DEVELOPMENT, VALIDATION AND EVALUATION OF NUTRITION AND PSYCHOLOGICAL MANAGEMENT MODULE FOR BARIATRIC SURGERY PATIENTS IN HOSPITAL UNIVERSITI SAINS MALAYSIA

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LIST OF ABBREVIATIONS

AIDS	acquired immunodeficiency syndrome
ASMBS	American Society for Metabolic and Bariatric Surgery
BED	binge eating disorder
BMI	body mass index
BPD-DS	biliopancreatic diversion with duodenal switch
CPG	Clinical Practice Guideline
CVD	cardiovascular diseases
DASS	Depression, Anxiety and Stress Score
DJB-SG	duodenojejunal bypass with sleeve gastrectomy
EVALPEM	Evaluation of the Printed Educational Material
GERD	gastroesophageal reflux diseases
HBM	Health Belief Model
HIV	human immunodeficiency virus
I-CVI	item-content validity index
I-FVI	item-face validity index
IGB	intragastric balloon
kcal	kilocalories
LAGB	laparoscopic adjustable gastric band
LCD	Low-calorie diet
LRYGB	Laparoscopic Roux-en-Y gastric bypass
LSG	Laparoscopic Sleeve Gastrectomy
MDD	major depressive disorder
MOH	Ministry of Health

MUFA	Monounsaturated Fatty-Acid
NAFLD	non-alcoholic fatty liver disease
NHMS	National Health Morbidity Survey
OSA	obstructive sleep apnoea
PPH	postprandial hypoglycaemia
PUFA	Polyunsaturated Fatty-Acid
RNI	Recommended Nutrient Intake
RYDS	Roux-en-Y duodenal switch
RYGB	Roux-en-Y gastric bypass
SADI-S	single anastomosis duodenoileal bypass with sleeve
S-CVI	content validity index by scale
SFA	Saturated Fatty-Acid
S-FVI	face validity index by scale
SG	sleeve gastrectomy
SSB	sugar-sweetened beverages
T2DM	type 2 diabetes mellitus
VLCD	very low-calorie diet
VLCKD	very-low-calorie ketogenic diet
WHO	World Health Organization

LIST OF APPENDICES

PEMBANGUNAN, PENGESAHAN DAN PENILAIAN MODUL PENGURUSAN MAKANAN DAN PSIKOLOGI UNTUK PESAKIT BARIATRIK DI HOSPITAL UNIVERSITI SAINS MALAYSIA

ABSTRAK

Kadar obesiti yang meningkat secara global telah meningkatkan risiko kesihatan dan menjadikan pembedahan bariatrik sebagai salah satu pilihan untuk merawat obesiti morbid. Walaupun terdapat pelbagai manfaat, prosedur ini boleh mengakibatkan pelbagai komplikasi dan pesakit bariatrik perlu mematuhi perubahan diet dan gaya hidup sepanjang hayat. Malaysia kini bergantung pada garis panduan negara asing yang menyebabkan perlunya membangunkan garis panduan tempatan. Oleh sebab itu, kajian ini bertujuan menghasilkan dan mengesahkan sebuah modul yang komprehensif berkaitan pengurusan pemakanan dan psikologi untuk pembedahan bariatrik yang membincangkan isu-isu berkaitan dan sebagai panduan kepada pesakit pembedahan bariatrik dan profesional kesihatan. Kajian ini melibatkan pesakit yang telah menjalani pembedahan bariatrik di Hospital Universiti Sains Malaysia (Hospital USM). Kajian ini telah dijalankan dari Mac 2022 sehingga Jun 2023 yang melibatkan tiga fasa. Fasa satu melibatkan pendekatan kaedah campuran (‘*mixed methods approach’*) yang terdiri daripada kaedah kuantitatif melibatkan 63 pesakit untuk mengenal pasti komplikasi, gaya pemakanan dan status psikologi serta kaedah kualitatif melibatkan 12 pesakit untuk meneroka faktor dan strategi untuk menanganinya. Pembedahan bariatrik yang paling kerap dijalankan ialah `*laparoscopic sleeve gastrectomy*` (71.4%) dan komplikasi yang paling banyak dilaporkan ialah keguguran rambut (50.8%), refluks gastroesophageal (GERD) (49.2%) dan muntah (41.3%). Selain itu, terdapat perbezaan yang signifikan dalam jumlah pesakit lelaki dan perempuan yang telah melaporkan masalah kulit kering

dan keguguran rambut ($p<0.001$). Seterusnya, terdapat perbezaan yang ketara antara berat purata dan indeks jisim tubuh (BMI) antara sebelum dan selepas pembedahan bariatrik ($p<0.001$). Purata pengambilan serat, vitamin D, vitamin B-1, vitamin B-9, vitamin B-12, vitamin K, kalium, kalsium, besi, magnesium, zink dan tembaga untuk pesakit lelaki dan perempuan tidak mencapai saranan. Kebanyakan peserta adalah sihat dari segi psikologi dan hanya sebahagian yang melaporkan mereka mengalami kebimbangan tahap teruk (3.2%) dan sangat teruk (6.3%). Fasa kedua melibatkan pembangunan dan pengesahan modul (`*content and face validity*`) oleh 11 pakar. Nilai S-CVI/Ave ialah 0.98, S-CVI/UA ialah 0.83 dan semua skor S-FVI/Ave adalah pada tahap yang memuaskan kecuali skor S-FVI/UA untuk tiga komponen berada di bawah nilai yang memuaskan. Fasa ketiga ialah penilaian oleh 30 pesakit bariatrik. Kebanyakan pesakit berpuas hati dengan semua komponen dalam modul ini dengan beberapa cadangan untuk penambahbaikan modul ini seperti penggunaan lebih banyak gambar yang menarik, bahasa yang lebih mudah dan perbanyakkan menu tambahan. Kesimpulannya, modul ini telah diterima oleh pesakit dan pakar walaupun terdapat beberapa penambahbaikan. Modul ini boleh digunakan di hospital seluruh Malaysia sebagai garis panduan pengurusan pemakanan dan psikologi yang memberikan manfaat kepada pesakit bariatrik dan profesional kesihatan serta meningkatkan kejayaan prosedur bariatrik.

