Health Promotion Board

OBESITY

HPB-MOH Clinical Practice Guidelines 1/2016

Academy of Medicine, Singapore

College of Family Physicians, Singapore

Endocrine and Metabolic Society of Singapore

Ministry of Health, Singapore

Obesity & Metabolic Surgery Society of Singapore

Obstetrical & Gynaecological Society of Singapore

Singapore Association for the Study of Obesity

Singapore Nutrition and Dietetics Association

Singapore Paediatric Society

Singapore Paediatric Society

Sports Medicine Association, Singapore

June 2016

Levels of Evidence and Grades of Recommendation

Levels of Evidence

Level	Type of Evidence
1^{++}	High quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias.
1^{+}	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias.
1^{-}	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias.
2^{++}	High quality systematic reviews of case control or cohort studies. High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal.
2^{+}	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal.
2^{-}	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Grades of Recommendation

Grade	Type of Evidence
A	At least one meta-analysis, systematic review of RCTs, or RCT rated as 1^{++} and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1^{+}, directly applicable to the target population, and demonstrating overall consistency of results.
B	A body of evidence including studies rated as 2^{++}, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1^{++} or 1^{+}
C	A body of evidence including studies rated as 2^{+}, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2^{++}
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2^{+}
GPP (Good Practice Points)	Recommended best practice based on the clinical experience of the guideline development group.

CLINICAL PRACTICE GUIDELINES

OBESITY

HPB-MOH Clinical Practice Guidelines 1/2016

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Statement of Intent

These guidelines are not intended to serve as a standard of medical care. Standards of medical care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge advances and patterns of care evolve.

The contents of this publication are guidelines to clinical practice, based on the best available evidence at the time of development. Adherence to these guidelines may not ensure a successful outcome in every case. These guidelines should neither be construed as including all proper methods of care, nor exclude other acceptable methods of care. Each physician is ultimately responsible for the management of his/her unique patient, in the light of the clinical data presented by the patient, and the diagnostic and treatment options available.

Contents

Foreword

Obesity is a growing worldwide epidemic. According to the World Health Organization, obesity prevalence has more than doubled since 1980. In 2014, more than 1.9 billion adults were overweight, and over 600 million were obese. Among those younger, 42 million preschool children were overweight globally in 2013. This aggravates the problem of obesity as overweight children are likely to become obese adults.

In Singapore, obesity prevalence is also rising from 5.5% in 1992 to 10.8% in 2010, and then dropped to 8.6% in 2013, although it remains one of the world's lowest. Obesity is a major risk factor for non-communicable diseases such as cardiovascular disease, diabetes, musculoskeletal disorders and some cancers. From the Ministry of Health's Singapore Burden of Disease Study 2010, high body mass accounted for 12.1% of the total burden of disease in Singapore. Fortunately, obesity is preventable, thus making it a public health priority to address.

As part of the obesity control efforts, Singapore continually empowers health professionals to better manage obesity in the community. With the updating of the Obesity Clinical Practice Guidelines, the revised guidelines aim to equip health professionals with the evidence-base for a holistic multi-disciplinary approach to manage obesity ranging from diet, physical activity, medication, surgery and more. With an all-rounded approach towards managing weight loss and weight maintenance, we aim to improve the health outcomes for both children and adults as they journey towards healthy living.

Associate Professor Benjamin Ong
DIRECTOR OF MEDICAL SERVICES

Foreword

The fundamental cause of overweight and obesity is an energy imbalance between calories consumed and calories expended. Over the years, the Health Promotion Board (HPB) has embarked on a multi-sectorial strategy targeted at modifying risk factors such as diet and physical activity to address the public health epidemic of rising obesity among Singaporeans. The strategy is aimed at working with the industry (e.g. food manufacturers to use healthier ingredients), making healthier choices widely accessible in the community (e.g. childcare centres, restaurants), and motivating and empowering individuals to manage their weight.

Another initiative is to equip healthcare professionals with current knowledge and scientific evidence on best practices towards weight management. This led to the revision of the Obesity Clinical Practice Guidelines by a panel of health experts including medical specialists and health practitioners. The scientific literature on the different aspects of obesity management has been reviewed through the development of these guidelines, and these revised guidelines highlight recent advances such as using information and communication technology for weight management as well as addressing specific considerations for managing obesity in pregnant women.

I would like to take this opportunity to thank the workgroup for their time and valuable contribution. I believe that these guidelines will serve useful for both clinicians and allied health professionals in their engagement with overweight and obese patients.

Mr Zee Yoong Kang
CEO, HEALTH PROMOTION BOARD

Key Guideline Recommendations

Details of recommendations are located in the main text at the pages indicated.

Diagnosis and Classification

C Current World Health Organization (WHO) and international guidelines recommend BMI cut-offs of 25 and 30 kg/m^2 to define overweight and obesity respectively. Based on body fat equivalence and comorbid disease risk, *BMIs of 23 kg/m^2 and 27.5 kg/m^2, respectively, have been recommended as the cut-off points for public health action in Asians.* **(pg 32)**

Grade C, Level 2$^+$

C Waist circumference is the most practical anthropometric measurement for assessing a patient's abdominal fat content before and during weight loss treatment, and should be used in conjunction with BMI to identify increased disease risk. The current international guidelines recommend waist circumference cut-offs of 102 and 88 cm to define excess risk in males and females respectively. *Based on an Asian-Pacific consensus, cut-offs of 90 and 80 cm, respectively, may be more appropriate for Asians.* **(pg 34)**

Grade C, Level 2$^+$

Assessment

GPP In clinical evaluation of patients, practitioners should consider and exclude predisposing factors for and secondary causes of obesity. **(pg 37)**

GPP

C Overweight and obese adults should be screened for comorbid conditions, and should be stratified according to their health risks, in particular for cardiovascular disease, prior to the commencement of treatment. **(pg 38)**

Grade C, Level 2$^+$

GPP

Table: Clinical and laboratory assessment (pg 38)

	Recommended items
History	• Detailed history of obesity: childhood weight history, previous weight loss attempts, and weight change triggers (e.g. significant life events, job change and smoking cessation) • Current level of motivation for and barriers to weight loss • Current and past medical history including psychiatric history • Current and past drug history including over-the-counter and traditional medications • Lifestyle factors including details on dietary habits (e.g. binge eating), exercise, sleep hygiene, smoking and alcohol intake • Attitude of family members and co-workers to diet and physical activity • Financial resources or lack of, and its impact on food choices and lifestyle habits • Assessment of stress level and coping mechanisms • Assessment of level of motivation and readiness to change
Physical examination	• Weight / height / BMI • Waist / hip circumference • Blood pressure • Signs of insulin resistance (acanthosis nigricans) and pathological causes such as moon facies, increased interscapular and supraclavicular fat pads and goitre
Laboratory evaluation	Metabolic profiling: • Fasting serum total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides • Fasting plasma glucose • Alanine transaminase / aspartate transaminase • ECG (if > 50 years)

Assessment for secondary causes:
- Thyroid function tests: Thyroid stimulating hormone / free thyroxine
- Cushing's syndrome: Screen only if clinically suspected
- Hypogonadism: Screen only if clinically suspected

BMI: body mass index; ECG: electrocardiography; HDL: high-density lipoprotein; LDL: low-density lipoprotein

GPP

C Patient motivation – an important prerequisite in weight loss management – should be relatively high before initiating therapy. Proper evaluation of issues related to motivation should be undertaken. **(pg 40)**

Grade C, Level 2⁺

Treatment: Introduction

A A multi-faceted or a multi-disciplinary strategy should be utilised to achieve and maintain weight loss. This could be adequately achieved at the primary health care level depending on the patient's response. **(pg 41)**

Grade A, Level 2⁺

A The appropriate short-term treatment goals are an initial 5–10% weight loss over 6 months, and if this is not attainable, then a prevention of further weight gain may be recommended, which can improve mechanical symptoms and metabolic parameters. Long-term goals should continue in the same vein as the short-term goals, and the patient should be encouraged to lose more weight if possible (e.g. 10–20% of initial body weight). **(pg 42)**

Grade A, Level 1⁺⁺

A Realistic weight loss should be safe and should preferably not exceed 0.5–1 kg a week. **(pg 42)**

Grade A, Level 1⁺⁺

Treatment: Diet

C Nutritional counselling should aim to facilitate long-term adherence to reduced-calorie diets to achieve sustainable weight loss. Every 24 kcal/day reduction in energy intake will eventually lead to approximately a 1 kg loss in body weight with half of the weight loss occurring in about one year. **(pg 44)**

Grade C, Level 2⁺⁺

B Physical activity should be recommended in addition to dietary changes as it can contribute to the maintenance of weight loss. **(pg 44)**

Grade B, Level 1⁺

A Diets that contribute to a calorie deficit of at least 500 kcal below estimated daily energy requirements are recommended to aid weight loss. The prescribed diets may be adjusted to meet the individual's nutritional needs and to encourage prolonged compliance. **(pg 47)**

Grade A, Level 1⁺

B Because of the lack of evidence for long-term beneficial effect, caution should be exercised when recommending a high-protein, low-carbohydrate diet, especially to individuals who have osteoporosis, kidney disease or elevated low-density lipoprotein cholesterol. **(pg 47)**

Grade B, Level 2⁺⁺

B Long-term compliance with a reduced-calorie diet and the adoption of positive lifestyle and behavioural changes should be encouraged to aid successful weight loss maintenance. **(pg 49)**

Grade B, Level 1⁺

GPP In order for weight loss or weight maintenance to be successful, food intake should ideally be distributed regularly throughout the day. Skipping of meals should be discouraged. Food portions at each meal should be adequate so as to prevent the need for frequent snacking between meals. **(pg 50)**

GPP

A Sugar-sweetened beverages should be avoided to prevent excess weight gain. **(pg 51)**

Grade A, Level 1⁺

C Maintain a diet that is higher in vegetables, legumes, fruits and whole grains, and lower in sugar and refined carbohydrates. **(pg 51)**

Grade C, Level 2⁺

D Adequate amounts of low energy density, lean, high-protein foods (e.g. chicken breast, fish, egg white, beans and tofu) should be included in weight loss diets to help control hunger. **(pg 51)**

Grade D, Level 4

GPP Dietary advice should consider foods that are locally available and match culinary preferences to facilitate long-term compliance. **(pg 51)**

GPP

D Caution should be exercised when making choices regarding processed foods as these can be energy dense and high in sugar. **(pg 51)**

Grade D, Level 4

Treatment: Physical Activity (PA)

A To maintain health and prevent diseases, overweight or obese adults should engage in ≥ 150 minutes of moderate-intensity physical activity per week. **(pg 53)**

Grade A, Level 1⁺

D Physicians should provide advice on physical activity regardless of BMI status. The exercise prescription should be tailored to individual patients, taking into consideration their body weight and comorbidities. **(pg 53)**

Grade D, Level 3

Screening:

GPP Patients should be screened for common comorbidities, current physical and behavioural readiness before participating in physical activities. **(pg 54)**

GPP

GPP For inactive/unfit individuals, the recommended weekly volume of activity should be gradually increased over time as fitness improves. **(pg 54)**

GPP

Aerobic physical activity:

C For weight loss, a negative energy balance (approximately 1000 kcal per day) achieved through both dietary restriction and physical activity is encouraged. **(pg 55)**

Grade C, Level 2⁺

Frequency:

GPP Physical activity should be established as a regular behaviour throughout the week. **(pg 55)**

GPP

Intensity:

D Moderate-intensity aerobic activity should be recommended for the management of body weight. **(pg 55)**

Grade D, Level 3

GPP For unfit/inactive individuals, light-intensity physical activity may be considered first before progressing to moderate-intensity over time. **(pg 55)**

GPP

Time:

A For weight loss, adults should engage in 150–420 minutes of moderate-intensity physical activity per week. **(pg 56)**

Grade A, Level 1⁺

B To maintain weight loss, adults should engage in 200–300 minutes of moderate-intensity physical activity per week. **(pg 56)**

Grade B, Level 1⁺

B Physical activity can be accumulated in short bouts of at least 10 minutes per session or one long bout of up to 60 minutes. **(pg 56)**

Grade B, Level 2⁺⁺

GPP A total of 10–60 minutes of physical activity is recommended per day, with a gradual increase for unfit/inactive individuals over time. **(pg 56)**

GPP

Type:

GPP Low-impact physical activities and cross training may be recommended. **(pg 56)**

GPP

Strength or resistance activity:

A Adults should engage in strength activities on two non-consecutive days per week to provide additional health benefits. **(pg 57)**

Grade A, Level 1⁺

Lifestyle & sedentary behaviour:

B Adults should be encouraged to spend less time engaging in sedentary behaviours. They should also break up prolonged periods of sitting. **(pg 57)**

Grade B, Level 2⁺

GPP Individuals should be encouraged to work towards taking 10,000 steps per day. **(pg 57)**

GPP

Treatment: Behavioural modifications and related therapy

D Healthcare professionals working with weight loss patients should strive to have the patient adopt a more 'internal' style of motivation over time, such as 'I want to' lose weight for personal satisfaction and enjoyment of activities. **(pg 58)**

Grade D, Level 2⁺

A Weight loss programmes should incorporate cognitive behavioural interventions for achieving weight loss and weight maintenance of up to 10% between 1–5 years of follow-up. **(pg 60)**

Grade A, Level 1⁺

B Interventions need to combine behavioural strategies, such as self-monitoring and goal-setting, with dietary modification and increased physical activity. **(pg 60)**

Grade B, Level 2⁺

A After initial weight loss treatment it is recommended that participants continue at least 6–12 months of a weight maintenance programme that combines dietary modification and physical activity. **(pg 62)**

Grade A, Level 1⁺

Treatment: Information and Communication Technology (ICT) and tools for weight loss

B Clinicians who implement or recommend ICT interventions to their overweight and obese patients should ensure that such interventions include established treatment components such as tailoring, goal setting, self-monitoring, social support and targeted feedback. **(pg 64)**

Grade B, Level 2⁺

Treatment: Medical treatment of obesity and related comorbidities

A Lifestyle modification should be the main treatment strategy for weight management. Pharmacotherapy, if used, should be adjunctive to lifestyle modification and be combined with diet, physical activity and behaviour modification. **(pg 65)**

Grade A, Level 1⁺

C Drug therapy may be considered when BMI is ≥ 30 kg/m^2, or when BMI is 27.5–29.9 kg/m^2 in Asians with comorbidities or complications of obesity such as hypertension, Type 2 diabetes mellitus. **(pg 65)**

Grade C, Level 2⁺

A Phentermine and mazindol may be used for weight management for the short-term (6–12 months). Liraglutide may be used for weight management up to 2 years while orlistat may be used as an anti-obesity drug for long-term therapy (up to 4 years). **(pg 70)**

Grade A, Level 1⁺

B Acupuncture by trained/qualified professionals may be considered as short-term, adjunctive anti-obesity therapeutic option on a case-by-case basis. **(pg 70)**

Grade B, Level 2⁺⁺

Treatment: Surgical and related options

C Bariatric surgery should be part of a programme of care delivered by a multi-disciplinary team including surgeons, dietitians, nurses, psychologists, physicians and physical therapists. It should only be carried out in institutions where a full range of facilities and services are available 24 hours a day. These include (but are not limited to): specialist medical and nursing staff, access to operating rooms and intensive care units and radiology service with interventional capability. **(pg 71)**

Grade C, Level 2⁺

A Patients with BMI above 40 kg/m^2, or above 35 kg/m^2 with at least one obesity-related comorbidity, especially if difficult to control with lifestyle and pharmacological therapy, may be considered for bariatric surgery as a medical treatment.* **(pg 73)**

Grade A, Level 1$^+$

B A bariatric procedure should only be offered after extensive work-up and discussions with the relevant stakeholders. **(pg 74)**

Grade B, Level 2^{++}

A Patients with Type 2 diabetes mellitus and other medical comorbidities should be followed up by appropriate physicians according to the usual protocols for management of the respective conditions. **(pg 75)**

Grade A, Level 1^{++}

C Lifelong follow-up by a multi-disciplinary team is mandatory for patients who undergo bariatric surgery. **(pg 76)**

Grade C, Level 2$^+$

B Regular laboratory tests should be made available to monitor nutritional deficiencies. Regular supplementation is mandatory following bariatric procedures with a malabsorptive component. **(pg 77)**

Grade B, Level 2^{++}

Fertility and pregnancy:

C Female patients should avoid getting pregnant post-bariatric surgery until weight loss has stabilised. Appropriate contraceptive advice should be given. **(pg 77)**

Grade C, Level 2$^+$

C Close liaison between the obstetrician and the bariatric team is highly desirable. For pregnant women who have undergone bariatric surgery, nutritional supplements over and above the usual requirements in a normal pregnancy are recommended. **(pg 77)**

Grade C, Level 2$^+$

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* Based on WHO BMI data, Asian BMI data is estimated to be about 2.5 kg/m^2 lower.

Older population:

C Among the older population, each case of bariatric surgery should be considered on its own merit taking into account the special circumstances affecting the older age group. **(pg 78)**

Grade C, Level 2+

Adolescents:

B Bariatric surgery should be considered only for obese paediatric patients who fulfil the following criteria: **(pg 79)**

1. The adolescent has attained Tanner 4 or 5 pubertal development, and final or near-final adult height.
2. The adolescent has BMI greater than 50 kg/m^2 or has BMI above 40 kg/m^2 and significant severe comorbidities.
3. Severe obesity and comorbidities persist despite a formal programme of lifestyle modification, with or without a trial of pharmacotherapy.
4. Psychological evaluation confirms the stability and competence of the family unit.
5. There is access to an experienced surgeon in a medical centre employing a team capable of long-term follow-up of metabolic and psychosocial needs of the patient and the family. The institution must also be either participating in a study of the outcome of bariatric surgery or sharing data.
6. The adolescent demonstrates the ability to adhere to the principles of healthy dietary and activity habits.

