.3.1 Phase 1

1.3.1.1 Study design

We propose to conduct a qualitative study using semi-structured interviews to explore participants' experience as well as their perceived barriers and facilitators about lifestyle change following SG.

1.3.1.2 Sample & recruitment

We will recruit participants from the Center for Obesity and Metabolic Surgery, Huashan Hospital, China. It is one of the highly rated hospitals in China where SG was introduced in 2012, and the number of surgeries performed per year is approximately 30 with a steady increase each year since 2012. Age, gender, ethnicity, and the period of time post SG procedure will be taken into consideration in order to form a sample with sufficient variability. The targeted sample size for Phase 1 (10 to 15) is based on the number expected to provide data saturation.

Inclusion criteria for Phase 1 include (a) age between 18 and 65 years; (b) being able to read and write in Chinese; (c) living within 50 miles of the Shanghai area. Individuals who have severe psychiatric disorders (e.g., schizophrenia) will be excluded. Permission from the hospital and associated departments will be obtained before initiating the study. Through collaboration with the surgeons and case manager, potential eligible participants will be identified through the electronic health record (EHR). Individuals will be contacted by the principal investigator (PI) to determine their interest and informed about this qualitative study via telephone. During the phone call, we will ask their interest and provide informed consent to participate in this study and also further confirm their eligibility. For those who provide oral consent to participate, we will send them a printed consent form and a pre-paid envelop for them to return the signed consent to the research center via postal mail. No research activity will take place until we receive the signed written consent.

1.3.1.3 Setting & data collection

Data will be collected using an in-depth, semi-structured interview format. The interview consists of 10 open-ended questions that will allow us to fully elicit participants' experience on post-surgical lifestyle change. Interviews will be conducted by the PI in a private room in the Center for Obesity and Metabolic Surgery, Huashan Hospital. The interviewer will take field notes to ensure interview quality and all the interviews will be digitally recorded upon approval of participants. We will inform participants that we will not judge them on what they did or say related to their post-surgical life experiences. Each interview will last approximately 30 to 45 minutes and will be recorded upon approval from participants. We will explore:

Patients' experiences related to post-surgical lifestyle change. Open-ended questions such as “Now that you are xx weeks after surgery, how has your life changed from before the surgery? (e.g., daily habits)” and “How do you feel about those changes?” will be asked.

Participants' perceived barriers and facilitators that influence their efforts to meet the post-surgical lifestyle requirements. Open-ended questions such as “What things make it easier for you to follow the dietary/PA recommendations after surgery?” and “What have been the biggest challenges for you to follow the dietary/PA recommendations after surgery?” will be asked. Each participant will be compensated \$20 in Chinese currency for completing the interview.

1.3.1.4 Plan for data analysis

Interpretive thematic approach will be used to analyze data. First, interviews will be transcribed verbatim by the PI (YY). We will ask the study collaborator WZ (case manager in the bariatric center) in China to listen to the recording and check for accuracy. The transcripts will not be returned to the participants for comments. The two researchers who are responsible for data analysis (YY and WZ) will become familiarized with the data by reading and re-reading the transcripts and field notes independently and repeatedly. Afterwards, the data set will be sorted to a group of codes, and then codes will be merged to form larger themes based on the relationship identified between and within the codes. Both researchers will meet to discuss the analysis and any differences in the coding will be resolved through consensus. Finally, a descriptive passage that discusses the essence of the experience for the individuals incorporating “what” they have experienced after surgery and “how” they perceive the experience will be generated. Data analysis will follow standard procedures for coding qualitative data.(Field, 1991)

1.3.1.5 Human subjects

All interactions with human subjects will take place at the Center for Obesity and Metabolic Surgery, Huashan Hospital, China. Approval by the Institutional Review Board from the University of Pittsburgh and Huashan Hospital will be obtained prior to the initiation of the study and an informed consent will be obtained from all participants prior to the data collection process. Even though the questions being asked are non-risky and non-sensitive in nature, participants may feel uncomfortable exposing the habits and their feelings regarding their post-surgical lives. Patients may feel that traveling to the hospital and being interviewed are time-consuming and burdensome. Otherwise, there are no risks associated with participating in this study. Maintaining confidentiality of the collected information is a very important concern. We will follow several rules. First, confidential information will be maintained and assured by use of a unique numerical code that will be used for managing the data. Second, we will use ID codes instead of participants' name to process data, and the master list of code numbers will be kept in a password-protected, separate computer file maintained by the PI in a locked file cabinet. The PI will monitor all data management and security throughout the study. Third, the data will be maintained anonymously until 7 years after the completion of the study according to the University of Pittsburgh Human Subjects regulations. Forth, every precaution will be taken to minimize exposure of the data to persons outside of this project by using passwords for all computer files and we will make sure to turn off the computer once the person has completed the questionnaires and is leaving. Last, the taped interview content will be destroyed after it has been transcribed, which we anticipate will be within one year of its taping.

1.3.2 Phase 2

1.3.2.1 Study design

Using Social Cognitive Theory as the framework, the second phase of this proposed study will use a cross-sectional design to examine the associations of psychosocial factors, behavioral factors, dietary and PA behaviors, and weight loss outcomes among Chinese patients who have undergone the SG procedure. The rationale for using a cross-sectional design as the research approach is that despite extensive evidence that psychosocial factors influence the occurrence of desired diet and PA behavior and impact weight loss, this is the first time this investigation will be conducted in the bariatric surgery population in China. The absence of published evidence warrants observational studies to be conducted to generate descriptive data and build the foundation for future research.

1.3.2.2 Sample, setting & recruitment

Our target population is the individuals who have undergone the SG procedure in China. The most recently available data reported that approximately 3900 adults have undergone the SG procedure in China as of 2015. Based on the rapidly growing rate of this procedure being performed, we estimate that the population pool will be much larger. However, due to the limited time and resources in the proposed study, the recruitment will be restricted to the Center for Obesity and Metabolic Surgery, Huashan Hospital, China. The center has a strong multidisciplinary team including experienced surgeons, nurses, dietitians, psychologists and case managers to support the proposed study. Besides, the bariatric center in Huashan Hospital attracts patients from a socioeconomically and culturally diverse population of men and women. Thus far, they have accumulated approximately 200 cases and by the time we will start to recruit, we expect that approximately 230 individuals can be reached.

We will recruit patients who have undergone SG since 2012 in Huashan Hospital. Inclusion criteria include (a) age \geq 18 years; (b) at least 1 year after SG; the time window was chosen to detect the first year of weight variability; (c) having a digital weighing scale; and (d) being able to read and write in Chinese. Exclusion criteria include (a) receiving SG as a revisional procedure from other types of bariatric surgery; (b) being previously diagnosed with cognitive impairment; and (c) participating in other weight loss studies. Due to the small number of surgical procedures performed, it is not feasible to use traditional recruitment strategies (e.g., electronic and postal mailings, posts of study announcements on various social media sites, buses, etc. and fliers posted in the community) to obtain our target sample. Instead, we will work with the bariatric surgery team in Huashan Hospital; we believe that the frequent contact and strong relationship built between health care providers and patients will largely facilitate patient recruitment. Permission

from the hospital and other associated departments will be obtained prior to any contact with patients for recruitment and after approval by the University of Pittsburgh Human Subject Approval Committee.

For the participant recruitment, given that the follow-up rate in the surgery center is unacceptably low, the potential participants will be identified via the EHR by the PI and case manager. We will mail the study package including consent forms, questionnaires, one-day paper diary and pre-paid envelop to every potential participant. Since all the patients who have undergone SG in the surgery center were in a same social media chatting group, which gives us a chance to notify them at once to inform about this study and ask for participation. Reminder will be sent weekly for the first month after mailing the package and monthly for the following months.

1.3.2.3 Sample size

Due to the fixed number of surgical procedures performed since 2012, the potential sample pool is approximately 230. The surgeons and the case manager have frequent contact and a good relationship with the patients that will facilitate patient recruitment. To obtain the data on disordered eating behaviors, depression, self-efficacy, social problem-solving, PA and dietary behaviors, we will administer standardized questionnaires and one-day paper diary (details will be provided later). We expect a 50% consent rate giving us a minimal sample of 120. Given the exploratory nature of this study, the sample of 120 participants was not determined for the purposes of testing specific hypotheses. Instead it was determined based on the feasibility of recruitment and retention. With a sample of 120, we will have 81% power to detect a correlation as small as 0.28 using a two-sided hypothesis test with a significance level of 0.05.

1.3.2.4 Measures and instruments

(1) Demographics: data (age, gender, race, marital status, employee status, family income, education level, number of years after surgery) will be collected using the investigator-developed Sociodemographic Questionnaire. It has nine questions and may take five minutes to finish.

(2) The Chinese version of the Eating Disorder Inventory-1 (EDI-1): EDI-1 is a well-established measure to assess the presence of eating disorders. Although EDI-2 and EDI-3 have been introduced, we cannot use the newer version because there are no validated Chinese translations. EDI-1 consists of 64 items with 8 subscales that evaluate drive for thinness, body dissatisfaction, bulimia, perfectionism, interpersonal distrust, maturity fears, interoceptive awareness and ineffectiveness.(M. E. Murawski et al., 2009) For each item, a 6-point Likert scale is used ranging from “never” to “always”. The higher the total score, the more severe the eating disorder. EDI-1 has well-tested reliability and validity in Chinese populations with an overall Cronbach’s alpha of .95.(Hollis et al., 2008; Perri et al., 2001) It takes 10 minutes to finish the EDI-1.

(3) The Chinese version of Center for Epidemiological Studies Depression Scale (CES-D): CES-D is a 20-item scale that has been widely used to assess depressive symptoms experienced by individuals over the previous week.(F. Li, 2016) Each item is scored from 0 to 3 and the total score range is from 0 to 60 with higher scores indicating more severe depressive symptoms. The cut-off value of ≥ 16 has been widely used to define clinically meaningful depressive symptoms.(F. Li, 2016) CES-D has been shown to have a strong reliability and validity in the Chinese population.(Butrym, Webb, & Wadden, 2011; Hales, Fryar, Carroll, Freedman, & Ogden, 2018; Kim & Basu, 2016) Overall Cronbach’s alpha has been reported at .85-.92 among various samples.(Hales et al., 2018; Kim & Basu, 2016) It takes five minutes to finish CES-D.

(4) Weight Efficacy Lifestyle (WEL) Questionnaire: WEL is a 20-item questionnaire with well-established validity and reliability (Cronbach's alpha >.7(Jeffery, Wing, Sherwood, & Tate, 2003)) and used to measure individuals' confidence in resisting eating in various situations. It includes 5 dimensions: negative emotions, availability, social pressure, physical discomfort, and positive activities. Participants rate their confidence on a 10-point scale ranging from 0 to 9, a higher score indicates a greater eating self-efficacy.(Clark et al., 1991) Currently, the Chinese version of WEL is not available, therefore, we have followed standard protocol to translate and pilot tested it prior to the proposed study. It takes five minutes to complete the WEL.

(5) The Chinese version of The Social Problem-Solving Inventory Revised (C-SPSI): C-SPSI is a 25-item questionnaire measuring individuals' problem-solving ability. The scale was translated and adapted from the original 32-item English version.(Siu & Shek, 2005) It includes five dimensions: positive problem orientation, negative problem orientation, rational problem-solving, impulsivity/carelessness style, and avoidance style. Participants will be asked to rate on a 5-point Likert scale from 1 (not at all true of me) to 5 (extremely true of me). Lower scores denote better problem-solving skills. Cronbach's alpha for the five subscales ranges from 0.65 to 0.88.(Siu & Shek, 2005) It takes 10 minutes to finish C-SPSI. Currently, to use the C-SPSI requires permission (permission letter is attached in the appendix).

(6) Adherence to diet: Adherence to diet will be assessed by self-reported food intake using one-day paper diary. Participants will be asked to recall everything they ate and drank (type and amount) for the previous 24 hours. We will calculate adherence to the dietary goals as follows: (total number of calories consumed per day)/daily calorie goal *100 in which daily calorie goal will be defined as 25kcal/kg ideal weight based on the nutritional guideline in Shanghai Huashan Hospital. Ideal weight in kg is set to be (height in cm-105).

(7) Chinese version of International Physical Activity Questionnaire Short Form (IPAQ-SF): IPAQ-SF is a 7-item questionnaire assessing three levels of intensity PA (walking, moderate-intensity, vigorous intensity) and average weekday sitting time in the last 7 days. Based on frequency (days per week) and duration (time per day) of different levels of PA, both categorical and continuous outcomes can be calculated. IPAQ-SF has a good reliability and validity across countries and has been used among bariatric population.(Craig et al., 2003; Mundi, Lorentz, Swain, Grothe, & Collazo-Clavell, 2013) Adherence to PA will be calculated as [(median MET-minutes per week for moderate or vigorous intensity activity)/(500 MET-minutes per week) × 100%].

(8) Weight: due to the wide range of geographical distribution of participants, it is not feasible to obtain an objective weight. Patients' self-reported weights following bariatric surgery have been shown to be very close to their weights measured by clinical personnel and may not significantly bias study results.(Christian, King, Yanovski, Courcoulas, & Belle, 2013) Therefore, self-reported weight will be used in this study. Percent weight change will be calculated as weight at assessment minus weight before surgery divided by weight before surgery times 100% $[(\text{Weight}_t - \text{Weight}_0) / \text{Weight}_0] \times 100\%$. Weight at the time of surgery will be based on self-report.

(9) Height: participants' height will be based on self-report.

1.3.2.5 Plan for data analysis

Data analysis will be performed using IBM SPSS (version 24, IBM Corp., Armonk, NY). For all analysis, $P \leq 0.05$ will be considered statistically significant. Preliminary data analysis will be applied before the final data analysis. First, data cleaning will be used as the first step to ensure the correctness of the data. Frequency distributions will be used to check whether all data values are valid or not. For example, if the variable gender was coded as "0" and "1", then any other value

will be considered as invalid and may indicate a data entry error. Then we will check for outliers, univariate outliers will be examined by boxplot or Z-scores, and multivariate outliers will be checked using the Mahalanobis distance. Frequency distribution will be used to identify outliers for categorical variables. Given the sample size in this proposed study is relatively small (approximately 120), if there is no strong evidence suggesting that the outliers were due to technical mistakes, we will perform data transformation and retain the outliers. The amount of missing data will be first checked by frequency distribution. The pattern of missing data will be examined by using missing value analysis (MVA). If the *p* value of Little's MCAR test is not significant (*p* >.05), we will consider the missingness of data as completely at random. Depending on the patterns of missing data (missing completely at random, missing at random, missing not at random), several strategies will be used: 1) exclude cases with missing data. By only using complete data, we will lose a lot of valuable information, therefore this is not an ideal strategy for this project; 2) imputation. We can either use the mean value of the variable or conduct a regression analysis or expectation-maximization (EM) analysis to predict and impute the missing value; 3) if the data were missing completely at random, theoretically, there is no need for imputation. However, given the small expected sample size, we will still apply the imputation technique to retain as many cases as possible. Last, we will check underlying assumptions. Multiple linear regression will be the main statistical method to examine the association between psychosocial (eating disorder, depression, self-efficacy, social problem-solving), behavioral (adherence to diet and physical activity) and percent weight change following GS surgery. The level of measurement of all variables is ratio except for some sociodemographic variables, e.g., gender, marital status and education level. The key underlying assumptions include: 1) multivariate normality. Histogram, P-P plot and Q-Q plot will be used for checking normality graphically. Tests, such as

the Kolmogorov-Smirnov (K-S) test, will also be performed. If the results indicate that the distributions are markedly nonnormal (i.e. skewed or there are issues with kurtosis), transformations (e.g., square-root, logarithmic (log 10)) will be applied; 2) A linear relationship between the psychosocial and behavioral variables and % weight change. Scatter plots will be used to examine linearity. Partial regression and residual plus component plots, which indicates whether any nonlinearity is present in the relationship between y and each x variable, will also be used. If these plots show a non-linear pattern, alternative methods, such as transforming the variables, removing outliers or influential values, or try to fit a nonlinear model, will be applied; 3) Multicollinearity. Variance Inflation Factor (VIF) statistic and BKW collinearity diagnostics will be used to assess for multicollinearity, if VIF is larger than 10, it may suggest that the independent variables are highly correlated with each other. Possible remedies may include data transformation, removing the highly correlated variables, or using partial least squares regression; 4) Homoscedasticity. A scatter plot of the studentized residuals against the unstandardized predicted values of dependent variable (% weight change) will be generated. If this assumption is violated, we can consider data transformation or weighted least squares as potential remedies; 5) Independence. Since this proposed study will use a cross-sectional design without repeated measures, therefore, the assumption of independence is not likely to be an issue.

Aim 3: To describe patients' psychosocial factors (e.g., disordered eating behaviors, depression, self-efficacy, social problem-solving) and behavioral factors (adherence to prescribed diet, adherence to PA recommendations) self-reported during the post-surgical period and the percent weight change from pre-surgical baseline.

Means and standard deviations will be used to describe continuous variables (age, depression, eating disorder, self-efficacy, social problem-solving, adherence to dietary intake,

adherence to PA, % weight change). If non-normality is identified for continuous variables, we will use median, range, mode, and percentile for data description. Frequency and percentage will be used for categorical variables (gender, race, marital status, education, employment status, income). In addition, graphical techniques (e.g., histograms, scatter plots) will also be applied to illustrate the variable description.

Aim 4: To explore the associations between: 1) psychosocial factors and weight change; 2) behavioral factors and weight change.

Scatter plots will be generated to explore the relationships between pairs of variables, and after that, we will follow two steps to examine the association between psychosocial/behavioral factors and % weight change. First, a univariate analysis will be applied. In this step, a simple linear regression will be used to model the association between each psychosocial predictor variable (depression, eating disorder, self-efficacy, social problem-solving) and % weight change, and each behavioral predictor variable (adherence to dietary intake, adherence to PA) factors and % weight change. The p-values of regression coefficients will be computed using a t-test. Then the potential important variables identified in this step ($p < .20$) will be entered to build up multiple linear regression model. A stepwise procedure will be used to select the significant psychosocial and behavioral predictors which will be included in the final model ($P < .10$). Interaction between independent variables in the final model will also be examined. Potential confounding variables, such as demographics and number of years after sleeve gastrectomy, will be checked by generating two regression models, one including the suspected confounders and the other model not including the confounders. If there is a big difference of coefficients between two models, it means that the confounders do exist and should be controlled for. Model diagnostics will be conducted by

assessing outliers, collinearity, influential values (e.g., Jack knife residuals, Leverage or Cook's D) as well as analyzing residuals.

1.4 POTENTIAL LIMITATIONS OF THE PROPOSED PROCEDURES

This proposed study has several limitations. Due to limited time and resource, the second part of this study will be cross-sectional in design. Though considerable data can be collected, it is not possible to collect data on the changes in psychosocial and behavioral factors over time. Additionally, participants will be recruited in one hospital, which will limit the generalizability of the study's findings. All of the measurements in this study are based on self-report which are known to be potentially inaccurate and biased. Most important, the primary outcome of post-SG weight will be based on self-report, which may not be accurate if the individual is embarrassed of any weight regain or less than desirable weight loss. In addition, due to the wide geographical distribution, we need to use postal mail or email to distribute questionnaires which may potentially influence the return rate and measurement validity.

1.5 RESEARCH PARTICIPANT RISK AND PROTECTION

Risks for the proposed study are minimal, and several strategies will be used to guarantee human subjects protection. (1) the research protocol will be evaluated by the University of Pittsburgh Human Subjects Institutional Review Board (IRB) and also approval will be obtained

from the Huashan Hospital and related departments prior to initiation of any contact with potential study participants; (2) details of the study and assessment procedures (purpose, duration, potential risks and benefits) will be explained thoroughly to participants and they will be told they have the right to refuse or withdraw from the study at any time; a written consent form will be obtained from each participant prior to enrollment; (3) all involved research members will complete the human subject training courses required by the IRB and (4) maintaining confidentiality of the information is a very important concern. We will follow several rules. Any information obtained from this research will be kept confidential (private). All documents related to participants' involvement in this research study will be stored in a locked file cabinet. Participants' identity on the questionnaires will be indicated by a study identification number rather than their names. Documents that contain participants' names, such as contact information and consent form, will be stored in a locked cabinet in a locked office. Similarly, research data that are stored electronically will be coded with participants' ID number in a database on a password-protected computer. Identifiable information will be stored in a separate password protected database. Participants will not be identified by name in any publication; any publication reports results in the aggregate, not by individual; (5) the PI will review reports regularly concerning data quality, safety, and monitoring; during recruitment phases, she will review recruitment reports weekly; throughout the study she will review reports at least on a monthly basis. Any questions or concerns related to reportable events, safety, or changes in the benefit-to-risk ratio will also be directed to the PI. The PI will report any reportable events to the University of Pittsburgh Human Subjects Review Committee as per their established protocol that is in accordance with the seriousness of any event. No protocol modification will be instituted without IRB approval.

1.6 STUDY TIMELINE

Table 1 Study Timeline

| | 2018 | | | | | 2019 | | | | | | |
|---------------------------|------|----|----|----|----|------|----|----|----|----|----|----|
| | 08 | 09 | 10 | 11 | 12 | 01 | 02 | 03 | 04 | 05 | 06 | 07 |
| Recruit participants | X | X | X | | | | | | | | | |
| Data collection | | X | X | X | X | X | | | | | | |
| Data entry/analysis | | | | | X | X | X | X | X | | | |
| Manuscript preparation | | | | | | | | X | X | | | |
| Prepare final report | | | | | | | | | | | X | X |
| Consult with statistician | X | X | X | X | X | X | X | X | X | X | X | X |

2.0 MANUSCRIPT 1: PREDICTORS OF WEIGHT REGAIN AFTER SLEEVE GASTRECTOMY: AN INTEGRATIVE REVIEW

2.1 ABSTRACT

Background: Sleeve gastrectomy (SG) is one of the most effective treatments for severe obesity, but weight regain after surgery is a challenging issue. The mechanism of post-surgical weight relapse is barely understood due to the lack of long-term data.

Objective: To review and synthesize current evidence related to factors that contribute to weight regain after SG.

Method: Whittemore and Knafl's integrative method guided the research. The databases PubMed, EMBASE, and CINAHL, as well as two selected journals were searched through October 2018 to gather English-language journal articles on the potential predictors of post-SG weight regain among adult populations. Only articles with sample size ≥ 10 were included. A narrative synthesis was used to analyze the 17 studies included in the review.

Results: In recent years, there has been an upward trend in the published reports of SG on longer-term outcomes. After a review of 6863 records, 17 eligible studies were identified, reporting various definitions of weight regain and three main categories of predictors: surgical/anatomic factors, hormonal/metabolic imbalance and behavioral/mood factors. The 17 studies used quantitative ($n= 16$) and qualitative methods ($n= 1$).