DEVELOPMENT, VALIDATION AND EVALUATION OF NUTRITION AND PSYCHOLOGICAL MANAGEMENT MODULE FOR BARIATRIC SURGERY PATIENTS IN HOSPITAL UNIVERSITI SAINS MALAYSIA

ABSTRACT

Globally escalating obesity rates have increased health risks, prompting bariatric surgery as a final resort for severe and complex obesity. Despite its benefits, bariatric surgery has complications, requiring lifelong dietary and lifestyle changes. Malaysia currently relies on foreign guidelines, highlighting the need for locally tailored guidelines. Therefore, this study aimed to develop and validate a comprehensive nutritional and psychological management module for bariatric surgery to address common issues and guide patients and healthcare professionals. All bariatric patients at Hospital Universiti Sains Malaysia (Hospital USM). This study was conducted from March 2022 to June 2023 and included three phases. Phase one involved the mixed methods approach, combining a quantitative method of 63 participants to identify complications, dietary habits, and psychological status, and a qualitative method of 12 participants to explore the underlying causes of these issues and strategies to address them. The most frequent bariatric surgery was laparoscopic sleeve gastrectomy (71.4%) and the most reported complications were hair loss (50.8%), gastroesophageal reflux disease (GERD) (49.2%) and frequent vomiting (41.3%). There were significant differences in genders reporting dry skin and hair loss, and the mean weight and body mass index (BMI) before and after bariatric surgery ($p<0.001$). In addition, qualitative findings also highlighted issues with gastric problems, GERD, food intolerance, lethargy, nausea, and vomiting. The mean intake of fibre, vitamin D, vitamin B-1, vitamin B-9, vitamin B-12, vitamin K, potassium, calcium, iron, magnesium, zinc and

copper for men and women did not meet the recommendations. Most participants were psychologically healthy and only some reported having severe (3.2%) and extremely severe (6.3%) anxiety. The second phase involved the development of the module and the content and face validation by 11 experts. The value of S-CVI/Ave is 0.98 S-CVI/UA is 0.83 and all S-FVI/Ave scores achieved satisfaction except the S-FVI/UA score for three components were below the acceptable FVI value. The third phase was the evaluation of the module by 30 bariatric patients. Most participants were satisfied with all the components of the module with some suggestions to improve the module such as using more attractive pictures, simpler language and adding more menus. In conclusion, this module achieved the research objectives and can be used in hospitals throughout Malaysia as a nutritional and psychological management guideline benefiting both bariatric patients and healthcare professionals thus, optimizing the success of bariatric procedures.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The World Health Organization (WHO) defined obesity as an 'abnormal or excessive fat accumulation that debilitates health'. The current Clinical Practice Guideline (CPG) for the Management of Obesity in Malaysia defined obesity in adults as individuals having a body mass index (BMI) equal to or greater than 27.5 kg/m^2. An adult is classified as obese III when the BMI is greater or equal to 37.5 kg/m^2 (Ministry of Health [MOH], 2023). The global prevalence of obesity escalated almost thrice in 2016 since 1975. Obesity is a non-communicable, chronic disease. Overweight and obesity are correlated with a higher prevalence of mortality, associated with comorbidities and conditions such as dyslipidaemia, type-2 diabetes, atherosclerosis, hypertension and overall impaired quality of life and function (Abdelaal et al., 2017).

Currently, bariatric surgery is known as an effective treatment for severe and complex obesity (Bray et al., 2016). It is associated with numerous health benefits such as remission of type 2 diabetes mellitus, cardiovascular health recovery, and a decrease in mortality rates (Singh et al., 2020). Bariatric surgery becomes the final option of treatment when other interventions such as dietary intervention, pharmacotherapy and intragastric balloon are in vain (Ruban et al., 2019). Current guidelines have recommended bariatric surgery as one of the treatments based on the patient's BMI levels and associated obesity-related diseases. The annual rate of bariatric surgery has increased over time, resulting in a growing of patients who had a history of bariatric surgery in their lives (Busetto et al., 2017). In Malaysia, the number of bariatric or metabolic surgery cases increased from 156 cases in 2010 to 2068 cases in 2019 and

slightly decreased to 686 cases in 2020 because of coronavirus disease 2019 (COVID-19) (Ohta et al., 2022).

However, bariatric surgery or weight loss surgery involves various procedures that may cause the changes in metabolic and physiological of the patients and is associated with various clinical problems, complications and side effects. For example, patients may be at high risk of malnutrition or primary protein malnutrition due to poor protein intake if they are unable to follow the nutritional guidelines and maintain regular follow-ups with professional healthcare providers (Parretti, et al., 2021).

In Malaysia, the field of bariatric surgery evolves quickly because of the increasing prevalence of morbid obesity with comorbidities especially cardiovascular disease, type 2 diabetes mellitus (T2DM) and fatty liver disease. In 2014, consensus statements and meetings that involved 62 surgeons from the Society of Endoscopic (SELSMA) and the Malaysian Bariatric Surgery (MyMBS) and comprising the guidelines developed by a committee that includes bariatric surgeons, endocrinologists, dieticians, pharmacists, intensivists and anaesthetists were conducted. It was then documented in a paper comprising previously published guidelines such as those by the National Institute of Health (NIH), Japanese Society of Surgery for Obesity and Metabolic Disorders (JSSO), Asia Pacific Metabolic and Bariatric Surgery Society (APMBSS), Obesity Surgical Society of Australia and New Zealand (OSSANZ), Asian Consensus Meeting on Metabolic Surgery (ACMOMS), Asian Diabetic Surgery Summit (ADSS), Diabetes Surgery Summit (DSS), and the IFSO-APC (Gafoor et al., 2021).