Grade B, Level 2++

B Adolescents undergoing bariatric surgery must be able to provide informed consent and understand the nature of the operation, the risks involved, and the need for long-term follow-up. **(pg 80)**

Grade B, Level 2++

Special focus: Children and adolescents

GPP During the transition to young adulthood, there may be discrepancy in weight status due to differences in the two classification systems. For the older adolescents (e.g. > 16 years old), obesity may be defined as a BMI-for-age equal to or greater than 97th percentile, or BMI equal to or greater than 30 kg/m^2, whichever criterion is met. **(pg 84)**

GPP

GPP The majority of overweight and obese children may be managed in primary care. Referral to tertiary general paediatric, paediatric endocrine or medical genetic clinics should be guided by the degree of obesity, presence or likelihood of comorbidities (e.g. family history), or where pathological cause of obesity is suspected. **(pg 84)**

GPP

GPP In children, investigations for comorbidities should not be regarded as routine, but may be ordered as indicated clinically. Screening may include glucose levels, lipid profile, liver function test or other investigations if clinically indicated. **(pg 87)**

GPP

C Obese children and adolescents (BMI ≥ 97th percentile) should be evaluated for obesity-related comorbidities or complications. Overweight children (BMI ≥ 90–97th percentile) should be screened for comorbidities, especially if risk factors are present. **(pg 87)**

Grade C, Level 2$^+$

D Screening for Type 2 diabetes mellitus may be performed for Asian overweight and obese children who are in puberty or ≥ 10 years old, and have any one of these risk factors: Family history of Type 2 diabetes mellitus in first- or second-degree relatives, maternal gestational diabetes, and features of insulin resistance (acanthosis nigricans, hypertension, dyslipidaemia, non-alcoholic fatty liver disease, polycystic ovarian syndrome). Repeat screening with fasting glucose or oral glucose tolerance test can be offered every 2 years if excessive adiposity persists. **(pg 87)**

Grade D, Level 4

GPP The vast majority (> 95%) will have common or primary obesity. Pathological causes or secondary obesity (inclusive of monogenic causes) are uncommon but should be carefully considered. If there are no significant abnormalities in the history and examination indicative of pathological causes of obesity, investigations for these pathologies are generally not necessary. Testing may be limited to thyroid function. If there are clinical suspicions of pathological causes, these patients should be referred to tertiary centres for proper investigations and interpretation of the results. **(pg 87)**

GPP

D Weight management in children and adolescents should emphasise behavioural modifications that influence weight status e.g. healthy eating habits and regular physical activity, rather than focus on actual weight loss. Weight maintenance or a slower weight gain to allow a gradual decline in BMI is an acceptable approach for pre-pubertal children with obesity. Weight loss should be limited to post-pubertal adolescents who are severely overweight and are supervised by paediatric specialists. **(pg 89)**

Grade D, Level 4

D Referral to a paediatric specialist or structured weight management programme for children and adolescents should be considered for the following cases: Children with a suspected secondary cause of obesity, severely overweight children and adolescents with comorbidities that require weight loss. **(pg 89)**

Grade D, Level 4

A Obese children and adolescents should enrol in multi-component lifestyle interventions, which consist of nutrition, physical activity and behavioural modifications, which can result in a modest, but significant reduction in obesity and cardiovascular risk, compared to standard care, self-help or no treatment. **(pg 90)**

Grade A, Level 1⁺

A Parental involvement can enhance the effectiveness of lifestyle interventions, particularly in pre-adolescent children, by changing and adapting parenting styles, parenting skills and child management strategies during the intervention, such as role modelling and active parental participation. **(pg 90)**

Grade A, Level 1⁺

C Dietary interventions for obese children and adolescents should comprise the following strategies: reducing intake of calorie-dense, nutrient-poor foods (sweetened beverages, fruit drinks and juices, fast foods, calorie-dense snacks), portion control, reducing saturated fat intake (for children > 2 years), encouraging intake of fibre / whole grains, fruits and vegetables, as well as encouraging healthy eating behaviours such as eating regular meals (especially breakfast), avoiding having meals in front of the television (TV) / computer and avoiding frequent food nibbling or "grazing" during the day, especially after school. Diets should also be adequate in micronutrient intake to promote optimal linear growth. **(pg 91)**

Grade C, Level 2⁺⁺

D The use of restrictive diets is not appropriate for children and adolescents except when combined with specialist supervision and intensive follow-up. **(pg 92)**

Grade D, Level 4

A Physical activity should be routinely included within a multi-component lifestyle intervention for reducing overweight and obesity in school-age children and adolescents. **(pg 92)**

Grade A, Level 1⁺

D Obese children and adolescents should be encouraged first to meet the National Physical Activity Guidelines for children and youths by increasing their daily physical activity level progressively. Additional physical activity on top of the recommended guidelines may be needed for general health benefits for this group of youths. **(pg 93)**

Grade D, Level 4

D Sedentary activities (TV viewing, playing video games etc.) should be limited to not more than 2 hours a day, or equivalent to 14 hours per week for all children. **(pg 93)**

Grade D, Level 4

A Pharmacotherapy for weight loss should only be considered as an adjunct to lifestyle interventions in obese adolescents with severe comorbidities or when lifestyle interventions have failed. It should only be administered by experienced clinicians. The decision should be carefully weighed against the potential for adverse effects, the lack of evidence for persistent weight loss after active treatment and the long-term safety in adolescents. **(pg 94)**

Grade A, Level 1⁺

Special focus: Pregnancy

Screening:

B Women of childbearing age, especially overweight and obese women, should receive information and advice from healthcare providers about the benefits of weight loss before pregnancy and the risks of being overweight or obese. An ideal preconception weight will optimise pregnancy outcome for both mother and baby. **(pg 95)**

Grade B, Level 2⁺

B Height and pre-pregnancy weight should be recorded in the health record for all women at the initial antenatal visit. Pre-pregnancy BMI can be calculated and classified using the WHO BMI cut-off points (see Table 11). **(pg 95)**

Grade B, Level 2⁺

D Prior to attempting to conceive, women of childbearing age should stop taking medication for weight loss. **(pg 95)**

Grade D, Level 4

Pregnancy weight management:

B The range of desirable total weight gain and the rate of gain should be discussed with the woman early in her pregnancy. A plan to achieve these goals should be documented. **(pg 96)**

Grade B, Level 2⁺

B Nutritional advice should be routinely provided to all pregnant women (refer to Chapter 7 on Treatment: Diet for an explanation of a healthy diet). General advice should include: **(pg 96)**

- Eating a healthy, balanced diet as per "Pregnancy and Diet, Health Promotion Board, Singapore" including foods rich in calcium, folate and iron.
- Not restricting dietary intake below the recommended food group requirements for pregnancy.
- Avoiding certain foods and drinks (such as raw foods, coffee/tea and alcohol) which can be harmful to the pregnancy.
- Taking folic acid supplements.
- Adhering to recommended weight gain ranges (Table 11).

Grade B, Level 2⁺

B In the absence of obstetric or medical complications, all pregnant women should accumulate 150 minutes per week of moderate-intensity exercise (e.g. accumulate 30 minutes per day, best to spread this activity throughout the week). Qualified supervision may be offered to assist with assessment and individual exercise prescription. **(pg 97)**

Grade B, Level 2⁺

Complications of obesity in pregnancy:

B Consider booking an early visit to plan pregnancy care. A pregnancy care plan with increased clinical surveillance is recommended for obese, pregnant women in the antenatal, intrapartum and postnatal periods. Consider a cardiac risk assessment for women with pre-existing medical conditions, especially those with Class III Obesity and who have other risk factors such as smoking or Type 2 diabetes mellitus. **(pg 97)**

Grade B, Level 2⁺⁺

B All overweight or obese women should be screened for diabetes with a 75 g oral glucose tolerance test at 24–28 weeks gestation. For women with Class II and III Obesity (pre-pregnancy BMI ≥ 35.0 kg/m^2), consider an early oral glucose tolerance test (below 14 weeks gestation if possible) to assess for pre-existing diabetes. If the initial oral glucose tolerance test is negative, consider repeating at 28 weeks if the risk of diabetes is significantly high or if the patient exhibits clinical symptoms of diabetes. **(pg 97)**

Grade B, Level 2^{++}

B For women with Class III Obesity (pre-pregnancy BMI ≥ 40 kg/m^2), co-manage with a physician who will establish baseline renal (presence of proteinuria, serum creatinine and urea) and liver function to assist in distinguishing chronic renal dysfunction secondary to maternal chronic hypertension and/or diabetes from pregnancy-associated hypertensive/diabetic disorders. **(pg 98)**

Grade B, Level 2^{+}

B The risk of venous thromboembolism for every obese woman should be evaluated in the presence of additional clinical risk factors. Thromboprophylaxis for antenatal and postnatal, if indicated, should be individualised. **(pg 98)**

Grade B, Level 2^{++}

B Consider antenatal anaesthetic consultation to review analgesic options, especially for women with pre-pregnancy BMI > 35 kg/m^2 and consider facility capabilities including equipment and extra staffing when performing caesarean section and other surgeries. **(pg 99)**

Grade B, Level 2^{+}

Post-natal management:

D Discuss healthy eating, physical activity and breastfeeding as strategies for returning to pre-pregnancy weight with all postpartum women. Women in a healthy pre-pregnancy BMI range should be advised of the importance of maintaining a healthy pre-pregnancy BMI between pregnancies. Overweight and obese women should be encouraged to lose weight before considering a future pregnancy. **(pg 99)**

Grade D, Level 4

D

Offer obese women additional support for breastfeeding. Consider referral to a lactation consultant, increasing supervision during breastfeeding and providing early postpartum breastfeeding support. **(pg 99)**

Grade D, Level 4

1 Introduction

1.1 Objective of the guidelines

This Clinical Practice Guidelines (CPG) on Obesity is an update of the Obesity CPG developed by the Ministry of Health in 2004. The revised guidelines aim to provide health and allied healthcare professionals updated evidence-based recommendations to support effective interventions to manage obesity.

These guidelines are not to be viewed as a protocol, but they provide a framework to:

- assist health and allied healthcare professionals in the management of overweight and obesity in the community and clinical setting;
- provide an update of various lifestyle, behavioural, medical, surgical and ancillary intervention modalities in the management of obesity; and
- address the management concerns of specific populations (e.g. children, adolescents, pregnant women).

1.2 Target users

These guidelines are intended for all medical and allied healthcare professionals who have a role in managing overweight or obese patients. This includes medical professionals such as general practitioners, endocrinologists, paediatricians, surgeons, family physicians, advanced practice nurse clinicians as well as allied healthcare professionals such as nutritionists, dietitians, pharmacists, and exercise and behavioural therapists.

1.3 Guideline development

The Obesity CPG is developed by a committee appointed by the Health Promotion Board, a statutory board under the Ministry of Health. The committee comprises of specialists from the fields of endocrinology, surgery, paediatrics, family medicine, obstetrics and gynaecology, sports science and physical activity, nutrition and dietetics, behavioural sciences and psychology as well as public health specialists. The guidelines are developed by reviewing the best current research evidence.

1.4 Review of guidelines

Evidence-based clinical practice guidelines are only as current as the evidence supports them. Users must keep in mind that new evidence could supersede recommendations in these guidelines. The committee advises that these guidelines be scheduled for review 5 years after publication, or if new evidence emerges that requires substantive changes to the recommendations.

2 Epidemiology, public health aspects and definition

2.1 The epidemiology of obesity

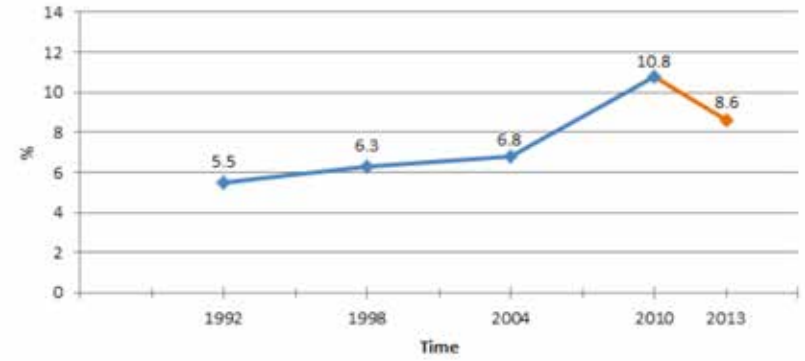
Obesity can be defined as a condition of abnormal or excessive accumulation of body fat to the extent that health may be adversely affected[1] and is associated with various major chronic diseases including cardiovascular disease, Type 2 diabetes mellitus and cancer. These are discussed in greater detail in Chapter 3.

2.2 Overweight and obesity in Singaporean adults

The prevalence of overweight (body mass index [BMI] ≥ 25 kg/m^2) among all Singapore adults in 2013 was 34.3% with 40.2% of males and 28.6% of females considered overweight. The prevalence of pre-obesity (BMI 25–29.9 kg/m^2) was 25.7% and was also higher in males (30.8%) than in females (20.7%).[2]

The prevalence of obesity (BMI ≥ 30 kg/m^2) among Singapore adults is on an upward trend increasing from 5.5% in 1992[3] to 8.6% in 2013* (see Figure 1) with 9.4% of males and 7.9% of females considered obese. Among the ethnic groups in Singapore, 20.7% of Malays, 14.0% of Indians and 5.9% of Chinese were considered obese (see Figure 2). The highest prevalence of obesity was also noted in the 30-39 year old age group (11.5%).[2]

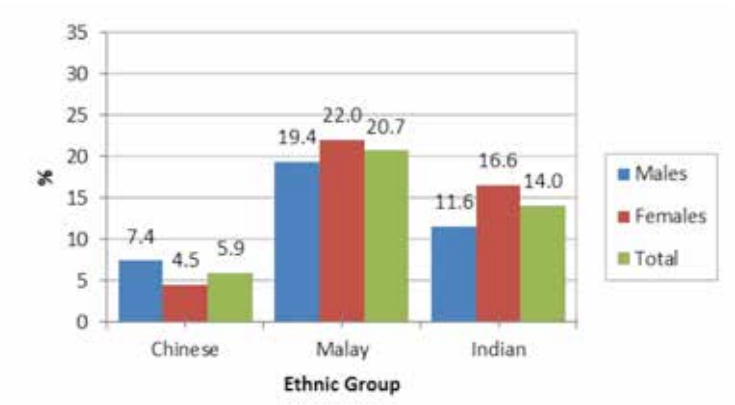
Figure 1: Age-standardised prevalence of obesity (BMI ≥ 30 kg/m²) in Singapore adults (1992–2013)*



Source: Ministry of Health, Singapore. National Health Survey 1992, 1998, 2004 & 2010; National Health Surveillance Survey 2013.

*2013 data is not directly comparable with previous years' due to differences in research methodology.

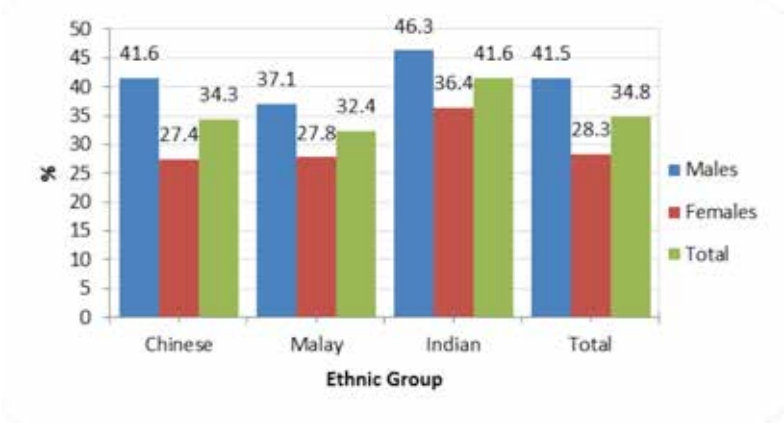
Figure 2: Crude prevalence of obesity (BMI ≥ 30 kg/m²) among Singapore residents aged 18–69 years, by gender and ethnic group in 2013



Source: Ministry of Health, Singapore. National Health Surveillance Survey 2013.

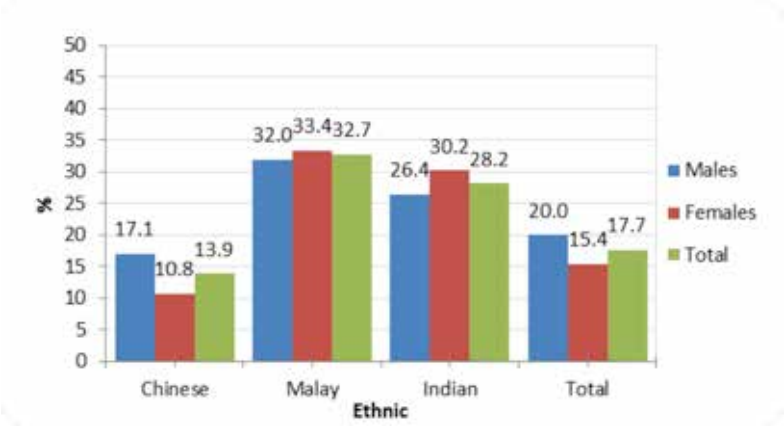
The World Health Organization (WHO) has revised the BMI risk categories for cardiovascular disease and diabetes in Asian populations into low-risk (18.5–22.9 kg/m^2), moderate-risk (23.0–27.4 kg/m^2) and high-risk (≥ 27.5kg/m^2).[4] Based on these categories, 39.7% of Singapore adults aged 18–69 years have a low-risk BMI, 34.8% have a moderate-risk BMI (see Figure 3) and 17.7% have a high-risk BMI (see Figure 4).

Figure 3: Prevalence of moderate-risk BMI among Singapore adults by gender and ethnic group in 2013



Source: Ministry of Health, Singapore. National Health Surveillance Survey 2013.

Figure 4: Prevalence of high-risk BMI among Singapore adults by gender and ethnic group in 2013



Source: Ministry of Health, Singapore. National Health Surveillance Survey 2013.