Conclusion: There is a dearth of available literature addressing predictors of weight regain following SG and the inconsistency in the definition of regain limited the comparability between studies. Besides the surgical/anatomic factors that have been reported as significant predictors,

other modifiable factors such as behavioral and psychosocial determinants need to be further investigated.

Key words: bariatric surgery, sleeve gastrectomy, weight regain, predictors

2.2 INTRODUCTION

Obesity has become a global epidemic affecting more than 650 million (13%) adults aged 18 years and older.(WHO, 2015a) Bariatric surgery has been recognized as the only evidence-based, surgical treatment for severe obesity.(Diabetes Prevention Program Research et al., 2009) Sleeve gastrectomy (SG), which is conducted by removing approximately 80% of the lateral aspect of the stomach,(Diabetes Prevention Program Research et al., 2009) has become the most widely performed procedure worldwide(Khorgami et al., 2017) due to its relatively simple procedure and comparable effectiveness in terms of short and mid-term weight loss and remission of comorbidities compared to the gold standard Roux-en-Y Gastric Bypass (RYGB).(Kalinowski et al., 2016; J. Li et al., 2016; Ndumele et al., 2016) Investigators have identified other advantages offered by SG, such as a short learning curve for the surgeon, the absence of introducing foreign objects, and short hospital stay.(Gagner, Hutchinson, & Rosenthal, 2016)

SG has proven to be very effective in initiating weight loss for individuals with severe obesity, at least in the early to midterm of the postoperative period. Emile et al.(Emile et al., 2017) reviewed short-term weight loss data after SG from the previous 5 years and found a significant reduction in body mass index (BMI), which decreased from a mean of 43.8 ± 4.9 at baseline to a mean of 30.7 ± 3.9 at 1 year, 28.6 ± 4 at 18 months and 28.7 ± 3.1 at 24 months after SG ($P < .0001$). Although long-term weight loss data following SG is rare, some studies have

noted that weight regain may be a significant issue.(M. Lauti, M. Kularatna, et al., 2016) Mean percent excess weight loss (%EWL) is a common metric for measuring post-surgical weight loss outcomes that can be calculated as:

$$\%EWL = \frac{(\text{Initial Weight/Kg}) - (\text{Post-operative Weight/Kg})}{(\text{Initial Weight/Kg}) - (\text{Ideal Weight/Kg})}$$

in which ideal weight is defined by the weight with a BMI of 25 kg/m². Follow-up studies have revealed that only 79.7% and 54.5% of patients successfully achieved the expected weight loss goal (%EWL ≥50%) 2 and 5 years after SG, respectively.(Ndumele et al., 2016) These results were supported by a systematic review, which reported that the percent of people who regained weight ranged from 5.7 % at 2 years to 75.6 % at 6 years after SG.(M. Lauti, M. Kularatna, et al., 2016) Beyond 7 years, the weight regain rate was estimated to be 27.8% with a range of 14% to 37%. (Clapp et al., 2018) The failure to achieve the desired post-surgical weight may attenuate the surgery-induced benefits of comorbidity remission and possibly revisional bariatric surgery, ("Overview: Behavioral Risk Factor Surveillance System 2017," 2017) which will create an additional economic and emotional burden.(Saunders, 2004) Reduced weight loss and weight regain are the two major predictors for the re-emergence of type 2 diabetes (T2D), which was demonstrated in one study where 19% of patients experienced a recurrence of T2D after an initial remission.(Brethauer et al., 2013) To correct this recidivism, approximately 10-20% of patients undergo revisional surgery to improve surgical outcomes in the long-term.(Kowalewski et al., 2018; Noel et al., 2017)

Although research addressing the mechanism of post-surgical weight regain on SG is emerging, it is still very limited due to SG being a relatively new surgical approach that was not performed as a stand-alone procedure until 2008 and the long-term follow-up data are lacking. Based on accumulated evidence from studies of gastric bypass and gastric banding procedures,

weight regain after surgery is due to a complex combination of technical, physiological, behavioral and psychosocial factors (e.g., pouch dilation, hormonal imbalance, disordered eating behaviors). (Maleckas et al., 2016) SG differentiates itself from gastric bypass or gastric banding procedures for its purely restrictive modes of action that eliminate the possibility of malabsorption, its impact on gastrointestinal signaling and that weight regulation is also distinctively different from other surgery types. (Pucci & Batterham, 2018) The hormonal changes resulting from the SG procedure may lead to an alteration in appetite and food preference. Thus, the lifestyle habits, especially the dietary intake and eating behaviors, are potentially unique for SG. (Magnoni et al., 2012; Melero et al., 2014; Primeaux et al., 2015) Also, research has reported that during the post-SG phases patients are at a higher risk for long-term weight loss failure compared to malabsorptive surgical techniques, which supports the importance of this review to identify potential factors influencing the post-operative phase. (Clapp et al., 2018; Johnson Stoklossa & Atwal, 2013)

This paper presents a synthesis of evidence related to the factors that contribute to weight regain after SG by providing a comprehensive overview of the relevant published literature. This paper may provide researchers a better understanding of the underlying mechanisms that may inform development of interventions that target modifiable factors to prevent weight regain.

2.3 METHODS

This integrative review was guided by the methodology developed by Whittemore and Knafl. (Whittemore & Knafl, 2005) The review process involved identifying the research question,

searching the literature using a systematic approach, evaluating and analyzing the data and presenting the results.

Two reviewers (YY and MJ) searched the following databases: PubMed (1947 to October 9, 2018), Embase.com (1974 to October 9, 2018), and Ebscohost CINAHL (1981 to October 9, 2018). In addition, we reviewed the bibliographies of papers that were selected for inclusion in the review and hand-searched the contents of two journals: Obesity Surgery (January 2017 through October 2018), and Surgery for Obesity and Related Diseases (January 2017 through October 2018). A health sciences librarian (MLK) designed the PubMed search strategy and translated it for use in other databases (appendix A). Each search string consisted of natural language and controlled vocabulary (when available) to represent the concepts of "sleeve gastrectomy" and "weight regain". The search was conducted on October 9th, 2018.

Eligible articles to be included in the review had to be: (1) reporting at least one predictor of weight regain after primary SG; (2) age of population: ≥ 18 ; (3) sample size ≥ 10 ; and (4) in English language with full-text available. Studies using qualitative and/or quantitative methods were included. For database searching, no time restrictions were placed on the publication year; however, for the hand searching on two journals, we included only studies published since 2007. The time window was chosen for the reason that this is when SG became an independent weight loss surgery and the majority of literature on SG has been published since then. Reviews, meta-analysis, animal studies, case reports, abstracts, comments, and kin studies (i.e., reports with overlapping data, or outcomes reported for the same time frame and/or by the same author group) were excluded. The initial screen for eligibility criteria by title and abstract was performed independently by two the reviewers (YY and MJ); any discrepancies were resolved by discussion until an agreement was reached. Then the two reviewers independently assessed the

full article for those of which abstracts met the inclusion criteria, and a decision for inclusion was made accordingly.

A total number of 2144, 4527 and 192 papers were identified through PubMed, EMBASE and CINAHL, respectively. After reading titles and abstracts, 6828 papers were excluded for duplication or irrelevance. Through a thorough examination of the remaining 35 published papers, 20 more papers were excluded for either reporting predictors following RYGB (n=15) or reporting predictors for weight loss instead of weight regain (n=5). In reviewing the remaining 15 articles, no new articles were identified in the bibliography. By hand searching of two journals, we found seven relevant articles, five of which overlapped with the database search. Therefore, only two additional articles were added to the final list. The study selection flow is illustrated below:

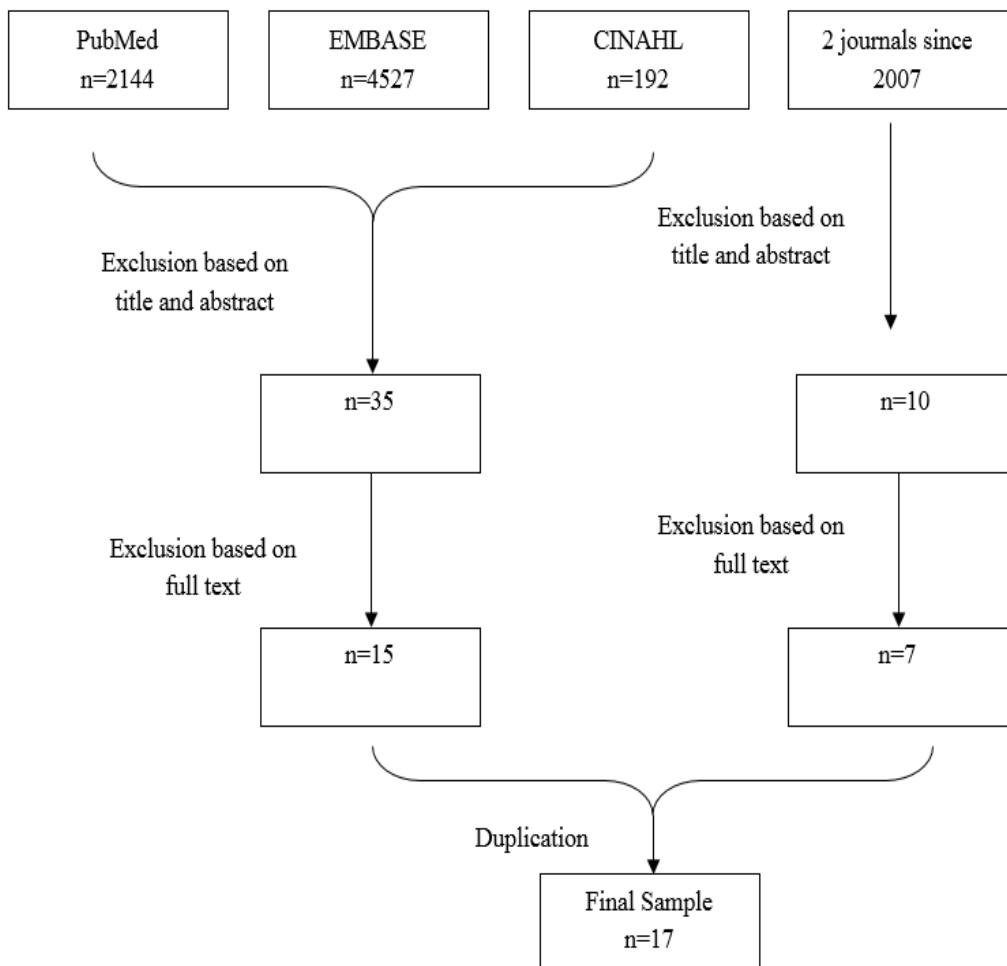


Figure 2 Study Flow

The data extracted from each paper included author(s), year of publication, country of origin, study design, sample description, duration of follow-up, definition of weight regain, and predictors of weight regain.

2.4 RESULTS

2.4.1 Description of included studies

Most of the studies published in the past three years were conducted in Europe. There were 16 studies that used quantitative methods and enrolled 10–1419 participants and one that used qualitative methods with the sample size of 38. The majority of study participants were female and middle-aged with a BMI ranging from 30-50 kg/m². The follow-up period ranged from 2 to 6 years.

Investigators used seven different definitions for weight regain across 17 articles, three of which defined weight regain by the percentage increase of body weight that had been lost initially ($\geq 5\%$, 15%, and 25%), two defined weight regain by the percentage increase of the minimum weight loss achieved (10% and 25%), one used the percentile estimates (participants who were in the >50th percentile for % weight regain), and three out of nine studies adopted the definition of an increase in body weight of more than 10 kg from the post-surgery weight nadir. The other 7 articles did not provide the definition for weight regain. The study descriptions are summarized in Table 2.

2.4.2 Predictors of weight regain after sleeve gastrectomy

2.4.2.1 Surgical/anatomic factors

Larger bougie size. SG is a restrictive surgical technique that is conducted by a removal of most of the fundus, body and antrum guided by a bougie, which is an instrument used to guide surgeons when performing stomach resection. Bougie size is assumed to be an influencing factor

for weight loss effect after SG. Balla et al.(Balla et al., 2017) divided 127 patients into 3 groups based on bougie size and other surgical techniques, the bougie diameter for group A, B and C were 48F (.6 inches), 42F (.52 inches) and 36F (.45 inches), respectively. Results showed that among seven individuals who experienced weight regain, 6 of them were in group A and only one individual was in group B, supporting the premise that a larger bougie size may be a risk factor for weight regain. It is worth noting that the follow-up period was different for the three groups with group C having the shortest follow-up of 14.8 months, which may have limited the chance to capture any weight regain. Thus, the results need to be interpreted with caution as a longer follow-up duration is needed to confirm the results. Similarly, Ellatif and colleagues(Abd Ellatif et al., 2014) analyzed data from 1,395 individuals who underwent SG and reported that weight regain occurred in 29 people (3.5%) in the group using a larger bougie size (\geq 44 Fr.) and 8 people (1.4%) in the group using a smaller bougie size (\leq 36F). The difference between the bougie sizes was statistically significant suggesting that a thinner bougie may be a protective factor against post-SG weight regain. One major flaw of this study is that it did not provide a definition of weight regain, instead, the authors confused the concept of insufficient weight loss and weight regain, which could influence the outcome interpretation.

Higher residual gastric volume. Investigators consistently identified the volume of residual stomach as a predictor of weight regain after SG. Obeidat et al.(F. Obeidat et al., 2015) compared the surgical outcomes between two groups, group A consisted of 54 individuals with 6-cm antral remnant and group B was comprised of 56 individuals with 2-cm antral remnant. After 2 years, the rate of weight regain was 12% and 2% for groups A and B, respectively (P=.003), which demonstrated that a more radical antral resection may be more useful in preventing weight regain. These findings were replicated in another study conducted by Abdallah et al.(Abdallah et

al., 2014) Similarly, 105 individuals were divided into 2 groups and followed for 2 years, significant weight regain after SG occurred in 9.4% of the group with the higher residual gastric volume compared to 1.9% of the group with a smaller gastric remnant. Weiner et al.(Weiner et al., 2007) conducted a study with a 5-year follow-up period and divided participants into 3 groups, the removed gastric volume for groups A, B, and C were 490.2 cc, 732.7 cc and 1156.1cc, respectively. Although, the authors did not define weight regain nor report the regain rate for each group, they concluded that a removal of less than 500cc gastric volume may result in early weight regain after SG. Alvarez et al.(Alvarez et al., 2016) conducted a retrospective case-control study to examine the mechanisms for weight regain among 40 patients undergoing SG, and reported that the weight regain group had a greater gastric volume and the residual gastric volume was significantly and positively correlated with weight regain.

Other factors that have an influence on the volume of gastric remnant, such as the distance between the pylorus and the beginning of the staple line, were also reported to be related to the incidence of post-surgical weight regain. After following 89 individuals who had undergone SG in the previous 2 years, Fahmy et al.(Fahmy et al., 2016) reported that 10.1 % had weight regain and in the logistic regression model, the distance between the pylorus and the beginning of the staple line, as well as the residual gastric volume were the predictors of weight regain. The longer the distance from the pylorus, the larger was the amount of weight regain. Not only influenced by the surgical technique, the remnant gastric volume also correlated significantly with the time interval after surgery which may cause gastric dilation.

Gastric dilation. The volume of the gastric remnant may gradually increase after initial SG,(Braghetto et al., 2009) and it is considered a main complication of SG that will lead about 4.5% of individuals to undergo a revisional surgery to repair the pouch.(Gumbs, Gagner, Dakin,

& Pomp, 2007) Moreover, the dilation of the gastric pouch continues to be regarded as one of the crucial elements that may lead to failure of weight loss after SG.(Tassinari et al., 2017) However, whether the dilation is correlated with weight regain remains unclear. Langer et al.(Felix B. Langer et al., 2006) followed 23 individuals after SG for a median of 20 months, three participants experienced weight regain, and gastric dilation occurred in only one patient. For the case with sleeve dilation, the authors continued to follow individuals for 10 months and reported that satisfactory weight loss was achieved despite sleeve dilation, indicating dilation itself may not be mandatorily related to weight loss failure. Braghetto et al.(Braghetto et al., 2009) measured gastric capacity of 15 patients who were submitted to SG, and reported that 24-36 months after the operation, the mean capacity of the stomach increased from 108 ± 25 ml at the third operative day to 250 ± 85 ml ($p=.0000$). The increased gastric capacity was not associated with weight regain. The results in both studies need to be interpreted with caution given the small sample sizes.

2.4.2.2 Hormonal/metabolic imbalance

Ghrelin. While ghrelin level has been widely accepted as a key hormone for successful weight maintenance after intentional weight loss, its role in SG remains largely understudied. Bohdjalian et al.(Bohdjalian et al., 2010) followed 26 individuals for 5 years, and reported an incidence of 19.2% for weight regain. Furthermore, plasma ghrelin levels were measured on 12 patients and the ghrelin level decreased significantly early after SG and remained low for the 5-year follow-up. Although a slightly higher ghrelin level was detected among individuals with weight regain, no conclusion could be drawn due to a small sample size.

Serotonin. Serotonin is another weight regulating hormone that has been investigated in SG studies. In a prospective cohort study conducted by Demerdash et al.,(Demerdash, Sabry, & Arida, 2018) individuals undergoing SG were divided into two groups based on weight loss

outcomes. Group I included 78 patients who had a stable weight loss, and group II was comprised of 14 patients who experienced weight regain two years after surgery. Serotonin levels were significantly higher in the weight regain group compared to the weight stable group, and there was a positive correlation between serotonin level and BMI in both groups. Results supported the authors' hypothesis that serotonin may play an important role in regulating weight loss and weight maintenance after SG.

2.4.2.3 Behavioral/mood factors

Eating disorder. Grazing has been recognized as a category of eating disorders that can be defined as a consumption of smaller amounts of food over a longer period of time.(Saunders, 2004) Nicolau et al.(Nicolaua et al., 2015) examined the influence of grazing on post-surgical outcomes among adults who underwent different bariatric surgical procedures (RYGB: n = 50, SG: n = 10). Results revealed that 41.7% of participants had grazing behaviors and that participants with grazing habits were more likely to suffer from mental health problems, withdraw from follow-up visits, be less physically active and experience weight regain after surgery ($P's < .0001$). Since this study included a mixed sample of individuals undergoing different surgical procedures (RYGB and SG) with a small representation of the SG group, the authors did not present results separately for the RYGB and SG groups. Other types of disordered eating behaviors such as binge eating, loss of control eating and night eating syndrome have been demonstrated to be related to weight loss outcomes after gastric bypass surgery,(Beck, Mehlsen, & Stoving, 2012) but have not been widely investigated in the SG population. In our review, only one study reported that binge eating was not a predictor of weight regain after SG.(Alvarez et al., 2016)

Energy consumption and expenditure. It is generally acknowledged that higher calorie intake is associated with less weight loss. Alvarez et al.(Alvarez et al., 2016) reported that for

patients undergoing SG, compared to weight maintainers, weight regainers tended to have a higher fat and energy intake. Essayli et al.(Essayli, LaGrotte, Fink-Miller, & Rigby, 2018) examined the relationship between behavioral weight management skills and weight loss outcomes after SG, the results showed that participants who regained more weight were more likely to abandon healthy eating styles and consume a higher number of calories. The authors also noted that weight regainers were more likely to discontinue self-weighing and daily recording of their food intake compared to weight maintainers; although the difference was not statistically significant, it is still worth our attention given the fact that self-monitoring is the most helpful skill in weight maintenance. In order to examine whether dietary habits contribute to weight regain, Fahmy et al.(Fahmy et al., 2016) provided individuals who experienced weight regain after SG with nutritional counseling. The results showed that 37.5% of participants who regained weight had failed to adhere to the recommended dietary regimens.

Besides dietary intake, physical activity (PA) is another part of lifestyle modification required for a sustained weight loss. Keren et al.(C. Mitchell et al., 2018) examined the reasons for weight regain among 114 participants by asking them whether or not they had significantly changed their eating or PA behaviors since undergoing SG. By comparing the regain and non-regain groups, results revealed that poor dietary and exercise habits contributed to weight regain ($P<.05$).

Mood. Patients' mood status such as depression and anxiety are closely related to weight loss outcomes.(Alhalel et al., 2018) However, very few studies have examined the association in populations undergoing SG. Using standardized questionnaires, Alvarez et al.(Alvarez et al., 2016) classified patients as normal, borderline, or with a clinical disturbance based on their depression and anxiety scores. Based on a median split of weight regain, the higher % regain group was

reported to have higher clinical or borderline levels of anxiety than the lower % weight regain group, but the depression level was comparable between the two groups. In the final regression analysis, neither anxiety nor depression was associated with weight regain, after controlling for potential confounders including preoperative age, weight, and BMI.

Follow-up support. Following SG, appropriate follow-up care needs to include medical and psychosocial strategies to support maintenance of a healthy lifestyle and long-term weight loss.(Melanie Lauti, Samantha Stevenson, Andrew G. Hill, & Andrew D. MacCormick, 2016) Although not specifically designed to examine the reasons for post-SG weight regain, Himpens et al.(Himpens, Dobbeleir, & Peeters, 2010) evaluated the surgical results of SG at the sixth postoperative year and reported that an interruption of continued follow-up visits may be associated with post-surgical weight regain, however, the author did not provide a description on how weight regain was defined, what the rate of weight regain was and how long was the interval to follow-up clinic visits.

The only qualitative study included in this review used focus group discussions with 38 participants who were at least 2 years post-SG. Several behaviors viewed as the causes of weight regain were described by the participants including poor eating and exercise behaviors as well as factors that may negatively influence behaviors, such as psychological (e.g., stress, eating disorders), health factors (e.g., pregnancy, injuries), the high cost of good food, limited access to exercise facilities, and lack of social support or follow-up care.(M. Lauti, S. Stevenson, A. G. Hill, & A. D. MacCormick, 2016)

2.5 DISCUSSION

One of the main findings of this integrative review is that it identified the currently reported predictors of relapse following weight loss from an initial SG procedure. The identified predictors can be categorized as: surgical/anatomic factors, hormonal/metabolic imbalance, and behavioral/mood factors. Although a very broad searching strategy was used, only 17 relevant articles were located, which reminds us that the literature in this area is sparse. Weight loss recidivism is a phenomenon that normally occurs at a later phase after surgery. Since SG has been performed as a stand-alone procedure since only 2008, it is understandable that few long-term studies have been conducted which were able to detect weight regain. Clapp et al.(Clapp et al., 2018) conducted a meta-analysis that included only papers with at least 7 years of follow-up post SG and found only 9 studies and 652 individuals met the inclusion criteria. Longer follow-up data are needed to better identify predictors of weight regain.