1.1.1 Problem statement and study rationale

Morbid obesity is linked with various adverse health effects such as uncontrolled T2DM, hypertension, osteoarthritis, cancer, obstructive sleep apnoea (OSA), infertility, erectile dysfunction, and stroke (Lopez-Jimenez et al., 2022; Predergast et al., 2022). Bariatric surgery is an approach for achieving drastic weight loss within a short duration for remarkable improvement in obesity-related comorbidities. Bariatric surgery is able to improve blood pressure, uric acid level, blood transaminase, insulin resistance, glucolipid metabolism as well as reduce the risk of myocardial infarction and cardiovascular-related death (Feng et al., 2023).

Nutritional management is one of the most critical aspects to be monitored pre- and post-bariatric surgery. To optimize current health status, significant weight reduction is often pursued through the prescription of a very low-calorie diet (VLCD) one to three weeks before surgery. It is essential to assess and address the nutritional status before the surgery to prevent or minimize the risk of complications and nutritional issues post-surgery (Bettini et al., 2020). Nutritional counselling and long-term multidisciplinary follow-up after the procedure, are vital in aiding the patients in adapting to the new eating behaviour prior to the new gastrointestinal physiology. On the other hand, gastroesophageal reflux diseases (GERD), dumping syndrome reactive hypoglycaemia, dry skin and hair loss are the common nutritional problems experienced by patients after the procedure. Therefore, they require long-term post-operative dietary monitoring to manage these symptoms (Bettini et al., 2020).

Additionally, uncontrolled eating and inability to adhere to nutritional and behavioural modifications lead to significant weight regain (Endevelt et al., 2013; Berino et al., 2022). Weight regain may trigger the recurrence of obesity-related comorbidities such as T2DM, hypertension, and dyslipidemia, and negatively impact

emotional well-being (Noria et al., 2023). Kaouk et al. (2019) highlighted the importance of informing patients about the modifiable factors linked to weight regain in producing long-term weight loss.

While bariatric surgery effectively aids weight loss, bariatric patients often experience depression, anxiety, and specific eating disorders, such as binge eating, with prevalence rates exceeding 15% (Francois et al., 2024). The findings of a meta-analysis conducted by Dawes et al. (2016) demonstrated increased rates of alcohol abuse among post-surgical patients. Mental health problems among these patients may be due to life-long adherence to strict lifestyle changes as well as difficulties in adapting to the complications after surgery such as hair loss, scaly skin and loose skin. In addition, weight regain or plateauing of weight after surgery is another factor contributing to depression (Alyahya & Alnujaidi 2022; Jumbe et al., 2017). A research by Vanoh et al. (2015) conducted among post-bariatric surgery patients visiting Hospital Canselor Tuanku Mukhriz UKM demonstrated that binge eating disorder was frequent among post-bariatric surgery patients with poor compliance with dietary advice.

With the increasing prevalence of nutrient deficiencies and loss of follow-up of patients post-procedure, developing a module for the nutritional and stress management of pre and post-bariatric surgery patients may guide the patients in managing their lifestyles by themselves as well as facilitate dietitians in delivering nutrition advice to the patients.

There are several guidelines published for bariatric surgeries and nutrition for bariatric surgeries that are used globally such guidelines from the National Institute for Health and Care Excellence (NICE), the American Society for Metabolic and

Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient and the Brigham and Women's Center for Metabolic and Bariatric Surgery's Nutrition Guidelines for Sleeve Gastrectomy and Gastric Bypass (National Institute for Health and Care Excellence [NICE], 2023; Mechanick et al., 2019; Brigham and Women's Center for Metabolic and Bariatric Surgery, 2017). In summary, these guidelines covered the history and indications of bariatric surgery, different surgical options and revisional surgery, lifestyle and behavioural interventions, nutritional complications, perioperative nutrition care and the importance of follow-up care for bariatric surgery patients. There were limited guidelines covering the psychological management of bariatric surgery patients.

Currently, in Malaysia, there are no standardized modules focusing on nutrition and psychological management for pre-and post-bariatric surgery. Current nutritional management in Malaysia has been relying on guidelines from foreign countries and each hospital in Malaysia has its guidelines which resulted in non-standardized management. Considering the difference in Malaysian culture as compared to other countries, there is a need to develop a bariatric surgery module suitable for the three major ethnicities in Malaysia besides adding the psychological management for bariatric surgery. This research may be helpful as it will determine the nutritional, medical and emotional problems experienced by patients after the procedure, identify the differences in dietary intake of patients according to the duration after the bariatric surgery procedure, and develop a bariatric surgery support module highlighting the nutritional strategies for pre- and post-bariatric and psychological management for bariatric patients as well as validate the newly developed module by the healthcare professionals and evaluate the satisfactory among bariatric surgery patients.

1.2 Research questions

1. What are the nutritional and medical problems experienced by patients after the bariatric surgery procedure?

2. Are there any significant differences in the dietary intake of patients according to the duration after the bariatric surgery procedure?

3. What is the psychological well-being (depression, anxiety and stress) of the patients after bariatric surgery?

4. How to develop a module emphasizing on nutritional and psychological management of bariatric surgery and what is the validity of the newly developed module among healthcare professionals?

5. What is the satisfaction level of the newly developed module among bariatric surgery patients?

1.3 Objectives

1.3.1 General objective

To develop and validate a nutritional and psychological management module for bariatric surgery patients and access the acceptance of the newly developed module among bariatric surgery patients.