2.3 Obesity in childhood and adolescence in Singapore

The prevalence of childhood overweight/obesity has increased worldwide over the past few decades[5-10] though there are signs of stabilisation in some age groups of children in certain countries.[11-14] In Singapore, a review of eight anthropometric studies conducted over the past five decades (from 1957 to 2002) found that although the height of pre-schoolers and school-age children appeared to have optimised according to their genetic potential, their weight was found to be still increasing, and as such BMI was also increasing.[15,16]

From July 2010, BMI-for-age norms replaced the weight-for-height norms measures in schools. As both measures are different, direct comparison between 2010 statistics and those from earlier years cannot be made for trend analysis. Using the BMI-for-age norm, the prevalence of overweight/severely overweight for students in primary and secondary schools in Singapore for 2010 is shown in Table 1. The prevalence of overweight/severely overweight was 12.0% among primary school students and 10.5% among secondary school students.

Table 1: Prevalence of overweight/severely overweight among students in primary and secondary schools in Singapore, 2010

	Prevalence of overweight/ severely overweight (%)		
School level	Male	Female	Total
Primary school	13.2	10.6	12.0
Secondary school	11.1	9.8	10.5

Childhood overweight / obesity is a public health concern given the adverse effects on the health and quality of life in childhood, as well as the increased risk of obesity and associated health complications in adulthood.[17]

2.4 Conclusion

Overweight and obesity are growing problems in Singapore adults and in children and adolescents. Strategies for our population are required to address this rising trend so as to reduce the morbidity and mortality rate attributable to obesity.

3 Clinical significance of obesity

3.1 Importance of addressing obesity

Being overweight is a well-established risk factor for cardiovascular disease and Type 2 diabetes as part of the metabolic syndrome,[18] and other chronic diseases such as cancer, osteoarthritis, gallbladder disease, obstructive sleep apnoea and psychosocial disorders.[4,19] It is also significantly associated with a high risk of premature mortality[20] and with reductions in average life expectancy.[21,22] In addition to overall body fatness, the distribution of fat is relevant for the risk of chronic diseases with an abdominal fat distribution (including excess subcutaneous and visceral fat) having particularly detrimental cardio-metabolic effects.[23,24]

3.2 Major complications and comorbidities of obesity

3.2.1 Cardiovascular disease

Being overweight is an independent risk factor for cardiovascular disease morbidity and mortality through the influence on principal risk factors such as hypertension and dyslipidaemia,[25] and other risk factors such as inflammation and insulin resistance.[26] Cardiovascular diseases affected by obesity include coronary heart disease, stroke, congestive heart failure, arrhythmias ('sudden cardiac death') and cardiomyopathy.[27] Recent large epidemiological studies in both Western and Asian populations have shown significant associations between being overweight and an increased risk of stroke in both males and females,[28-31] resulting in the American Heart Association and the American Stroke Association currently recommending the treatment of obesity as both a primary[32] and secondary[33] stroke prevention intervention.

3.2.2 Metabolic and endocrine disorders

Results from several large population-based epidemiological studies have demonstrated a close relationship between high body fat mass and the risk of Type 2 diabetes.[34,35] Independent of current weight status, the level, duration and fat distribution of overweight and obesity has a strong influence on the risk of developing diabetes.[36,37]

Proposed mechanisms linking obesity and insulin resistance, and the onset of diabetes include: (a) reduced levels of adiponectin and the increased production of adipokines,[38] (b) ectopic fat deposition, particularly in the liver,[39] and (c) mitochondrial dysfunction, as evident by decreased mitochondrial mass and/or function that has been implicated in decreasing insulin sensitivity and β-cell function.[40]

Obesity is also an important contributory cause to impaired glucose tolerance[41] that increases the risk of cardiovascular disease. Several studies have shown that obese children and adolescents with impaired glucose tolerance (referred to as pre-diabetes), intra-myocellular and intra-abdominal lipid accumulation is closely linked to the development of severe peripheral insulin resistance.[42-44]

Overweight, in particular central obesity and insulin resistance have been shown to be important contributors to the development of polycystic ovarian syndrome (PCOS).[45,46] In females, the early onset of obesity is linked to menstrual irregularities, anovulation, infertility and increased risk of miscarriage, whereas in males it is associated with low levels of testosterone, reduced spermatogenesis and erectile dysfunction.[47]

3.2.3 Obstructive sleep apnoea

Obstructive sleep apnoea (OSA) is the occurrence of recurrent episodes of upper airway obstruction/collapse during sleep. Obesity, in particular central obesity,[48] has been shown to be a risk factor for obstructive sleep apnoea.[49,50] Several studies have shown that there is also an increased prevalence of metabolic syndrome in subjects with obstructive sleep apnoea.[51,52] Obstructive sleep apnoea increases cardiovascular risk through various mechanisms, such as insulin resistance and increased leptin levels.[50,53]

Weight loss, through dietary,[54] pharmacological[55] and surgical[56] interventions has been shown to be associated with improvements in severity indices of sleep apnoea.

3.2.4 Cancers

Certain cancers are more prevalent in overweight and obese individuals, termed 'obesity-related cancers'.[19,57] Recent studies showed strong associations between increased BMI and the risk of colorectal, oesophageal adenocarcinoma, kidney and pancreatic cancer for both males and females; increased risk of thyroid cancer in males, and of gallbladder, endometrial and postmenopausal breast cancer in females.[57,58] Weaker associations were noted for risk of leukaemia and non-Hodgkin's lymphoma in males and females; for malignant melanoma, multiple myeloma and rectal cancer in males, and for premenopausal breast cancer in females.

3.2.5 Orthopaedic disorders

A high BMI has been identified as a major risk factor for the onset and progression of knee osteoarthritis,[59,60] suggesting that mechanical stress may be a contributing factor. However, evidence for hip osteoarthritis is limited.[60] Other observational studies have shown a moderate association between obesity and a higher risk of osteoarthritis of the smaller non-weight bearing joints of the hand.[61] These findings suggested that other non-mechanical factors such as adipokines and inflammatory factors may also be involved.[62,63]

3.2.6 Gallbladder disease

Abdominal obesity is a well-known risk factor for gallstones.[64,65] A meta-analysis of four prospective studies evaluating the association between obesity and risk of gallbladder disease showed a greater risk for both men and women.[19]

3.2.7 Fatty liver diseases

Non-alcoholic fatty liver disease is closely associated with obesity and is regarded as the liver manifestation of the metabolic syndrome.[66,67] A systematic review of four studies reviewing the epidemiology and natural

history of non-alcoholic fatty liver disease in adults showed that it is highest in populations with pre-existing metabolic conditions such as obesity and Type 2 diabetes.[68]

3.2.8 Psychosocial problems

Significant psychological consequences in the form of depression, low self-esteem and poor body image have been documented in obese individuals as a consequence of prejudice and discrimination due to weight stigmatisation.[69]

4 Diagnosis and Classification

4.1 Adults

The WHO defines obesity as abnormal or excessive fat accumulation to the extent that health may be impaired.[1] It is well established that adipose tissue is not uniformly distributed throughout the body with more or less fat stored in the abdomen, and fat accumulating in either subcutaneous or visceral adipose tissue compartments. This is of relevance as these different anatomical distributions in both males and females have unique metabolic properties.[70]

While there are accurate methods to measure body fat, the methods must be feasible at the ground and practicable. Many techniques are often expensive and require special skills, or are not readily available clinically.

4.1.1 BMI and excess weight

The WHO has recommended BMI (kg/m^2) as an international index to assess total body fat by classifying underweight, overweight and obesity in adults (see Table 2).[1] This classification is based primarily on the association between BMI and disease risk of comorbidities,[71] and has been shown to be the most suitable for assessing weight status as it is minimally correlated with height while being highly correlated with body fat percentage.[72,73]

Table 2: Weight classification of adults (aged 18 and above) according to BMI[#1]

Classification	BMI	Risk of comorbidities
Underweight	<18.5	Low*
Normal range	18.5–24.9	Average
Overweight (Pre-obese)	25.0–29.9	Increased
Obese class I	30.0–34.9	Moderate
Obese class II	35.0–39.9	Severe
Obese class III	≥ 40.0	Very severe

[#] Age dependent and the same for both sexes
*Associated with increased risk of other clinical conditions

BMI does have some limitations. At the same BMI as younger adults, older adults (> 65 years old) tend to have a higher body fat composition as a result of loss of lean body mass with age. Therefore the use of BMI to assess health risk is less accurate in this sub-population.[74]

BMI also does not assess body fat distribution in the context of the higher morbidity associated with abdominal (central, visceral) obesity in males compared to the gluteofemoral (peripheral) obesity observed in females.[75]

The WHO Expert Consultation Group recommends the current BMI cut-off points should be retained as international classifications. However, further 'potential public health action points' (23.0, 27.5, 32.5 and 37.5 kg/m^2) indicating different levels of health risks should be considered for the Asian population (see Table 3). The WHO recommends that countries should make decisions about the definitions of increased risk for their specific population.

Table 3: Proposed BMI cut-off points for public health action in Asians

Cardiovascular disease risk	Asian BMI cut-off points for action (kg/m²)	Current WHO BMI cut-off points (kg/m²)
	<18.5	<18.5
Low	18.5–22.9	18.5–24.9
Moderate	23.0–27.4	25.0–29.9
High	27.5–32.4	30.0–34.9
Very high	32.5–37.4	35.0–39.9
	≥ 37.5	≥ 40.0

Some Asian populations had a higher percentage of body fat,[76-78] while some Pacific populations[79] had a lower percentage of body fat compared with Caucasian populations of the same age, sex and BMI.

Studies conducted among Asian populations in China,[80] Singapore,[81] Pakistan[82] and Taiwan[83] have found a higher prevalence of Type 2 diabetes and increased cardiovascular risk factors at BMI below 25 kg/m², with associations between BMI and health risks differing across the various populations based on ethnicity, age and gender. Other studies[84,85] in Korea and Japan, however, did not demonstrate a need to lower BMI cut-off points for obesity in Asians.

C

Current WHO and international guidelines recommend BMI cut-offs of 25 and 30 kg/m² to define overweight and obesity respectively. Based on body fat equivalence and comorbid disease risk, *BMIs of 23 kg/m² and 27.5 kg/m², respectively, have been recommended as the cut-off points for public health action in Asians.*

Grade C, Level 2⁺

4.1.2 Abdominal obesity

Abdominal adiposity (subcutaneous and visceral) is associated with cardiovascular risks of the metabolic syndrome, including Type 2 diabetes, hypertension and hyperlipidaemia.[86]

4.1.3 Waist circumference, waist–hip ratio and others

Waist circumference (WC) should be measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest.[87] This parameter is reasonably well correlated with the amount of visceral adipose tissue, highly correlated with general adiposity[88] and is a useful measure for predicting chronic disease risk.[89]

Both the waist and waist-hip ratio increases with age. A large portion of this increase is due to an increase in the body weight. This increase is larger than would be predicted from an increase in BMI alone and an increase in waist circumference is observed in ageing without weight gain.[90] This may reflect that waist circumference is less affected by loss in lean body mass, which often occurs with ageing, compared to BMI. Using waist circumference rather than using BMI may thus be particularly advantageous in older individuals.

The cut-offs for waist circumference recommended by the WHO are shown in Table 4. Recent studies have indicated the cut-offs for Asians should be lower than for Europeans.[91] A reduction in waist measurement, even without weight loss, may result in significant cardiovascular risk reduction.[92]

Table 4: High-risk gender-specific waist measurement thresholds

Guideline	Waist circumference (cm)	
	Men	Women
WHO[75]	102	88
Asia Pacific Consensus[93]	90	80

The waist-to-hip ratio (WHR) is another method of determining abdominal obesity. Commonly used cut-offs indicative of increased risk of metabolic

complications are for men > 0.90 and for women > 0.85.[94,95] Waist circumference is, however, preferred because it is a better marker of abdominal fat content than waist-to-hip ratio, and is easier to measure and to interpret.

The waist-to-height ratio (WHtR) has also been reported as an indicator of central obesity that has been correlated with abdominal fat assessed by imaging techniques.[96,97] Waist-to-height ratio has been shown to denote cardio-metabolic risk among individuals who are not obese according to other anthropometric indices.[98,99] The cut-off of 0.5 for both men and women is commonly used as a boundary value for increased risk in men and women,[97,98] although some Asian studies have reported a lower cut-off. While in recent years waist-to-height ratio has been suggested as a better screening tool than BMI and waist circumference for assessing cardio-metabolic risk,[100-102] several studies showed that waist circumference was a better predictor of cardiovascular disease risk.[88,103-105]

C Waist circumference is the most practical anthropometric measurement for assessing a patient's abdominal fat content before and during weight loss treatment, and should be used in conjunction with BMI to identify increased disease risk. The current international guidelines recommend waist circumference cut-offs of 102 and 88 cm to define excess risk in males and females respectively. *Based on an Asian-Pacific consensus, cut-offs of 90 and 80 cm, respectively, may be more appropriate for Asians*.

Grade C, Level 2+

4.1.4 Body composition analysis

There are several other methods used outside of large epidemiological studies for the analysis of body composition and estimation of body fat. These include skinfold measurement, bioimpedance analysis (BIA) and dual-energy x-ray absorptiometry (DXA), computed tomography (CT) and magnetic resonance imaging (MRI) for the measurement of visceral fat.[106] Other less used methods include isotope dilution techniques (such as deuterium oxide dilution), densitometry (using underwater weighing or air plethysmography), and 4-compartment estimation (using a combination of methods to assess the content of water, lean tissue, mineral and fat).[4]

Skinfold measurement, requiring only skinfold callipers, is inexpensive, but the person conducting the measurements must be skilled and experienced. It also has limitations with regard to validity as a measure of body fat percentage and central adiposity and reproducibility.[107,108] BIA mostly measures extracellular and intracellular water (fat-free mass) and not fat mass directly. At present, standardised protocols of usage in diverse populations have yet to be established due to ethnic differences that exist in the interpretation of skinfold and BIA measurements.[24,109]

The other methods to determine body fat are also indirect, more laborious, time-consuming, costly and not suitable for use in general clinical practice.

5 Assessment

The objective of clinical evaluation is to assess the severity of obesity in the patient and examine its impact. Once evaluation is complete, the healthcare provider will be able to formulate a treatment and management plan for the patient.

The assessment approach must determine the causes and the impact of obesity. In addition, it should involve an assessment of the patient's motivation and readiness to change.

5.1 Causes of obesity

Causes of obesity are often hard to establish with great precision. The most frequent form of obesity is common obesity. As much as 40–70% of BMI variance is attributed to genetic factors.[110] In clinical settings, it is rarely necessary to perform detailed genetic studies during assessment.

Environmental factors are often implicated in the pathogenesis of obesity. These include:

- sedentary lifestyle;
- high intake of energy-dense foods;
- lack of regular physical activity;
- heavy marketing of energy-dense foods and proliferation of fast food; and
- sleep insufficiency.

Secondary causes of obesity are rarely seen. These may include:

- drug-induced obesity;
- endocrine causes (Cushing's syndrome, hypogonadism, hypothyroidism); and
- genetic disorders (often characterised by hyperphagia and severe obesity from early childhood e.g. Prader-Willi, melanocortin-4 receptor deficiency).

Clinical studies have also identified insomnia, depression and binge eating disorder as secondary causes of obesity.

GPP In clinical evaluation of patients, practitioners should consider and exclude predisposing factors for and secondary causes of obesity.

GPP

5.2 Impact of obesity

The following conditions may be the result of, or associated with, or aggravated by obesity.

5.2.1 Metabolic/inflammatory

- Cardiovascular disease: Coronary artery disease, congestive cardiac failure, stroke
- Type 2 diabetes
- Dyslipidaemia
- Hypertension
- Cancers
- Infertility / polycystic ovarian syndrome
- Non-alcoholic fatty liver disease / gallstones / pancreatitis
- Renal stones
- Gout
- Asthma

5.2.2 Mechanical

- Osteoarthritis of knees/hips/back
- Musculo-skeletal pain
- Obstructive sleep apnoea / obesity hypoventilation syndrome
- Hernia
- Varicose veins
- Stress incontinence

5.2.3 Psychosocial

- Depression
- Anxiety

C Overweight and obese adults should be screened for comorbid conditions, and should be stratified according to their health risks, in particular for cardiovascular disease, prior to the commencement of treatment.[19,25,27,37]

Grade C, Level 2+

5.3 History and clinical examination

Wherever possible, each patient should be assessed for the degree of obesity (see Table 2 on page 31). Baseline clinical evaluation should include the items listed in Table 5.

GPP **Table 5: Clinical and laboratory assessments**

	Recommended items
History	• Detailed history of obesity: childhood weight history, previous weight loss attempts, and weight change triggers (e.g. significant life events, job change and smoking cessation) • Current level of motivation for and barriers to weight loss • Current and past medical history including psychiatric history • Current and past drug history including over-the-counter and traditional medications • Lifestyle factors including details on dietary habits (e.g. binge eating), exercise, sleep hygiene, smoking and alcohol intake • Attitude of family members and co-workers to diet and physical activity • Financial resources or lack of, and its impact on food choices and lifestyle habits • Assessment of stress level and coping mechanisms • Assessment of level of motivation and readiness to change

Physical examination	• Weight / height / BMI • Waist / hip circumference • Blood pressure • Signs of insulin resistance (acanthosis nigricans) and pathological causes such as moon facies, increased interscapular and supraclavicular fat pads and goitre
Laboratory evaluation	Metabolic profiling: • Fasting serum total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides • Fasting plasma glucose • Alanine transaminase / aspartate transaminase • ECG (if > 50 years) Assessment for secondary causes: • Thyroid function tests: Thyroid stimulating hormone / free thyroxine • Cushing's syndrome: Screen only if clinically suspected • Hypogonadism: Screen only if clinically suspected

BMI: body mass index; ECG: electrocardiography; HDL: high-density lipoprotein; LDL: low-density lipoprotein

GPP

5.4 Patient motivation and goal setting

During assessment, it is appropriate to set realistic, personalised goals that take into account of the patient's physical condition, motivation level, social support, stress level and other psychological factors. Often normalisation of BMI is not a realistic goal. Instead, an initial goal of 5–10% weight loss over 6 months will help reduce comorbidities significantly. An appropriate goal might also be weight maintenance (or weight gain prevention). In the long term, keeping weight off is an important goal.