Another issue that warrants our attention is that among the 17 selected articles, only nine provided a definition of weight regain. Moreover, among the nine studies, seven different definitions were used, and an increase in body weight of more than 10 kg from the minimum weight loss achieved was the most frequently identified definition. To demonstrate how the lack of a standard definition confounds the interpretation of the weight regain rates, Lauti et al.(Lauti et al., 2017) applied six definitions of weight regain to a series of individuals who had undergone SG and the result of the weight regain rate varied widely from 9% to 91%. King et al.(King, Hinerman, Belle, Wahed, & Courcoulas, 2018) compared different approaches to measure weight regain from nadir weight, including kilograms, BMI, percentage of pre-surgery weight, percentage of nadir weight, and percentage of maximum weight lost. In terms of the associations with clinical outcomes, weight regain quantified as percentage of maximum weight lost appeared

to have the best performance. Although weight nadir is the most frequently used reference to define weight regain, further review is needed to determine if this definition is valid to reflect the weight relapse phenomenon. After reaching the weight nadir, because of the homeostasis and weight set point, there is a tendency to return to the original weight.(Hall & Guo, 2017)

Therefore, the lowest weight is actually a temporary and extreme point that is not suitable for use as a reference. The American Society for Metabolic and Bariatric Surgery (ASMBS) has standardized the report of weight loss outcomes in bariatric surgery,(Moloney et al., 2017) but it does not specifically address the weight regain issue. Additional research is needed to create an appropriate and uniform definition to facilitate a synthesis and comparison across studies.

The majority of the reviewed studies focused on examining how surgical technique influences weight loss outcomes. The size of the bougie is one of the most debated issues. Although the optimal bougie size is suggested to be 32–36F,(Rosenthal et al., 2012) there are some who hypothesize that using a larger bougie size (> 40F) is associated with a lower incidence of complications (e.g., leaks) without hampering the weight loss effect.(Yuval, Mintz, Cohen, Rivkind, & Elazary, 2013) For example, Cal et al.(Cal, Deluca, Jakob, & Fernandez, 2016) compared weight loss outcomes following SG using 27 versus 39 F bougie diameters, and the results showed that the bougie size had no impact on surgical outcomes one year after surgery. Although the post-operative follow-up period in most studies is insufficient to examine the effect of bougie size on regain, the two articles included in this review supported the use of a smaller bougie size that was also correlated to a lower weight regain rates.(Abd Ellatif et al., 2014; Balla et al., 2017) This can be partly explained by the fact that a smaller bougie may result in a smaller gastric reservoir volume, which is a key factor for long-term weight loss success after bariatric surgery.(Weiner et al., 2007) Similarly, other surgical factors such as a longer

distance between the pylorus and the staple line may also influence weight regain through increased gastric reservoir, which could provide for storage of food and increase the amount of food required to create satiation, a factor related to weight regain.(Vidal et al., 2014) An interesting finding that emerged in this review is that sleeve dilation does not necessarily lead to a higher incidence of weight regain, which differs from the findings reported from gastric bypass surgery. For example, Yimcharoen et al.(Yimcharoen et al., 2011) followed 205 patients who underwent RYGB and found that individuals with an increasing pouch regained a larger amount of weight after a mean of 6.9 years follow-up. Felsenreich et al.(Felsenreich et al., 2017) reported that sleeve enlargement occurred in 60% of patients after SG; however, the etiology for sleeve dilation remains unknown and needs further study to establish its influence on weight regain.

Metabolic changes after SG are one of the postulated mechanisms responsible for post-SG weight regain. SG alters the digestive system through removing a major part of the gastric fundus where the ghrelin-producing cells are predominantly located. Findings reported in the literature note that post SG, ghrelin was reduced significantly in the short-term but had a gradual recovery over a long period.(F. B. Langer et al., 2005) The recovery of ghrelin levels after surgery may partially account for an increased energy intake and weight regain. Besides ghrelin, other key appetite-mediating hormones such as glucagon-like peptide 1 (GLP-1), peptide YY (PYY), leptin, cholecystokinin (CCK), pancreatic polypeptide (PP), and uroguanylin have been reported as part of the mechanisms underlying weight relapse after intentional weight loss and their hormonal responses changed significantly after bariatric surgery.(Dimitriadis, Randeva, & Miras, 2017) Given the essential role that these hormones play in the regulation of appetite and body weight, it is worth investigating their effects on weight loss following SG.

It became apparent during this review that there is a dearth of available literature exploring the behavioral and psychosocial factors related to weight regain post SG. As key components in standard behavioral treatments, we cannot ignore the importance of behavioral domains, e.g., modifying dietary habits and encouraging PA to support weight loss and maintenance. SG is conducted by removing a substantial portion of the stomach and reduces the volume of food that can be consumed,(Alhalel et al., 2018) however, it does not necessarily guarantee an improvement in the quality or quantity of the foods consumed. Even in the short term (12 months), only a minority of individuals adhere to dietary and PA recommendations.(Sherf Dagan, Keidar, et al., 2017) Studies have shown that adherence to dietary recommendations declined over time(Ferreira et al., 2018) and were negatively associated with weight loss.(Moize et al., 2013) Similarly, adherence to PA presents a similar pattern with a lower level of adherence in the long term,(Magnoni et al., 2012) which was reported to significantly contribute to worse weight loss outcomes.(C. Mitchell et al., 2018) Post-surgical eating disorders is a well-recognized predictor of poorer weight loss. Sioka et al.(Pagoto et al., 2018) reported that binge eating disorder is associated with worse post-SG weight loss, and Ivezaj et al.(Rafiei & Gill, 2018) reported a significant association between loss of control in eating and poorer weight loss outcome after SG. Apart from eating disorders, negative mood was found to negatively affect self-regulation behaviors while individuals with negative mood have more difficulty controlling their eating or exercising behaviors.(Lazarus, 2016; Rodriguez-Garcia et al., 2018) Among patients who have undergone gastric bypass or gastric banding, depression has been indicated as a predictor of poorer weight loss outcomes, and this finding has been repeated in SG patients.(Burgmer et al., 2014) It can be seen from this review that only three articles were identified that specifically attributed weight regain to grazing and lifestyle patterns;

thus, there is a significant gap in examining lifestyle behaviors to identify potential factors that may impact weight loss and maintenance post SG.

It is worth noting that Essayli et al.(JH, CA, EL, & A, 2018) reported that weight regainers were more likely to discontinue self-monitoring their weight and diet compared to weight maintainers. To the best of our knowledge, this is the first time the concept of self-monitoring was introduced to the post-SG management. Self-monitoring of diet, PA and more recently body weight are the cornerstone of behavioral weight loss treatment.(Turk et al., 2009; Warziski et al., 2008; Wing, 1998) Several systematic reviews showed that self-monitoring of diet and PA are standard procedures and that daily self-monitoring of weight does not cause adverse effects. Each of these behavioral strategies are related to weight loss.(Shieh et al., 2016; Teixeira et al., 2015; Zheng et al., 2015)

2.6 LIMITATIONS

There were several limitations to this integrative review. First, only published full articles were searched, therefore, we may have missed some relevant information presented in the grey literature (e.g., abstracts and unpublished manuscripts). Second, articles included were restricted to only those written in English, prohibiting generalizability to non-English populations. Third, the literature search was limited to only three databases and two journals. Additional literature may exist that was not included within the scope of this search. Fourth, although the searching strategy was purposefully broad, given the heterogeneity of terms used to describe weight regain, it is possible that additional sources of literature may have been missed.

2.7 CONCLUSION

In summary, predictors of weight regain following SG identified in this review can be categorized as surgical/anatomic factors, hormonal/metabolic imbalance and behavioral/mood factors. Further, the surgical and behavioral/mood factors are modifiable contributors influencing post-SG weight regain, tailored interventions that target those modifiable factors can be developed to improve post-surgical weight loss maintenance and sustain comorbidity remission. There is a diversity of definitions of post-surgery weight regain used in the literature and researchers would benefit from developing and adopting a standardized definition to report weight regain.

Table 2 Study Description

| Author and Country | Sample Size & Characteristics | Study Design | Follow-up Duration | Definition of Weight Regain | Predictors of Weight Regain |
|--|---|----------------------------------|---------------------------|--|---|
| Lauti et al. (2016) New Zealand | 38 Age: 51.4 ± 6.7 Female: 26 (68.4%) | Qualitative | 3.9 ± 1.6 | / | 1. Psychological factors, e.g. stress, and eating disorders 2. Health factors, e.g., pregnancy, and injuries 3. High cost of good food and limited access to exercise facilities 4. Social support |
| Fahmy et al. (2016) Egypt | 89 Age: 18 to 55 (mean, 33.9 years) Female: 75 (84.3%) | Longitudinal | 2 | A regain of $\geq 5\%$ of the body weight that had been initially lost, occurring 12–24 months after SG. | Distance between pylorus and beginning of staple line, large residual gastric volume |
| Alvarez et al. (2016) Chile | 40 Age: 43 ± 11 Female: 32 (80%) | Retrospective case-control study | 38.5 mo (34–41 mo) | In the >50 th percentile for % weight regain (weight regain [kg]/maximum weight loss [kg] * 100). | Greater residual gastric volume, higher fat intake and a trend toward higher total energy intake, anxiety |
| Nicolau et al. (2015) Spain | 50 RYGB and 10 SG Age: 46.35 ± 9.9 Female: 47 (78.3%) | Cross-sectional | 46.48 ± 18.1 months | An increase of more than 10% of the minimum weight loss achieved. | Grazing |
| Obeidat et al. (2015) Jordan | 110 Age: 33.8 ± 10.8 Female: 83 (75.5%) | Retrospective | 33 months | As an increase in body weight of more than 10 kg from the nadir. | Less antral resection |
| Himpens et al. (2010)(Himpens et al., 2010) Belgium | 41 Age: 28 to 71 (mean, 44 years) Female: 30 (73.2%) | Cross-sectional | 6 years | / | - |
| Weiner et al. (2007) Germany | 120 Age: 40.3 Female: 86 (71.7%) | Longitudinal | 5 years | / | A removed gastric volume of <500 cc |
| Bohdjalian et al. (2010) Austria | 26 Age: 46.2 ± 2.5 Female: 19 (73.1%) | Longitudinal | 5 years | An increase of body weight of more than 10 kg from the nadir. | - |

| Author and Country | Sample Size & Characteristics | Study Design | Follow-up Duration | Definition of Weight Regain | Predictors of Weight Regain |
|--|--|--------------------------|--|--|--|
| Langer et al. (2006) Austria | 23 Age: 41.2 ± 12.8 Female: 17 (73.9%) | Longitudinal | 20 months | / | - |
| Braghetto et al. (2009) Chile | 15 Age: 34.6 Female: 12 (80%) | Longitudinal | 2 years | / | - |
| Balla et al. (2017) Italy | 127 Group A: Age: 46.3 ± 10.82 Female: 31 (86.1%) Group B: Age: 44 ± 10.9 Female: 31 (67.4%) Group C: Age: 45.04 ± 10.6 Female: 34 (75.6%) | Retrospective | Group A: 69.7 months Group B: 33.3 months Group C: 14.8 months | Regain of $\geq 15\%$ of lost weight | Larger bougie size |
| Abdallah et al. (2014) Egypt | 105 Age: 29.9 ± 7.4 Female: 78 (74.3%) | Longitudinal | 2 years | An increase of body weight of more than 10 kg from the nadir | - |
| Ellatif et al. (2014) Egypt | 1419 Age: 33 ± 7 Female: 1050 (74%) | Retrospective | 76 months | / | Smaller bougie (<36F) |
| Chou et al. (2017)(Chou et al., 2017) Taiwan | 40 Age: 33.5 | Cross-sectional | ≥ 5 years | Weight increase from nadir more than 25% of their lost weight. | - |
| Keren et al. (2014) Israel | 114 Age: 42.1 Female: 87 (76.3%) | Retrospective | 5 years | / | Poor nutrition habits and lack of exercise in later years post procedure |
| Demerdash et al. (2018) Egypt | 92 Female: 64 (69.6%) | Prospective cohort study | 2 years | / | Increased serotonin level |

| Author and Country | Sample Size & Characteristics | Study Design | Follow-up Duration | Definition of Weight Regain | Predictors of Weight Regain |
|---|---|---------------------|---|--|---|
| Essayli et al. (2018) United States | 167 Age: 49.1 ± 12.4 Female: 140 (83.2%) | Cross-sectional | 1 year (98) 2 years (36) 3 years (33) | Regained more than 20% of their lowest postsurgical weight | Discontinue using portion control, abandoning self-monitoring, limiting sweets, avoiding drinking during meals and drinking more water. |

**3.0 MANUSCRIPT 2: A QUALITATIVE EXPLORATION OF PATIENTS'
EXPERIENCES WITH LIFESTYLE CHANGES AFTER SLEEVE GASTRECTOMY
IN CHINESE POPULATION**

3.1 ABSTRACT

Background: Sleeve gastrectomy (SG) is the most widely used surgical treatment for severe obesity, and it leads to weight loss and improvements in obesity-related comorbidities. SG imposes significant lifestyle changes on individuals who have undergone the surgery and how they perceive those changes may influence their ability to lose weight and maintain the weight loss post-surgery. Overall, there has been limited research examining patient experiences with the recommended lifestyle changes following the SG procedure. Specifically in China, where SG makes up over half of the bariatric surgical procedures, there have been no reports of research addressing this issue.

Objectives: This study aimed to describe individuals' experiences related to post-surgical lifestyle changes and to identify participants' perceived barriers that influence their efforts to make the post-surgical lifestyle adjustments.

Methods: Semi-structured interviews were conducted with 15 adults who had undergone SG since 2012 at the Shanghai Huashan Hospital in China. An interpretive thematic approach was used by two independent raters to analyze transcripts for categories and themes.

Results: Interviews revealed three major themes of participants' experiences with post-surgical lifestyle changes: advantages outweigh disadvantages; adjusting to lifestyle changes positively; and taking control of life. Barriers to healthy eating included feelings that the diet recommendations were "ridiculous" and hard to follow, no access to certain foods, cannot suppress appetite, and old age. Barriers to physical

activity included no motivation, not having an exercise facility, lack of time, absence of good weather, no peers, fatigue and no effects from previous exercise experience.

Summary: The data from this study provide insight and improved understanding of patients' experiences in the period following a SG procedure. Although participants viewed the changes positively and made appropriate efforts to adjust, we cannot ignore the existence of both individual and community barriers that may impede patients' meeting the required behavioral changes.

3.2 INTRODUCTION

Obesity is a global epidemic affecting more than 650 million (13%) adults aged 18 and older.(WHO, 2015a) Over the past several decades, China has experienced a sweeping shift toward westernized diets and physical activity (PA) patterns that have led to the increased obesity prevalence. Since 2014, China has replaced the U.S. as the country with the largest number of adults with obesity.(Cesare et al., 2016) Obesity is estimated to afflict nearly 89.6 million adults in China, among which, approximately 13.3% have severe obesity (body mass index [BMI] $\geq 35\text{kg}/\text{m}^2$)(Cesare et al., 2016). People with severe obesity are at a higher risk of developing the metabolic syndrome (e.g., hypertension, type 2 diabetes [T2DM]), cardiovascular disease, and all-cause mortality compared to their counterparts with normal-weight or moderate-obesity.(Flegal et al., 2013)

Bariatric surgery encompasses a number of different procedures that have been effective for weight loss. A relatively new surgical procedure called sleeve gastrectomy (SG), which achieves weight loss by removing approximately 80% of the lateral aspect of the stomach,(Diabetes Prevention Program Research et al., 2009) has been demonstrated to have comparative effects on short- and mid-term weight loss and remission of comorbidities compared to the gold standard Roux-en-Y Gastric Bypass (RYGB) surgical procedure.(Kalinowski et al., 2016; J. Li et al., 2016; Ndumele et al., 2016) SG has gained a wide

acceptance since it was first introduced to China in 2011. It is estimated that approximately 7700 cases of bariatric surgery were performed in 2015 with SG accounting for half of them.(S. Lin et al., 2017)

Unlike the non-invasive standardized treatment for obesity that emphasizes gradual modification of the eating and exercise behavior, SG initiates rapid weight loss by limiting the size of the stomach and the alterations of gastrointestinal anatomy and hormone system may produce a series of behavior changes that force patients to make adjustments. Starting right after surgery, due to the significant weight loss and the drastically altered gastrointestinal physiology, patients may report early complications including nausea, vomiting, dumping syndrome and acid reflux, which may prevent them from eating too much or consuming certain kinds of food.(Frame-Peterson, Megill, Carobrese, & Schweitzer, 2017) However, over the long-term, along with the recovery of the digestive system, some degree of weight regain becomes very common. In order to achieve maximum weight loss and prevent weight gain recidivism, patients are required to follow a postoperative dietary protocol that includes specific recommendations on eating behaviors (e.g., take small bites, split meals throughout the day, chew well and stop as soon as feel full) and on nutrition composition.(Sherf Dagan, Goldenshluger, et al., 2017) Further, although SG removes a substantial part of the stomach and reduces the volume of food that can be consumed,(Alhalel et al., 2018) it does not necessarily guarantee an improvement in food quality. Studies have shown that patients' adherence to dietary recommendations declined over time (Ferreira et al., 2018; Schiavo et al., 2017) and the decreased adherence has a negative impact on the weight loss outcome.(Moize et al., 2013) Patients' adherence to PA presents a similar pattern with lower levels of PA in the long-term, (Goldenshluger et al., 2017; Magnoni et al., 2012) and insufficient PA was reported to significantly contribute to the weight regain.(C. Mitchell et al., 2018)

Patients' thoughts and experiences regarding the required post-surgery lifestyle changes, particularly eating and PA, may influence post-surgical lifestyle behaviors and contribute to weight loss patterns.(Batsis et al., 2009; Fitzpatrick et al., 2013; Karmali et al., 2013) Several negative thoughts have been identified that may impede patients' adoption and maintenance of recommended post-operative lifestyle changes, e.g., regarding behavioral change as a huge sacrifice,(da Silva & da Costa Maia, 2012)

seeing oneself as a passive spectator without personal commitment,(A. M. Kriska et al., 1990) having no intention to make change,(Bond et al., 2013) feeling a lack of social support,(Liebl et al., 2016) feelings of shame and failure, perceiving a sense of loss,(Liebl et al., 2016) experiencing feelings of defeat and failure with weight regain,(Jr et al., 2014) worrying about the unmet expectations(Pereira et al., 1997) and frustrated about the physical changes that occurred post-surgery (e.g., hair loss, surplus skin, chronic pain, and fatigue).(K.-L. Edward et al., 2016; Gribsholt et al., 2016; Mayor, 2016) A successful identification and modification of those negative thoughts was reported to be positively related to an improvement in anxiety, psychological distress,(A. M. Kriska & Caspersen, 1997) depression, disordered eating(Bolger & Laurenceau, 2013) and better weight loss outcome.(Abiles et al., 2013)

Furthermore, the importance of exploring patients' experiences and thoughts cannot be ignored given that these can also be important results of the post-surgical behavioral response. For example, one's inability to adhere to a healthy eating plan may result in distressing thoughts and feelings, and finally deteriorating effects of surgery. To the best of our knowledge, there has been no published qualitative investigations of patients' experiences related to post-operative lifestyle changes focused on SG procedures. This lack of evidence suggests a strong need for qualitative research on the lifestyle changes post SG. Moreover, the limited available research examining patients' post-surgical life experiences focuses primarily on western populations whose personal characteristics are very different from that of Chinese. Exploring this culture-specific experience will offer insight into the interaction between patients' thoughts and post-surgical behavioral responses and weight loss variance and will also inform future interventions or patient counseling strategies to facilitate positive lifestyle changes following SG.

The aim of this study was to describe patients' experiences related to post-SG lifestyle changes. We explored participants' self-reported feelings and perceptions of how the surgery impacted their daily life. We also documented participants' perceived barriers that influenced their efforts to make the recommended post-surgical lifestyle changes.

3.3 METHOD

This study used a qualitative design with semi-structured interviews to explore and describe the participants' experiences with lifestyle changes (specifically diet and PA) and their perceived barriers to make adjustments after a SG procedure.

3.3.1 Participants

Participants were recruited from the Center for Obesity and Metabolic Surgery at Huashan Hospital in China. It is one of the highest ranked hospitals in China where SG was introduced in 2012, and the number of surgeries conducted per year is approximately 30 with a steady increase each year since 2012. Age, gender, and the length of time post SG procedure were considered when forming a sample with enough variability. Inclusion criteria included: (a) age between 18 and 65 years; (b) being able to read and write in Chinese; and (c) living within 50 miles of the Shanghai area. Individuals who underwent SG as revisional procedure or previously diagnosed with cognitive impairment were excluded. Through collaboration with the surgeons and case manager in the bariatric ward, potential eligible participants were identified through the electronic health record. The case manager contacted potential participants first to check if they would agree to be contacted by principle investigator (PI). Individuals who consented to release their names were called by the PI to be informed about the qualitative study and to determine their interest in participating. For those who provided oral consent to participate, we scheduled a time and interview location based on their preferences. The signed written consent was obtained prior to the interview. This study was approved by the University of Pittsburgh and Huashan Hospital Institutional Review Boards.

3.3.2 Data collection

Data were collected through individual, face-to-face, semi-structured interviews. During the interview process, we informed participants that we will not judge them on what they did or said related to their post-surgical life experiences. Each interview consisted of 9 open-ended questions that allowed us to fully elicit participants' experience and perceived barriers in making post-surgical lifestyle changes (Appendix B). Sample questions were: "Now that you are xx weeks after surgery, how has your life changed from before the surgery? (e.g., daily habits)," "How do you feel about those changes?" and, "What have been the biggest challenges for you to follow the dietary/PA recommendations after surgery?" Interviews were conducted in Chinese by the PI in a private room in the Center for Obesity and Metabolic Surgery, Huashan Hospital, or at other convenient places, such as a participant's office. Each interview lasted approximately 30 to 45 minutes and was recorded upon approval from participants. Each participant was compensated \$50 in Chinese currency for completing the interview.

3.3.3 Data analysis

An interpretive thematic approach was used to analyze the data. First, interviews were transcribed verbatim and translated into English by the PI (YY). Another researcher (RS) fluent in English and Chinese with knowledge of the study topic listened to the recording and check for accuracy. The two researchers were responsible for data analysis (YY and RS) and became familiarized with the data by reading the transcripts independently and repeatedly. Afterwards, the data set were sorted according to a group of codes, and these codes were merged later to form larger themes that were based on the relationship identified between and within the codes. Both researchers met to discuss the analysis and any differences in the coding were resolved through consensus. Finally, a descriptive passage that discussed the essence of the experiences and perceived barriers for individuals were generated for final comparison. Data analysis followed standard procedures for coding qualitative data.(Field, 1991)

3.4 RESULTS

At the time of interview, the 15 participants (8 female and 7 male) ranged in age from 19 to 60 years, and the post-surgical time frame ranged from one to six years. Their profile characteristics are shown in Table 3. Several themes emerged as we analyzed the data.