1.3.2 Specific objectives

Phase 1

1. To determine and explore the nutritional and medical problems experienced among post-bariatric surgery patients within 5 years after bariatric surgery using surveys, medical reports and in-depth interviews.

2. To identify the differences in dietary intake of patients according to duration after the bariatric surgery procedure using 24-hour dietary recall.

3. To determine and explore the psychological well-being (depression, anxiety and stress) among post-bariatric surgery patients using the DASS-21 questionnaire.

Phase 2

4. To develop and validate a new module regarding nutrition and psychological management after bariatric surgery.

Phase 3

5. To evaluate the acceptance or satisfaction of the bariatric surgery nutrition and psychological management module among bariatric surgery patients using surveys.

1.4 Research hypothesis

Hypothesis 1

H_o: Patients do not experience any nutritional and medical problems after bariatric surgery procedure.

H_1: Patients are at high risk of nutritional and medical problems such as infection, bleeding, vomiting, nausea, hair loss, and gastroesophageal reflux disease after bariatric surgery.

Hypothesis 2

H_0: There are no differences in the dietary intake of the patients according to the duration of bariatric surgery.

H_1: The dietary intake of post-bariatric surgery patients differs according to the duration of bariatric surgery.

Hypothesis 3

H_0: Patients have no depression, anxiety and stress after bariatric surgery.

H_1: Patients experienced depression, anxiety and stress after bariatric surgery.

Hypothesis 4

H_0: The newly developed nutritional and psychological management bariatric surgery module had poor validation among healthcare professionals.

H_1: The newly developed nutritional and psychological management bariatric surgery module had good validity index by the healthcare professionals.

Hypothesis 5

H_0: The bariatric surgery patients had poor satisfaction towards the newly developed nutrition and psychosocial management module

H_1: The bariatric surgery patients had good satisfaction towards the newly developed nutrition and psychosocial management module.

1.5 Definition of terms

1.5.1 Nutritional and medical problems

The complications following bariatric surgery arise from reduced food intake, nutrient malabsorption, food intolerance, and failure to adhere to dietary and supplement recommendations that lead to nutritional problems, which are particularly prevalent in malabsorptive or mixed procedures rather than restrictive procedures

(Lupoli et al., 2017). In the current study, nutrition and medical problems refer to dry skin, anaemia, lethargy, hair loss, unhealthy nails, nausea, vomiting, diarrhoea, loss of appetite, constipation, GERD, dental problems, infection, leakage and irregular menses. Early dumping syndrome is symptoms such as nausea, diarrhoea, abdominal cramps, vomiting, dizziness and rapid heart rate which occur 10 to 30 minutes after a meal (van Furth et al., 2021). Late dumping syndrome presents symptoms of hypoglycemia such as dizziness, fatigue, sweating and weakness, which occur one to three hours after a meal (Berg & McCallum, 2016).

1.5.2 Psychological well-being

Psychological well-being pertains to an individual's subjective encounter with positive psychological states, encompassing life fulfilments, pleasure and a sense of purpose (Dhanabhakyam & Sarath, 2023). Psychological well-being refers to the presence of positive feelings such as self-esteem and the absence of negative feelings such as symptoms of depression or anxiety. In this current study, the psychological state of the participants will be determined by the depression, anxiety and stress scores measured by the Depression, Anxiety and Stress Score- 21 (DASS-21) questionnaire.

Depression is characterized by symptoms like loss of interest or pleasure, sadness, feelings of guilt or low self-worth, changes in sleep or appetite, lethargy, and difficulty concentrating (Marcus et al., 2012). Anxiety is the emotional state caused by internal or external stimuli that include a set of measurable physiological, behavioural, hormonal, and autonomic reactions besides a consciously perceived experience or feeling of anxiety or worry, nervousness, or unease (Hall et al., 2023). Stress is the feeling that is initiated when an individual encounters environmental demands greater than the adaptive capacity of the individual (Usman et al., 2011).

1.5.3 Obesity

Obesity is characterized by abnormal or excessive fat accumulation, posing health risks. Obesity in adults is identified by the body mass index (BMI) greater than or equal to 30 kg/m^2 (World Health Organization [WHO], 2024). Obesity is a complex and chronic condition that has a diverse presentation (MOH, 2023). Class III obesity, previously known as morbid obesity in adults, is defined as individuals having a body mass index (BMI) greater than or equal to 37.5 kg/m^2 (MOH, 2023).

1.5.4 Bariatric surgery

Bariatric surgery is an efficient therapy for morbid and complex obesity that consists of a variety of procedures like Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG) biliopancreatic diversion with duodenal switch (BPD-DS) and laparoscopic adjustable gastric band (LAGB) (Tsenteradze et al., 2023). Pre-bariatric surgery is when patients are planning for any bariatric procedures in the future. Post-bariatric surgery is when patients who have already undergone any bariatric procedures and under follow-up and monitoring by healthcare professionals.

Low-calorie diet (LCD) is limiting energy intake to 800-1600 kcal per day (Ruban et al., 2019). A very low-calorie diet (VLCD) limits energy intake to less than 800 kcal per day (Ruban et al., 2019).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

An extensive analysis of the prevalence and precise definition of obesity is necessary due to the serious health risks posed by the global obesity epidemic. This section addresses the determinants of obesity and explores the resulting health consequences. Then, several strategies to reduce obesity's prevalence and related health risks are discussed in terms of strategic approaches to obesity management. Comprehensive information is provided about bariatric procedures such as Laparoscopic Roux-en-Y gastric bypass (LRYGB), Laparoscopic Sleeve Gastrectomy (LSG), Sleeve Plus, and Laparoscopic Adjustable Gastric Band (LAGB). Further exploration of bariatric procedure indications and contraindications, post-operative medical issues, and important nutritional concerns pre- and post-operation is covered in this segment.