C

Patient motivation – an important prerequisite in weight loss management – should be relatively high before initiating therapy. Proper evaluation of issues related to motivation should be undertaken.

Grade C, Level 2⁺

6 Treatment: Introduction

The patient's level of motivation and the goals determined with his healthcare provider will decide the treatment intensity and modality. The appropriate short-term treatment goals are an initial 5–10% weight loss over 6 months, and if this is not attainable, a prevention of further weight gain, which can improve mechanical symptoms and metabolic parameters.

The long-term goals should continue in the vein of the short-term goals, and the patient should be encouraged to lose more weight if possible (e.g. 10–20% of initial body weight).

Realistic weight loss should be safe and should preferably not exceed 0.5–1kg a week.[111]

Evidently, management of obesity requires a multi-faceted, multi-disciplinary approach. The latter involves a multi-disciplinary team comprising physicians, dietitians, behavioural therapists and exercise therapists. Family members should be involved where possible.

Treatment should be holistic and involve a combination of dietary therapy, physical activity, behavioural modifications, medical treatment and surgical options.

A multi-faceted strategy should be utilised to achieve and maintain weight loss. This could be adequately achieved at the primary health care level for many patients, but may require multi-disciplinary expertise at primary or tertiary level to address individual aspects in more difficult or resistant cases. The multi-faceted approach addresses weight control from several angles, not all of which need to be employed, but rather is dependent on the evaluation of the patient's requirements.

A A multi-faceted or a multi-disciplinary strategy should be utilised to achieve and maintain weight loss. This could be adequately achieved at the primary health care level depending on the patient's response.

Grade A, Level 2+

A The appropriate short-term treatment goals are an initial 5–10% weight loss over 6 months, and if this is not attainable, then a prevention of further weight gain may be recommended, which can improve mechanical symptoms and metabolic parameters. Long-term goals should continue in the same vein as the short-term goals, and the patient should be encouraged to lose more weight if possible (e.g. 10–20% of initial body weight).

Grade A, Level 1++

A Realistic weight loss should be safe and should preferably not exceed 0.5–1kg a week.

Grade A, Level 1++

The concept of caloric balance

A reduced calorie intake will lead to weight loss in the absence of changes in physical activity. Sustained dietary modification is necessary to avoid weight regain. Therefore, dietary counselling should focus on optimal dietary habits for individuals to achieve long-term adherence to a reduced calorie diet.

Weight loss requires a negative energy balance; dietary energy intake has to be lower than energy expenditure for weight loss to occur.[112] Although dietary energy restriction or greater energy expenditure can lead to weight loss, recommending to 'eat less and exercise more' will rarely be sufficient for successful long-term weight loss. The composition of the diet, meal patterns and environmental and psychological determinants can affect the ability of an individual to adhere to a reduced calorie diet as described in other parts of this guideline. Nutritional counselling should therefore be individualised to provide advice on achieving a reduced calorie diet that the patient can maintain in the long term.

Energy is expended as a result of resting energy expenditure (for metabolism and organ function), dietary-induced thermogenesis (to digest, absorb, metabolise and store nutrients after meals), thermoregulation (to regulate body temperature), and physical activity. Physical activity includes exercise and non-exercise activity thermogenesis as a result of daily activities and fidgeting. Physical activity is the most modifiable component of energy expenditure and in combination with reduced dietary energy intake can contribute to long-term weight loss.[113] However, compensation for greater energy expenditure through physical activity by subsequent additional energy intake should be monitored.[114]

When calories are permanently reduced by a specific amount, the loss in body weight will decrease over time and eventually a new equilibrium will be achieved where no further weight loss will occur.[112] This is a result of weight loss leading to decreased energy expenditure because less energy is required for body maintenance and movement. A reduction in calorie intake relative to

calorie intake before the weight loss effort will have to be sustained for weight maintenance. Going back to the 'old diet' will lead to rapid regain of body weight. Web-based programmes can be used to calculate the expected changes in weight and body fat for specific reductions in energy intake.[112] A rule of thumb is that every 24 kcal/day calorie deficit (i.e. lower energy intake than energy expenditure) that is permanently maintained will eventually lead to a 1 kg loss in body weight with half of the weight loss occurring in about 1 year and 95% in about 3 years.[112]

C Nutritional counselling should aim to facilitate long-term adherence to reduced-calorie diets to achieve sustainable weight loss. Every 24 kcal/day reduction in energy intake will eventually lead to approximately a 1 kg loss in body weight with half of the weight loss occurring in about one year.

Grade C, Level 2++

B Physical activity should be recommended in addition to dietary changes as it can contribute to the maintenance of weight loss.

Grade B, Level 1+

7.1 Types of diets

Modifying a diet remains one of the cornerstone interventions in weight management. There is a plethora of diets available, all with varying compositions of macronutrients and may be calorie restricted or prescribed ad libitum. These diets can be generalised into the moderate-fat and nutritionally balanced reduced-calorie diets with or without meal replacement utilisation, low-fat and the low-carbohydrate high-protein diets. Although meal replacements may induce greater reductions in weight and abdominal obesity initially compared to conventional diets, it is difficult to sustain and not advisable for long term management.[115]

Table 6: Examples of popular diets

Type of diet	Examples	Content (% of total energy intake)		
		CHO*	Protein	Fat
High protein, moderate-high fat, low-carbohydrate	• Dr Atkin's New Diet Revolution • Zone Diet • Protein Power • Dukan Diet	< 20–40	25–40	25–30
Moderate-fat, nutrient balanced, calorie-reduced	• USDA My Plate • My Healthy Plate (SG) • DASH Diet (Dietary Approaches to Stop Hypertension) • Academy of Nutrition & Dietetics • American Heart Association • American Diabetes Association • Jenny Craig • Nutri-systems • Weight Watchers • Mediterranean Diet	55–60	15–20	20–30
Low-fat and very low-fat diet	• Ornish diet • Volumetrics • The New Pritikin Programme	≥ 65	10–20	< 10–19

*CHO = carbohydrate

7.2 Effects on weight loss

Diets have been classified according to macronutrient compositions, although which is the most effective is still under much research. There remains the suggestion that reducing fats as part of a calorie-restricted diet is a practical way to help lose weight.[116]

Low-fat and very low-fat diets typically advocate a reduction of total dietary fat content to 10–19% of total energy intake. They are also accompanied by a high proportion of complex carbohydrate sources such as fruits, vegetables and whole grains that are naturally high in fibre and lower in energy density.[117] Low-fat diets produce weight loss primarily by decreasing energy intake. Caution should be exercised when embarking on this diet as they may be inadequate in protein if food choices are poor. Micronutrients such as fat-soluble vitamins, vitamin B_{12}, and zinc[118] may also be insufficient due to the dietary restrictions.

Individuals consuming a high-protein low-carbohydrate diet may experience greater weight loss compared to conventional diets at 6 months, although this effect tapers off at 12 months.[119-125] The initial weight loss may be from fluid loss and ketosis-induced appetite suppression. Some versions of this diet have lax restrictions on fat consumption and this could cause the diet to be excessive in cholesterol and saturated fat. While these diets appear safe in the short term and do not appear as problematic towards cardiovascular risk factors[116,121,123,125] practitioners are urged to exercise caution when suggesting this approach to patients with osteoporosis, kidney disease or increased LDL-cholesterol.[116,121] Moreover, the overall diet could also be deficient in certain vitamins like vitamins A, B_1, B_6, folate, C and E, and minerals such as magnesium, potassium, calcium and iron.[116,126]

Most dietary guidelines of governing health authorities recommend a reduced calorie diet (≥ 500 kcal deficit) that is moderately restricted in total fat (≤ 30% of total calories), protein and carbohydrates with an emphasis on wholegrain consumption.[116] Reducing fat intake without an overall reduction in calories is insufficient for weight loss, but as it is an energy-dense macronutrient reducing fat as part of a low-calorie diet is a practical

approach.[116,127] Additionally, it is vital to promote good food choices as the contrary may lead to micronutrient deficiencies.[118]

The low-glycaemic index (GI) diet has previously been proposed to aid weight loss by increasing satiety, therefore leading to a reduced energy intake. The low-GI diet on its own is not recommended for weight loss,[116] and it is imperative to consider the total energy intake and the overall glycaemic load of the individual's diet while using this dietary approach.

Overall, the principal finding is that all diets, regardless of the macronutrient manipulation, are equally successful in promoting clinically significant weight loss as long as there is a deficit in total calories and a high level of dietary adherence.[120,121,127,128]

A Diets that contribute to a calorie deficit of at least 500 kcal below estimated daily energy requirements are recommended to aid weight loss. The prescribed diets may be adjusted to meet the individual's nutritional needs and to encourage prolonged compliance.

Grade A, Level 1⁺

B Because of the lack of evidence for long-term beneficial effect, caution should be exercised when recommending a high-protein, low-carbohydrate diet, especially to individuals who have osteoporosis, kidney disease or elevated low-density lipoprotein cholesterol.

Grade B, Level 2⁺⁺

7.3 Effects of various diets on metabolic parameters

Diets that bring about weight loss will decrease blood lipid levels i.e. total cholesterol, low-density lipoprotein (LDL), triglycerides (TG) or high-density lipoprotein (HDL) in addition to improving glycaemic and blood pressure control.[120,128,129]

Moderate and low-fat diets showed a significant decrease in total cholesterol and LDL levels.[128,130,131] But the high-protein low-carbohydrate diet showed a more favourable outcome in increasing HDL and decreasing TG when

compared to the low-fat diet,[121,123,125,128,130-132] but this difference only persisted for 12 months.[120,121,123,130] Generally, low-carbohydrate diets are at least as effective as a low-fat diet up to one year, but may not be the recommended option for the prevention of cardiovascular disease.[123]

A high-protein low-carbohydrate diet also reduces fasting serum insulin[128] most significantly, although the Mediterranean diet also produces a similar favourable effect.[132]

7.4 Nutritional adequacy of various diets

The moderate-fat calorie-reduced diet ensures adequate nutritional intake with the condition that it contains a wide variety of proper food choices and poor choices could still lead to micronutrient deficiencies such as vitamin E, thiamine, magnesium,[118] calcium, iron and zinc. On the other hand, very low-fat diets are deficient in Vitamin B_{12}, E and zinc.[118]

High-protein low-carbohydrate diets are also nutritionally imbalanced. With a high fat allowance, the diet would be excessive in saturated fat and cholesterol while being low in vitamins A, C[118,133] and E, thiamine, B_6, folate, calcium, magnesium, iron and potassium.[126] Supplementation is usually recommended with this dietary prescription.[126,133]

7.5 Dietary approaches to weight loss maintenance

A large number of individuals regain weight after a period of successful weight loss owing to several factors, such as hormonal and adaptive changes, psychological strain, and a lack of long-term monitoring.[134] This difficulty may be contributed by the complex mechanisms that are triggered upon dieting, implicating energy balance, neurological and hormonal responses.[135]

Successful weight loss maintenance requires long-term compliance with a reduced-calorie diet (with or without meal replacements), high levels of physical activity and regular monitoring with continued professional support.[136,137] There is inadequate consensus as to whether a higher protein

diet is superior to aid weight loss maintenance,[129] although a diet where protein contributes 25–30% of total calories promotes better compliance.[138,139]

There seems to be no optimal diet for reducing or curbing appetite.[128,139] There is, however, indication that including low-GI carbohydrates may prolong satiety and delay the return of hunger.[129]

It appears that long-term success of weight maintenance is not solely dependent on dietary compliance but also sustaining behavioural changes.[128,140]

B Long-term compliance with a reduced-calorie diet and the adoption of positive lifestyle and behavioural changes should be encouraged to aid successful weight loss maintenance.

Grade B, Level 1⁺

7.6 Food-based recommendations for weight loss

With the availability of a wide variety of food, choosing the right dietary options to avoid excess energy intake is important and a few principles can contribute to appropriate food choices.

The fat and water contents of foods are the main determinants of the energy density of the diet.[141] Increasing consumption of energy-dense food (high-fat, high-sugar, high-starch), and energy-dense drinks (high free sugar) may contribute to higher total energy intakes. Foods high in fat and sugar should be avoided as this contributes to increase in the total energy intake. Excessive intake of sugar-sweetened drinks contributes to weight gain[142,143] compared with solid sugar in foods, and produces an increased risk of development of Type 2 diabetes possibly due to excessive calories and large amounts of absorbable sugars.[144,145] Drinks that are rich in free sugars increase overall energy intake by reducing appetite control.[146] A study conducted by de Ruyter et al, 2012, confirmed an association between artificially sweetened beverages and weight gain in children.[143]

Conversely, a higher intake of energy-dilute foods (vegetables, fruits) and foods high in non-starch polysaccharides (whole grain cereals) may reduce total energy intake, and improve micronutrient and phytochemical intakes.[141] It is probably reasonable and sensible to maintain a diet that is higher in vegetables, legumes, fruit and whole grains and lower in sugar and refined carbohydrates.

Protein-rich foods may be particularly satiating. Adequate amounts of low energy density, lean protein (e.g. chicken breast, fish, egg white, beans and tofu) are better choices as they are lower in calories and may help control hunger. However, high energy density protein foods such as non-lean meat and normal-fat dairy products may cause weight regain.

Advice on food selection should ideally be more reflective of local foods. Annex A lists some nutritional information on common, selected local foods.

Caution has to be exercised when making choices regarding processed food and food products. For example, currently available so-called 'low-fat' products may actually contain large quantities of sugars and hence may not have lower caloric content overall. Canned fruits and dried fruits are fairly energy dense, so portions need to be kept small and used only occasionally.

Other energy-dense foods such as nuts do not seem to be related to weight gain[147-149] and may have a beneficial effect on heart health[150] (e.g. cholesterol lowering effect, beneficial effects on oxidative stress, inflammation, blood pressure and glycaemic control).[150,151] However, total energy intake is still important for weight loss and excessive intake of any food will ultimately contribute to energy intake, and hence, weight gain.[116]

GPP In order for weight loss or weight maintenance to be successful, food intake should ideally be distributed regularly throughout the day. Skipping of meals should be discouraged. Food portions at each meal should be adequate so as to prevent the need for frequent snacking between meals.

GPP

A Sugar-sweetened beverages should be avoided to prevent excess weight gain.

Grade A, Level 1+

C Maintain a diet that is higher in vegetables, legumes, fruits and whole grains, and lower in sugar and refined carbohydrates.

Grade C, Level 2+

D Adequate amounts of low energy density, lean, high-protein foods (e.g. chicken breast, fish, egg white, beans and tofu) should be included in weight loss diets to help control hunger.

Grade D, Level 4

GPP Dietary advice should consider foods that are locally available and match culinary preferences to facilitate long-term compliance.

GPP

D Caution should be exercised when making choices regarding processed foods as these can be energy dense and high in sugar.

Grade D, Level 4

7.7 Weight loss supplements

There is generally a lack of good-quality research or published data on the numerous non-prescription weight loss supplements. Therefore, many of the advertising claims could be misleading.

Table 7: Compounds associated with weight loss

Compounds demonstrating weight loss in several trials[152,153]	• Ephedrine • Ma Huang • Caffeine • Guarana • Non-prescription and off-label weight loss supplements
Compounds demonstrating weight loss in small, single studies	• Pyruvate[152] • Glucomannan[152-154]

Compounds with questionable or no weight loss results	• Calcium (supplementation or increased dairy consumption)[116,152] • *Camellia sinensis* (Green tea)[152] • Conjugated linolenic acid (CLA)[152,155] • Thyroxin, triiodothyronine[156] • Chitosan[152,157] • Citrus aurantium (bitter orange)[152,157] • Chromium picolinate[152-154] • Hydroxycitric acid (*Garcinia cambogia*)[153] • Guar gum[153] • Psyllium[153]
Compounds with little or no data on weight loss	• St John's wort (*Hypericum perforatum*) • Melatonin • Capsaicin • L-carnitine • Pectin • DHEA • Guggul • Marine brown seaweed (*Fucus vesiculosus*)

8 Treatment: Physical activity

Physical activity

Current National Physical Activity Guidelines[158] state that to acquire substantial health benefits, adults need to accumulate 150 minutes or more of moderate-intensity aerobic physical activity per week. This amount of physical activity is independently associated with reduced risk of cardiovascular disease, stroke, hypertension, colon cancer, breast cancer, Type 2 diabetes, falls, depression and dementia.[159-162] Therefore, physicians should provide physical activity advice to patients regardless of BMI status. Consequently, the recommended level of physical activity needed to maintain health and prevent disease is the baseline for obesity prevention and control. The exercise prescription should be tailored to individual patient, taking into consideration the body weight and comorbidities.

A To maintain health and prevent diseases, overweight or obese adults should engage in ≥ 150 minutes of moderate-intensity physical activity per week.

Grade A, Level 1⁺

D Physicians should provide advice on physical activity regardless of BMI status. The exercise prescription should be tailored to individual patients, taking into consideration their body weight and comorbidities.

Grade D, Level 3

8.1 Screening

Screening patients prior to participation in a physical activity programme may be useful considering that comorbidities are common. Using tools such as the Clinical Practice Guidelines for Screening for Cardiovascular Disease and Risk Factors provide guidelines on pre-participation screening for exercise.[163]

Any advice provided on physical activity should take into account the person's current physical and behavioural readiness. The following recommendations focus on the role that physical activity plays in energy balance or creating an energy deficit. Achieving energy balance or creating a deficit is dependent on both caloric intake and caloric expenditure.[161]

During the initial phase of weight loss, the recommended weekly volumes of activity for inactive/unfit individuals should be gradually increased over time as fitness improves (e.g. start with 60 minutes per week and gradually progress to 150 minutes per week).