3.4.1 Advantages outweigh disadvantages

Most of the participants, regardless of when they had the surgery, reported that the surgery itself changed their life dramatically in both positive and negative ways. Even though SG had some adverse effects on their daily life, no one regretted their choice and said that the advantages far exceeded disadvantages.

3.4.1.1 Disadvantages

The disadvantages participants described were mostly changes related to eating, for example, experiencing belching, nausea, dumping syndrome, difficulty to swallow, and gastro-esophageal regurgitation (GERD), and feelings of abdominal fullness after eating certain food. For example:

The most obvious change I can feel is eating. Before surgery, I usually ate a lot, no matter what kind of food, I only wanted to get them all into my stomach. But now, although I'm already 3rd year post-SG, I do not feel my digestive system recovering, my eating is still like the time when I just finished the operation. Food gets stuck in my esophagus, cannot go down or come out. It makes me nauseous, and I have to induce vomiting to make myself relieved. Every time, my body only allows me to take 2 or 3 bites of food, this is such a disappointing thing to me, since I'm a food lover. (P1)

Participants reported experiencing symptoms of hypoglycemia after surgery. This altered eating pattern may have further influenced their social life, for example, participant noted how social events can be awkward due to the need to “eat like a bird.” However, choosing certain activities over others can

mitigate the awkwardness and challenges. The same participant commented on she/he now prefers hot pot restaurants “because everyone is focusing more on chatting rather than eating” and “no one will pay attention to how much you eat or how slowly you eat.” Other disadvantages that participants described included extensive hair loss and loose skin, additionally, some of them reported becoming “lazy” and “procrastinating”. Participants said that compared to the other health improvements, those were the trivial things that could be easily tolerated.

3.4.1.2 Advantages

All of the participants were grateful to have had such a surgery that gave them an opportunity to live a better life. The favorable changes were described in both physical and psychological terms. Most of the participants said that health was the major motivation for surgery, for example, a considerable portion of them had uncontrolled diabetes, hypertension or knee damage before SG, but most of these chronic symptoms were relieved shortly after surgery even before significant weight loss occurred. Participants described the health improvement is “the happiest thing the surgery brought me and it is worth everything”. Also, some of the participants said they experienced improved sleep quality.

I was over 100kg before surgery, and had severe lumbar intervertebral disc and knee injury because of my excessive weight. I could hardly walk at that time, and had to lean against the tree for rest after moving 2 or 3 steps. Now my weight has reduced significantly, and I feel so much relieved, at least I can walk like a normal person. Life goes on, and I need to survive. (P3)

Additionally, one participant mentioned that his sexual function improved after surgery, which improved the relationship between him and his girlfriend. Nearly all of the participants agreed that they became much more confident, feel “younger” and be able to “walk comfortably in the street without worrying about other people’s funny looks” with a smaller body size. Further, the improvement in their body shape enabled them to shift attention away from weight and made them become willing to face up to some important issues that have been ignored before.

3.4.2 Adjusting to life changes positively

Participants described the life after surgery as a journey to get to know their new body, they were striving to adjust themselves positively with all the changes that occurred post-SG. In the process of adaptation, they held positive attitude, formed new habits and became confident in managing their weight.

3.4.2.1 Make self-adjustment

Owing to the significant changes imposed by SG, including altered eating habits and physical appearance, individuals experienced a period of psychosocial adjustment post-surgically. Participants described the self-adjustment as a process of “discovering and exploring a new body”, getting to know everyone is different, and researching the method that works best for him/her whenever a problem occurs. Participants identified themselves as the “best doctor” and believed that they would go through difficulties only if they took care of themselves.

3.4.2.2 Make new behaviors a habit

After SG, individuals are forced to accept new eating behaviors, and the altered dietary pattern needs to be sustained which gives people a chance to develop new habits for the long-term. As a participant shared:

I think one of the purposes of this surgery is to force you to not eat certain kinds of food, simply because certain foods will make you sick. When you experience discomfort repeatedly, you will take initiative to avoid. This is my 3rd year after surgery, and I think it is long enough to develop the repeated things as a habit. Now I'm used to eat vegetables and healthy food, and I have the confidence to keep in this way in the future. (P10)

3.4.2.3 Stay determined

Most of the 15 interviewees in this study reported strong motivation and determination to meet the required behavioral changes, and they also reported a strong desire to maintain the weight and the improved health after surgery. Participants perceived themselves “suffered a lot from surgery”, and would feel “all the hard work being unrewarded” if their weight went back. With the fear of being “big” and “unhealthy” again, participants held their goals and willpower to overcome difficulties.

3.4.3 Taking control of life

Individuals with severe obesity tended to regard themselves as powerless and incapable of doing things that they were advised to do, either due to social stigma or physical restraint. After surgery, owing to the improvement of physical function and improved confidence, patients were becoming more ready to take control of their life.

3.4.3.1 More sensitive and focused

An obvious theme that stood out through the interviews was that at the cognitive level, people tended to feel more sensitive towards what was happening around them--being able to capture information from multiple aspects and diverse viewpoints, experiencing more profound thinking and staying focused on the important issues. Participants expressed that before surgery, they were “struggling and painful” because the heavy burden that the extra weight imposes on their body, and the burden distracted them from concentrating on their studies or works. However, after surgery, they became “more proactive” and felt “full of power”, even when things appear to be unacceptably difficult, they were “not afraid of hardship anymore” and were willing to take the situation and face it.

3.4.3.2 Self-monitoring

Another manifestation of gaining control is that almost all the participants kept monitoring their weight to get a sense of where they were and adapted their eating and PA plans accordingly. Most of participants reported that they weighed themselves one to two times a week, and if the weight went beyond their acceptable level, they would pay attention to what they recently ate and do some modification accordingly.

I know self-monitoring is very important, so I record my weight every day. Not to say over-concern with my weight, just want to know what happens to my body. I think the weight up and down is nothing more normal, just like the sunrise and sunset. It catches my attention if my weight increases continuously over a period of time, then I would probably go to the gym more frequently and reduce the sweetened beverage. That is my way to control weight, I'm confident to do it well. (P9)

Even though most of the participants had positive attitude and were quite confident in weight management, significant barriers of adhering to post-surgical lifestyle recommendations were reported.

3.4.4 Barriers to healthy eating

Nearly all of the participants reported that they did not follow the dietician's instructions, instead, they were eating in a way that makes their body comfortable. Possible reasons listed included that the dietary recommendations were "ridiculous" and hard to follow, having limited access to certain foods that was especially true for students or workers who ate in the canteen, having difficulty to suppress appetite, and advanced age.

The dietician gave me some suggestions on how to eat, but it absolutely does not make any sense. For example, I was told to chew 60 times for every bite of food, how could that be possible? If I do so, I can only eat one bite while others already finishing their meals. In addition, the protein supplement the dietitian suggested us to eat is atrocious and hard to swallow, not only for me, but also true for other people. I believe no one can do that. (P10)

3.4.5 Barriers to PA

Compared to eating, PA received much less attention. Besides the two young male adults who were actively engaged in exercising in a gym setting, other participants reported that they rarely did any exercise intentionally. Although participants confided that most of the barriers they could think of were no more than excuses that could be conquered, they were just hesitate to put PA on their daily agenda. Reported barriers were multidimensional, including absence of motivation, absence of exercise facility, insufficient time, poor weather, no peer support, fatigue and no recognizable effects from previous exercise experience.

I think having a social circle is really important. Like me, I am a businessman, and is busy with all kinds of business dinners after work, totally have no time to work out. Some people may have peers for exercises like basketball, jogging, but I'm certainly not in that group. (P2)

3.5 DISCUSSION

This study sought to explore individuals' experiences related to post-surgical lifestyle changes and the barriers that they perceived influenced their efforts to make the required post-surgical lifestyle changes. During the interviews, many participants were willing to discuss their experiences and to share the process they underwent to adjust to the major changes in their life following the SG procedure. Most of the participants were very grateful to have undergone the surgery that helped them achieve an improvement or remission of their chronic conditions. Previous literature has consistently shown that SG has been highly effective in creating remission of multiple obesity-related comorbidities, such as obstructive sleep apnea syndrome,(Garg, Aggarwal, et al., 2017; Nocca et al., 2017), T2DM, hypertension, and hyperlipidemia.(Altun et al., 2016; Gray et al., 2017) SG promotes glycemic control with a 60.8% T2DM resolution five years after surgery.(Switzer et al., 2016) A meta-analysis, which included 33 studies

examining the effects of SG on hypertension, concluded that at one year after SG, 58% of patients had complete resolution of hypertension and, on average, 75% of individuals experienced resolution or improvement.(Sarkhosh et al., 2012)

In addition to the physical improvement, almost all of the participants expressed enhanced confidence due to a visibly changed appearance, and even those who experienced some amount of weight regain were still satisfied with the weight loss effect. It is interesting to notice that some studies conducted in the US and Europe reported that even though bariatric surgery significantly reduced BMI, a large proportion of post-surgical patients presented a high degree of dissatisfaction with their body weight and had body image concerns.(Lacerda et al., 2018; Perdue, Schreier, Swanson, Neil, & Carels, 2018) This may be partly be explained by the fact that the majority of surgery in China was conducted for comorbidity treatment rather than for obesity, so the unique context may

The disadvantages that participants reported in this qualitative study, including hypoglycemia, vomiting, palpitation, hair loss, acid reflux, and excess skin, are consistent with the empirical literature.(Chang et al., 2017) Our study sample reported positive experiences on the psychological aspects post-SG, for instance, participants expressed happiness, improved confidence, and better self-control. However, the psychological outcomes reported in previous literature were not always positive. The likelihood of certain types of mental illness may increase post-surgery, e.g., there is evidence that post-SG patients may develop new onset alcohol use disorder and other substance abuse.(Ibrahim et al., 2018) Additionally, patients may experience an increased rate of self-harm and suicide attempts post-surgery.(Castaneda, Popov, Wander, & Thompson, 2018) These conditions were not reported in our study but warrant further investigation in the Chinese population.

Participants' eating behavior changed dramatically regardless of which year they had the SG procedure performed. Most of the participants mentioned they had difficult to swallow and could not eat much and felt full often because of the frequent occurrence of GERD and changed appetite. Unlike other surgical techniques, such as gastric banding and gastric bypass that provide improvements for reflux symptoms, SG appears to increase the incidence of GERD.(El-Hadi, Birch, Gill, & Karmali, 2014) It is

well documented in the literature that the hormone changes (e.g., decreased plasma ghrelin and serotonin levels) resulting from the SG procedure will lead to an alteration of appetite and food preference which may explain the dietary intake and eating behavior alterations for patients after SG.(Magnoni et al., 2012; Melero et al., 2014; Primeaux et al., 2015) In our study, most participants admitted that they had some kind of disordered eating before surgery, such as binge eating and loss of control eating, but none of the irregular eating behaviors occurred after surgery. A study with 134 patients pointed out that disordered eating remains a concern post-SG, specifically, patients tended to engage in loss of control eating in response to negative emotions, such as anxiety, boredom, and sadness.(Wiedemann, Ivezaj, & Grilo, 2018) Furthermore, there have been a few studies reporting the unsatisfactory diet quality and micronutrient deficiency among post-SG patients.(Boyle, Carruthers, & Mahawar, 2019) For future study, it would be beneficial to quantify dietary intake to achieve a full picture of patients' dietary behavior.

Due to the significant changes imposed by SG on individuals, it is a personal journey for them to make adjustments to the new life. Coping with changes in life is not easy, especially when the process of adaptation takes considerable efforts. That is why some of the individuals who undergo bariatric surgery may give up and relapse to their previous comfort zone. We found that participants in our study saw the adjustment as a natural process and were using some of the core behavior change strategies (e.g., self-efficacy enhancement and self-monitoring) to help them. First, most of the participants said that they were confident in making the required behavioral changes and maintaining the lost weight, which was reflective of self-efficacy. Self-efficacy refers to a person's confidence in his or her ability to perform a behavior, and it plays a major part in determining the success for behavior change.(Bandura, 1986) Research has repeatedly demonstrated that people with a higher level of self-efficacy for changing their lifestyle behaviors are more likely to engage in weight management behaviors such as healthy eating and regular PA,(Nezami et al., 2016; Strachan & Brawley, 2009) and they have a higher chance of achieving weight loss and weight loss maintenance as well.(Faghri & Buden, 2015; Nezami et al., 2016; Shin et al., 2011; Warziski et al., 2008)

Second, participants in our study were very determined and motivated to make changes as they were afraid of seeing the lab results, such as blood glucose and blood pressure, become abnormal again. Motivation is core construct in self-determination theory (SDT) which is well proved and widely used in the field of behavior change. The essence of SDT lies in that autonomous motivation which in this context can be interpreted as individuals having identified with the personal importance of weight management behavior for their own self-selected goals (e.g., health) will lead to greater long-term persistence and yield better weight maintenance outcomes.(Deci & Ryan, 2008; Teixeira et al., 2015; Trief et al., 2017)

Third, almost all of the participants in our study reported that they weighed themselves regularly, either on a daily basis or several times a week to help control weight. Self-monitoring is the core construct in self-regulation theory, it increases an individual's awareness of his/her behavior and progress made in altering the behaviors targeting caloric restriction and increased PA. Systematic reviews have shown that self-monitoring of diet, PA and weight are potential predictors of beneficial weight loss outcomes without causing unwanted adverse effects.(Shieh et al., 2016; Teixeira et al., 2015; Zheng et al., 2015) We noted that although participants were doing well in monitoring their weight, none of them mentioned they recorded their daily diet or exercise, which should be the target for future patient education.

Last, patients expressed that they had more control over their lives and being able to focus on the important things. The importance of self-control has been highlighted in literature for its important implications for weight loss effect, a stronger control in behaviors has been shown to be positively related to a healthier eating pattern, more active PA and better weight loss maintenance.(Leahey, Xu, Unick, & Wing, 2014; Ogden, Clementi, & Aylwin, 2006) Clearly, participants in this study had not been counseled on the use of behavior change strategies, however, they were able to use and adopt the core techniques to help make adjustments.

Although it appeared that participants in this study were adjusting to the post-surgical lifestyle changes, they were also facing certain challenges. The major barriers reported in the literature include lack of a support system; higher cost of healthy foods; lack of time and facilities to plan meals; lack of knowledge to prepare and cook healthy foods; and living in a obesogenic environment.(Munt, Partridge, & Allman-

Farinelli, 2017) China has a unique diet culture that relies heavily on grains and vegetables, and steaming and boiling are the primary cooking methods that may be beneficial in reducing energy intake.(Del Giudice et al., 2016) There is no significant price difference between majority of the healthy and unhealthy food.(Y. Liu et al., 2019) In addition, the traditional Chinese restaurants still holds a dominant presence despite the expansion of the fast food industry. Based on our participants' statements, they received dietary education during the post-surgical in-hospital period and were given brochures at the time of discharge. Furthermore, the dietician was available to provide follow up consultation either online or in person. Therefore, we can say that our study population had access to information related to healthy eating, but it is clear that retention of this information during the post-operative and pre-discharge period is poor.(Mahawar et al., 2019) Participants reported trying to meet the dietary guidelines but usually failed largely due to the physical constraints caused by reduced stomach or the nature of the guideline itself. To the best of our knowledge, there is no standardized dietary guideline for post-SG patients in China and this study reminded us the need to modify existing guidelines to be better tailored to suit patients' needs.

Being physically active is not heavily emphasized in China(Zang & Ng, 2016) that and was reflected in the interviews, e.g., participants were not ready to put efforts into PA. In China, occupational, household and transport domains are the most common types of PA, whereas leisure-time activity is the main contributor to total PA in high-income countries.(AE et al., 2012; Macniven et al., 2012) In June, 2016, the Chinese government approved the 2016-2020 National Fitness Plan. Through activities such as increasing sports investments, developing fitness activities and constructing public sport facilities, the national plan targets promoting PA awareness and increasing fitness and health of the whole country. Patients who have undergone bariatric surgery would benefit from those society-based strategies, in addition, given the fact that employment status significantly improved after bariatric surgery(Mancini & Reche, 2018) and the effectiveness of worksite PA promotion has been supported by literature,(Anderson et al., 2009) it may also be a promising strategy to consider in the future.

3.6 LIMITATIONS

This study has several limitations. First, participants were recruited in one hospital and all resided in the Shanghai area, which limits the generalizability of the study's findings. Second, since SG was introduced to China in 2012, the longest post-SG follow-up period we were able to capture was 6 years, which may not be representative of the longer-term post-SG experience. Third, this study focused on individuals' experiences regarding dietary and PA lifestyle changes and may have missed some important psychosocial issues such as changes in family relationships.

3.7 CONCLUSION

This study explored the experiences and perceived barriers of individuals who underwent a SG procedure in China and how they adapted to the required lifestyle changes. Results revealed that although the surgery imposed a drastic alteration in their life (e.g., dietary alteration), participants viewed the changed positively and were able to use several important strategies to make appropriate adjustments. Both individual-level and community-level barriers existed for individuals in their attempt to meet the required dietary and PA changes. Future efforts need to focus on developing culturally-tailored dietary guidelines and promote increased PA in this group of individuals who are striving to make long-term changes to support weight loss maintenance.

Table 3 Characteristics of Qualitative Sample (N=15)

| Participant | Sex | Age | Years post SG |
|-------------|--------|-----|---------------|
| 1 | Female | 39 | 2 |
| 2 | Male | 40 | 1.5 |
| 3 | Male | 64 | 2 |
| 4 | Female | 21 | 1 |
| 5 | Female | 19 | 2 |
| 6 | Female | 28 | 3 |
| 7 | Male | 35 | 1.5 |
| 8 | Male | 41 | 3 |

| Participant | Sex | Age | Years post SG |
|-------------|--------|-----|---------------|
| 9 | Male | 37 | 3.5 |
| 10 | Male | 21 | 3 |
| 11 | Female | 30 | 4 |
| 12 | Female | 36 | 3 |
| 13 | Female | 62 | 4 |
| 14 | Male | 45 | 5 |
| 15 | Female | 60 | 6 |

4.0 MANUSCRIPT 3: PSYCHOSOCIAL STATUS AND WEIGHT LOSS OUTCOME IN ADULTS WHO UNDERWENT SLEEVE GASTRECTOMY IN CHINA

4.1 ABSTRACT

Background

Severe obesity that is defined as body mass index (BMI) $40\text{kg}/\text{m}^2$ or higher, is associated with an increased risk for developing the metabolic syndrome, cardiovascular disease, sleep apnea, and chronic kidney disease. Sleeve gastrectomy (SG) is one of the most effective surgical treatments for severe obesity and has been associated with psychosocial changes in patients' lives. Weight loss is highly variable in the bariatric population in China and it is unclear what the psychosocial status of patients who have undergone SG is and the relationship between psychosocial status and post-surgery weight loss is not known.

Objective

We used a cross-sectional design to describe the psychosocial status of individuals who had undergone SG and focused on disordered eating behaviors, depression, self-efficacy and social problem-solving. We also explored the relationships between these psychosocial factors and post-surgical weight change.

Methods

Survey questionnaires were administered to individuals who had undergone SG at the Center for Obesity and Metabolic Surgery, Huashan Hospital, China during the period of 08/15/2019 to 08/25/2019. We mailed the surveys to 250 potential eligible participants to collect data on disordered eating behaviors, depression, self-efficacy, social problem-solving and post-surgical

weight loss. Pre-surgical weight and height were based on self-report. Spearman correlation and linear regression were applied to examine the relationships between the psychosocial factors and post-surgical weight change, controlling for possible confounding variables, such as age, sex and length of time post SG.

Results

The sample (N=67, response rate 20.8%) was mostly female (64.2%) with at least a bachelor's degree (50.8%). The mean age was 33.67 ± 11.09 years, and the mean length of time post SG was 1.82 ± 0.94 years with a range from one to five years. The mean scores represented a low level of disordered eating behaviors (mean: 43.60 ± 25.61 ; possible score range: 0-192), a relatively low level of social problem-solving skills (mean: 89.5 ± 12.87 ; possible score range: 25-125) and depression (mean: 14.22 ± 11.00 ; possible score range: 0-60). Participants' self-efficacy was moderately high (mean: 112.42 ± 40.60 ; possible score range: 0-180). The mean percent excess weight loss (%EWL) that was calculated as $[(\text{Pre-surgical Weight}) - (\text{Post-surgical Weight})] / [(\text{Pre-surgical Weight}) - (\text{Ideal Weight})] \times 100$ (in which ideal weight was defined by the weight corresponding to a BMI of 25 kg/m^2), was 102.99 ± 80.39 . Self-efficacy and the subscales of disordered eating behaviors (body dissatisfaction) significantly correlated with weight loss outcome. Depression and social problem-solving were not significantly correlated with any indicator of weight loss outcome.

Conclusion

Patients undergoing SG in China demonstrated a high level of self-efficacy and low level of social problem-solving skills without severe disordered eating behaviors and depressive symptoms, and they achieved a significant weight loss after surgery. This study provided evidence for a role of self-efficacy and disordered eating behavior as significant predictors for the weight loss response

after SG. Larger longitudinal studies with longer follow-up and pre-surgical measurement were needed to further understand the psychosocial mechanism in weight loss effect among SG population.