2.2 Prevalence and definition of obesity

Obesity is a multifactorial disease that increases globally each decade and is recognized as an epidemic disease. The World Health Organization (WHO) has foreseen that by 2030, obesity-related complications will become a leading cause of mortality in both resource poverty and developing countries due to the endless adoption of Western dietary habits and the widespread availability of fast food. Notably, overweight and obese carry a risk of a higher mortality prevalence than underweight (Dramé and Godaert, 2023). The body mass index (BMI) is an international standard in assessing obesity, calculated by dividing an individual’s weight in kilograms by the square of their height in meters (kg/m^2). A person can be classified into different

categories of obesity. The latest Clinical Practice Guidelines (CPG) for the management of obesity proposed a new BMI classification for the Asian population, which has a lower cut-off point. A person with BMI 23.0-27.4 kg/m^2, 27.5-32.4 kg/m^2, 32.5-37.4 kg/m^2, and ≥37.5 kg/m^2 is classified as pre-obese or overweight, obese I, obese II and obese III respectively (MOH, 2023).

Obesity rates have skyrocketed in all ages and both sexes across regions and countries (Chooi et al., 2019). Presently, Malaysia stands out among the Southeast Asian countries for having the highest prevalence of obesity with around half of its population being overweight or obese (Mohd-Sidik et al., 2021). The prevalence of obesity among adults in Malaysia has increased four-fold, surging from 15.1% in 1996 to 17.7% in 2015 (Mohd-Sidik et al., 2021). According to the National Health Morbidity Survey (NHMS) 2019, the prevalence of obesity was recorded at 19.7%, compared to 17.7% in 2015 and 15.1% in NHMS 2011 (National Health and Morbidity Survey [NHMS], 2020). In addition, the NHMS 2019 reported that one in two adults in Malaysia were overweight or obese, and similarly, one in two adults had abdominal obesity (NHMS, 2020). In comparison, from 1980 to 2015, the prevalence of obesity increased in America from 12.9% to 28.3%, the European region from 14.5% to 22.9%, the Eastern Mediterranean region from 11.8% to 19.6% and in the African region doubled from 6.2% to 12.7% (Chooi et al., 2019).

2.3 Determinants of obesity

Dietary patterns and diet quality are the fundamental factors causing obesity. Physical inactivity and a continuous positive energy balance also contribute to obesity. According to Lee & Wan Muda (2019), the participants' energy-dense diet, which is high in fats and simple sugars, is the main source of calories which results in weight

gain. Furthermore, people who consistently consumed excessive portions of refined carbohydrates such as pastries, chips, white bread, white rice, and sweetened beverages gained more weight than people who consistently consumed more whole grains and achieved total dietary fibre intake. According to Nguyen et al., (2023) consuming more sugar-sweetened beverages (SSB) leads to weight gain. Higher consumption of dietary fibre such as fruits, vegetables and whole grains results in less weight gain (Lee & Wan Muda, 2019).

Furthermore, the COVID-19 pandemic affects negatively physical activity and dietary-related behaviour which contributed to weight gain in the population. Frequent snacking, limited access to fresh produce, alcohol intake, emotional eating, and sedentary behaviour due to reduced incidental activity and inability to engage in structured exercise were associated with weight gain during periods of self-quarantine during the COVID-19 pandemic (Moschonis & Trakman, 2023). The changes in dietary and physical activity patterns are due to food advertising and marketing, changes in forms of work, increasing urbanization, changes in modes of transportation, and health education and awareness (Amin et al., 2023). Increased physical activity levels are linked to weight loss, weight maintenance and prevention of weight gain. Nonetheless, there is a risk of weight gain if the intensity and the duration of physical activity remain constant or decline over time (Jakicic et al., 2019). The National Health and Morbidity Survey (NHMS) 2019 revealed that the rate of physical inactivity among Malaysian adults was 24.6%, while a study reported that 37.3% of Malaysian adults were inadequately active (Nik-Nasir et al., 2022). Besides, low tolerance of stress was associated with increased BMI which was attributed to neurobiology stress. This may trigger hunger and comfort eating which will reduce the lipolytic growth hormone, thus leading to the accumulation of fat (Mohd-Sidik et al., 2021). Women were more

susceptible to emotional distress that may increase the intake of highly palatable foods, which contributes to weight gain (Conklin et al., 2019).

2.4 Consequences of Obesity

Being overweight and obese is associated with numerous health conditions such as cardiovascular diseases and type 2 diabetes mellitus, as it heightens the risk of metabolic syndrome including insulin resistance, dyslipidaemia and hypertension (Kachur et al., 2017). Besides, body fat distribution, determined by higher waist circumference or waist-to-hip ratio is also a predictor of diabetes risk (Hruby et al., 2016). Next, the accumulation of adipose tissue, particularly around the abdominal region, accelerates the onset of obesity-related health issues and mortality. This is because of the limited capacity of the subcutaneous adipose tissue to accommodate excess calories in obese individuals, potentially resulting in ectopic fat deposition in other metabolic tissues and causing subsequent insulin resistance (Goossens, 2017).