GPP Patients should be screened for common comorbidities, current physical and behavioural readiness before participating in physical activities.

GPP

GPP For inactive/unfit individuals, the recommended weekly volume of activity should be gradually increased over time as fitness improves.

GPP

8.2 Aerobic physical activity

In the absence of dietary energy restriction, there is sufficient evidence that regular physical activity alone can aid in the prevention and control of obesity,[164-169] but physical activity is most effective when combined with a moderate energy restriction (≈ 500 kcal per day).[160,170] There is also evidence suggesting that diet combined with physical activity is associated significantly with greater weight loss compared with diet alone.[160,171]

Physical activity exposures can be characterised by the interplay between bouts of frequency, intensity, time and type. The product of frequency and time (duration) can be thought of as volume.[159,167] The minimum volume of physical activity necessary for obesity prevention and control in the absence of caloric restriction is ≈ 1000–1250 kcal per week. [159,167,172]

C For weight loss, a negative energy balance (approximately 1000 kcal per day) achieved through both dietary restriction and physical activity is encouraged.

Grade C, Level 2+

i. Frequency:

This should be spread throughout the week (3–7 days per week). More frequent activity is desirable, and care should be taken first to establish a regular physical activity behaviour before recommending levels that may not be sustainable in the long term.

GPP Physical activity should be established as a regular behaviour throughout the week.

GPP

ii. Intensity:

Moderate-intensity aerobic activity (64–76% of maximal heart rate – Annex B) appears sufficient for the management of body weight. Moderate-intensity aerobic activity causes a noticeable increase in breathing and heart rate whereby one should still be able to talk, but do not have enough breath to sing.

**For unfit/inactive individuals, light-intensity physical activity may be considered at first before progressing to moderate-intensity over time. Individuals who become more active/fit may be able to progress to more vigorous-intensity physical activity over time.*

D Moderate-intensity aerobic activity should be recommended for the management of body weight.

Grade D, Level 3

GPP For unfit/inactive individuals, light-intensity physical activity may be considered first before progressing to moderate-intensity over time.

GPP

iii. Time:

To achieve weight loss, 150–420 minutes per week of physical activity is needed.[167] There is a dose-response relationship between exercise volume and amount of weight loss; > 150 minutes per week of physical activity results in a weight loss of 2–3 kg and > 225–420 minutes per week of physical activity results in 5–7.5 kg weight loss. To maintain weight loss, at least 200–300 minutes per week of physical activity is needed.[167]

A For weight loss, adults should engage in 150–420 minutes of moderate-intensity physical activity per week.

Grade A, Level 1⁺

B To maintain weight loss, adults should engage in 200–300 minutes of moderate-intensity physical activity per week.

Grade B, Level 1⁺

B Physical activity can be accumulated in short bouts of at least 10 minutes per session or one long bout of up to 60 minutes.

Grade B, Level 2⁺⁺

GPP A total of 10–60 minutes of physical activity is recommended per day, with a gradual increase for unfit/inactive individuals over time.

GPP

iv. Type:

Low-impact physical activity (e.g. brisk walking, cycling, dancing, gardening, low-impact aerobics, swimming, water aerobics etc.) are convenient, accessible and perceived as enjoyable by the participant. Cross training is also advised.

GPP Low-impact physical activities and cross training may be recommended.

GPP

8.3 Strength or resistance activity

Strength or resistance physical activity does not appear to be superior to aerobic physical activity for the prevention or control of obesity.[160,167,173-175] Supplementary muscle strengthening exercises, however, may help improve one's metabolic profile, promote loss of total body fat and mitigate intra-abdominal fat increase over time.[167,176] Muscular strength in overweight and obese adults may also improve functional tasks, e.g. getting out of a chair, and hence aid in the adoption of a more active lifestyle.

A Adults should engage in strength activities on two non-consecutive days per week to provide additional health benefits.

Grade A, Level 1+

8.4 Lifestyle activity and sedentary behaviour

The shift in lifestyle towards an increased use of automation and labour-saving devices at work, at home and in the community has seen an increase in sedentary behaviour (e.g. TV and the use of computers). These trends influence the amount of physical activity needed to achieve discretionary energy balance. Therefore, decreasing sedentary behaviour may be an effective option for increasing volume of physical activity, and influencing the prevention and control of obesity.[177,178] To increase the volume of physical activity, individuals should work progressively towards the target of 10,000 steps per day of incidental daily activities. While initially the target of 10,000 steps was proposed arbitrarily, subsequent research affirms the resultant health benefits.[179-181]

B Adults should be encouraged to spend less time engaging in sedentary behaviours. They should also break up prolonged periods of sitting.

Grade B, Level 2+

GPP Individuals should be encouraged to work towards taking 10,000 steps per day.

GPP

9 Treatment: Behavioural modifications and related therapy

While managing obesity, behavioural and psychological aspects need to be taken into consideration. 'Behavioural' aspects primarily refer to the energy-balance behaviours of diet, lifestyle and physical activity that are associated with some psychological factors, such as motivation and body image. Interventions addressing behaviour ('behaviour therapy') should address adherence with and barriers to adoption of the diet and physical activity recommendations. Psychological factors such as beliefs, attitudes, intentions, social support and motivation are crucial in determining the success of any weight loss programme.

9.1 Psychological evaluation

9.1.1 Evaluation of motivation

Patient motivation is important for a successful treatment, yet motivation is a diverse and complex issue (see Table 8). Initial motivation for weight loss is likely to be 'externally' driven, such as being told to lose weight by the general practitioner or the health professional or a feeling of 'I have to' lose weight for health and appearance reasons. Those working with weight loss patients should strive to have the patient adopt a more 'internal' style of motivation over time, such as 'I want to' lose weight for personal satisfaction and enjoyment of activities.[182] This style of motivation will be more long lasting. One way to achieve this is to provide a meaningful rationale for weight loss, boost patient confidence, and enlist social support. Self-monitoring and setting goals around behaviours should also help.

D Healthcare professionals working with weight loss patients should strive to have the patient adopt a more 'internal' style of motivation over time, such as 'I want to' lose weight for personal satisfaction and enjoyment of activities.

Grade D, Level 2+

Table 8: Possible factors associated with motivational readiness for weight loss

Type of factor	Examples
Demographic	• Financial circumstances • Cultural norms • Educational level
Psychological	• Personal reasons for weight loss • Identifying, understanding and weighing up the risks and benefits • Self-efficacy for energy-balance behaviours
Social	• Social support provided by family and friends • Social norms • Support from colleagues / employer • Valid support programmes (e.g. commercial weight loss programmes such as Weight Watchers)
Environmental	• Local physical environment encouraging positive or negative energy-balance behaviours • Accessibility and availability of exercise facilities such as gym, park, pool • Availability of healthier food choices
Specific characteristics of the individual	• Health status • Health literacy • Readiness to change

9.2 Behavioural treatments and therapies

Evidence supports the use of behavioural and cognitive-behavioural strategies in weight loss treatment,[183] while other psychological interventions have less of an evidence base at this time. Moreover, it has yet to be determined whether theory-based interventions for physical activity in the obese are more effective than those not based on theory.[184] As weight loss is most effective in the first 6 months, strategies are required to help patients maintain weight loss after this period. Until better evidence is available, including what constitutes the best 'active ingredients' for behaviour change,[185] it is recommended that interventions combine

behavioural strategies, such as self-monitoring and goal-setting with dietary modification and increased physical activity.

A Weight loss programmes should incorporate cognitive behavioural interventions for achieving weight loss and weight maintenance of up to 10% between 1–5 years of follow-up.

Grade A, Level 1+

B Interventions need to combine behavioural strategies, such as self-monitoring and goal-setting, with dietary modification and increased physical activity.

Grade B, Level 2+

Examples of cognitive and/or behavioural strategies and treatments include:

i. Motivational interviewing:

Motivational interviewing (MI) is a directive, client-centred counselling style for eliciting behaviour change.[186] It is often associated with moving people through stages of change, such as used in the Transtheoretical Model. 'Active ingredients' for MI include the counsellor expressing empathy with reflective listening, developing discrepancy between client goals/values and the current (problem) behaviour, avoiding arguments and direct confrontation, acknowledging and understanding client resistance to change rather than opposing such resistance, and supporting the patient's self-efficacy and optimism for change. Evidence has showed that MI can be effective in assisting weight loss in overweight and obese patients.[187]

ii. Self-monitoring eating habits and exercise/activity:

Self-monitoring can be an effective strategy for health behaviour change.[188] This might involve a food diary, a suitable mobile device-based 'app' or the use of a step counter (pedometer) for physical activity. New information and technological communication is developing rapidly in this field and holds great promise. Self-monitoring using various devices coupled with goal-setting can help the patient to be aware of the amount and types of food to consume and watch his/her patterns of behaviour.

iii. Goal-setting and plans of action:

Goals and action plans can stimulate behaviour and sustain motivation, such as by specifying the behaviour, when it will take place, where, and for how long. Goals should be objective and achievable, yet challenging. Small non-food rewards may be appropriate for reaching key goals.

iv. Cognitive restructuring:

This involves identifying the patient's beliefs, negative thoughts or self-destructing statements that may jeopardise weight loss plans (e.g. unrealistic expectations or myths surrounding weight loss strategies) so as to help the patient restructure or replace such beliefs and thoughts with more rational thought processes.

v. Stimulus control:

This is when the patient identifies certain situations or contexts that trigger inappropriate eating or excessive sedentary behaviour. Specific strategies may include keeping problem foods away from the house, limiting the time and place for eating, and avoiding use of energy-saving devices. High-risk situations require a plan for identifying and seeking alternatives.

vi. Problem solving:

Problem solving refers to the mental processes that the patient goes through to identify, analyse and solve problems associated with eating behaviour, physical activity and sedentary behaviour. It involves identifying the weight-related problem, developing possible solutions, selecting the appropriate ones, taking actions to resolve the problem and re-evaluating alternate solutions if the implemented ones are not effective.

vii. Social support:

Providing strong social support and a 'buddy' system can help change the patient's behaviour. Social support from family members, spouses, friends, clinicians or even having a support group can help facilitate behaviour change.

viii. Relapse prevention:

Many health behaviours 'cycle' through stages of behaviour change (e.g. contemplation, action) and this may include relapse. Patients need to be aware of relapse and the high-risk situations for a relapse. They should learn strategies that minimise such risks, including boosting self-confidence to deal with relapse. Other plans to either avoid or cope with relapse may be needed, such as relaxation techniques to prevent stress-induced over-eating. Patients might need to learn relaxation techniques and other coping strategies in dealing with high-risk relapse contexts.

9.3 Behaviour therapy for weight maintenance

Weight loss achieved through physical activity and dietary change is often not well maintained after 6 months. Continued use of behavioural strategies and therapy is therefore recommended.

A After initial weight loss treatment it is recommended that participants continue at least 6–12 months of a weight maintenance programme that combines dietary modification and physical activity.

Grade A, Level 1⁺

9.4 Size and self-acceptance

Many obese patients successfully lose weight but not to levels that are considered 'normal' for BMI. While weight loss of 5–10% of original weight constitutes medically defined success and has clear health benefits, it may still leave the patient with a sense of frustration and even failure. There may be dissatisfaction with what is considered a socially acceptable body shape and size. The patient needs to address the issue of 'self-acceptance' and discuss issues on 'healthy' weight and appearance. The focus should be on self-improvement rather than on an externally imposed goal of an 'ideal' weight, which may not be achievable. In other words, it is about the process of adopting and maintaining the 'right' energy-balance behaviours rather than the outcome of weight loss or body shape *per se*.

10 Treatment: Information and communication technology (ICT) and tools for weight loss

Although clinically significant weight loss can be achieved by intensive behavioural interventions, their scalability is limited by their costs as well as resources. Information and Communication Technology (ICT)-based weight loss interventions that allowed patients to monitor and track their behaviours online versus standard paper reports or non ICT-based controls, produced significantly greater weight loss,[189-192] as well as a significant decrease in total energy and saturated fat intake[193,194] and a small but positive effect on physical activity.[195] Significant correlations were observed between adherence to online tracking of diet and physical activity entries and weight loss.[192,193,196,197] Physical activity and healthy eating behaviour interventions have been found to be more effective if they involve self-monitoring and at least one other control theory technique (prompt intention formation, prompt goal setting and feedback/review of goals).[198] There is insufficient evidence for the long-term effectiveness of ICT on weight loss beyond 24 weeks.

ICT, including structured websites and internet-enabled mobile phone applications, is therefore an effective intervention tool as it transcends time and space, is cost-effective[199] and has the potential to reach large numbers of people.[200] As of April 2012, the mobile phone penetration rate in Singapore was 150%, and residential wired broadband household penetration rate was 104%.[201]

Information and Communication Technology interventions are effective in producing modest (5–10%) weight loss (12–24 weeks) among overweight and obese adults.[189-191,193,196,198,200,202] Such interventions, regardless of their technology platform, (PDAs, web-based and smart phones) should include the following treatment components:

- tailoring
- goal setting
- self-monitoring
- social support
- targeted feedback

B Clinicians who implement or recommend ICT interventions to their overweight and obese patients should ensure that such interventions include established treatment components such as tailoring, goal setting, self-monitoring, social support and targeted feedback.

Grade B, Level 2+

11 Treatment: Medical treatment of obesity and related morbidities

Lifestyle modification is the main treatment strategy for weight management. However, its efficacy in weight loss and subsequent weight maintenance may be limited to a sub-population of obese subjects. Hence, use of anti-obesity medication may be an adjunctive treatment strategy in carefully selected individuals.

A Lifestyle modification should be the main treatment strategy for weight management. Pharmacotherapy, if used, should be adjunctive to lifestyle modification and be combined with diet, physical activity and behaviour modification.

Grade A, Level 1⁺

Drug therapy can be considered when BMI is ≥ 30kg/m^2. At any given level of BMI, Asians tend to have greater adiposity[4], drug therapy can be considered when BMI is 27.5–29.9 kg/m^2 in patients with comorbidities or complications of obesity such as hypertension and Type 2 diabetes mellitus.[203]

C Drug therapy may be considered when BMI is ≥ 30 kg/m^2, or when BMI is 27.5–29.9 kg/m^2 in Asians with comorbidities or complications of obesity such as hypertension, Type 2 diabetes mellitus.

Grade C, Level 2⁺

11.1 Anti-obesity medications

11.1.1 Medications acting on the central nervous system

These agents primarily act through the noradrenergic or serotoninergic pathway to enhance satiety and to suppress appetite.

1) Noradrenergic pathway, e.g. phentermine, mazindol and ephedrine
2) Serotoninergic pathway, e.g. lorcaserin, fluoxetine, sertraline, fenfluramine and dexfenfluramine
3) Serotoninergic and noradrenergic pathways, e.g. sibutramine
4) Dopaminergic and noradrenergic pathways, e.g. bupropion

5) Opioid receptor, e.g. naltrexone
6) Anti-epileptics, e.g. topiramate and zonisamide

In Singapore, phentermine is the only medication approved for use in weight management under this category. Mazindol is also approved as a diet pill by the Food and Drug Administration (FDA), USA. Fenfluramine, dexfenfluramine and sibutramine have been withdrawn due to safety concerns relating to cardiovascular risks. In a few relatively small studies, zonisamide was found to be useful for weight management[204,205] and binge-eating.[206] However, it has yet to be approved by FDA for these indications.

11.1.2 Medications acting on the gastrointestinal tract

Orlistat, which inhibits gastrointestinal lipases, blocks the absorption of ~ 30% of ingested fat. The recommended dose is 120 mg with each main meal. A recent meta-analysis of long-term (≥ 1 year) clinical trials (involving 16 studies, > 10,000 subjects) suggested that orlistat resulted in an average weight reduction of 2.9 kg compared with placebo.[207] The drug is relatively safe. The most frequently encountered adverse reactions include steatorrhea, bloating, flatulence and abdominal pain. Serious adverse events are rare. Uncommon cases of liver injury, however, have been reported to be associated with orlistat.[208] Orlistat is approved for weight management in Singapore.

Since obesity is etiologically complex, combination pharmacotherapy is an attractive intervention strategy. However, there is limited data on the efficacy and safety of combination anti-obesity pharmacotherapy. In addition, most clinical trials on anti-obesity medications are relatively short term (majority are up to 1 year, few up to 2 years follow-up). Therefore, the long-term (i.e. ≥ 4 years) efficacy and safety of anti-obesity pharmacotherapy for weight reduction and subsequent weight maintenance is largely unknown. In addition, weight regain after stopping anti-obesity medication is common. Therefore, clinicians are encouraged to carefully consider the risks and benefits when recommending pharmacotherapy for obesity.[209,210]

Several medications used to treat obesity-related comorbid conditions (e.g. diabetes) are weight-friendly. These include metformin, sodium–glucose cotransporter 2 (SGLT2) inhibitors, dipeptidyl peptidase-4 (DPP4) inhibitors and glucagon-like peptide 1 (GLP1) agonists (e.g. exenatide and liraglutide). Thus, they are preferred agents in individuals with obesity and glucose intolerance.[211]

11.2 Recent FDA-approved anti-obesity drugs

11.2.1 Monotherapy

11.2.1.1 Lorcaserin (Belviq)

The US Food and Drug Administration Department (FDA) has recently approved the marketing of lorcaserin (Belviq), a selective serotonin-2C receptor agonist appetite-suppressant for weight management.