4.2 INTRODUCTION

Obesity continues to be a significant health burden affecting 12% of the adult population worldwide.(Collaborators et al., 2017) Over recent decades, China has experienced the biggest increases in obesity prevalence from 1980 (0.6%) to 2015 (5.3%).(Chooi, Ding, & Magkos, 2019) Although the obesity prevalence is much lower compared to 39.8%(Hales et al., 2018) in U.S., China leads in the number of individuals with obesity because of its large population base. Obesity estimated to afflict nearly 89.6 million adults in China, which translates to afflicting approximately 16.3% of the worldwide male population and 12.4% of the worldwide female population. The subset of people with severe obesity, which is defined for Asian populations as a body mass index [BMI] $\geq 35 \text{ kg/m}^2$, has also been increasing rapidly and warrants particular attention.(Cesare et al., 2016) Compared to moderate obesity, severe obesity increases the risk for developing the metabolic syndrome (e.g., hypertension, type 2 diabetes [T2DM]), cardiovascular disease, sleep apnea, chronic kidney disease and all-cause mortality.(Flegal et al., 2013; Navarro Diaz, 2016)

Individuals with severe obesity usually fail to respond to the standard lifestyle intervention in the long-term(Natvik, Raheim, Andersen, & Moltu, 2018); however, bariatric surgery has been demonstrated to be an effective treatment for severe obesity and its related comorbidities. Sleeve gastrectomy (SG), which is the most commonly performed bariatric surgery procedures worldwide, induces weight loss by removing approximately 75% of the stomach and restricting

food intake.(Nguyen & Varela, 2017) SG has been reported to have comparable effects in terms of short-and mid-term weight loss, comorbidity remission and less long-term complications compared to the gold standard Roux-en-Y Gastric Bypass (RYGB).(Kalinowski et al., 2016; J. Li et al., 2016; Ndumele et al., 2016) SG also has other advantages, such as a short learning curve for the surgeon, the absence of introducing foreign objects, and a shorter hospital stay than other bariatric procedures. Although the first SG in China was in 2006 and is still at an early stage, SG has prevailed since 2011 and has gained increasing acceptance among bariatric surgeons and accounts for 71% of the selected surgical procedures in 2018.(S. Lin et al., 2017; Yang et al., 2019)

While SG has proven to be very effective in initiating early short- to mid-term weight loss and reducing comorbidity for individuals with severe obesity, it may impose psychosocial changes due to major weight loss and surgery-related complications (e.g., nausea and vomiting, pulmonary embolism, nutritional deficiencies, stricture formation, hair loss and excess skin).(Ruiz-Tovar et al., 2014; Wakefield et al., 2014) It has been documented in the literature that the prevalence of mental illness is higher in individuals seeking bariatric surgery than in the general population,(Malik, Mitchell, Engel, Crosby, & Wonderlich, 2014b) and the most commonly diagnosed condition is depression, followed by binge eating disorder, anxiety, substance use disorder, and posttraumatic stress disorder.(Dawes et al., 2016) Patients usually experience an alleviation in depression and anxiety after surgery, however, this improvement has not been durable. For example, a study followed patients who underwent bariatric surgery for 3 years and found that the severity of depressive symptoms abated after surgery but attenuation in improvement was observed after the first postoperative year.(J. E. Mitchell et al., 2014) In a sample of 104 participants undergoing RYGB, the prevalence of having any mental disorder decreased 4 years after surgery, but no significant difference was observed at 7-year point compared to pre-

surgical prevalence.(Kalarchian et al., 2019) Similar to depression and anxiety, the same pattern can be seen in most types of the eating disorders, such as food addiction,(Pepino et al., 2014) binge eating,(Rusch & Andris, 2007) emotional eating, and external eating,(Pepino et al., 2014) and loss of control eating.(Smith et al., 2019a) Post-surgical mental health appears to be relevant to weight loss outcome. Post-surgical disordered eating and depression are predictors of poorer weight loss in the literature on gastric banding and gastric bypass,(Fitzpatrick et al., 2013; Heppner & Petersen, 1982; Kalarchian et al., 2016) but little is known about patients after undergoing SG.

In addition to mental health, self-efficacy and social problem-solving are two key psychosocial constructs that may influence postoperative weight loss.(Bandura, 1986; Koharchik & Redding, 2016) The concept of self-efficacy comes from Bandura's social cognitive theory, which refers to a person's confidence in his or her capability to perform a behavior and has been regarded as the one of the most powerful constructs in explaining behavior change.(Bandura, 1986) One study with mean 4-year follow-up documented that among 268 post-RYGB patients, self-efficacy was significantly related to weight loss outcome.(Batsis et al., 2009) Social problem-solving is a cognitive-affective-behavioral process by which people attempt to discover effective or adaptive solutions to problems they experience in everyday life,(Nezu & D'Zurilla, 2007) and it has been demonstrated to be a key component in relapse prevention therapies and weight maintenance.(Mary E. Murawski et al., 2009; Perri et al., 2001) Social problem-solving has been barely studied among individuals who have had bariatric surgery.

Psychosocial research on bariatric surgery remains underdeveloped in China. Unlike the findings reported in western countries, there is an inverse relationship between depressive symptoms and weight in Chinese populations, which is known as the "jolly fat" phenomenon. That is, individuals who are obese are significantly less likely to report depressive symptoms compared

to their normal weight counterparts.(Dong et al., 2013; Yu et al., 2011) However, it is unclear what the psychosocial status of individuals who have undergone SG is, as well as how it relates to their post-surgical weight loss, suggesting an area in need of further study. Therefore, the aim of this study was to describe patients' psychosocial status (including disordered eating behaviors, depression, self-efficacy and social problem-solving) and weight loss outcome among patients who have undergone SG in China. We also sought to explore the relationship between psychosocial outcomes and weight loss in the study sample.

4.3 METHODS

4.3.1 Design and participants

We recruited participants in this cross-sectional study from the Center for Obesity and Metabolic Surgery, Huashan Hospital, China. It is one of the top ranked hospitals in China where SG was introduced in 2012, and the number of surgeries conducted per year has grown steadily to approximately 60 per year. Inclusion criteria included (a) age ≥ 18 years; (b) at least 1 year after SG; (c) having access to a weighing scale; and (d) being able to read and write in Chinese. People who received SG as a revisional procedure or previously diagnosed with cognitive impairment were excluded. Permission from the hospital and other associated departments was obtained prior to any contact with patients for recruitment. This study was approved by the University of Pittsburgh and Huashan Hospital Institutional Review Boards.

The surgery center has a strong multidisciplinary team including experienced surgeons, nurses, dietitians, psychologists and case managers that largely facilitated the participant

recruitment process. Our subjects came from two sources. First, given that the follow-up rate in the surgery center is relatively low, the majority of the potential participants were identified via the electronic health record (EHR) by the principal investigator and case manager. During the time period of 08/10/2018 to 08/25/2018, we mailed the study packet that included consent forms, questionnaires, and a pre-paid, returned-addressed envelope to each of the 250 potential participants. Most of the individuals who had undergone SG in the surgery center were in a social media chatting group, through sending messages in the chatting group, we informed individuals about this study and asked for their participation. A message reminder was sent weekly for the first month after mailing the packet and monthly for the following months. Second, after screening the EHR, a small portion of the sample was given the study packet face-to-face during their follow-up visits. Participants finished the questionnaires in a private room in the surgical center.

4.3.2 Measurements

Demographics. Demographic data (age, gender, race, marital status, employment status, family income, education level, and number of years after surgery) were collected using the investigator-developed, 9-item Sociodemographic Questionnaire.

Disordered eating behavior. The Chinese version of the Eating Disorder Inventory-1 (EDI-1) was used to assess the presence of eating disorders. Although EDI-2 and EDI-3 have been released, we were not able to use the newer version because there are no validated Chinese translations of these later versions. EDI-1 consists of 64 items with 8 subscales that assess drive for thinness, body dissatisfaction, bulimia, perfectionism, interpersonal distrust, maturity fears, interoceptive awareness and ineffectiveness.(M. E. Murawski et al., 2009) For each item, a 6-point Likert scale was used that ranged from 1 (never) to 6 (always). For scoring, “never”, “rarely”, and

“sometimes” was given the score of 0; “occasionally”, “often”, and “always” was the given the score of 1, 2, and 3, respectively. The higher the total score, the more severe the eating disorder. EDI-1 has well-tested reliability and validity in Chinese populations with an overall Cronbach’s alpha of .95.(Decker & Dennis, 2013; Perri et al., 2001)

Depression. Depression was measured by the Chinese version of the Center for Epidemiological Studies Depression Scale (CES-D). CES-D is a 20-item scale that has been widely used to assess depressive symptoms experienced by individuals over the previous week.(F. Li, 2016) Each item is scored from 0 to 3 and the total score range is from 0 to 60 with higher scores indicating more severe depressive symptoms. The cut-off value of ≥ 16 has been widely used to define clinically meaningful depressive symptoms.(F. Li, 2016) CES-D has been shown to have a strong reliability and validity in the Chinese population.(Butrym et al., 2011; Hales et al., 2018; Kim & Basu, 2016) Overall Cronbach’s alpha has been reported at .85-.92 among various samples.(Hales et al., 2018; Kim & Basu, 2016)

Self-efficacy. Self-efficacy was measured by the Weight Efficacy Lifestyle (WEL) Questionnaire. The WEL is a 20-item questionnaire with well-established validity and reliability (Cronbach’s alpha $>.7$ (Jeffery et al., 2003)) and used to measure individuals’ confidence in resisting eating in various situations. It includes 5 dimensions: negative emotions, availability, social pressure, physical discomfort, and positive activities. Participants rate their confidence on a 10-point scale ranging from 0 to 9, a higher score indicates a greater eating self-efficacy.(Clark et al., 1991) Currently, the Chinese version of WEL is not available, therefore, we followed standard protocol to translate and pilot test it prior to the proposed study.

Social problem-solving. Social problem-solving was measured by the Chinese version of the Social Problem-Solving Inventory Revised (C-SPSI). C-SPSI is a 25-item questionnaire

measuring individuals' problem-solving ability. The scale was translated and adapted from the original 32-item English version.(Siu & Shek, 2005) It includes five dimensions: positive problem orientation, negative problem orientation, rational problem-solving, impulsivity/carelessness style, and avoidance style. Participants were asked to rate on a 5-point Likert scale from 1 (not at all true of me) to 5 (extremely true of me). Lower scores denote better problem-solving skills. Cronbach's alpha for the five subscales ranges from 0.65 to 0.88.(Siu & Shek, 2005)

Weight and height. Due to the wide range of geographical distribution of participants, it was not feasible to obtain an objective measure of weight. Patients' self-reported weights following bariatric surgery have been shown to be very close to their weights measured by clinical personnel and may not significantly bias study results.(Christian et al., 2013) Therefore, self-reported weight was used in this study. Based on the standardized outcomes reporting in bariatric surgery,(Moloney et al., 2017) we used three metrics to report the weight loss outcomes. First, Change in BMI (Δ BMI) was calculated as (Pre-surgical BMI) – (Post-surgical BMI); second, percent of total weight loss (%TWL) was calculated as [(Pre-surgical Weight) – (Post-surgical Weight)] / [(Pre-surgical Weight)] x100; third, percent excess weight loss (%EWL) was calculated as [(Pre-surgical Weight) – (Post-surgical Weight)] / [(Pre-surgical Weight) – (Ideal Weight)] (in which ideal weight was defined by the weight corresponding to a BMI of 23 kg/m²). Height and pre-surgical weight were also based on self-report.

4.3.3 Data analysis

Data analysis was performed using IBM SPSS (version 24, IBM Corp., Armonk, NY). For all analysis, $p \leq 0.05$ was considered statistically significant. Since the dataset was very complete with less than 5% of missing data, missing data were assumed to be missing completely at random,

and no imputation was applied. Means and standard deviations were used to describe continuous variables (age, disordered eating behavior, depression, self-efficacy, social problem-solving, Δ BMI, %TWL, %EWL). Frequency and percentage were used for categorical variables (gender, race, marital status, education, employment status, and income).

In order to explore the associations between psychosocial outcomes and weight loss, we first applied Spearman correlation analysis to model the association between each psychosocial predictor variable (disordered eating behaviors, depression, self-efficacy, and social problem-solving) and three indications of weight loss (Δ BMI, %TWL, and %EWL). Then the potential important variables identified in this step ($p<0.20$) were entered using stepwise selection to build multiple linear regression models for each of the three weight loss metrics, controlling for potential confounding variables, such as demographics and length of time after SG.

4.4 RESULTS

4.4.1 Sample characteristics

By April 2019, we received 52 completed questionnaire packets returned to the surgery center, and combined with the 15 questionnaires collected face-to-face, our sample was comprised of 67 adults who underwent SG. The majority of participants were female (64.2%, eight from face-to-face and 35 from mailed survey) with at least a bachelor's degree (50.8%). The mean age was 33.67 ± 11.09 years, and the mean length post SG was 1.82 ± 0.94 years (Table 4).

Table 4 Quantitative Sample Characteristics (N=67)

| Characteristic | <i>n</i> | Mean (SD) or % | Range |
|-------------------------------|----------|----------------|-------------|
| Age (years) | 67 | 33.67 (11.09) | 18-64 |
| Pre_BMI (kg/m ²) | 63 | 37.93 (6.74) | 26.35-49.64 |
| Post_BMI (kg/m ²) | 67 | 25.74 (4.77) | 17.09-41.81 |
| Length since SG (years) | 67 | 1.82 (0.94) | 1-5 |
| Gender | | | |
| Female | 43 | 64.2 | |
| Marital status | | | |
| Married | 33 | 49.3 | |
| Education | | | |
| At least a bachelor's degree | 34 | 50.8 | |
| Employment | | | |
| Full time | 43 | 64.2 | |
| Income | | | |
| ≥ \$ 15,000 | 27 | 40.3 | |

Pre_BMI: BMI before sleeve gastrectomy; Post_BMI: BMI after sleeve gastrectomy.

4.4.2 Description of psychosocial factors and weight loss

The mean subscale score of disordered eating behavior, total score of depression, self-efficacy, and social problem-solving, and weight loss outcomes are presented in Table 5. The results showed that while the patients' symptoms of disordered eating behaviors and depression were in the lower end of the score range, they reported a moderately high level of self-efficacy and low level of social problem-solving skills.

Table 5 Disordered Eating Behaviors, Depression, Self-efficacy, Social Problem-solving and Weight Loss One to Five Years after SG (N = 67)

| Characteristic | <i>n</i> | Mean (SD) or % | Possible score range |
|----------------------------|----------|----------------|----------------------|
| Disordered eating behavior | | | |
| Drive for thinness | 67 | 6.08 (4.75) | 0-21 |
| Bulimia | 66 | 1.66 (3.54) | 0-21 |
| Body dissatisfaction | 67 | 11.24 (7.69) | 0-27 |
| Ineffectiveness | 67 | 5.26 (5.01) | 0-30 |
| Perfectionism | 67 | 5.55 (4.38) | 0-18 |
| Interpersonal distrust | 67 | 2.79 (2.58) | 0-21 |
| Interoceptive awareness | 66 | 4.41 (4.66) | 0-30 |
| Maturity fears | 66 | 6.50 (5.13) | 0-24 |
| Depression | 64 | 14.22 (11.00) | 0-60 |
| Self-efficacy | 66 | 112.42 (40.60) | 0-180 |
| Social problem-solving | 66 | 89.5 (12.87) | 25-125 |

| Characteristic | n | Mean (SD) or % | Possible score range |
|----------------|----|----------------|----------------------|
| Weight loss | | | |
| ΔBMI | 63 | 12.52 (6.12) | |
| %TWL | 63 | 59.38 (31.92) | |
| %EWL | 63 | 88.40 (32.65) | |

ΔBMI: BMI change; %TWL: percent of total weight loss; %EWL: percent excess weight loss

4.4.3 Relationships between psychosocial factors and weight loss

Using Spearman correlation test, we observed that disordered eating behavior subscale (body dissatisfaction) were negatively and significantly correlated with %EWL, and self-efficacy was positively and significantly correlated with %TWL (Table 6). However, depression and social problem-solving and weight loss were not significantly correlated.

Further, the potential important variables ($p < 0.20$) were entered into the multiple regression model for each of the weight loss metrics, controlling for age, sex, education, income, and time since SG. The results revealed that only sex was significant in predicting %EWL (Table 7).

Table 6 Bivariate Associations between Disordered Eating Behaviors, Depression, Self-efficacy, and Social Problem-solving with Weight Loss (N =67)

| | ΔBMI | %TWL | %EWL |
|----------------------------|-------|-------|---------|
| Disordered eating behavior | | | |
| Drive for thinness | -.141 | -.201 | -.211 |
| Bulimia | .018 | -.017 | -.084 |
| Body dissatisfaction | -.120 | -.240 | -.391** |
| Ineffectiveness | .122 | .078 | -.093 |
| Perfectionism | -.138 | -.114 | -.007 |
| Interpersonal distrust | .066 | .034 | -.044 |
| Interoceptive awareness | .004 | -.019 | -.005 |
| Maturity fears | .093 | .095 | .077 |
| Depression | .131 | .098 | -.046 |
| Self-efficacy | .217 | .277* | .236 |
| Social problem-solving | -.119 | -.064 | .185 |
| Age | -.156 | -.018 | .232 |
| Sex | -.167 | -.118 | .138 |
| Education | .054 | .037 | .004 |

| | ΔBMI | %TWL | %EWL |
|---------------|------|------|------|
| Income | .012 | .064 | .116 |
| Time since SG | .001 | .064 | .071 |

a. ΔBMI: BMI change; %TWL: percent of total weight loss; %EWL: percent excess weight loss

b. *: P<.05; **: P<.01

Table 7 Linear Regression of the Potential Predictors of Weight Loss (N =67)

| | ΔBMI | | | %TWL | | | %EWL | | |
|----------------------------------|--------|-------|------|--------|-------|------|---------|-------|-------|
| | b | SE | p | b | SE | p | b | SE | p |
| Drive for thinness | / | / | / | -.029 | .416 | .945 | -.417 | 1.158 | .720 |
| Body dissatisfaction | / | / | / | -.228 | .261 | .388 | -1.130 | .728 | .127 |
| Self-efficacy | .029 | .021 | .176 | .061 | .043 | .163 | .209 | .124 | .098 |
| Social problem-solving | / | / | / | / | / | / | -.107 | .374 | .776 |
| Age | -.077 | .072 | .295 | -.033 | .149 | .824 | .572 | .417 | .176 |
| Sex (Female) | 1.191 | 1.664 | .477 | -1.109 | 3.313 | .739 | -19.614 | 9.136 | .036* |
| Education (Bachelor's degree) | -1.865 | 1.626 | .256 | -.547 | 3.229 | .165 | -8.185 | 8.977 | .366 |
| Income (> \$20,000) | -.092 | 1.804 | .960 | 1.596 | 3.593 | .659 | 2.131 | 9.881 | .830 |
| Time since SG | .176 | .905 | .846 | .722 | 1.837 | .696 | .720 | 5.032 | .887 |

a. ΔBMI: BMI change; %TWL: percent of total weight loss; %EWL: percent excess weight loss;

SE: standard error

b. *: P<.05

4.5 DISCUSSION

This is the first study to our knowledge that examined psychosocial status and weight loss outcome in adults who underwent SG in China, although our results were limited by the small sample size, this study may serve as a basis for further large-scale studies. Our study showed that eight subscale scores of EDI-1 were in the lower end of the possible score range, which revealed that participants did not have significant cognitive, emotional, and behavioral symptoms of disordered eating after SG. Similar results can be found in another study conducted in Germany, which reported low level of eating disorder symptoms measured by EDI after SG.(Figura, Rose,

Ordemann, Klapp, & Ahnis, 2017) It is worth noting that although EDI was applied in bariatric population in several studies, most of them used newer versions.(Matini, Ghanbari Jolfaei, Pazouki, Pishgahroudsari, & Ehtesham, 2014) This lack of uniformity makes it difficult to compare results across studies, thus warranting the need for developing a validated Chinese version of EDI-2 or EDI-3. Although we did not measure physiological variables, the absence of disordered eating may be partially explained by both biological and neurobehavioral factors. As a restrictive operation that entails resection of more than 70% of the stomach and removes most ghrelin-producing cells, it expected that there will be a significant reduction in plasma ghrelin levels after SG. Further, the literature provides evidence that decreased serotonin levels and increased circulating levels of peptide tyrosine tyrosine (PYY) and glucagon-like peptide 1 (GLP-1) play a role in the regulation of appetite and eating behavior.(Makaronidis & Batterham, 2016) Due to the narrowed stomach and metabolic changes, some gastrointestinal symptoms may occur. Nausea, vomiting, regurgitation, reflux, belching, and abdominal fullness after eating small amounts of food were common short-term side effects reported in literature.(El Labban, Safadi, & Olabi, 2015) Due to the changes in hormone and digestive systems, it has been reported that after SG, there is reduced interest for sweets, alcoholic drinks and fatty food.(Coluzzi et al., 2016; Nance, Eagon, Klein, & Pepino, 2017) Individuals experienced less hunger and food craving, and had increased enjoyment of healthy foods.(Vuorinen, Strahilevitz, Wansink, & Safer, 2017) The alteration in taste and food preference is a possible reason for individuals' improvement in disordered habits of eating(Rieber et al., 2013) in the short term after surgery.

Another point to consider is that the mean length of time individuals were assessed post SG in our study was approximately 2 years, due to the physical restraint, participants may not be able to demonstrate obvious disordered eating behaviors during this period. As time post procedure

increases, along with the gastric dilation and appetite recovery, there is a need to be concerned about the re-occurrence of problematic eating behaviors. Based on the gastric bypass or gastric banding literature, problematic eating behaviors such as emotional eating, loss of control eating and binge eating disorders had the greatest improvement at one or two years after surgery, but the prevalence increases in the longer follow-up periods.(Opozda, Chur-Hansen, & Wittert, 2016; Smith et al., 2019b) Although there is dearth literature regarding long-term eating behaviors investigation on SG, Ivezaj et al.(Ivezaj, Wiedemann, Lawson, & Grilo, 2019) reported that nearly 18% of patients met the diagnostic criteria of loss of control and food addiction at 6 months after SG, thus were at a higher risk for developing binge eating disorder in the future. During the 2-year window after SG, clinical dietitian and health care providers may have the opportunity to help patients make healthful changes in their eating habits that can be sustained for a long time when biological and appetite changes play a positive role in altering eating behavior.

On average, our study sample did not have clinically meaningful depressive symptoms two years after surgery. As one of the most diagnosed mental disorder among patients seeking surgery, it has been reported that SG has an independent positive effect on depression.(Mack et al., 2016; Monte, Russo, Mustafa, & Caruana, 2018) The improvement in depressive symptoms may be attributed to the weight loss effect, remission of comorbidities, improved self-esteem and body image,(Nickel et al., 2017) confidence boost, and improved quality of sexual life.(Cherick et al., 2019) Similar to the eating disorder, attention needs to be given to the possible re-occurrence of depression. For example, a study reviewed the medical record of 3045 participants who received bariatric surgery and reported that the rate of clinical depression decreased from 36% before surgery to 32% in the second post-surgical year. However, this improvement could not be maintained more than three years after surgery with the rate increasing to an even higher number

than the 37% at baseline.(Booth et al., 2015) The result was supported by another study reporting that there was a recurrence of depressive symptoms one year post-operatively.(J. E. Mitchell et al., 2014) Although our study sample did not present severe depression symptoms, the pattern of change documented in the literature reminds us of the importance of psychological support for patients undergoing SG. Cognitive behavioral intervention for weight maintenance incorporating components like healthy eating, physical activity (PA), coping with stress, relaxation, self-monitoring training, group discussion and social support have been shown as promising strategies to alleviate depressive symptoms.(Cassin et al., 2016; Wild et al., 2017) While gastric surgery may have positive effects on problematic eating and depressive symptoms, the likelihood of other mental illness may increase post-surgery. Specifically, SG patients are at a higher risk to develop alcohol and other substance abuse. Moreover, there has been emerging literature reporting increased risk for suicide attempts, self-harm,(Castaneda, Popov, Wander, & Thompson, 2019) and borderline personality disorder after surgery. Given that a healthy psychosocial status is essential for optimal weight loss and weight maintenance, further research is warranted to examine the long-term psychiatric outcomes and inform the development of interventions to provide patients needed support for maintenance of positive behavior changes.