A higher BMI beyond the age of 18 years old is linked to an increasing risk of hypertension and heart disease. The risk escalates with a higher waist-to-hip ratio and larger waist circumferences (Hruby et al., 2016). Meanwhile, losing weight reduces the risk of hypertension and the risk of developing heart disease over time. Moreover, weight gain is also linked to an escalated risk of stroke and smoking further worsens the condition (Hruby et al., 2016). In postmenopausal obese women, low serum availability of sex hormone binding globulin leads to increased availability of bioavailable estrogen compared to thin postmenopausal women. This indicates a positive association between obesity and heightened breast cancer risk in postmenopausal women. Similarly, obese premenopausal women may experience longer menstrual cycles and more frequent anovulatory cycles compared to lean

premenopausal women, resulting in reduced overall exposure to estrogen and a decreased risk of breast cancer. (Mohanty & Mohanty, 2021). A larger body shape is associated with the risk of large adenomas in the distal colon and higher BMI and weight gain increase the risk of endometrial cancer, and cancers of the kidney and pancreas (Song et al., 2016). Additionally, besides having lower physical functioning and vitality and extensive body pain, weight gain is associated with lower physical quality of life (Hruby et al., 2016). Moreover, a higher BMI negatively affects the psychological health of an individual with greater perceived stress, suicidal ideation and poor quality of life especially among men. Furthermore, a study done by Mohd-Sidik et al. (2021) among Malaysian adults in Selangor revealed that obese women had poor mental health status due to greater body image dissatisfaction (Mohd-Sidik et al., 2021).

2.5 Strategies for managing obesity

There are many approaches to managing obesity. According to the Clinical Practice Guideline (CPG) in Management of Obesity, 2023, individuals with a BMI of ≥23 kg/m² or with a waist circumference of ≥80 cm for women and ≥90 cm for men should be assessed for overweight/obesity-associated conditions and overweight/obesogenic medication used (Ministry of Health [MOH], 2023). A comprehensive lifestyle intervention becomes the first line of therapy in managing overweight and obesity which includes modification in dietary and activity habits (Aldubikhi, 2023). First and foremost, if the patient is willing to participate in a weight loss programme, diet therapy will be introduced, aiming to create a net deficit of energy intake that may result in weight loss. Reduction of energy intake can be achieved by adjusting macronutrient composition by reducing fat intake within the recommended range of 25-30% and replacing simple carbohydrates with whole grain products.

Reducing saturated fatty acid helps in managing weight and reducing the risk of cancers like colorectal and breast cancers (Kim, 2021). Fat reduction facilitates weight loss due to its highest calorie contribution of 9 kilocalories per gram of fat, compared to 4 kilocalories per gram for carbohydrates and protein, respectively (Parmar & Can, 2024). Reducing fat intake is the main strategy in weight reduction as fat is less satiating, easily absorbed and the most calorie-dense macronutrient. A very low-fat diet typically consists of ≤10% of calories from fat. However, meta-analysis has demonstrated that a very low-fat diet was not effective in supporting long-term weight loss. In addition, a low carbohydrate diet is used for weight loss and managing glycemia. A low carbohydrate diet is defined as carbohydrates within the range of 10% to 45% of daily calories, with a high protein of 1.5 g/kg ideal body weight (Kim, 2021). Consumption of less than 10% of daily calories from carbohydrates is considered a ketogenic diet (Al Aamri et al 2022). A low carbohydrate diet leads to greater weight loss due to loss of glcogen stores and water. However, there will be a decrement in the rate of weight loss after two weeks (Ruban et al., 2019).

Another approach involves restricting calorie intake through adherence to a low-calorie diet (LCD), limiting energy consumption to 800-1600 kcal/day and a very low-calorie diet (VLCD) which allows the intake of less than 800 kcal/day. However, there is a risk of weight regain especially in very low-calorie diets due to various factors such as, challenges in calorie tracking, and lack of dietary adherence (Ruban et al., 2019), metabolic adaptation which is the condition of decline in energy expenditure following episodes of rapid weight loss (Martins et al., 2021). Another convenient method for calorie restriction and weight loss is by practising partial or full meal replacement. Lean et al. (2018) stated that partial meal replacement improves and remits obesity-associated comorbidities such as type 2 diabetes mellitus, and hypertension besides producing

weight loss. Other weight loss strategies include pharmacotherapies using orlistat, liraglutide and naltrexone as well as surgical procedures namely sleeve gastrectomy (SG), Roux-en-Y-gastric bypass (RYGB), biliopancreatic diversion with duodenal switch (BPD-DS), single anastomosis duodenoileal bypass with sleeve (SADI-S), and duodenojejunal bypass with sleeve gastrectomy (DJB-SG). Besides bariatric surgery, there are other non-surgical minimally invasive procedures for promoting weight loss such as intragastric balloon (IGB) involving the placement of a saline-filled balloon in the stomach for promoting satiety (Ruban et al., 2019).

2.6 Bariatric surgery

Besides dietary therapy, pharmacotherapy and lifestyle modification, bariatric surgery is currently recognized as a viable option for managing obesity. Recent research shows that bariatric surgery results in weight loss and reaches a peak two years post-surgery. Weight loss is significantly stable for at least 10 years after surgery (O'Brien et al., 2018). Furthermore, bariatric surgery is associated with improvements in obesity-related comorbidities. It was reported to result in complete or partial remission of T2DM compared to the individual who receives no therapy or medical therapy only (Roth et al., 2020). Moreover, bariatric surgery is highly preferred for preparation for liver transplantation in patients with advanced cirrhosis, with the absence of portal hypertension. Bariatric surgery has shown positive results in patients with steatosis, steatohepatitis and stable cirrhosis (Provost, 2014). The study also has demonstrated that individuals who had bariatric surgery have a reduced occurrence of hypertension, heart failure, cardiovascular disease (CVD) and mortality. The association between bariatric surgery with hypertension and CVD remains consistent whether patients have

T2DM or not, although there is no significant decrease in the risk of atrial fibrillation and stroke among those with T2DM (Singh et al., 2020).