In a randomised, double-blind, placebo-controlled clinical trial, 3,182 lifestyle-treated obese or overweight adults (average BMI 36.2 kg/m^2) were assigned to lorcaserin 10 mg twice daily or placebo for 52 weeks. Subsequently, those on lorcaserin were re-randomised to either placebo or lorcaserin for maintenance of weight loss in year 2. At 1 year, close to half (47.5%) of the patients on lorcaserin had lost ≥ 5% of their weight while only 20.3% of those on placebo achieved the same results. Among patients on lorcaserin in year 1, weight loss was maintained during year 2 in 67.9% of those re-randomised to lorcaserin compared to 50.3% weight-maintenance among those re-assigned to placebo. Cardiac valvulopathy was not increased with use of lorcaserin. The most frequently reported adverse events include headache, dizziness and nausea. Loss to follow-up was substantial in this study: 44.6% and 54.9% among those receiving lorcaserin and placebo, respectively.

In a separate placebo-controlled study, 604 subjects with Type 2 diabetes receiving oral anti-diabetic agents (metformin and/or sulphonylurea) (BMI 27–45 kg/m^2) were randomly assigned to placebo, lorcaserin 10 mg daily or 10 mg twice daily for 52 weeks.[212] More patients lost ≥ 5% body weight with lorcaserin BID (37.5%) or lorcaserin QD (44.7%) vs. placebo (16.1%). HbA_{1c} decreased 0.9 ± 0.06 with lorcaserin BID, 1.0 ± 0.09 with lorcaserin

QD, and 0.4 ± 0.06 with placebo. Symptomatic hypoglycaemia occurred in 7.4% of patients on lorcaserin BID, 10.5% on lorcaserin QD, and 6.3% on placebo. Cardiac valvulopathy was not increased with use of lorcaserin. Loss to follow-up was also substantial: 34% for lorcaserin 10 mg BID, 21.1% for 10 mg QD and 37.9% for placebo.

11.2.1.2 Liraglutide

Liraglutide, a glucagon-like peptide-1 (GLP-1) analogue, was initially developed as anti-hyperglycaemic agent for Type 2 diabetes at a dose between 0.6 to 1.8 mg daily. Besides glucose lowering, weight loss (on average ~ 2–3 kg) ascribed to its anorexigenic effect was often observed during treatment. It has been recently approved by FDA for weight loss management (up to 3.0mg) [213]

Recent randomised controlled trials[214-216] (included post-trial open-label follow-up for ~ 2 years) involving several hundred non-diabetic obese individuals (BMI ≥ 30 kg/m^2 or 27 kg/m^2 with comorbidities) suggested that liraglutide (dose-dependently, up to 3 mg daily) in conjunction with a low-calorie diet could induce weight loss of ~ 6%. Among those receiving liraglutide therapy, the proportion of subjects achieving ≥ 5% weight loss and maintaining ≥ 5% weight loss was significantly higher than with the comparator treatment, placebo. Reported adverse events were predictably mild to moderate, transient nausea and vomiting. Among overweight and obese participants with type 2 diabetes, the use of subcutaneous liraglutide (up to 3.0 mg) daily resulted in significant weight loss over 56 weeks, compared to placebo.[217] The long-term safety of high dose liraglutide therapy is, however, unclear.[218]

11.2.1.3 Combination therapy

Given that obesity is a multi-factorial condition, combination therapy targeting at different aspect of physiology is an appealing idea.

11.2.1.4 Qsymia (phentermine and topiramate)

In a recent 56-week phase 3, randomised placebo-controlled trial, Qsymia was shown to induce weight loss of up to 10.2 kg in a dose-dependent fashion in a large group of individuals with BMI of 27–45 kg/m² and two or more obesity-related comorbidities.[219] At its highest recommended dose (phentermine 15 mg and topiramate 46 mg daily), Qsymia induced ≥ 5% and ≥ 10% weight loss in 70% and 48% of subjects, respectively. The most common adverse events were dry mouth, paraesthesia, constipation, insomnia, dizziness and dysgeusia. The main limitation of this study is the high (and largely non-random) attrition rate (up to 26% in the treatment arm and ~ 38% in the placebo control arm).

11.2.1.5 Contrave (naltrexone SR/bupropion SR combination)

Bupropion is a dopamine and norepinephrine reuptake inhibitor that stimulates pro-opiomelanocortin (POMC) neurons in the arcuate nucleus.[220] When combined with naltrexone, bupropion enhances the effect of naltrexone on pro-opiomelanocortin.

In a recent 56-week, phase 3, randomised, placebo-controlled trial, Contrave was shown to induce weight loss of up to 6.1% in a dose-dependent manner in a large group of individuals with BMI of 30–45 kg/m² and uncomplicated obesity or BMI 27–45 kg/m² with obesity-related comorbidities.[221] At its highest recommended dose (naltrexone SR 32 mg and bupropion 360 mg daily), Contrave induced ≥ 5% weight loss in 48% of subjects. The most frequent adverse event in participants assigned to combination treatment was nausea. A transient increase of around 1.5 mm Hg in mean systolic and diastolic blood pressure was followed by a reduction of around 1 mm Hg below baseline in the naltrexone plus bupropion groups. Combination treatment was not associated with increased depression or suicidality compared with placebo. Loss to follow up in this study was also considerable (~17%).

Qysmia and Contrave have recently been approved by the US Food and Drug Administration (FDA)[222,223] for long-term adjunctive anti-obesity treatment.

A Phentermine and mazindol may be used for weight management for the short-term (6–12 months). Liraglutide may be used for weight management up to 2 years while orlistat may be used as an anti-obesity drug for long-term therapy (up to 4 years).

Grade A, Level 1⁺

11.3 Acupuncture

The evidence that acupuncture is more effective than placebo or lifestyle modification alone is limited although some studies showed modest results for weight reduction.[224] Similarly, studies comparing acupuncture to anti-obesity agents are small, and do not show conclusively that acupuncture has an impact on weight regain and weight maintenance.[225]

B Acupuncture by trained/qualified professionals may be considered as short-term, adjunctive anti-obesity therapeutic option on a case-by-case basis.

Grade B, Level 2⁺⁺

12 Treatment: Surgical and related options

12.1 Definition

Bariatric surgery is a gastrointestinal surgery designed to reduce weight in the morbidly obese and to maintain long-term weight loss.

12.2 Introduction

Bariatric surgery is a complicated surgery and should only be carried out in specially equipped medical centres by properly trained surgeons.

Bariatric surgeons should be part of a multi-disciplinary group of trained professionals that include dietitians, physical therapists, psychologists/ psychiatrists, endocrinologists and nurse clinicians caring for morbidly obese patients who present for surgery.

Results from six recent randomised trials suggested that bariatric surgery combined with optimal medical therapy may be more effective than optimal medical treatment alone for glycaemic control in obese individuals with Type 2 diabetes. Additional benefits were noted in the control of blood pressure and lipid levels in the surgery group.[226-232]

C

Bariatric surgery should be part of a programme of care delivered by a multi-disciplinary team including surgeons, dietitians, nurses, psychologists, physicians and physical therapists. It should only be carried out in institutions where a full range of facilities and services are available 24 hours a day. These include (but are not limited to): specialist medical and nursing staff, access to operating rooms and intensive care units and radiology service with interventional capability.

Grade C, Level 2+

12.3 Efficiency for weight loss and health outcome

Clinical trials comparing bariatric surgery with non-surgical weight management showed that weight loss after bariatric surgery was superior to non-surgical weight management alone for morbid obesity.[233,234] Long-term data showed sustainable weight loss. Following bariatric surgery, weight loss occurred rapidly initially, then tapered off and tended to stabilise after 1 to 2 years. Depending on the procedure, the mean weight loss after 10 years ranged from 14–25%.[235]

12.4 Details of health outcome and decrease in long-term mortality

A significant proportion of obesity-related comorbidities can be improved or remitted with weight reduction post-surgery. These include Type 2 diabetes, hypertension, hyperlipidaemia, obstructive sleep apnoea (OSA), degenerative diseases of the joints and spine, fatty liver and male and female sub-fertility including polycystic ovarian syndrome (PCOS).[236-239] Health-related quality of life and psychological well-being were improved.[240] There was a 30% decrease in long-term mortality, primarily due to a reduction of cardiovascular and cancer mortality.[241]

12.5 Selection criteria/indications

Patients who are considered for bariatric surgery should be evaluated by a multi-disciplinary team and fulfil the following conditions:

1. Have attempted and failed dietary and lifestyle intervention alone and deemed to have low probability of success with non-surgical weight-loss measures.
2. Be well informed about the long- and short-term risks and benefits of surgery.
3. Be highly motivated to lose weight through surgery.
4. Have an acceptable operative risk.
5. Be willing to undergo lifelong medical surveillance.

Patients with BMI above 40 kg/m^2, with or without obesity-related comorbidities or between 35 and 40 kg/m^2 with at least one obesity-related comorbidity (for example Type 2 diabetes, hypertension etc.), especially if difficult to control with lifestyle and pharmacological therapy, may be considered for bariatric surgery according to well-established guidelines.[242-244]

For patients with mild to moderate obesity (i.e. BMI 30–35 kg/m^2) recent studies demonstrated weight loss benefits and improvements in glycaemic control and cardiovascular risk factors.[245-247] There is, however, limited long-term data at present.[244]

A Patients with BMI above 40 kg/m^2, or above 35 kg/m^2 with at least one obesity-related comorbidity, especially if difficult to control with lifestyle and pharmacological therapy, may be considered for bariatric surgery as a medical treatment.

Grade A, Level 1$^+$

As Asians have more adiposity for a given BMI, the BMI action points for Asians may be reduced by 2.5 kg/m^2.[4,232,243]

12.6 Contraindications

12.6.1 Absolute contraindications

Individuals who cannot tolerate general anaesthesia and those who suffer from an uncontrolled psychological disorder or substance abuse are contraindicated for bariatric surgery. Pregnancy and active malignancy are also contraindications.

12.6.2 Relative contraindications

Several medical conditions may require pre-operative optimisation, e.g. individuals at high risk for general anaesthesia, patients with severe cardio-respiratory illness, liver disease with portal hypertension, treatable psychological disorder and history of substance abuse. Individuals who lack social support must be appropriately counselled prior to undergoing bariatric surgery.[248]

12.7 Procedures

12.7.1 Common procedures

The following procedures are carried out in Singapore predominantly by laparoscopic technique:[249]

Laparoscopic Adjustable Gastric Band (LAGB)
Laparoscopic Sleeve Gastrectomy (LSG)
Roux-en-Y Gastric Bypass (RYGB)

12.7.2 Less common procedures

There are several variations to the above list that are carried out, but not as frequently. These include:

Biliopancreatic diversion (BPD)
Duodenal switch (DS)
Mini-gastric bypass (MGB)

All procedures are performed laparoscopically with a very low rate of conversion to open operation. Each procedure has its own particular advantages and disadvantages.

B A bariatric procedure should only be offered after extensive work-up and discussions with the relevant stakeholders.

Grade B, Level 2++

12.8 Post-operative follow up

Patients undergoing bariatric surgery should be followed up lifelong by properly trained medical staff. Depending on the procedure performed, several visits are usually required in the first two years, after which the visits should be at least annual. Routine laboratory tests may be required during these visits.

Although rapid improvement in glycaemic control in Type 2 diabetes patients following aggressive medical therapy may lead to microvascular complications, bariatric surgery does not appear to be associated with the same morbidity.[250] Nevertheless, patients with Type 2 diabetes and other medical comorbidities should be followed up by appropriate physicians according to the usual protocols for management of the respective conditions.

The appointment of specialist case managers for bariatric surgery is helpful. So is the use of patient support groups and the use of electronic media.

A Patients with Type 2 diabetes mellitus and other medical comorbidities should be followed up by appropriate physicians according to the usual protocols for management of the respective conditions.

Grade A, Level 1++

12.9 Surgical complications

12.9.1 Mortality rate

The mortality rate from bariatric surgery is very low – less than 0.5% worldwide. Gastric banding has the lowest mortality rate, with the highest in BPD/DS.[251]

12.9.2 Short-term complications

Short-term complications can be up to 20% depending on the procedure. Gastric banding carries the lowest perioperative complication rate. Examples include bleeding, infection, venous thromboembolism and chest problems. For other procedures, more serious complications can occur. These include staple line/anastomotic leaks, bleeding, intestinal obstruction etc. Minor complications can be managed conservatively while serious complications, such as anastomotic leaks, may require re-intervention (sometimes multiple) and a prolonged hospital stay.[252]

12.9.3 Long-term complications

Long-term complications after bariatric surgery include anatomical problems, such as intestinal obstruction from adhesions and internal hernias, physiological alterations, such as dumping syndrome, diarrhoea, the development of renal calculi and gallstones and nutritional deficiencies.

Specific long-term complications particular to gastric banding include: band prolapse/slippage/erosion and tubing/adjustment port-related problems.[253,254]

12.9.4 Weight regain

After bariatric surgery, weight usually reaches the lowest level at 1 to 2 years post-surgery. Subsequently, there may be a small increase till a new nadir is reached.

In up to 20% of patients, there may be weight regain over time to pre-surgical levels or higher. This regain is multi-factorial. The most common reasons are non-compliance to the required eating habits and a lack of physical activity. There are various strategies to deal with this problem and patients should be referred to a specialised weight management team.

12.9.5 Long-term nutritional deficiency

Some bariatric procedures have a significant malabsorptive element, particularly the bypass procedures such as biliopancreatic diversion, duodenal switch and Roux-en-Y gastric bypass. Some patients develop calorie and protein malnutrition over time and this can be quite severe. Mineral and vitamin deficiencies may also occur. Life-time monitoring and routine vitamin supplementation is mandatory post-malabsorptive procedures. Restrictive bariatric procedures also require careful monitoring as deficiencies can occur.[248]

C Lifelong follow-up by a multi-disciplinary team is mandatory for patients who undergo bariatric surgery.

Grade C, Level 2⁺

B Regular laboratory tests should be made available to monitor nutritional deficiencies. Regular supplementation is mandatory following bariatric procedures with a malabsorptive component.

Grade B, Level 2++

12.10 Bariatric surgery in subgroups of patients

12.10.1 Fertility and pregnancy

Fertility may improve after bariatric surgery, both for males and females.

Pregnancy should be avoided in the phase of rapid weight loss, i.e., in the first 1 to 2 years post-surgery, because of the risk of nutritional deficiencies in the mother, thus compromising foetal development.

There should be close liaison between the obstetrician and the bariatric team in the management of a pregnant woman post-bariatric surgery. Careful monitoring of nutrition is mandatory, and supplements over and above the usual requirements in a normal pregnancy are recommended. There is no evidence of increased morbidity to the mother or foetus in patients who have undergone bariatric surgery and have lost a significant amount of weight.[255,256]

C Female patients should avoid getting pregnant post-bariatric surgery until weight loss has stabilised. Appropriate contraceptive advice should be given.

Grade C, Level 2+

C Close liaison between the obstetrician and the bariatric team is highly desirable. For pregnant women who have undergone bariatric surgery, nutritional supplements over and above the usual requirements in a normal pregnancy are recommended.

Grade C, Level 2+

12.10.2 Older population

Being over 65 years of age is not an absolute contraindication for bariatric surgery. Obviously, the older the subject, the less advantage there is to gain from substantial weight loss. Each case should be assessed on its own merit. Evidence to date shows that while there are more comorbidities in older patients (> 65 years) undergoing bariatric surgery, the complication rate is similar to that seen in younger patients, as is weight loss and resolution of weight related comorbidities.[257]

C Among the older population, each case of bariatric surgery should be considered on its own merit taking into account the special circumstances affecting the older age group.

Grade C, Level 2+

12.11 Surgical treatment for adolescents and children

The two main bariatric surgical procedures used for obese adolescents at present are the Roux-en-Y gastric bypass and the laparoscopic adjustable gastric band. Laparoscopic sleeve gastrectomy is emerging as a promising new option for selected extremely obese adolescents.[258]

In a meta-analysis of retrospective case series of bariatric surgery in paediatric patients, with average age of 16.8 years (range 9-21) and mean follow-up of 1 to 11 year, sustained and clinically significant BMI reductions for both laparoscopic adjustable gastric band (-10.6 to -13.7 BMI) and Roux-en-Y gastric bypass (-18.8 to -22.3 BMI) was reported at the longest follow-up, as well as resolution of some comorbidities such as diabetes and hypertension, although comorbidity resolution was infrequently reported.[258,259]

Band slippage (3%) and micronutrient deficiency were the most frequently reported complications for laparoscopic adjustable gastric band, whereas for Roux-en-Y gastric bypass more severe complications such as pulmonary embolism, shock, intestinal obstruction, post-operative bleeding, staple line leak and severe malnutrition were documented. No in-hospital or post-operative deaths were reported in any laparoscopic adjustable gastric

band study, but re-operations were performed on 8% of the patients to correct various complications. Mortality rate was 0.5–1% for Roux-en-Y gastric bypass.[258]

There are good reasons to be particularly careful when offering bariatric surgery to adolescents and children (< 18 years of age). Potential concerns include the ability to understand the implications of bariatric surgery and to give informed consent and growth and development in the environment of long-term calorie and nutrient deficiency.

However, extreme obesity in the young is on the rise, with associated significant weight related comorbidities. Surgery has been performed in adolescents successfully with similar results as observed in adults.

B

Bariatric surgery should be considered only for obese paediatric patients who fulfil the following criteria:[260]

1. The adolescent has attained Tanner 4 or 5 pubertal development, and final or near-final adult height.
2. The adolescent has BMI greater than 50 kg/m^2 or has BMI above 40 kg/m^2 and significant severe comorbidities.
3. Severe obesity and comorbidities persist despite a formal programme of lifestyle modification, with or without a trial of pharmacotherapy.
4. Psychological evaluation confirms the stability and competence of the family unit.
5. There is access to an experienced surgeon in a medical centre employing a team capable of long-term follow-up of metabolic and psychosocial needs of the patient and the family. The institution must also be either participating in a study of the outcome of bariatric surgery or sharing data.
6. The adolescent demonstrates the ability to adhere to the principles of healthy dietary and activity habits.

Grade B, Level 2^{++}

B Adolescents undergoing bariatric surgery must be able to provide informed consent and understand the nature of the operation, the risks involved, and the need for long-term follow-up.