The participants in our study demonstrated a high level of eating self-efficacy and low level of social problem-solving skills suggesting that they were confident in controlling their eating in challenging situations but may not able to use appropriate skills and resources to deal with daily barriers and difficulties. A study with 84 post-SG patients reported similar results on eating self-efficacy that increased significantly from baseline to 16 months after SG and this increase was able to be maintained to 55 months post-surgery.(Flølo et al., 2018) Similarly, Nickel et al.(Nickel et al., 2017) also presented an increasing trend of self-efficacy after bariatric surgery. The possible

reasons for the high perceived eating self-efficacy may include, first, the sample in our study was mostly comprised of adults with high education and income levels in China that may affect their confidence in controlling eating behaviors; second, literature has reported individuals with severe obesity seeking bariatric surgery have higher self-efficacy compared to those who choose conservative treatment;(Batsis et al., 2009; Kvalem et al., 2015) third, because stomach and hormone alterations still dominate the food regulation the first 24 months post-operatively, participants may underestimate the difficulties for eating control. Given that self-efficacy changes over time and fluctuates with post-surgical weight loss success and failure, longer term research is needed to examine the factors that can be addressed to support maintenance of self-efficacy. Patients undergoing bariatric surgery were facing multiple barriers in adhering to post-surgical eating and PA regimen, such as lack of motivation, lack of time and social support issues,(Zabatiero et al., 2018) which my partially explain the low level of social problem-solving in our study. Future studies may need consider applying strategies to help individuals build positive problem-solving techniques, for example, the problem-solving training that includes five steps (defining the problem, collecting relevant information, generating possible solutions, comparing for each solution, and implementing and evaluating the solution) has shown to be promising in improving individuals' ability to find an effective solution to problems and promote weight loss.(M. E. Murawski et al., 2009; Perri et al., 2001)

Participants achieved a significant weight loss effect in our study. Percent excess weight loss reported among different ethnic populations at 2 years after SG was around 67% in Americans,(Cottam et al., 2018; Froylich et al., 2018) 89% in Turkey,(Altun et al., 2016) and 62% in France,(Gaillard et al., 2016) and there is a study reported favorable weight loss outcome among Chinese patients compared to their Caucasians counterparts after SG with a difference of 18.55%

in mean %EWL.(Koh et al., 2019) One literature review that included 183 participants from different countries performing SG concluded that the mean %EWL 2 years post-SG was 58.44%.(Moloney et al., 2017) It is worth noting that the %EWL in our study was also significantly higher than that reported in another study conducted in China (49.5%).(Hans, Guan, Lin, & Liang, 2018) These findings can be explained in several ways. First, %EWL as a weight loss outcome measurement favors those who have a lower pre-operative weight. The mean pre-surgical BMI in our sample was 37.93 kg/m^2 , which was much lower compared to other countries. Given that adverse health effects occur at a lower BMI for Asian population, the Chinese Society for Metabolic and Bariatric Surgery has set the surgery indication as $\text{BMI} \geq 32.5 \text{ kg/m}^2$ or $\text{BMI} \geq 27.5 \text{ kg/m}^2$ with uncontrolled diabetes.(Lee & Wang, 2005) However, in the US, the BMI requirement for surgery is $\geq 40 \text{ kg/m}^2$ or $\geq 35 \text{ kg/m}^2$ with one or more obesity-related comorbidities. The lower pre-surgical BMI may contribute to a better post-surgical weight loss.(Sillen & Andersson, 2017) The other reason may be attributed to cultural and lifestyle differences. Although the dietary pattern in China has been shifting away from the traditional diet toward high-fat, westernized diets, studies have reported that Chinese males and younger Chinese females consumed lower total energy and the contribution of carbohydrate to total energy in Chinese participants was lower than that in American participants.(Zhang et al., 2015) Finally, due to the low follow up rate and widely distributed demographic characteristic, it is difficult to ask the participants return to the surgery center for an objective weight. The self-reported post-surgical weight may be subject to reporting bias. For future work, we may consider to send participants a weight transmitting scale for an objective weight.

Although the overall disordered eating score was low, our study revealed that disordered eating behavior seems to be a significant predictor of post-surgical weight loss. More specifically,

among the eight subscales, lower body dissatisfaction was associated with more favorable weight loss outcomes. Body dissatisfaction refers to the dissatisfaction with one's physical appearance, and it was shown to be associated with poorer behavioral weight loss outcome.(Austin, Serier, Sarafin, & Smith, 2017) Although the bariatric literature is limited, the findings of the study by Figura et al.(Figura et al., 2017) and Thonney et al.(Thonney, Pataky, Badel, Bobbioni-Harsch, & Golay, 2010) support our finding that higher %EWL was significantly associated with decreases in body dissatisfaction. In contrast, a study on 67 patients reported no significant correlation between weight loss and body dissatisfaction at 6 months after bariatric surgery.(Matini et al., 2014) Further, body dissatisfaction is one of the contributing factors for developing body image disturbance and binge eating,(Stice & Desjardins, 2018) and binge eating is a consistent predictor for poorer post-surgical weight loss outcome.(Pagoto et al., 2018) These findings highlight the importance of targeting disordered eating behaviors, especially body dissatisfaction, to promote optimal post-surgical weight loss. Self-efficacy plays an important role in behavioral weight loss intervention, our study added evidence supporting self-efficacy as a contributing factor for surgical weight loss outcome. In a study followed 84 participants for 55 months after SG, it reported that a greater improvement in self-efficacy significantly predicted greater post-surgical weight loss.(Flølo et al., 2018) Similarly, there have been some studies reporting a positive relationship between self-efficacy and post-surgical lifestyle adherence and weight loss.(Batsis et al., 2009; Boeka et al., 2010) Several interventions that were designed to address self-efficacy by way of providing post-operative nutrition and PA information, education on coping with stress, relaxation, body image, and self-care have shown to be effective in enhancing self-efficacy following bariatric surgery.(Powell, Faszewski, Gill, & Davis, 2018; Wild et al., 2017) It is worth mentioning that the observed associations between body dissatisfaction and self-efficacy and weight loss was no

longer significant in the multivariate regression model, which means further study with larger population is warranted to validate this finding.

Research findings related to the relationship between depression and weight loss are inconsistent. Although some studies report a negative association(Odom et al., 2010) or no association,(Strain et al., 2014) most of the studies conducted among patients who have undergone gastric bypass or gastric banding reported support for depression as a predictor of poorer weight loss outcomes, and this finding has been repeated in SG patients.(Burgmer et al., 2014) From the limited published studies on problem-solving, one study reported that SG patients with high %EWL reported significantly more active coping behavior and better problem-solving skills than patients with moderate and low %EWL.(Figura et al., 2015) The possible reasons for the negative findings in our study may include, first, the sample size in our study was small and lacked power to detect any association; second, the mean length after SG was less than 2 years, which is the period that the physiological alteration may play a bigger role than the psychosocial mechanism; third, all of the outcomes were based on self-report that may have reporting bias; fourth, we do not have perfect measurements in this study. For example, EDI-1 was used instead of EDI-2 or EDI-3 because of lacking the validated translation. C-SPSI has not been widely tested among Chinese population, which all contribute to the negative findings.

4.6 LIMITATIONS

There were several limitations in our study. First, due to limited resources, baseline data were not collected. Without such data, although we could obtain a sense of the general picture after surgery, we were unable to demonstrate changes of psychosocial status from the pre-operative

period to the post-operative period. Second, despite the efforts made for participant recruitment, the response rate in our study was 20.8%, and the small sample size diminished our ability to detect any association that may exist. Further, we recruited participants from one single hospital in China that may limit the result dissemination and generalizability of the findings. Third, the mean length after SG was relatively short and limited our ability to capture more weight and psychosocial variability. Fourth, self-reported weight and psychosocial measurements were used that may create reporting bias.

4.7 LESSONS LEARNED

Through conducting the very first study that examined the psychosocial status and weight loss outcome of individuals who had undergone SG, we learned several lessons that can aid further investigation. First, although the literature has reported a tense doctor-patient relationship in China, (Xu, 2014) patients still prefer to seek and trust health information from a doctor.(Qiu et al., 2019) In addition to seeking the assistance of case managers or nurses, the response rate could be improved by better engaging surgeons in the recruitment process, for example, providing study information, writing a cover letter to patients asking them to participate and sending reminders. Second, given that bariatric surgery in China is still in a preliminary stage, and the number of surgeries performed in each hospital is small,(X. Du et al., 2016) it would be helpful to establish a registry of bariatric patients to facilitate monitoring of health outcomes. Third, since pre-surgical psychosocial evaluation is mandatory and necessary to improve surgical outcome for patients undergoing bariatric surgery in developed countries such as US, it would also be valuable to implement some standardized psychosocial measurements in China to provide baseline data.

4.8 CONCLUSION

In summary, patients undergoing SG in China had good psychosocial status and significant weight loss, at least in the short- to mid-term post-surgical period. That is, patients reported a high level of self-efficacy without severe eating disorder behaviors and depressive symptoms. The low level of social problem-solving skills implies room for improvement. In our study, among all the psychosocial variables, post-surgical disordered eating behavior and self-efficacy were predictors of weight loss outcome. Larger longitudinal studies incorporating pre-surgical assessments and objective weight measurements are needed to further understand the psychosocial mechanisms in weight loss in the SG population.(Malik et al., 2014a)

5.0 SUMMARY OF STUDY

Severe obesity has been a growing concern in China and SG has been widely accepted as an effective treatment for severe obesity and its related comorbidities. Limited research in China has investigated the psychosocial and behavioral outcomes following SG. This mixed method study was designed to address this gap in the literature by describing participants' experiences and perceived barriers and facilitators on post-surgical lifestyle adjustments, furthermore, we also sought to quantify some of the important concepts that emerged from qualitative interviews (e.g., self-efficacy, eating behavior change) during the cross-sectional phase. It is worth noting that while we did not reach our target sample size for the cross-sectional phase, due to the exploratory nature of this study, we were able accomplish all of the proposed study aims.

From the qualitative study, we learned that participants after SG experienced drastic lifestyle changes both in positive and negative ways. The major disadvantages reported by participants were related to eating behavior change, such as experiencing GERD and difficulty swallowing, however, people were more concerned about the benefits of the surgery. The fact that their comorbidities got cured or relieved shortly after surgery made them feel the surgery was worth everything. Further, while dealing with all those pleasant and unpleasant changes, participants held a positive attitude and reported a strong motivation, determination and confidence in managing life, and also a regular commitment to self-weighing. The barriers and facilitators for adhering to the diet and exercise recommendations were multidimensional, including individual level (e.g., advance age, no time), interpersonal level (e.g., lack of peer support), institutional level (e.g., hard to follow the dietary guidelines) and community level (e.g., lack of exercise facility). Our subsequent cross-sectional study largely confirmed the findings from the qualitative study by

showing that participants had good psychosocial status and were able to apply behavior change strategies without prior instruction. The completion rate for the PA questionnaire and food diary was low, participants' PA level was far from enough and we could not analyze the dietary intake data due to its vagueness. Eating behavior was the most obvious change participants reported during the interview, and it also turned out to be a predictor of weight loss outcomes. More specifically, drive for thinness was the major contributor for post-surgical weight loss.

Several improvements can be made to better shape future studies. First, since we recruited participants only from one bariatric surgery center, future studies may consider expanding the recruitment area to multiple study sites to ensure an adequate sample size. Second, we used the postal mail system to deliver questionnaires in our study, which may partially explain the low response rate. In the future, we may want to apply multiple recruitment strategies (e.g., recruit during regular discharge follow-up visits) and to use an online survey platform to collect data. Third, we may need to consider better measurements for collecting diet, PA and weight data. For example, using a pedometer instead of PA questionnaires and using a wifi-scale to obtain remotely measured weight data.

Appendix A INSTITUTIONAL REVIEW BOARD APPROVAL DOCUMENTS

A.1 IRB APPROVAL LETTER FROM UNIVERSITY OF PITTSBURGH

**University of Pittsburgh
Institutional Review Board**

Human Research Protection Office
3500 Fifth Avenue, Suite 106
Pittsburgh, PA 15213
Tel (412) 383-1480
www.hrpo@pitt.edu

CONTINUING REVIEW (Expedited)

| | |
|----------|--|
| IRB: | STUDY19010259 |
| PI: | yang yu |
| Title: | Patients' Experiences, Post-operative Psychosocial and Behavioral Factors Related to Weight Change among Patients who have Undergone Sleeve Gastrectomy in China |
| Funding: | Name: University of Pittsburgh; Name: Sigma Theta Tau International |
| Date: | May 8, 2019 |

On 5/8/2019, the Institutional Review Board reviewed and approved the above referenced application through the administrative review process. The study may begin as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

| | |
|------------------|------------------------------|
| Review type: | Initial Study |
| Risk Level: | No greater than minimal risk |
| Approval Date: | 5/8/2019 |
| Expiration Date: | 5/7/2020 |

| | |
|---------------------|--|
| Expedited Category: | (6) Voice, video, digital, or image recordings, (4) Noninvasive procedures, (7)(a) Behavioral research |
| Determinations: | <ul style="list-style-type: none">• Waiver of consent documentation |
| Approved Documents: | <ul style="list-style-type: none">• Translator certificate_Version_0.01.pdf• Site Permission -- Huashan.pdf• Consent_Cross-sectional.pdf• Telephone script for research recruitment_Qualitative.pdf• Consent_Qualitative.pdf• Telephone script for research recruitment_Cross-sectional.docx• Telephone script for research recruitment_Qualitative.docx• Local IRB approval.JPG• Telephone script for research recruitment_Cross-sectional.pdf• Cover letter.docx• Food diary.docx• Interview Script.docx• IPAQ_short.pdf• Questionnaires.docx• Local IRB approval.JPG• Site Permission -- Huashan.pdf• Overview Proposal_Yang_07_20.docx |

**University of Pittsburgh
Institutional Review Board**

Human Research Protection Office
3500 Fifth Avenue, Suite 106
Pittsburgh, PA 15213
Tel (412) 383-1480
www.hrpo@pitt.edu

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at <http://www.hrpo.pitt.edu/>.

Continuing review (CR) can be submitted by clicking "Create Modification/CR" from the active study at least 5 weeks prior to the expiration date.

Research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS). Contact OSPARS@upmc.edu with questions.

If you have any questions, please contact the University of Pittsburgh IRB Coordinator, [Nena Ansari](#).

Please take a moment to complete our [Satisfaction Survey](#) as we appreciate your feedback.

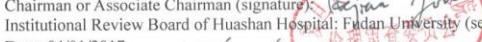
A.2 IRB APPROVAL LETTER FROM HUASHAN HOSPITAL, SHANGHAI, CHINA

March 7th, 2017 Institutional Review Board of Huashan Hospital, Fudan University (HIRB) Meeting No: 2017 M-003

HIRB Approval Letter

Statement: In compliance with China GCP and relevant regulation, the review process and the decision made by this committee are independent of any third party or person's undue influence.

Approval No: 2017--227

| | |
|---|---|
| Meeting Date | March 7 th , 2017 |
| Meeting Location | Institutional Review Board Office, 9F Building No.1, Huashan Hospital, Fudan University |
| Study Project | Associations between Post-operative Psychosocial and Behavior Factors on Weight Change among Patients who have Undergone Sleeve Gastrectomy in China |
| Documents reviewed | Initial Review (March 7th, 2017) 1. Ethical Institutional Review Application Form 2. Clinical Study Protocol (KY2017-227; 01, February, 24 th , 2017) 3. Informed Consent Form (01, February, 24 th , 2017) 4. PIs' Curriculum Vitae 5. Brief introduction of other investigators Review of Resubmitted Protocols (April 1st, 2017) 1. Clinical Study Protocol (02, March 27 th , 2017) 2. Informed Consent Form (02, March 27 th , 2017) |
| Sponsor | None |
| Clinical Study Unit | Department of General Surgery, Huashan Hospital, Fudan University |
| Principal Investigator | Qiyuan Yao, Qiwei Shen, Yang Yu |
| Review Mode | <input checked="" type="checkbox"/> Full Board Review <input type="checkbox"/> Expedited Review |
| HIRB members | Hejian Zou (Professor), Yong Gu (Professor), Yingyuan Zhang (Professor, Female), Chuanzhen Lu (Professor), Weihu Fan (Professor), Dayou Wang (Chief Pharmacist), Jianhua Zhang (Lawyer, Female, Other work units), Quanxing Ni (Professor), Xiaoyuan Feng (Professor), Jie Chen (Professor, Female, Other work units), Huangyuan Huang (Professor), Rong Wu (Associate Professor, Female, Absence), Yuejuan Wang (Community Secretary, Female, Other work units), Guoying Cao (Chief technician, Female, Absence), Qiang Dong (Professor, Absence), Qinping Yang (Professor, Female, Absence), Deliang Fu (Professor), Yanpei Cao (Vice chief nurse, Female, Absence), Tong Chen (Professor, Female, Absence) |
| Review Decision | 1. The protocol (KY2017-227; 02, March, 27 th , 2017) is approved Advice and Suggestion: None 2. Does the study require continuing review? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Frequency of the continuing review: <input type="checkbox"/> Three Months <input type="checkbox"/> Six Months <input type="checkbox"/> One Year 3. IRB reserves the right to change the review frequency depending on proceeding status. |
| Chairman or Associate Chairman (signature):  Institutional Review Board of Huashan Hospital: Fudan University (seal) Date: 04/01/2017  | |
| Notes: (peruse carefully) 1. Export of any specimen involving human genetic resources must be approved by the relevant state departments, are required to obtain approval before project implementation. 2. Projects approved by the IRB were involved in human (drug) study, must be strictly in accordance with the approved time limit and subjects number, and shall not exceed freely. Before a project is to be carried out as a clinical routine, it must be approved by the hospital IRB, and must be approved by the relevant state departments in accordance with the regulations of the state new technology application. 3. The approval letter should be kept in each central institute and its IRB. Please contact the IRB in time, if there are any different opinions concerning the protocol's feasibility (including investigators' qualification and experience, equipment and requirement, et al) in your institute. 4. The study must be conducted according to the protocol approved by the IRB, and must comply with SFDA/GCP and «Declaration of Helsinki». 5. Please notify the IRB in time, if you want to suspend or terminate the clinical study. 6. Please notify the IRB in time, if there is Serious Adverse Event or unexpected event that may affect study's risk/benefit ratio. 7. any change to the approved Clinical Study Protocol, Informed Consent Form or Principal Investigator, please submit the amendment for the IRB to review and proceed after obtain the approval. 8. Please notify the IRB in time if there is any protocol violation or non-compliance. 9. Please submit continuing review application one month before the due date of the continuing review, regardless of the study has been initiated or not. 10. When the clinical study has been completed, please submit a final study report to IRB for review. 11. Upon the completion of study, a project report should be submitted to IRB for further reviewing. | |

Address: 12 Wulumuqi Zhong Rd.Shanghai; **Postcode:** 200040; **Tel:** 021-52888045

Appendix B SUPPLEMENT MATERIALS

B.1 SEARCH STRATEGY FOR REVIEW PAPER

Search strategy for PubMed

((("Gastrectomy"[Mesh]) AND (((("Obesity, Morbid"[Mesh]) OR "Obesity"[Mesh>NoExp]) OR
"Bariatric Surgery"[Mesh>NoExp]))) OR sleeve gastrectomy[Title/Abstract])) AND
((((("Weight Gain"[Mesh]) OR "Treatment Outcome"[Mesh>NoExp])) OR weight
regain[Title/Abstract]) OR weight recidivism[Title/Abstract]) OR long term[Title/Abstract]) OR
follow up[Title/Abstract]).

Search strategy for Embase.com

(('sleeve gastrectomy'/exp AND ('obesity'/de OR 'morbid obesity'/de)) OR ('sleeve
gastrectomy':ti,ab OR 'sleeve gastrectomies':ti,ab) AND (obese:ti,ab OR obesity:ti,ab))
AND
('body weight maintenance'/de OR 'weight change'/de OR 'weight gain'/de OR 'weight regain'/de
OR 'follow up'/de OR '12th month':ti,ab OR '12 month':ti,ab OR '12 months':ti,ab OR 'twelve
month':ti,ab OR 'twelve months':ti,ab OR '24 month':ti,ab OR '24 months':ti,ab OR 'twenty four
months':ti,ab OR '1 year':ti,ab OR 'one year':ti,ab OR '5 year':ti,ab OR '5 years':ti,ab OR 'five
year':ti,ab OR 'five years':ti,ab OR 'follow up':ti,ab OR 'long term':ti,ab OR 'treatment
outcome':ti,ab OR 'treatment outcomes':ti,ab OR 'regained weight':ti,ab OR 'weight gain':ti,ab
OR 'weight regain':ti,ab OR 'weight recidivism':ti,ab)

Search strategy for Ebscohost CINAHL

(MH "Gastrectomy" AND (MH "Obesity" OR MH "Obesity, Morbid" OR MH "Bariatric Surgery")) OR (("sleeve gastrectomy" AND ("weight recidivism" OR "weight regain" OR "follow up" OR "long term" OR "treatment outcome" OR "treatment outcomes" OR "regained weight" OR "weight gain")))

B.2 QUALITATIVE INTERVIEW SCRIPTS

1. Now that you are xx weeks after surgery, how much weight have you lost? And what do you attribute that to (e.g., the surgery, eating less, getting more active...)
2. Now that you are xx weeks after surgery, how has your life changed? (e.g., daily habits)
3. How do you feel about those changes?
4. What kind of physical activity are you doing now? Please tell me about it.
5. Can you tell me about your eating habits now? For example, what you eat, how often, the amount, food intolerances, binge eating, etc.
6. What guidelines were you given with respect to diet and activity after surgery?
7. What things make it easier for you to follow the dietary/physical activity recommendations after surgery?
8. What have been the biggest challenges for you to follow the dietary/PA recommendations after surgery?
9. Is there anything important I have not asked, or anything that you would like to add?