In Malaysia, the first bariatric procedure performed was an open vertical gastroplasty in 1996. Subsequently, different bariatric procedures are available such as laparoscopic gastric bypass (LGB), laparoscopic adjustable gastric banding (LAGB) and laparoscopic sleeve gastrectomy (LSG) (Kosai & Rajan, 2018). The trends in Malaysia are similar to Asia and worldwide where there is a great shift from LAGB to Roux-en-Y Gastric Bypass (RYGB) or LSG. This is because LAGB notably depends on the patient's compliance while RYGB or LSG is a permanent surgery solution that has a higher percentage of excess weight loss. A nationwide survey conducted in Malaysia shows that the total number of bariatric procedures performed in the country has increased from 158 to 463 cases annually in 2016 from 2010. This survey revealed that prior to surgery, 20% of patients were diagnosed as class 1 obese, 30% as class 2 obese, 24% as class 3 obese, and the remaining 26% as morbidly obese (Kosai & Rajan, 2018). The prevalence of bariatric procedures in Malaysia has witnessed a significant rise over the past decade due to the increased awareness among healthcare providers regarding the surgical management of obesity and associated comorbidities, effective public campaigns by the Ministry of Health (MOH) and the spreading of information through media channels regarding the adverse effects of obesity and available treatment options (Kosai & Rajan, 2018).

2.6.1 Types of bariatric procedure

2.6.1(a) Laparoscopic Roux-en-Y gastric bypass (LRYGB)

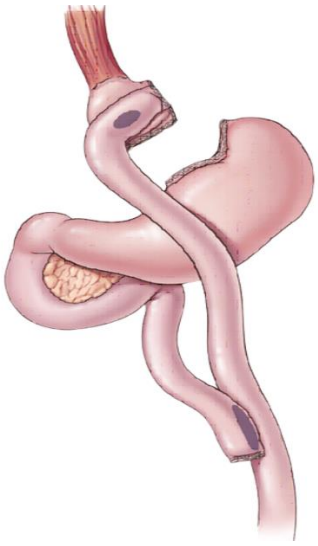

Figure 2.1 Roux-en-Y Gastric Bypass (adapted from American Society for Metabolic and Bariatric Surgery)

Laparoscopic Roux-en-Y gastric bypass (LRYGB) involves dividing the stomach into a small proximal pouch while bypassing the larger portion of the stomach where food is no longer stored and digested. Then, a Roux-en-Y gastrojejunostomy is done, diverting ingested nutrients away from the body of the stomach, duodenum, and proximal jejunum, thereby bypassing the initial part of the small intestine (Figure 2.1). Thus, this procedure results in diminished food consumption, and limited nutrient absorption, causing significant weight loss and may lead to malabsorption of essential nutrients such as calcium, iron, and vitamin B12, along with other micronutrients (Ruban et al., 2019). LRYGB produces weight loss of approximately 73% in one year and remission of diabetes (95%), sleep apnoea (95%), hypertension (80%) and dyslipidemia (80%) (Ruban et al., 2019). However, RYGB may cause complications such as marginal ulceration, anastomotic stenosis and frequent vomiting due to the influx of interstitial fluid in the intestinal lumen (Schulman & Thompson, 2017; Berg & McCallum, 2016).

2.6.1(b) Laparoscopic Sleeve Gastrectomy (LSG)

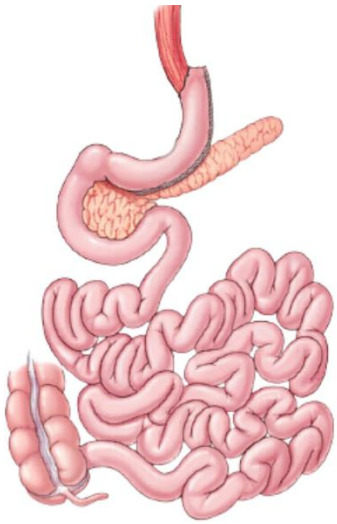

Figure 2.2 Sleeve Gastrectomy (adapted from American Society for Metabolic and Bariatric Surgery)

Laparoscopic sleeve gastrectomy (LSG) is the procedure of resecting approximately 80% of the stomach, leaving only a narrow sleeve without requiring anastomosis (Figure 2.2). The smaller part of the stomach has restricted motility and allows a smaller volume of ingested food to pass through it, thus promoting early satiety and rapid weight loss. LSG also increases the remission rates of diabetes (86%), sleep apnoea (91%), hypertension (82%) and dyslipidaemia (83%) (Ruban et al., 2019). Besides, LSG is a simpler procedure and is associated with fewer postoperative morbidities as compared to LRYGB (Huang & Katakwar, 2020). However, LRYGB produced greater weight reduction in the long term as compared to LSG by 11.9% and 13.11% at three and five years respectively (Uhe et al., 2022). In addition, LSG has a higher risk of GERD due to the alteration of the gastroesophageal junction and the LES function (Hutopila & Copaescu, 2019).

2.6.1(c) Sleeve Plus

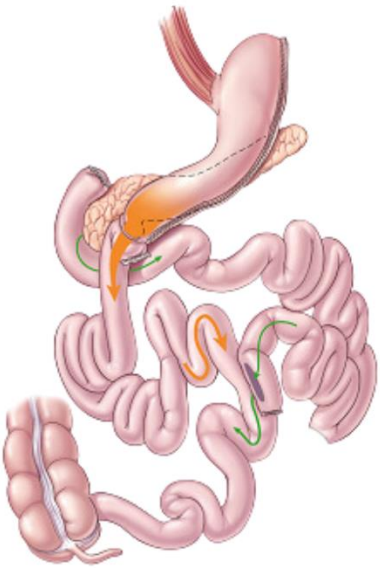

Figure 2.3 Biliopancreatic Diversion with Duodenal Switch (adapted from American Society for Metabolic and Bariatric Surgery)

In addition, there are a few procedures called "sleeve plus" procedures such as the biliopancreatic diversion with duodenal switch (BPD-DS), single anastomosis duodenoileal bypass with sleeve (SADI-S), and duodenojejunal bypass with sleeve gastrectomy (DJB-SG). The BPD-DS is a more complicated irreversible procedure involving gastrectomy, leaving a tubular pouch and anastomosis between the proximal duodenum and bypassed intestine (Ruban et al., 2019) (Figure 2.3). It results in sustainable weight loss for up to five years, fewer nutritional issues and improved quality of life (Huang & Katakwar, 2020). On the other hand, SADI-S is an upgraded and simpler version of the Roux-en-Y Duodenal Switch (RYDS) that aims to reduce the risk of internal hernias and ulcers, resulting in fewer complications (Surve et al., 2020). SADI-S may also be performed as a revision surgery following LSG (Huang & Katakwar, 2020). This procedure consistently achieves significant weight loss and improves obesity-related comorbidities (Surve et al., 2020). BPD-DS is associated with the highest perioperative malnutrition and metabolic complications (Conner & Nottingham, 2022).