Grade B, Level 2++

12.12 Other gastrointestinal interventions

The intra-gastric balloon is the most popular endoscopic weight-loss intervention with several proprietary intra-gastric balloons available. The presence of the balloon in the stomach increases satiety and decreases meal size. Nausea and vomiting is common. Up to 20% of subjects require early balloon removal due to intolerance. Approximately 10% of body weight loss is achievable on average. The balloon is typically implanted for 6 months after which it requires removal to prevent degradation by gastric acid. Weight regain is common after explant. A subsequent balloon may be placed if deemed necessary.[261]

Plication procedures attempt to duplicate gastric restriction either endoscopically with an intra-gastric device or utilising a laparoscopic approach. Early results showed reasonable weight loss, but there are no medium- or long-term data available.[263,264]

Several proprietary neuro-modulation devices are commercially available. In 2015, the US FDA granted preliminary approval for the clinical use of the VBLOC Maestro after a review committee noted a small but sustained weight loss in patients who had the device implanted.[265,266] Electrical impulses are delivered by afferent/efferent electrodes implanted in the stomach wall or adjacent to the vagal nerve at the gastro-oesophageal junction. Only small numbers of subjects have been reported with equivocal results.[267,268]

13 Special focus: Children and adolescents

13.1 Introduction

The global escalation of childhood obesity is of great concern as excessive adiposity is the root cause of leading metabolic and cardiovascular diseases and related mortality. Obesity-related comorbidities can afflict obese children and doctors now have to manage these chronic illnesses that were once regarded as adult diseases. An obese child is more likely to become an overweight or obese adult,[8] and childhood adiposity predicts subsequent cardiovascular risk in adulthood.[9,10,13] Therefore, it is pertinent that we tackle childhood obesity in a concerted effort in order to prevent increasing healthcare burden inflicted by the next generation of adults as the present childhood obesity epidemic passes through to adulthood.

Childhood overweight / obesity is a public health concern given the adverse effect on health and quality of life in childhood, as well as the increased risk of obesity and associated health complications in adulthood.[17]

13.2 Consequences

The obese child is likely to become an overweight or obese adult. A study reported that 43% of obese children persisted to be obese adults, while another 29% were overweight as adults.[8] The severity of obesity in childhood increases this likelihood, and childhood BMI and insulin resistance are significant predictors of subsequent development of metabolic syndrome.[14] Increasing childhood BMI across the entire BMI range is associated with an increased risk for subsequent coronary heart disease in adulthood.[9]

Obese children can develop related morbidities such as:

13.2.1 Type 2 diabetes: This generally occurs in obese children during puberty, but children as young as 8 years of age may also be affected. A local study found abnormal glucose tolerance in 17.4% of obese paediatric subjects. 12.9% of them had impaired glucose tolerance or impaired fasting glucose, while 4.5% had Type 2 diabetes mellitus.[16]

13.2.2 Hypertension: Obese children are at approximately 3-fold higher risk for hypertension than non-obese children.[269] In addition, the risk of hypertension in children increases across the entire range of BMI values and is not defined by a simple threshold effect.

13.2.3 Dyslipidaemia: High triglyceride and low HDL-cholesterol

13.2.4 Hyperandrogenism: Associated with polycystic ovarian syndrome.

13.2.5 Obstructive sleep apnoea: Symptoms include snoring, morning headaches, fatigue and difficulty in breathing during sleep. Obstructive sleep apnoea may lead to the development of hypertension, cardiovascular diseases, behavioural disorders, poor school performance and poor quality of life. An estimated 33–94% of children with severe obesity suffer from sleep apnoea.[270-272] A local study estimated that 0.7% of local obese children had obstructive sleep apnoea, but the prevalence was about 13.3% among those with severe obesity (≥ 180% ideal weight for height).[273]

13.2.6 Non-alcoholic fatty liver disease: 10–25% of obese children have elevated hepatic transaminases suggestive of non-alcoholic fatty liver disease due to insulin resistance. A local study[274] found that 26.4% of obese children have raised liver transaminases, which is similar to the report on Hong Kong's obese Chinese children (24%).[275] Non-alcoholic fatty liver disease may progress to cirrhosis. Raised ALT (≥ 2x upper normal limit, about 70 U/L) is indicative of probable non-alcoholic fatty liver disease.

13.2.7 Orthopaedic conditions: Slipped capital femoral epiphysis, genu valgum, tibia vara (Blount disease), knee pain, flat foot, spondylolisthesis and scoliosis.

13.2.8 Psychosocial problems: Childhood obesity has significant impact on the emotional development of the child or adolescent. Overweight children and adolescents frequently experience discrimination and stigmatisation as well as reduced health-related quality of life in physical, emotional, and social aspects.[269,276-278] Individuals who were obese in childhood are more likely to have poor body image, low self-esteem and confidence. Obese adolescents may have less schooling, lower income and higher poverty rates.[279,280]

13.3 Identifying overweight and obese children and adolescents

Despite its limitations, BMI is a widely accepted and practical estimate of general adiposity in children. BMI changes with age, so BMI-for-age percentiles are more useful clinically. Different BMI percentile cut-offs have been proposed in different countries, but these are arbitrary and defined statistically rather than based on health outcomes. These are, however, the most appropriate in practice and reasonably identify children and adolescents at risk of present and future obesity-related morbidities.

BMI-for-age percentile charts for boys and girls are used to classify children and adolescents; overweight status is defined by 90th to < 97th percentile while severely overweight (obesity equivalent) is defined as ≥ 97th percentile. The Singapore Health Promotion Board BMI-for-age percentile chart for boys and girls is used to classify children and adolescents between the ages of 6 and 18 years (see Table 9). From 18 years onwards, young people are classified according to the adult BMI chart (see Table 2).

Table 9: Singapore HPB BMI-for-age Percentile Chart. Boys & Girls aged 6-18 years old

Classification	Percentile
Severely Underweight	< 3rd percentile
Underweight	3rd to 5th percentile
Acceptable Weight	5th to < 90th percentile

Overweight	90th to < 97th percentile
Severely Overweight* (Obesity equivalent)	≥ 97th percentile

**the classification of 'severely overweight' in children and adolescents in Singapore is the equivalent of 'obese' in most countries. These patients should be referred for obesity-related intervention.*

For children less than 6 years of age, the BMI-for-age percentile chart of National Healthcare Group Polyclinics (2000) can be used. There is, however, no consensus in the definition of overweight and obese status in very young children as of now. The WHO international growth standard for children aged 0–59 months (2006), based on data from healthy infants and young children from six countries who were breastfed for 12 months and without growth constraints, may be used to screen for unhealthy growth patterns.[281]

Currently, there is limited evidence on the routine clinical utility of waist circumference, skinfold thickness and electrical bio-impedance compared with BMI in children.

GPP During the transition to young adulthood, there may be a discrepancy in weight status due to differences in the two classification systems. For the older adolescents (e.g. > 16 years old), obesity may be defined as a BMI-for-age equal to or greater than 97th percentile, or BMI equal to or greater than 30 kg/m^2, whichever criterion is met.

GPP

GPP The majority of overweight and obese children may be managed in primary care. Referral to tertiary general paediatric, paediatric endocrine or medical genetic clinics should be guided by the degree of obesity, presence or likelihood of comorbidities (e.g. family history), or where a pathological cause of obesity is suspected.

GPP

13.4 Clinical evaluation

The key tasks are to assess lifestyle and eating habits, how these can be improved, and determine any pathological causes of obesity, as well as the presence of obesity-related comorbidities.

For obese children and adolescents (BMI ≥ 97th percentile), pathological causes of weight gain should be considered and evaluated if clinically suspicious. They should be evaluated for obesity-related comorbidities or complications. Overweight children (BMI ≥ 90–97th percentile) should also be evaluated for comorbidities if risk factors are present.

The vast majority (>95%) will have common or primary obesity. Pathological causes or secondary obesity (inclusive of monogenic causes) are uncommon but should be carefully considered, such as endocrinopathies (Cushing's syndrome, hypothyroidism, hypopituitarism), and syndromic/genetic conditions (e.g. pseudohypoparathyroidism, Prader Willi).

These patients should be referred to tertiary centres for further evaluation. Children with endocrinopathies usually have height growth failure or short stature, and therefore a useful feature to direct the assessment. Dysmorphism such as learning difficulties, short 4th metacarpals, deafness, polydactyly, vision problems suggestive of retinitis pigmentosa such as night blindness and tunnel vision, epilepsy and hypogonadism are features of genetic obesity syndromes. Consanguinity is also indicative of autosomal recessive obesity conditions.

Current evidence indicates a continuum effect on future adverse cardiovascular risk across the range of BMI,[9] and should be borne in mind when recommending intervention.

Children and adolescents with obesity (BMI ≥ 97th percentile) should be offered screening for related morbidities. Overweight children and adolescents (BMI ≥ 90–97th percentile) should be offered screening if:

- There are features suggestive of insulin resistance such as hypertension, acanthosis nigricans and irregular menstruation suggestive of polycystic ovarian syndrome (PCOS).
- There is a strong family history in first or second degree relatives of Type 2 diabetes, hypertension or premature coronary heart disease.
- There are significant risk factors, such as history of gestational diabetes mellitus, small for gestational age, large for gestational age, early adiposity rebound, lack or short duration of breastfeeding.
- Have signs and symptoms indicative of comorbidities, such as hyperglycaemia (polydipsia and polyuria), obstructive sleep apnoea (snoring, daytime somnolence, poor attention span), hirsutism (PCOS).

There is little evidence to guide investigations of obese children. Investigations for comorbidities should not be regarded as routine, but may be ordered as indicated clinically (refer to Table 10 on page 88):

- Fasting plasma glucose, random venous glucose, or oral glucose tolerance test (OGTT) (glucose 1.75 g/kg, maximum 75 g), especially if there is severe obesity, family history of Type 2 diabetes or gestational diabetes, presence of acanthosis nigricans or polydipsia/polyuria.
- Fasting lipid profile (triglyceride, total cholesterol, LDL-cholesterol, HDL-cholesterol).
- Liver function test or alanine aminotransferase/aspartate aminotransferase, followed by ultrasound and further blood investigations if transaminases are elevated, and exclusion of other pathologies (infections like hepatitis B, space occupying lesion, autoimmune causes, Wilsons) before diagnosis of non-alcoholic fatty liver disease can be made.
- Other investigations if clinically indicated: Overnight sleep study for obstructive sleep apnoea, serum testosterone, sex hormone binding globulin, dehydroepiandrosterone sulfate, 17-hydroxy-progesterone, LH, FSH, pelvic ultrasound for PCOS.

GPP In children, investigations for comorbidities should not be regarded as routine, but may be ordered as indicated clinically. Screening may include glucose levels, lipid profile, liver function test or other investigations if clinically indicated.

GPP

Generally screening for Type 2 diabetes mellitus may be performed for obese children who are in puberty or ≥ 10 years old,[282] as it is uncommon for Type 2 diabetes to occur in very young pre-pubertal children. Obese children as young as 8 years old, however, may be affected so screening may be offered if clinically indicated.

C Obese children and adolescents (BMI ≥ 97th percentile) should be evaluated for obesity-related comorbidities or complications. Overweight children (BMI ≥ 90–97th percentile) should be screened for comorbidities, especially if risk factors are present.

Grade C, Level 2+

D Screening for Type 2 diabetes mellitus[282] may be performed for Asian overweight and obese children who are in puberty or ≥ 10 years old, and have any one of these risk factors: Family history of Type 2 diabetes mellitus in first- or second-degree relatives, maternal gestational diabetes, and features of insulin resistance (acanthosis nigricans, hypertension, dyslipidaemia, non-alcoholic fatty liver disease, polycystic ovarian syndrome). Repeat screening with fasting glucose or oral glucose tolerance test can be offered every 2 years if excessive adiposity persists.

Grade D, Level 4

GPP The vast majority (> 95%) will have common or primary obesity. Pathological causes or secondary obesity (inclusive of monogenic causes) are uncommon but should be carefully considered. If there are no significant abnormalities in the history and examination indicative of pathological causes of obesity, investigations for these pathologies are generally not necessary. Testing may be limited to thyroid function. If there are clinical suspicions of pathological

causes, these patients should be referred to tertiary centres for proper investigations and interpretation of the results.

GPP

Table 10: Investigations for comorbidities and interpretation for children and adolescents

Related morbidities	Abnormal values requiring intervention
Impaired fasting glucose	Fasting* venous glucose ≥ 6.1 mmol/L, < 7 mmol/L[328-329] (*fasting defined as no intake for at least 8 hours before)
Impaired glucose tolerance (by OGTT)	Fasting venous glucose < 7 mmol/L 2 hour post OGTT ≥ 7.8 mmol/L to ≤ 11.1 mmol/L[283]
Diabetes mellitus	Fasting venous glucose ≥ 7 mmol/L* 2 hours post OGTT ≥ 11.1 mmol/L* Random venous glucose ≥ 11.1 mmol/L plus symptoms of diabetes[282,283] *If asymptomatic, to repeat second test on another day to confirm diagnosis
Dyslipidaemia	Fasting triglyceride (children 0–9 years) < 0.8 mmol/L (acceptable), > 1.1 mmol/L (elevated) (adolescents 10–19 years) < 1.0 mmol/L (acceptable), > 1.5 mmol/L (elevated) Total cholesterol < 4.4 mmol/L (acceptable), > 5.2 mmol/L (elevated) LDL-cholesterol < 2.9 mmol/L (acceptable) , > 3.4 mmol/L (elevated) HDL-cholesterol > 1.2 mmol/L (acceptable), < 1.0 mmol/L (low)[284]
Hypertension	Blood pressure ≥ 95th percentile (standardised according to gender, age, and height percentile, using the charts from the National High Blood Pressure Education Program (NHBPEP), National Heart, Lung, and Blood Institute, US

	http://www.cdc.gov/nccdphp/dnpa/growthcharts/training/modules/module3/text/bloodpressure.htm ; Local chart currently unavailable)[285]
Non-alcoholic fatty liver disease (NAFLD)	ALT and AST above upper range limit for the laboratory, especially if > 2x upper limit. ALT ≥ 2x upper normal limit, about 70 U/L – repeat in 3 months. If persistent, suggest liver ultrasound and investigations for other pathologies. ALT ≥ 120 u/L – repeat immediately and if persistent consult hepatologist for further investigations

13.5 Management

13.5.1 Treatment goals/outcomes

D

Weight management in children and adolescents should emphasise behavioural modifications that influence weight status e.g. healthy eating habits and regular physical activity, rather than focus on actual weight loss.[286,287] Weight maintenance or a slower weight gain to allow a gradual decline in BMI is an acceptable approach for pre-pubertal children with obesity. Weight loss should be limited to post-pubertal adolescents who are severely overweight and are supervised by paediatric specialists.

Grade D, Level 4

13.5.2 Care delivery

Overweight or obese children and adolescents with no significant comorbidity can be managed by primary health care providers.[286,287] Additional referrals to trained allied health professionals such as a dietitian, psychologist or exercise specialist may be considered based on the child's and family's readiness to change and motivation.

D

Referral to a paediatric specialist or structured weight management programme for children and adolescents should be considered for the following cases: Children with a suspected secondary cause of obesity, severely overweight children and adolescents with comorbidities that require weight loss.

Grade D, Level 4

13.5.3 Interventions

13.5.3.1 Multicomponent lifestyle interventions

A

Obese children and adolescents should enrol in multi-component lifestyle interventions, which consist of nutrition, physical activity and behavioural modifications, which can result in a modest, but significant reduction in obesity and cardiovascular risk, compared to standard care, self-help or no treatment.

Grade A, Level 1+

These lifestyle intervention programmes are delivered mostly in group settings by healthcare professionals including physicians, nurses, psychologists, dietitians and exercise specialists. The length of interventions generally ranges from 3 to 48 months.

A

Parental involvement can enhance the effectiveness of lifestyle interventions, particularly in pre-adolescent children, by changing and adapting parenting styles, parenting skills and child management strategies during the intervention, such as role modelling and active parental participation.

Grade A, Level 1+

Effective family-focused child obesity interventions frequently involve a high degree of parental participation, parents taking responsibility for intervention participation and implementation, as well as behaviour change techniques such as specific goal setting; setting graded tasks; prompt self-monitoring and self-talk; barrier identification; restructuring the home environment and providing contingent rewards. Intervention effectiveness did not seem to be influenced by the number of targeted nutrition and activity behaviours.[288] A small reduction in body weight (2–4 kg) at 6 months of treatment was achieved in most comprehensive lifestyle intervention trials as a result of weight loss and weight-gain prevention.[289-291] A greater effect on weight outcomes was reported in studies with more intensive and comprehensive programmes (26 hours of contact or more) conducted in specialty health care or similar settings.[290]

Outcomes on cardiovascular risk factors were not consistently reported in lifestyle intervention trials. Limited evidence suggests that improvement in insulin resistance may be achieved by intensive lifestyle interventions, but reductions in other cardiovascular risk factors are not observed routinely.[290,292] Obese children and adolescents took part in lifestyle intervention trials also showed improvement in quality of life, self-esteem, reduction in depression score and positive changes in eating styles and habits after treatment.[276,292]

A limited number of randomised control trials that have examined the long-term effectiveness of lifestyle interventions in obese adolescents, and these reported mixed results on weight maintenance during follow-up periods from 4 to 12 months post-treatment.[276,289,290] Based on the few studies that included measures of harm, lifestyle interventions appear to be safe. No significant adverse effects on linear growth, eating behaviours or psychological well-being were reported in the intervention groups.[276,290,293]

13.5.3.2 Dietary interventions

There are only a limited number of research studies that evaluate isolated dietary treatment programmes for childhood obesity. There is more evidence to support the inclusion of dietary therapy and/or nutrition education within a multi-component lifestyle intervention than using dietary therapy alone for reducing obesity in children.[260,287,292,294-296]

C Dietary interventions for obese children and adolescents should comprise the following strategies: reducing intake of calorie-dense, nutrient-poor foods (sweetened beverages, fruit drinks and juices, fast foods, calorie-dense snacks), portion control, reducing saturated fat intake (for children > 2 years), encouraging intake of fibre/whole grains, fruits and vegetables, as well as encouraging healthy eating behaviours such as eating regular meals (especially breakfast), avoiding having meals in front of the television (TV)/computer and avoiding frequent food nibbling or "grazing" during the day, especially after school. Diets should also be adequate in micronutrient intake to promote optimal linear growth.