B.3 CONSENT FORMS

CONSENT TO ACT AS A PARTICIPANT IN A RESEARCH STUDY

TITLE:

Patients' Experiences, Post-operative Psychosocial and Behavioral Factors Related to Weight Change among Patients who have Undergone Sleeve Gastrectomy in China

PRINCIPAL INVESTIGATOR

Yang Yu, PhD (Student), MsN
University of Pittsburgh
415 Victoria Building
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CO-INVESTIGATORS

| | | |
|--|--|--|
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| Dianxu Ren, PhD Associate Professor University of Pittsburgh 360 Victoria Building Pittsburgh, PA 15261 Phone: 412-383-5204 | Qiwei Shen, MD Resident Huashan Hospital, Fudan University No. 12 middle Urumqi Road Shanghai, China 200040 Phone: +86-13818757881 |
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SOURCE OF SUPPORT: Sigma Theta Tau International Honor Society of Nursing, Eta Chapter

Why is this research study being done?

As a relative new type of bariatric surgery, sleeve gastrectomy (SG) has been gaining increased acceptance in China. This study is being conducted to describe your experiences related to post-surgical lifestyle change and your perceived barriers and facilitators that influence your efforts to make the required post-surgical lifestyle changes.

What are the procedures that will be performed for research purposes?

If you participate in this research, you will be asked to be interviewed by us talking about your experience of lifestyle change after SG. Each interview will last approximately 30 to 45 minutes.

What are the possible risks, side effects and discomforts of this research study?

This study poses no physical risk to you. But a breach of confidentiality may be a concern. As

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described below, we do not place your name on the research forms, so it is unlikely that anyone except the key director of this research will be able to link your name to your private information. You may also feel uncomfortable when exposing personal information to us.

What are the possible benefits from taking part in this study?

There is no direct benefit from taking part in this study. Your participation will help us gain a better understanding of how the surgery impacts your daily life, from the patient's perspective.

Who will know about my participation in this research study?

Any information about you obtained from this research will be kept confidential (private). All documents related to your involvement in this research study will be stored in a locked file cabinet. Your identity on the questionnaires will be indicated by a study ID rather than by your name. Documents that contain your name, such as your contact information and this consent form, will be stored in a locked cabinet in a locked office. Similarly, research data that are stored electronically will be coded with your study ID number in a database on a password-protected computer. Identifiable information will be stored in a separate password protected database. You will not be identified by name in any publication; any publication reports results in the aggregate, not by individual. The digital file of the recorded interview will be deleted after the interview recording has been transcribed.

Will this research study involve the use or disclosure of my identifiable medical information?
No. This study will not involve the use or disclosure of your identifiable medical information.

Who will have access to identifiable information related to my participation in this research study?

The research team will have access to the identifiable data. In unusual cases, your research records may be released in response to an order from a court of law. It is also possible that authorized representatives from the University of Pittsburgh Research Conduct and Compliance Office or the Institutional Review Board in Shanghai Huashan Hospital may review your data for the purpose of monitoring the conduct of this study. The data may be shared with others but it will be shared without identifiers.

Is my participation in this study voluntary?

Your participation in this research study, to include the use and disclosure of your identifiable information for the purposes described above, is completely voluntary. Whether or not you provide your consent for participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh. Whether or not you provide your consent for participation in this research study will have no effect on your current or future medical care at the Center for Obesity and Metabolic Surgery, Huashan Hospital, China.

May I withdraw, at a future date, my consent for participation in this research study?

You may withdraw, at any time, your consent for participation in this research study. Any identifiable research information recorded for, or resulting from, your participation in this research study prior to the date that you formally withdrew your consent may continue to be used and disclosed by the investigators for the purposes described above.

To formally withdraw your consent for participation in this research study you should provide a written and dated notice of this decision to the principal investigator of this research study at the address listed on the first page of this form.

Your decision to withdraw your consent for participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh. Your decision to withdraw your consent for participation in this research study will have no effect on your current or future medical care at the Center for Obesity and Metabolic Surgery, Huashan Hospital, China.

Will I be paid if I take part in this research study?

You will be compensated \$10 for participation in the interview and \$5 for parking or transportation. Food and drink will be available at the time.

Will my insurance provider or I be charged for the costs of any procedures performed as part of this research study?

You will not incur any expenses by participating in this qualitative study.

VOLUNTARY CONSENT

All of the above has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions about any aspect of this research study during the course of this study, and that such future questions will be answered by the researchers listed on the first page of this form.

Any questions I have about my rights as a research participant will be answered by the Human Subject Protection Advocate of the IRB Office, University of Pittsburgh (1-866-212-2668).

By signing this form, I agree to participate in this research study. A copy of this consent form will be given to me.

Participant's Signature

Date/Time

CERTIFICATION of INFORMED CONSENT

I certify that I have explained the nature and purpose of this research study to the above-named individual(s), and I have discussed the potential benefits and possible risks of study participation. Any questions the individual(s) have about this study have been answered, and we will always be available to address future questions as they arise. I further certify that no research component of this protocol was begun until after this consent form was signed.

Printed Name of Person Obtaining Consent

Role in Research Study

Signature of Person Obtaining Consent

Date/Time

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University of Pittsburgh STUDY19010259 Approved: 5/8/2019 Expires: 5/7/2020

CONSENT TO ACT AS A PARTICIPANT IN A RESEARCH STUDY

TITLE:

Patients' Experiences, Post-operative Psychosocial and Behavioral Factors Related to Weight Change among Patients who have Undergone Sleeve Gastrectomy in China
PRINCIPAL INVESTIGATOR

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SOURCE OF SUPPORT: Sigma Theta Tau International Honor Society of Nursing, Eta Chapter

Why is this research study being done?

As a relative new type of bariatric surgery, sleeve gastrectomy (SG) has been gaining increased acceptance in China. Weight regain is a huge challenge facing patients after SG of which mechanism has rarely been examined. This cross-sectional study is being conducted to gain a preliminary knowledge of the mental and behavioral outcomes among patients who have undergone SG and to explore how those factors are related to weight loss outcomes.

What are the procedures that will be performed for research purposes?

If you participate in this research, you will be asked to complete:

- 6 questionnaires (Sociodemographic Questionnaire, Chinese version of Eating Disorder Inventory-1, The Chinese version of Center for Epidemiological Studies Depression Scale, The Chinese version of The Social Problem-Solving Inventory Revised, Weight Efficacy Lifestyle Questionnaire, and The Chinese version of the short-form International

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Physical Activity Questionnaire). The total number of page for the questionnaires is 7 which may take up to 35 minutes to finish.

- You will be asked to weigh yourself using a standard digital weight scale in the morning after you have gone to the bathroom and before eating.
- You will be asked to complete a food diary recording the day, date, time, number of meals, types and amounts of all food and drinks consumed for at least three days during assessment period.

What are the possible risks, side effects and discomforts of this research study?

This study poses no physical risk to you. But a breach of confidentiality may be a concern. As described below, we do not place your name on the research forms, so it is unlikely that anyone except the key director of this research will be able to link your name to your private information. You may also feel uncomfortable when providing the dietary information to us.

What are the possible benefits from taking part in this study?

There is no direct benefit from taking part in this study. Your participation will help us gain a better understanding of the psychosocial and behavioral outcomes of SG as well as the potential contributors to the post-SG weight change.

Who will know about my participation in this research study?

Any information about you obtained from this research will be kept confidential (private). All documents related to your involvement in this research study will be stored in a locked file cabinet. Your identity on the questionnaires will be indicated by a study ID rather than by your name. Documents that contain your name, such as your contact information and this consent form, will be stored in a locked cabinet in a locked office. Similarly, research data that are stored electronically will be coded with your study ID number in a database on a password-protected computer. Identifiable information will be stored in a separate password protected database. You will not be identified by name in any publication; any publication reports results in the aggregate, not by individual.

Will this research study involve the use or disclosure of my identifiable medical information?

No. This study will not involve the use or disclosure of your identifiable medical information.

Who will have access to identifiable information related to my participation in this research study?

The research team will have access to the identifiable data. In unusual cases, your research records may be released in response to an order from a court of law. It is also possible that authorized representatives from the University of Pittsburgh Research Conduct and Compliance Office or the Institutional Review Board in Shanghai Huashan Hospital may review your data for the purpose of monitoring the conduct of this study. The data may be shared with others but it will be shared without identifiers.

Is my participation in this study voluntary?

Your participation in this research study, to include the use and disclosure of your identifiable information for the purposes described above, is completely voluntary. Whether or not you provide your consent for participation in this research study will have no effect on your current

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or future relationship with the University of Pittsburgh. Whether or not you provide your consent for participation in this research study will have no effect on your current or future medical care at the Center for Obesity and Metabolic Surgery, Huashan Hospital, China.

May I withdraw, at a future date, my consent for participation in this research study?

You may withdraw, at any time, your consent for participation in this research study. Any identifiable research information recorded for, or resulting from, your participation in this research study prior to the date that you formally withdrew your consent may continue to be used and disclosed by the investigators for the purposes described above.

To formally withdraw your consent for participation in this research study you should provide a written and dated notice of this decision to the principal investigator of this research study at the address listed on the first page of this form.

Your decision to withdraw your consent for participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh. Your decision to withdraw your consent for participation in this research study will have no effect on your current or future medical care at the Center for Obesity and Metabolic Surgery, Huashan Hospital, China.

Will I be paid if I take part in this research study?

You will receive \$10 when you return the 6 questionnaires and food diaries.

Will my insurance provider or I be charged for the costs of any procedures performed as part of this research study?

You will not incur any expenses by participating in this cross-sectional study.

VOLUNTARY CONSENT

All of the above has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions about any aspect of this research study during the course of this study, and that such future questions will be answered by the researchers listed on the first page of this form.

Any questions I have about my rights as a research participant will be answered by the Human Subject Protection Advocate of the IRB Office, University of Pittsburgh (1-866-212-2668).

By signing this form, I agree to participate in this research study. A copy of this consent form will be given to me.

Participant's Signature

Date/Time

CERTIFICATION OF INFORMED CONSENT

I certify that I have explained the nature and purpose of this research study to the above-named individual(s), and I have discussed the potential benefits and possible risks of study participation. Any questions the individual(s) have about this study have been answered, and we will always be available to address future questions as they arise. I further certify that no research component of this protocol was begun until after this consent form was signed.

Printed Name of Person Obtaining Consent

Role in Research Study

Signature of Person Obtaining Consent

Date/Time

B.4 INSTRUMENTS

Sociodemographic Questionnaire

1. Age: _____
2. Date of birth: _____ (Month/Date/Year)
3. Gender: Male Female
4. Race: Han Other _____
5. Marital status: Never married Currently married Divorced
 Widowed Other: _____
6. Education: Grade school [grades 1-8] High school [grades 9-12]
 2-year college [Associate's level] 4-year college [Bachelor's level]
 Graduate school [Master's level and above]
7. Employment status: Full time (working at least 35 hours a week)
 Part time (working less than 35 hours a week)
 Laid off or unemployed
 Retired
 Other: _____
8. Gross annual income: Under \$5,000 \$5,000 to \$10,000
 \$10,000 to \$15,000 \$15,000 to \$20,000
 Over \$20,000
9. When did you receive the sleeve gastrectomy: _____

一般资料问卷

1. 年龄: _____
2. 出生年月: _____ (月/日/年)
3. 性别: 男 女
4. 民族: 汉 其他: _____
5. 婚姻状况: 未婚 已婚 离异 丧偶 其他_____
6. 教育程度: 小学或初中 高中 中专或大专 本科 研究生或以上
7. 工作状况: 全职 兼职 下岗待业 退休 其他
8. 个人年收入: 3万以下 3到6万 6到9万 9到12万
12万以上
9. 您是什么时候进行袖状胃切除术的? _____

Eating Disorder Inventory (EDI-1)

This is a scale which measures a variety of attitudes, feelings and behaviors, some of the items relate to food and eating, others ask you about your feelings about yourself. There are no right or wrong answers so try very hard to be completely honest in your answers. Results are completely confidential. Read each question and place a “” under the column which applies best for you.

Please answer each question very carefully, thank you.

| | Never | Rarely | sometimes | Occasionally | Often | Always |
|--|-------|--------|-----------|--------------|-------|--------|
| 1. I eat sweets and carbohydrates without feeling nervous | 1 | 2 | 3 | 4 | 5 | 6 |
| 2. I think my stomach is too big | 1 | 2 | 3 | 4 | 5 | 6 |
| 3. I wish that I could return to the security of childhood | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. I eat when I am upset | 1 | 2 | 3 | 4 | 5 | 6 |
| 5. I stuff myself with food | 1 | 2 | 3 | 4 | 5 | 6 |
| 6. I wish that I could be younger | 1 | 2 | 3 | 4 | 5 | 6 |
| 7. I think about dieting | 1 | 2 | 3 | 4 | 5 | 6 |
| 8. I get frightened when my feelings are too too strong | 1 | 2 | 3 | 4 | 5 | 6 |
| 9. I think my thighs are too large | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. I feel ineffective as a person | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. I feel extremely guilty after overeating | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. I think my stomach is just the right size | 1 | 2 | 3 | 4 | 5 | 6 |
| 13. Only outstanding performance is good enough in my family | 1 | 2 | 3 | 4 | 5 | 6 |
| 14. The happiest time in life is when you are a child | 1 | 2 | 3 | 4 | 5 | 6 |
| 15. I am open about my feelings | 1 | 2 | 3 | 4 | 5 | 6 |
| 16. I am terrified of gaining weight | 1 | 2 | 3 | 4 | 5 | 6 |
| 17. I trust others | 1 | 2 | 3 | 4 | 5 | 6 |
| 18. I feel alone in the world | 1 | 2 | 3 | 4 | 5 | 6 |
| 19. I feel satisfied with the shape of my body | 1 | 2 | 3 | 4 | 5 | 6 |
| 20. I feel generally in control of things in my life | 1 | 2 | 3 | 4 | 5 | 6 |
| 21. I get confused about what emotions I am feeling | 1 | 2 | 3 | 4 | 5 | 6 |
| 22. I would rather be an adult than a child | 1 | 2 | 3 | 4 | 5 | 6 |
| 23. I can communicate with others easily | 1 | 2 | 3 | 4 | 5 | 6 |
| 24. I wish I were someone else | 1 | 2 | 3 | 4 | 5 | 6 |
| 25. I exaggerate or magnify the importance of weight | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | |
|--|---|---|---|---|---|---|
| 26. I can clearly identify what emotion I am feeling | 1 | 2 | 3 | 4 | 5 | 6 |
| 27. I feel inadequate | 1 | 2 | 3 | 4 | 5 | 6 |
| 28. I have gone on eating binges where I have felt that I could not stop | 1 | 2 | 3 | 4 | 5 | 6 |
| 29. As a child, I tried very hard to avoid disappointing my parents and teachers | 1 | 2 | 3 | 4 | 5 | 6 |
| 30. I have close relationships | 1 | 2 | 3 | 4 | 5 | 6 |
| 31. I like the shape of my buttocks | 1 | 2 | 3 | 4 | 5 | 6 |
| 32. I am preoccupied with the desire to be thinner | 1 | 2 | 3 | 4 | 5 | 6 |
| 33. I don't know what's going on inside me | 1 | 2 | 3 | 4 | 5 | 6 |
| 34. I have trouble expressing my emotions to others | 1 | 2 | 3 | 4 | 5 | 6 |
| 35. The demands on adulthood are too great | 1 | 2 | 3 | 4 | 5 | 6 |
| 36. I hate being less than best at things | 1 | 2 | 3 | 4 | 5 | 6 |
| 37. I feel secure about myself | 1 | 2 | 3 | 4 | 5 | 6 |
| 38. I think about bingeing (overeating) | 1 | 2 | 3 | 4 | 5 | 6 |
| 39. I feel happy that I am not a child anymore | 1 | 2 | 3 | 4 | 5 | 6 |
| 40. I get confused as to whether or not I am hungry | 1 | 2 | 3 | 4 | 5 | 6 |
| 41. I have a low opinion of myself | 1 | 2 | 3 | 4 | 5 | 6 |
| 42. I feel that I can achieve my standards | 1 | 2 | 3 | 4 | 5 | 6 |
| 43. My parents have expected excellence of me | 1 | 2 | 3 | 4 | 5 | 6 |
| 44. I worry that my feelings will get out of control | 1 | 2 | 3 | 4 | 5 | 6 |
| 45. I think my hips are too big | 1 | 2 | 3 | 4 | 5 | 6 |
| 46. I eat moderately in front of others and stuff myself when they're gone | 1 | 2 | 3 | 4 | 5 | 6 |
| 47. I feel bloated after eating a small meal | 1 | 2 | 3 | 4 | 5 | 6 |
| 48. I feel that people are happiest when they are children | 1 | 2 | 3 | 4 | 5 | 6 |
| 49. If I gain a pound, I worry that I will keep gaining | 1 | 2 | 3 | 4 | 5 | 6 |
| 50. I feel that I am a worthwhile person | 1 | 2 | 3 | 4 | 5 | 6 |
| 51. when I am upset, I don't know if I am sad, frightened or angry | 1 | 2 | 3 | 4 | 5 | 6 |
| 52. I feel that I must do things perfectly or not do them at all | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | |
|--|---|---|---|---|---|---|
| 53. I have the thought of trying to vomit in order to lose weight | 1 | 2 | 3 | 4 | 5 | 6 |
| 54. I need to keep people at a certain distance (feel uncomfortable if someone tries to get too close) | 1 | 2 | 3 | 4 | 5 | 6 |
| 55. I think that my thighs are just the right size | 1 | 2 | 3 | 4 | 5 | 6 |
| 56. I feel empty inside (emotionally) | 1 | 2 | 3 | 4 | 5 | 6 |
| 57. I can talk about personal thoughts or feelings | 1 | 2 | 3 | 4 | 5 | 6 |
| 58. The next years of your life are when you become an adult | 1 | 2 | 3 | 4 | 5 | 6 |
| 59. I think my buttocks are too large | 1 | 2 | 3 | 4 | 5 | 6 |
| 60. I have feelings I can't identify | 1 | 2 | 3 | 4 | 5 | 6 |
| 61. I eat or drink in security | 1 | 2 | 3 | 4 | 5 | 6 |
| 62. I think that my hips are just the right size | 1 | 2 | 3 | 4 | 5 | 6 |
| 63. I have extremely high goals | 1 | 2 | 3 | 4 | 5 | 6 |
| 64. When I am upset, I worry that I will start eating | 1 | 2 | 3 | 4 | 5 | 6 |

进食障碍问卷（EDI-1）

这是一份测量一系列态度、想法和行为的问卷，一些问题与食物和进食有关，而另一些则询问你对自己的一些内心感受，答案不分对错，因此你应该尽力表达你真实的情况。

请仔细阅读每一个问题，从六个答案里选择一个最适合你的答案画上“√”

| | 从不 | 很少 | 有时 | 时常 | 经常 | 总是 |
|---------------------------------|----|----|----|----|----|----|
| 1、我吃甜食或主食时感到紧张 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2、我觉得我的腹部太胖 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3、我希望能够回到具有安全感的童年时代 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4、当情绪低落时我就吃东西 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5、我让自己拼命吃东西 | 1 | 2 | 3 | 4 | 5 | 6 |
| 6、我希望能变得更年轻一些 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7、我考虑过节食 | 1 | 2 | 3 | 4 | 5 | 6 |
| 8、当我情绪难以控制的时候我感到恐惧 | 1 | 2 | 3 | 4 | 5 | 6 |
| 9、我觉得自己的大腿太粗了 | 1 | 2 | 3 | 4 | 5 | 6 |
| 10、我觉得自己很无能 | 1 | 2 | 3 | 4 | 5 | 6 |
| 11、当我吃饭过多时我觉得非常内疚 | 1 | 2 | 3 | 4 | 5 | 6 |
| 12、我觉得我的腹部胖瘦适中 | 1 | 2 | 3 | 4 | 5 | 6 |
| 13、在我的家庭中，只有非常突出的表现才能得到认可 | 1 | 2 | 3 | 4 | 5 | 6 |
| 14、我认为人一生中最快乐的就是童年时代 | 1 | 2 | 3 | 4 | 5 | 6 |
| 15、我会向别人坦诚的表达自己的想法 | 1 | 2 | 3 | 4 | 5 | 6 |
| 16、我非常害怕体重增加 | 1 | 2 | 3 | 4 | 5 | 6 |
| 17、我信任别人 | 1 | 2 | 3 | 4 | 5 | 6 |
| 18、我觉得自己很孤独 | 1 | 2 | 3 | 4 | 5 | 6 |
| 19、我对我的体型满意 | 1 | 2 | 3 | 4 | 5 | 6 |
| 20、我通常能够处理生活中遇到的事 | 1 | 2 | 3 | 4 | 5 | 6 |
| 21、我不清楚自己的情绪状态 | 1 | 2 | 3 | 4 | 5 | 6 |
| 22、我宁愿自己是一个成人而不是儿童 | 1 | 2 | 3 | 4 | 5 | 6 |
| 23、我很容易与别人交流 | 1 | 2 | 3 | 4 | 5 | 6 |
| 24、我希望自己变成另外一个人 | 1 | 2 | 3 | 4 | 5 | 6 |
| 25、我夸大了体重的重要性 | 1 | 2 | 3 | 4 | 5 | 6 |
| 26、我很明了自己的情绪状态 | 1 | 2 | 3 | 4 | 5 | 6 |
| 27、我觉得自己不完美 | 1 | 2 | 3 | 4 | 5 | 6 |
| 28、我到了暴饮暴食不能自拔的地步 | 1 | 2 | 3 | 4 | 5 | 6 |
| 29、在儿童期间，为了不让父母和老师失望，我努力做好每一件事情 | 1 | 2 | 3 | 4 | 5 | 6 |
| 30、我有很亲近的朋友 | 1 | 2 | 3 | 4 | 5 | 6 |
| 31、我对自己臀部的形状满意 | 1 | 2 | 3 | 4 | 5 | 6 |
| 32、我非常渴望变得更瘦 | 1 | 2 | 3 | 4 | 5 | 6 |
| 33、我不清楚体内发生了什么变化 | 1 | 2 | 3 | 4 | 5 | 6 |
| 34、我不能很好地向别人表达自己的情绪感受 | 1 | 2 | 3 | 4 | 5 | 6 |
| 35、我觉得人们对成人的要求太高了 | 1 | 2 | 3 | 4 | 5 | 6 |
| 36、做任何事情我都试图做的最好 | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | |
|-----------------------------------|---|---|---|---|---|---|
| 37、我觉得自己很安全 | 1 | 2 | 3 | 4 | 5 | 6 |
| 38、我想狂吃 | 1 | 2 | 3 | 4 | 5 | 6 |
| 39、我高兴自己不再是一个孩子 | 1 | 2 | 3 | 4 | 5 | 6 |
| 40、我不清楚自己是否饥饿 | 1 | 2 | 3 | 4 | 5 | 6 |
| 41、我对自己评价很低 | 1 | 2 | 3 | 4 | 5 | 6 |
| 42、我觉得我能达到自己的目标 | 1 | 2 | 3 | 4 | 5 | 6 |
| 43、我的父母期望我会很出色 | 1 | 2 | 3 | 4 | 5 | 6 |
| 44、我担心自己的情绪会失控 | 1 | 2 | 3 | 4 | 5 | 6 |
| 45、我觉得我的腰围太粗了 | 1 | 2 | 3 | 4 | 5 | 6 |
| 46、我在别人面前吃饭不多，别人走后就会大吃大喝 | 1 | 2 | 3 | 4 | 5 | 6 |
| 47、我吃了一点食物就会觉得胃胀 | 1 | 2 | 3 | 4 | 5 | 6 |
| 48、我觉得人们最快乐的时光是在童年时期 | 1 | 2 | 3 | 4 | 5 | 6 |
| 49、如果我的体重增加一斤，我就会担心再胖下去 | 1 | 2 | 3 | 4 | 5 | 6 |
| 50、我觉得自己是一个有价值的人 | 1 | 2 | 3 | 4 | 5 | 6 |
| 51、当我情绪不好时，我分不清我的感觉是伤心、恐惧，还是生气□二 | 1 | 2 | 3 | 4 | 5 | 6 |
| 52、我做事必须十全十美，要不就干脆不做 | 1 | 2 | 3 | 4 | 5 | 6 |
| 53、我想通过用手抠喉咙的方法减轻体重 | 1 | 2 | 3 | 4 | 5 | 6 |
| 54、我需要跟别人保持一定的距离（如果别人靠我太近，我会觉得别扭） | 1 | 2 | 3 | 4 | 5 | 6 |
| 55、我对自己大腿的粗细程度满意 | 1 | 2 | 3 | 4 | 5 | 6 |
| 56、我觉得自己的内心很空虚（情感方面） | 1 | 2 | 3 | 4 | 5 | 6 |
| 57、我能够很自然的谈论自己的想法或感受 | 1 | 2 | 3 | 4 | 5 | 6 |
| 58、我觉得人生中最美好的时光是长大成人 | 1 | 2 | 3 | 4 | 5 | 6 |
| 59、我觉得我的臀部太大了 | 1 | 2 | 3 | 4 | 5 | 6 |
| 60、我会产生一些自己也辨别不清楚的感觉 | 1 | 2 | 3 | 4 | 5 | 6 |
| 61、我会（秘密）偷偷地吃喝 | 1 | 2 | 3 | 4 | 5 | 6 |
| 62、我对自己腰围的尺寸满意 | 1 | 2 | 3 | 4 | 5 | 6 |
| 63、我有非常远大的理想 | 1 | 2 | 3 | 4 | 5 | 6 |
| 64、情绪低落时，我担心自己会开始吃东西 | 1 | 2 | 3 | 4 | 5 | 6 |