2.6.1(d) Laparoscopic Adjustable Gastric Band (LAGB)

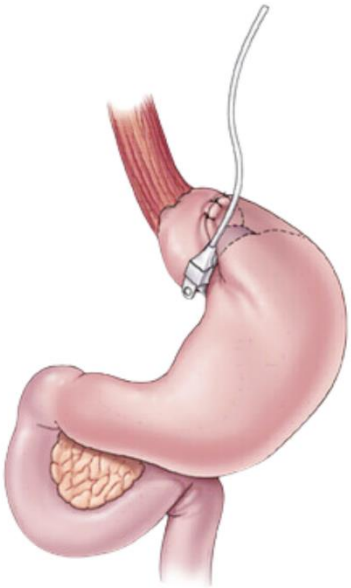

Figure 2.4 Laparoscopic Adjustable Gastric band (adapted from American Society for Metabolic and Bariatric Surgery)

Furthermore, another bariatric procedure involves the use of a laparoscopic adjustable gastric band (LAGB), an inflatable silicone band that is positioned at the proximal stomach to compress the size of the gastric pouch and outlet (Figure 2.4). This constriction impedes food passage through the stomach and limits the amount of food intake. The degree of constriction can be adjusted by injecting fluid. LAGB is a simple procedure and it is reversible. Although this procedure offers slower weight loss, it is associated with lower early complications, shorter time needed for operation, reduced length of hospital stays and promotes the remission of conditions such as diabetes, hypertension, dyslipidaemia and sleep apnoea (Ruban et al., 2019). However, LAGB is also associated with postoperative complications risks such as vitamin and mineral deficiencies, mild protein depletion and risk of band slips (Aron-Wisnewsky et al., 2016).

2.6.2 Indications for bariatric surgery

Bariatric candidates should be well-informed of the potential postoperative risks, feel motivated and capable of engaging in postoperative treatment and follow-up (Provost, 2014). Patients are required to comply with the follow-up with the healthcare teams as well as adhere to the recommended medical and dietary management (Gafoor et al., 2021). An evaluation of the risk-benefit and discussion between the healthcare team and patients before bariatric surgery is vital to identify the eligibility of the bariatric candidates to undergo bariatric surgery (NICE, 2023). The current guideline for bariatric surgery suggests that evaluation of patients' readiness and adherence are compulsory as bariatric surgery is a procedure that requires lifelong follow-ups and treatments to ensure the purpose of the surgery is achieved (Mechanick et al., 2020). Psychological assessment before the procedure is necessary to identify patients' psychological well-being including major depression, binge eating disorder and substance abuse and may help predict postoperative weight loss (Wolfe et al., 2016).

The current guidelines recommend referring patients for bariatric surgery if their BMI exceeds 40 kg/m^2 without any comorbidities or BMI below 40 kg/m^2 with associated metabolic syndrome or obesity-related morbidities that could benefit from weight loss. Bariatric surgery is proven to improve conditions such as hypertension, dyslipidaemia, new-onset T2DM and obstructive sleep apnoea (OSA) (Ebadinejad et al., 2022). Bariatric surgery decreases the symptoms of OSA and is completely resolved in approximately 40% of patients undergoing the procedure (Wyszomirski et al., 2023). Generally, bariatric surgery is suitable for patients aged 18 to 65 years (Gafoor et al., 2021), but a study shows that those aged 65 years and older can safely undergo this surgery under close supervision, without additional short-term postoperative complications. However, older patients may have a longer hospital stay and a higher

risk of gastroesophageal reflux disease and muscle wasting (Quirante et al., 2017). However, bariatric surgery is not recommended for patients younger than 18 years old as this may interfere with their growth and development.

2.6.3 Contraindications for bariatric surgery

Bariatric surgery is not recommended for patients at high risk of mortality, such as having irreversible cardiopulmonary damage, suffering from end-organ failure, and having metastatic or inoperable malignancies. Additionally, it is not suitable for pregnant women or those planning for pregnancy within a year post-surgery. Patients unable to attend post-surgical appointments and lack social support are not suitable candidates for this procedure (Provost 2014 & Gafoor et al., 2021). In addition, patients with underlying eating disorders, severe alcoholism, tenaciously non-compliant with nutritional requirements and supplementation are not recommended for bariatric surgery. Patients with contraindications to general anaesthesia or having untreatable coagulopathy, and increased cardiovascular risk are also not encouraged for bariatric surgery (Benalcazar & Cascella, 2022).

Bariatric surgery should only be considered for patients with active peptic ulcer disease when successful treatment for the ulcer disease has been confirmed. Besides, for patients with human immunodeficiency virus (HIV) infection, this procedure is not recommended as it may progress to acquired immunodeficiency syndrome (AIDS) and AIDS-associated cachexia. Another contraindication is for patients who are non-ambulant and have poor functional capacity, as bariatric surgery has been linked to higher postoperative comorbidities and diminished weight loss in such individuals. Moreover, bariatric surgery is contraindicated in patients with Prader-Willi syndrome or malignant hyperphagia, in addition to mental retardation, due to the complications that may arise (Provost, 2014).