Center for Epidemiologic Studies Depression Scale (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

| During the Past Week | | | | |
|--|--|--|--|--|
| | Rarely or none of the time (less than 1 day) | Some or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days) |
| 1. I was bothered by things that usually don't bother me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. I did not feel like eating; my appetite was poor. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. I felt that I could not shake off the blues even with help from my family or friends. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. I felt I was just as good as other people. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. I had trouble keeping my mind on what I was doing. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. I felt depressed. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. I felt that everything I did was an effort. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. I felt hopeful about the future. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. I thought my life had been a failure. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. I felt fearful. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. My sleep was restless. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. I was happy. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. I talked less than usual. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. I felt lonely. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. People were unfriendly. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. I enjoyed life. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. I had crying spells. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. I felt sad. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. I felt that people dislike me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. I could not get "going." | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

流调中心抑郁量表（CES-D）

下面有 20 条陈述，请在最能描述你最近一周里你的感觉的数字上画圈。

0. 没有或很少有（少于 1 天）
1. 有时或小部分时间（1-2 天）
2. 时常或一半的时间（3-4 天）
3. 绝多数或全部时间（5-7 天）

| 在过去的一周里 | 没有或很少 有 | 有时或小部分 时间 | 时常或一半的 时间 | 绝大多数或全部 时间 |
|----------------------------------|------------|--------------|--------------|---------------|
| | | | | |
| 1. 我为平时不烦扰的事所烦扰 | 0 | 1 | 2 | 3 |
| 2. 我不想吃东西，我胃口不好 | 0 | 1 | 2 | 3 |
| 3. 我觉得即使有家人和朋友帮助，我也无法摆脱 心中的苦闷 | 0 | 1 | 2 | 3 |
| 4. 我觉得我和别人一样好 | 0 | 1 | 2 | 3 |
| 5. 我很难集中精力做事 | 0 | 1 | 2 | 3 |
| 6. 我感到忧郁 | 0 | 1 | 2 | 3 |
| 7. 我感到做什么事情都很吃力 | 0 | 1 | 2 | 3 |
| 8. 我觉得前途是有希望的 | 0 | 1 | 2 | 3 |
| 9. 我觉得我的生活是失败的 | 0 | 1 | 2 | 3 |
| 10. 我感到害怕 | 0 | 1 | 2 | 3 |
| 11. 我的睡眠情况不好 | 0 | 1 | 2 | 3 |
| 12. 我感到高兴 | 0 | 1 | 2 | 3 |
| 13. 我比平时话要少了 | 0 | 1 | 2 | 3 |
| 14. 我感到孤单 | 0 | 1 | 2 | 3 |
| 15. 我觉得人们对我不太友好 | 0 | 1 | 2 | 3 |
| 16. 我觉得生活很有意思 | 0 | 1 | 2 | 3 |
| 17. 我曾哭泣 | 0 | 1 | 2 | 3 |
| 18. 我感到忧愁 | 0 | 1 | 2 | 3 |
| 19. 我觉得别人不喜欢我 | 0 | 1 | 2 | 3 |
| 20. 我得不到“进取” | 0 | 1 | 2 | 3 |

Social Problem Solving Inventory

For each item below, please place a check mark (✓) in the column which best describes what you will do when facing problems.

| Item | Not at all true of me | Slightly true of me | Moderately true of me | Very true of me | Extremely true of me |
|--|-----------------------------|---------------------------|--------------------------|--------------------|-------------------------|
| 1. avoid thinking about problems | 1 | 2 | 3 | 4 | 5 |
| 2. spend more time avoiding solving problems | 1 | 2 | 3 | 4 | 5 |
| 3. put off trying to solve problems as long as possible | 1 | 2 | 3 | 4 | 5 |
| 4. go out of my way to avoid dealing with problems | 1 | 2 | 3 | 4 | 5 |
| 5. put off solving problems until it's too late | 1 | 2 | 3 | 4 | 5 |
| 6. do not take time to evaluate all results carefully | 1 | 2 | 3 | 4 | 5 |
| 7. frustrated if first attempt to solve problem fails | 1 | 2 | 3 | 4 | 5 |
| 8. nervous and unsure when making important decisions | 1 | 2 | 3 | 4 | 5 |
| 9. a difficult problem makes me upset | 1 | 2 | 3 | 4 | 5 |
| 10. feel afraid when I have a problem to solve | 1 | 2 | 3 | 4 | 5 |
| 11. become depressed and immobilized | 1 | 2 | 3 | 4 | 5 |
| 12. examine mood, see how better it is after change | 1 | 2 | 3 | 4 | 5 |
| 13. keep in mind the goal | 1 | 2 | 3 | 4 | 5 |
| 14. weigh and compare the consequences of each option | 1 | 2 | 3 | 4 | 5 |
| 15. use a systematic method for comparing alternatives | 1 | 2 | 3 | 4 | 5 |
| 16. evaluate if the situation has changed for the better | 1 | 2 | 3 | 4 | 5 |
| 17. go with first good idea that comes to mind | 1 | 2 | 3 | 4 | 5 |
| 18. act on the first idea that comes to mind | 1 | 2 | 3 | 4 | 5 |
| 19. do not take time to consider pros and cons of options | 1 | 2 | 3 | 4 | 5 |
| 20. go with my "gut feeling" without thinking about effects | 1 | 2 | 3 | 4 | 5 |
| 21. analyze the situation and identify obstacles | 1 | 2 | 3 | 4 | 5 |
| 22. think of different solutions | 1 | 2 | 3 | 4 | 5 |
| 23. believe a problem can be solved | 1 | 2 | 3 | 4 | 5 |
| 24. deal with problems as soon as possible | 1 | 2 | 3 | 4 | 5 |
| 25. do not give up trying to solve problems when first attempt fails | 1 | 2 | 3 | 4 | 5 |

社会问题解决量表

本量表是测量当你遇到问题需要解决时，你会怎么做，请仔细阅读每一条目，按你真实经历回答，答案没有对错之分，在符合你的标号上画“√”。十分感谢您的合作！

5=非常符合；4=比较符合；3=有点符合；2=不太符合；1=一点都不符合

| 项目 | 一 点 都 不 符 合 | 不 太 符 合 | 有 点 符 合 | 比 较 符 合 | 非 常 符 合 |
|--------------------------|----------------------------|------------------|------------------|------------------|------------------|
| 1、回避思考问题 | 1 | 2 | 3 | 4 | 5 |
| 2、花很多时间逃避解决问题 | 1 | 2 | 3 | 4 | 5 |
| 3、尽可能久拖延尝试解决问题 | 1 | 2 | 3 | 4 | 5 |
| 4、用尽所有的方法避免处理问题 | 1 | 2 | 3 | 4 | 5 |
| 5、拖延解决问题直到不能再拖延为止 | 1 | 2 | 3 | 4 | 5 |
| 6、不花时间仔细地评价所有结果 | 1 | 2 | 3 | 4 | 5 |
| 7、若首次尝试解决问题失败，我感到挫败 | 1 | 2 | 3 | 4 | 5 |
| 8、做重要决定时，我感到紧张和不确定 | 1 | 2 | 3 | 4 | 5 |
| 9、一个困难的问题使我心烦意乱 | 1 | 2 | 3 | 4 | 5 |
| 10、有问题需要解决时，我感到害怕 | 1 | 2 | 3 | 4 | 5 |
| 11、解决问题时，我沮丧且束手无策 | 1 | 2 | 3 | 4 | 5 |
| 12、检测自己的心情，看看问题解决后心情是否好转 | 1 | 2 | 3 | 4 | 5 |
| 13、牢记解决问题的目标 | 1 | 2 | 3 | 4 | 5 |
| 14、权衡和比较各种解决方案的后果 | 1 | 2 | 3 | 4 | 5 |
| 15、用系统的方法来比较各种解决方案 | 1 | 2 | 3 | 4 | 5 |
| 16、评价问题解决后情况是否好转 | 1 | 2 | 3 | 4 | 5 |
| 17、伴随着第一个浮现在脑海的好想法 | 1 | 2 | 3 | 4 | 5 |
| 18、按首次浮现在脑海里的想法做事 | 1 | 2 | 3 | 4 | 5 |
| 19、不花时间考虑方案的正反两方面 | 1 | 2 | 3 | 4 | 5 |
| 20、凭直觉做事，不考虑效果 | 1 | 2 | 3 | 4 | 5 |
| 21、分析形势，识别障碍 | 1 | 2 | 3 | 4 | 5 |
| 22、考虑不同的解决方案 | 1 | 2 | 3 | 4 | 5 |
| 23、相信问题是可以解决的 | 1 | 2 | 3 | 4 | 5 |
| 24、尽可能快地处理问题 | 1 | 2 | 3 | 4 | 5 |
| 25、首次尝试失败时，我不放弃努力地解决问题 | 1 | 2 | 3 | 4 | 5 |

Weight Efficacy Lifestyle (WEL) Questionnaire

Please read each situation listed below and decide how confident (or certain) you are that you will be able to resist eating in each of the difficult situations. On a scale from 0 ("Not Confident") to 9 ("Very Confident") choose ONE number that reflects how confident you feel now about being able to successfully resist the desire to eat. Fill in the circle below the number that you have chosen for your answer.

I am confident that . . .

| | Not confident at all | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Very confident |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 0 | | | | | | | | | 9 |
| 1. I can resist eating when I am anxious (or nervous). | <input type="checkbox"/> |
| 2. I can control my eating on the weekends | <input type="checkbox"/> |
| 3. I can resist eating even when I have to say "no" to others | <input type="checkbox"/> |
| 4. I can resist eating when I feel physically run down | <input type="checkbox"/> |
| 5. I can resist eating when I am watching TV | <input type="checkbox"/> |
| 6. I can resist eating when I am depressed (or down) | <input type="checkbox"/> |
| 7. I can resist eating when there are many different kinds of food available | <input type="checkbox"/> |
| 8. I can resist eating even when I feel it's impolite to refuse a second helping | <input type="checkbox"/> |
| 9. I can resist eating even when I have a headache | <input type="checkbox"/> |
| 10. I can resist eating when I am reading | <input type="checkbox"/> |
| 11. I can resist eating when I am angry (or irritable) | <input type="checkbox"/> |
| 12. I can resist eating even when I am at a party | <input type="checkbox"/> |
| 13. I can resist eating even when others are pressuring me to eat | <input type="checkbox"/> |
| 14. I can resist eating when I am in pain | <input type="checkbox"/> |
| 15. I can resist eating just before going to bed | <input type="checkbox"/> |
| 16. I can resist eating when I have experienced failure | <input type="checkbox"/> |
| 17. I can resist eating even when high calorie foods are available | <input type="checkbox"/> |

| | | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 18. I can resist eating even when I think others will be upset if I don't eat | <input type="checkbox"/> |
| 19. I can resist eating when I feel uncomfortable | <input type="checkbox"/> |
| 20. I can resist eating when I am happy | <input type="checkbox"/> |

体重生活方式相关自我效能问卷

本量表是测量当你遇到各种情况时，你抵制食物的信心。0 表示完全不自信，9 表示非常自信。请仔细阅读每一条目，在最符合你自身情况的分数下画“√”

| | 完全不自信 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 非常自信 9 |
|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. 我在焦虑或紧张时，能忍住不吃 | <input type="checkbox"/> |
| 2. 在周末，我能控制自己的饮食 | <input type="checkbox"/> |
| 3. 尽管需要拒绝别人，我也能忍住不吃 | <input type="checkbox"/> |
| 4. 当觉得身体虚弱时，我能忍住不吃 | <input type="checkbox"/> |
| 5. 当看电视时，我能忍住不吃 | <input type="checkbox"/> |
| 6. 当我觉得抑郁（或情绪低落）时，我能忍住不吃 | <input type="checkbox"/> |
| 7. 当我面前有很多种食物时，我能忍住不吃 | <input type="checkbox"/> |
| 8. 尽管我觉得拒绝别人添加的食物是不礼貌的，我也能忍住不吃 | <input type="checkbox"/> |
| 9. 当我头痛时，我能忍住不吃 | <input type="checkbox"/> |
| 10. 当我在阅读时，我能忍住不吃 | <input type="checkbox"/> |
| 11. 当我生气（或易激惹）的时候，我能忍住不吃 | <input type="checkbox"/> |
| 12. 当我参加派对时，我能忍住不吃 | <input type="checkbox"/> |
| 13. 尽管别人在向我施加压力，我也能忍住不吃 | <input type="checkbox"/> |
| 14. 当我觉得疼痛时，我能忍住不吃 | <input type="checkbox"/> |
| 15. 当我准备上床睡觉之前，我能忍住不吃 | <input type="checkbox"/> |
| 16. 在经历失败之后，我能忍住不吃 | <input type="checkbox"/> |
| 17. 当我面前有高热量食物时，我能忍住不吃 | <input type="checkbox"/> |
| 18. 当我觉得别人会因为我不吃东西而沮丧时，我也能忍住不吃 | <input type="checkbox"/> |
| 19. 当我觉得不舒服时，我能忍住不吃 | <input type="checkbox"/> |
| 20. 当我觉得高兴时，我能忍住不吃 | <input type="checkbox"/> |

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (August 2002)

國際身體活動問卷 2002 年 8 月

SHORT LAST 7 DAYS SELF-ADMINISTERED FORMAT

最近 7 天身體活動自我填答短問卷版

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

年輕人與中年人適用(15-69 歲)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health-related physical activity.

國際身體活動問卷包含 4 組問卷，透過電話或自我填答的長問卷（5 種不同活動領域）與短問卷（4 種構面）兩種版本。問卷的主要目的在提供一般性的工具，使得健康相關之身體活動資料可以進行國際間的比較。

Background on IPAQ

The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

IPAQ 的背景

國際身體活動的測量發展源於 1998 年在日內瓦，至 2000 年間經過 12 個國家 14 個地方大量的信效度測試，最後結果建議這些評量在許多地方及國度的使用有令人滿意的特性，並且適合在全國性的母群體基礎下廣泛的針對參與身體活動實施研究。

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

IPAQ 的使用

IPAQ 工具的使用是以監控及研究為目的，建議不要改變其問卷的次序及字義，否則將影響工具的心理測量屬性。

Translation from English and Cultural Adaptation

Translation from English is supported to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

英文版翻譯成其他語言版與文化上的適和度

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

歡迎把英文版翻譯成其他語言版已促進全世界使用 IPAQ，可用之不同語言版 IPAQ 資料可在 www.ipaq.ki.se 獲得，如果從事新的翻譯，我們高度的建議使用制式的倒退翻譯法，如果可能的話請考慮將你的翻譯版本奉獻在 IPAQ 網站上，其更詳盡的翻譯與文化適應可以在網站上下載。

Further Developments of IPAQ

International collaboration on IPAQ is on-going and an *International Physical Activity Prevalence Study* is in progress. For further information see the IPAQ website.

IPAQ 進一步的發展

IPAQ 國際的合作是正在進行且國際體能活動廣泛研究正在進展中，進一步的資料參閱 IPAQ 網站。

More Information

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective*. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

更多的資訊

更詳盡的 IPAQ 執行步驟與在工具發展之研究法可連結 www.ipaq.ki.se 及 Booth, M.L. (2000)之研究-身體活動的評量：國際的展望。運動研究季刊，71 (2): s114-20.其它學術的刊物與發表有關使用 IPAQ 的概況已在網站上可查詢。

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

國際身體活動問卷

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

我們對找尋人們在他們日常生活中多種的身體活動有興趣，這個問卷會問你在最近 7 天花在身體活動的時間，請回答每一個問題，甚至如果你想自己是一個沒有活動的人，請想一想你在工作時的活動、像是你在家裡或園藝的部份、從一個地方到一個地方及在你空閒的時間運動或娛樂。

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

想一想在最近 7 天裡你做過所有強而有力的活動，強而有力的身體活動是指以費力的身體負荷且讓你呼吸較正常更為急促的活動，僅回想你所做過每次至少 10 分鐘的那些身體活動。

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

最近 7 天裡，你花多少天做強而有力的身體活動，像是提重物、苦力、有氧運動或快騎腳踏車？

_____ days per week 每週幾天

No vigorous physical activities → **Skip to question 3**

沒有強而有力的身體活動 → 跳到問題 3

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

在參與強有力身體活動的那些天，你通常花多少時間做強而有力的身體活動？

_____ hours per day 每天幾個小時

_____ minutes per day 每天幾分鐘

Don't know/Not sure 不知道/不確定

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

想一想最近 7 天你做過所有適度的活動，適度的活動是指以適度的身體負荷並且讓你呼吸比正常費力一些的活動。

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

最近 7 天裡，你花多少時間做適度的身體活動，像是提輕的物品、正常的速度騎腳踏車或網球雙打？不包含走路。

_____ days per week 每週幾天

No moderate physical activities → *Skip to question 5*

沒有適度的身體活動 → 跳到問題 5

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

在參與適度身體活動的那些天，通常你花多少時間做適度的身體活動？

_____ hours per day 每天幾小時

_____ minutes per day 每天幾分鐘

Don't know/Not sure 不知道/不確定

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

想一想最近 7 天你花多少時間在走路，包含工作、在家、從某地到某地、娛樂、遊戲或休閒時的走路。

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

最近 7 天裡，你花多少天走每次至少 10 分鐘的路？

_____ days per week 每週幾天

No walking → *Skip to question 7*

沒有走路 → 跳到問題 7

6. How much time did you usually spend **walking** on one of those days?
在走路的那些天，你通常花多少時間在走路？

_____ hours per day 每天幾小時

_____ minutes per day 每天幾分鐘

Don't know/Not sure 不知道/不確定

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

最後的問題是在最近連續 7 個非假日時間（扣除週六與週日）你花多少時間在坐著，包含花在工作、家裡、做作業及休閒時的坐著，這或許可以包含花在書桌、拜訪朋友、讀書或看電視的躺著或坐著。

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ hours per day 每天幾小時

_____ minutes per day 每天幾分鐘

Don't know/Not sure 不知道/不確定

This is the end of the questionnaire, thank you for participating.
問卷最後感謝你的參與。

Food diary

饮食日记

Day of the week 一周中的第几天 _____

Date 日期 _____

B.5 PERMISSION TO USE THE CHINESE VERSION OF SOCIAL PROBLEM-SOLVING INVENTORY

PERMISSION TO USE THE CHINESE VERSION OF SOCIAL PROBLEM SOLVING INVENTORY-RIVISED

Yang Yu, PhD (student), MsN
University of Pittsburgh
415 Victoria Building
Pittsburgh, PA 15261
Phone: 412-500-6189

Dear Wei Wang,

This is Yang Yu, a doctoral student from University of Pittsburgh, School of Nursing. I'm writing my application for the Eta Chapter, Sigma Theta Tau International Research and Clinical Project Award entitled *Associations between Post-operative Psychosocial and Behavior Factors on Weight Change among Patients who have Undergone Sleeve Gastrectomy in China*. This project will also be my dissertation which will be supervised by Dr. Lora Burke who can be reached at lbu100@pitt.edu. The University of Pittsburgh IRB committee can be contacted at (412) 383-1480 or by mail at 3500 Fifth Avenue Hieber Building, Room 106, Pittsburgh PA, 15213.

I would like your permission to use the Chinese version of Social Problem Solving Inventory-Revised (C-SPSI-R) in my research study. I would like to use and print your survey under the following conditions:

- I will use the surveys only for my research study and will not sell or use it for commercial activities and interests.
- I will cite this reference in any reports or publications in which C-SPSI-R is used:
Wang W, Cheng Y, Yuan HB. Preliminary application of the abbreviated C-SPSI to nursing students in Shanghai. Chinese journal of practical nursing, 2010, 26(1): 65-67. (in Chinese language)
- I will send a copy of my completed research study to your attention upon completion of the study.

If these are acceptable terms and conditions, please indicate so by signing this letter and returning this to me through e-mail: yay60@pitt.edu.

Sincerely,
Yang Yu

I grant permission requested by Yang Yu for the use of the Chinese version of Social Problem Solving Inventory-Revised (C-SPSI-R) in her research study on the terms stated in this letter.

Signature: Wei Wang 王伟
Contact information: 86-18560033362
Date: 01/16/2017

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