Grade C, Level 2⁺⁺

There is limited evidence to support the short-term use of diets with high-protein content and low glycaemic index to promote weight loss in obese adolescents.[296-299] More convincing evidence from long-term studies are needed before any dietary or macronutrient manipulation can be routinely prescribed for the treatment of childhood obesity.[260,287,289,292,296]

D The use of restrictive diets is not appropriate for children and adolescents except when combined with specialist supervision and intensive follow-up.[289,292,300]

Grade D, Level 4

13.5.3.3 Physical activity

A Physical activity should be routinely included within a multi-component lifestyle intervention for reducing overweight and obesity in school-age children and adolescents.[260,286,287,289,292,296,300]

Grade A, Level 1⁺

Regular physical activity also has other benefits, including improving aerobic fitness and reductions in cardiovascular risk factors in children and adolescents.[297,301,302] General agreement from systemic reviews that physical activity levels should be increased, but the type, amount and intensity required to affect childhood obesity is still unclear.[289,294-296,303]

The National Physical Activity Guidelines recommend that children and youths aged 7–18 should accumulate 60 minutes or more of moderate- to vigorous-intensity physical activity every day, emphasising aerobic-type physical activities (each exercise session should last more than 5 minutes). As part of the 60 minutes, vigorous-intensity physical activity should be incorporated at least 3 times per week, including those that strengthen muscle and bone. Obese children and adolescents with no significant comorbidities can safely participate in most organised sports or structured exercise programmes. They should be encouraged to achieve the recommended physical activity level by increasing the duration, frequency and intensity of their activities gradually. There is a possibility that they will need additional physical activity on top of the recommended physical activity level for general health benefits. An exercise programme that is

enjoyable, tailored to the child's physical capability and interest will encourage adherence. Activities that are beyond the capabilities of the child may result in overloading and injuries that may in turn discourage the child from future participation in physical activity. Other common factors that influence exercise adherence in adolescents are time, cost, convenience, availability (e.g. exercise equipment/facilities) and social support.

Parents can help children meet their activity goal by serving as role models, incorporating enjoyable physical activity into family life, monitoring the time their children spend watching TV, playing video games and using the computer and intervening if too much time is spent in sedentary pursuits. Decreasing time spent in sedentary activities such as TV watching, playing video games and using a computer for recreation can be a complementary strategy for promoting physical activity among children and adolescents and may also have a positive effect on weight.[287,292,300,304,305]

D Obese children and adolescents should be encouraged first to meet the National Physical Activity Guidelines for children and youths by increasing their daily physical activity level progressively. Additional physical activity on top of the recommended guidelines may be needed for general health benefits for this group of youths.

Grade D, Level 4

D Sedentary activities (TV viewing, playing video games etc.) should be limited to not more than 2 hours a day, or equivalent to 14 hours per week for all children.

Grade D, Level 4

13.5.3.4 Pharmacological treatment

Although sibutramine, orlistat and metformin have been studied in obese adolescents, they are not commonly used in clinical practice. The sale of sibutramine was suspended locally in 2010.

Orlistat was found to have a modest weight loss effect on obese adolescents over placebo when combined with a hypocaloric diet and lifestyle

intervention in clinical trials.[290,291,306-309] The BMI reduction reported in these studies ranged from 0.5 to 4.2 kg/m^2 at 6–12 months of treatment. Mild gastrointestinal adverse effects were common among patients taking orlistat. Common adverse effects include fatty/oily stool, oily spotting, increased defecation, abdominal discomfort and pain.[276-281,288,290,291,310]

In a few randomised trials with small sample size, metformin therapy (1,000–1,500 mg daily) plus lifestyle intervention in non-diabetic obese adolescents for 8 weeks to 6 months showed a small reduction in body weight or BMI in comparison with placebo.[291,306,309,311-313] In a recent multicentre trial which included 151 obese children and adolescents aged 8–18 years,[314] metformin treatment (1 g in the morning and 500 mg in the evening) in the intervention group was associated with a significant reduction in body weight, BMI, fasting glucose, alanine aminotransferase level and adiponectin to leptin ratio at 3 months as compared with placebo group, with changes in weight and BMI sustained at 6 months. Metformin can cause transient dose-related gastrointestinal adverse effects such as abdominal discomfort, nausea and diarrhoea but it is well tolerated by majority of the patients. Larger and longer-term studies in different populations, however, are needed before establishing the role of metformin in the treatment of obese children.

A Pharmacotherapy for weight loss should only be considered as an adjunct to lifestyle interventions in obese adolescents with severe comorbidities or when lifestyle interventions have failed. It should only be administered by experienced clinicians. The decision should be carefully weighed against the potential for adverse effects, the lack of evidence for persistent weight loss after active treatment and the long-term safety in adolescents.

Grade A, Level 1$^+$

14 Special focus: Pregnancy

14.1 Screening

Obstetric complications of maternal obesity are generally related to pre-pregnancy obesity, although excessive weight gain during pregnancy does have similar complications.

The WHO classification of obesity according to BMI should be used (Please refer to Table 2 in Chapter 4).

B Women of childbearing age, especially overweight and obese women, should receive information and advice from healthcare providers about the benefits of weight loss before pregnancy and the risks of being overweight or obese. An ideal preconception weight will optimise pregnancy outcome for both mother and baby.

Grade B, Level 2+

B Height and pre-pregnancy weight should be recorded in the health record for all women at the initial antenatal visit.[315] Pre-pregnancy BMI can be calculated and classified using the WHO BMI cut-off points (see Table 11).

Grade B, Level 2+

D Prior to attempting to conceive, women of childbearing age should stop taking medication for weight loss.

Grade D, Level 4

14.2 Pregnancy weight management

Women should set pregnancy weight gain goals based on their pre-pregnancy BMI,[316,317] as shown in Table 11. To achieve these goals, women should be at the healthiest weight possible when they contemplate pregnancy.

Table 11. Target pregnancy weight gain based on BMI

Classification	Pre-pregnancy BMI (kg/m^2)	Recommended total gain range (kg)
Underweight	< 18.5	12.7–18.1
Normal range	18.5–24.9	11.3–15.9
Overweight	25.0–29.9	6.8–11.3
Obese I, II and III	≥ 30.0	5.0–9.1

B

The range of desirable total weight gain and the rate of gain should be discussed with the woman early in her pregnancy. A plan to achieve these goals should be documented.

Grade B, Level 2+

Nutritional counselling is recommended for women not meeting the weight gain guidelines in Table 11. An evaluation of dietary intake and exercise habits can provide insight into women at risk.[318] A woman's overall health, including obstetric and medical risks, should be evaluated before prescribing an exercise programme.

B

Nutritional advice should be routinely provided to all pregnant women (refer to Chapter 7 on Treatment: Diet for an explanation of a healthy diet). General advice should include:

- Eating a healthy, balanced diet as per "Pregnancy and Diet, Health Promotion Board, Singapore" including foods rich in calcium, folate and iron.
- Not restricting dietary intake below the recommended food group requirements for pregnancy.
- Avoiding certain foods and drinks (such as raw foods, coffee/tea and alcohol) which can be harmful to the pregnancy.
- Taking folic acid supplements.
- Adhering to recommended weight gain ranges (Table 11).

Grade B, Level 2+

B In the absence of obstetric or medical complications, all pregnant women should accumulate 150 minutes per week of moderate-intensity exercise (e.g. accumulate 30 minutes per day, best to spread this activity throughout the week). Qualified supervision may be offered to assist with assessment and individual exercise prescription.

Grade B, Level 2+

14.3 Complications of obesity in pregnancy

Excessive gestational weight gain has been correlated with foetal macrosomia, operative vaginal delivery, caesarean section, low Apgar scores and admission to neonatal intensive care units.[319]

Increased clinical surveillance is recommended due to the increased risk of comorbidities and pregnancy complications. These include the risk of diabetes, pre-eclampsia, thromboembolism and the risk of caesarean section.

B Consider booking an early visit to plan pregnancy care. A pregnancy care plan with increased clinical surveillance is recommended for obese, pregnant women in the antenatal, intrapartum and postnatal periods. Consider a cardiac risk assessment for women with pre-existing medical conditions, especially those with Class III Obesity and who have other risk factors such as smoking or Type 2 diabetes mellitus.

Grade B, Level 2++

B All overweight or obese women should be screened for diabetes with a 75 g oral glucose tolerance test at 24–28 weeks gestation. For women with Class II and III Obesity (pre-pregnancy BMI ≥ 35.0 kg/m^2), consider an early oral glucose tolerance test (below 14 weeks gestation if possible) to assess for pre-existing diabetes. If the initial oral glucose tolerance test is negative, consider repeating at 28 weeks if the risk of diabetes is significantly high or if the patient exhibits clinical symptoms of diabetes.

Grade B, Level 2++

B

For women with Class III Obesity (pre-pregnancy BMI ≥ 40 kg/m^2), co-manage with a physician who will establish baseline renal (presence of proteinuria, serum creatinine and urea) and liver function to assist in distinguishing chronic renal dysfunction secondary to maternal chronic hypertension and/or diabetes from pregnancy-associated hypertensive/diabetic disorders.

Grade B, Level 2$^+$

The risk of thromboembolism is increased in obese parturients.[320] The Royal College of Obstetricians and Gynaecologists (RCOG) in the United Kingdom recommends thromboprophylaxis for 3 to 5 days, using low molecular weight heparin after vaginal delivery for women who are over age 35 and have a pre-pregnancy BMI > 30 kg/m^2 or weight > 90 kg.[321] The Pregnancy and Thrombosis Working Group in the United States, however, does not concur with the RCOG guidelines.

B

The risk of venous thromboembolism for every obese woman should be evaluated in the presence of additional clinical risk factors. Thromboprophylaxis for antenatal and postnatal, if indicated, should be individualised.

Grade B, Level 2^{++}

The risk of caesarean section is increased in obese women.[322] Up to 75% of all anaesthesia-related maternal deaths occur in pregnant obese women.[322] An anaesthetic review in pregnancy may provide the opportunity to assess comorbidities, especially those which increase anaesthetic risk including difficulty of intubation, regional anaesthesia and obtaining venous access. In addition, the hospital should consider its physical and service delivery capabilities including facility design (width of access doors and pathways), availability of large patient equipment with appropriate safe working loads and widths, workforce capabilities and the capability to manage potential risks and complications of obesity.

B Consider antenatal anaesthetic consultation to review analgesic options, especially for women with pre-pregnancy BMI > 35 kg/m^2 and consider facility capabilities including equipment and extra staffing when performing caesarean section and other surgeries.

Grade B, Level 2$^+$

14.4 Post-natal management

Obese women should be encouraged to continue with nutritional counselling and exercise programmes postnatally.[323] Obesity is a modifiable risk factor and weight reduction should be advised as an important goal for the obese woman who is anticipating future pregnancy.

D Discuss healthy eating, physical activity and breastfeeding as strategies for returning to pre-pregnancy weight with all postpartum women.[319] Women in a healthy pre-pregnancy BMI range should be advised of the importance of maintaining a healthy pre-pregnancy BMI between pregnancies. Overweight and obese women should be encouraged to lose weight before considering a future pregnancy.

Grade D, Level 4

Breastfeeding should be encouraged and supported, not only for the benefit of the newborn, but also to promote postpartum weight loss. However, obese women are at an increased risk of unsuccessful lactation and delay in establishment of lactation for a variety of reasons.[324]

D Offer obese women additional support for breastfeeding. Consider referral to a lactation consultant, increasing supervision during breastfeeding and providing early postpartum breastfeeding support.

Grade D, Level 4

15 Clinical quality improvements

To continue to arrest and check the increasing trend of obesity in the adult population, the Committee recommends that appropriate resources and facilities be available for promoting weight loss and maintenance in the community and health care setting.

Weight management for those impacted or at-risk should be integrated and organised around a multi-disciplinary team approach. The core team can include primary care physicians, nurse educators, nutritionists, physical exercise therapists, behavioural therapists and endocrinologists. Other specialists who provide support care include cardiologists, respiratory physicians and surgeons.

The committee proposes the following to assist patients and health care providers to assess their quality of care depending on their risk status.

Performance quality indicators	Recommended frequency for adults*
Patient education and counselling	At diagnosis and at least 6 monthly
Body weight, BMI, waist circumference	At diagnosis and at least 6 monthly
Blood pressure measurement	At diagnosis and quarterly, or as clinically indicated
Blood lipids profile	At diagnosis and at least annually
Blood glucose assessment	At diagnosis and at least annually
Outcome quality indicators	
Weight loss	Successful: lose at least 5% of initial body weight Very successful: lose at least 10–20% of initial body weight.
Blood pressure	Percentage of patients with most recent blood pressure < 140/90 mm Hg
LDL-cholesterol	Percentage of patients with most recent LDL-cholesterol < 3.4 mmol/L
Blood glucose	Percentage of patients with most recent blood glucose ≤ 6 mmol/L (fasting) and < 7.8 mmol/L (random)

*from baseline assessment

Annex A – Caloric and nutritional information for local select foods

Selected local food item	Weight per portion (g) / Portion size	Total calories (kcal)	CHO (g)	Protein (g)	Fat (g)	Fibre (g)
Carbohydrate items						
White rice, boiled	180 g	248	55.6	4.7	2.3	1.8
Brown rice, boiled	180 g	254	57.8	4.7	2	2.7
Plain porridge	200 g	98	18	3	2.2	1.6
Udon (made from wheat flour)	150 g	420	85.5	10.2	2.0	0.1
Tang hoon (made from mung bean starch)	150 g	167	41.5	0.0	0.0	Tr
Vermicelli (made from wheat flour)	200 g	220	48.2	6.8	0.0	Tr
Spaghetti (made from semolina or flour and water)	230 g	239	51.1	8.3	1.6	4.1
Macaroni (made from durum wheat)	230 g	198	42.5	6.9	1.1	3.5
Bee tai bak (made from rice flour)	150 g	189	45.3	0.9	0.5	1.5
Kway teow (made from rice)	150 g	210	47.9	4.5	0.0	1.5
Vegetable and fruits						
Caesar salad	100 g	47	3.7	3.7	2.1	1.6
Coleslaw	140 g	360	5.9	1.7	37	2.6
Stir fried cabbage	100 g	82	1.4	2.1	7.6	1.9
Stir fried long bean	100 g	45	2.6	2.7	2.7	4
Stir fried broccoli	100 g	57	2.5	2.9	3.9	3.1
Cabbage, boiled	100 g	16	2.2	1	0.4	2.3
Broccoli, boiled	100 g	24	1.1	3.1	0.8	3.2
Apple, whole	100 g	47	11.8	0.4	0.1	2
Orange, whole	120 g	44	10.2	1.3	0.1	2.2
Watermelon	150 g	47	10.7	0.8	0.5	0.5

Meat and alternatives						
Wanton soup w chye sim (no noodle)	400 g	236	18.4	11.6	12.8	0.2
Chicken meat, boiled	90 g	165	0	26.3	6.6	Tr
Curry chicken	120 g	161	8.7	20.1	5.6	6.2
Grilled chicken (lean)	90 g	133	0	26.8	2	Tr
Stir fried ginger chicken	90 g	183	3.33	13.1	13	Tr
Fish, steamed	90 g	75	0.5	15.2	1.3	Tr
Stir fried fish	90 g	139	1.5	17.6	6.9	Tr
Beef stew	150 g	161	7	18	6.9	1.4
Egg, boiled	50 g	74	0	6.3	5.4	Tr
Egg omelette	100 g	195	0	10.9	16.8	Tr
Snacks						
Curry puff	138 g	489	39.6	14.8	30.1	Tr
Tuna sandwich	76 g	164	15.3	7.4	8.6	0.8
Tau huay	300 g	177	33.3	6.9	1.8	0.9
Popiah	140 g	188	14.3	7.6	11.2	4.1
Cheng tng	350 g	154	37.1	1.1	-	2.4
Vegetable pau	80 g	156	23.8	4.3	4.9	2.6
Green bean soup	300 g	165	28.2	10.2	1.2	13.2
Soon kueh, steamed	72 g	122	24.4	1.6	2	2.1
Pandan cake	40 g	100	6.4	3.2	6.8	Tr
Wholemeal cracker	25 g	104	18	2.5	2.9	1.5
Cooked dishes						
Fish ball noodle soup	600 g	414	66	22.8	7.2	0.2
Ban mian	500 g	450	45.5	20.5	20.5	3
Fish sliced beehoon	650 g	332	45.5	22	7.2	3.25
Chicken rice	380 g	748	69.5	42.9	36.1	2.2
Duck rice	400 g	676	99.6	24	20	7.6
Nasi briyani w mutton	450 g	671	86	31.9	22.1	Tr
Bee hoon soto	600 g	240	20.4	13.2	11.4	Tr
Char siew rice	350 g	648	97.7	25.2	17.5	0.2
Chee cheong fun	200 g	262	50.6	5	3.2	2.4
Fish slice porridge	560 g	213	33	14	2.8	Tr

Tr: trace
Source: Diet plan 6[325]

Annex B – Tools and resources for information and communication technology (ICT) and weight loss

1) Heart rate table

Table C-1 Moderate-intensity and vigorous-intensity heart rate ranges

Age	Moderate-intensity beats per minute	Vigorous-intensity beats per minute	Moderate-intensity beats per 15 seconds	Vigorous-intensity beats per 15 per seconds
19–24	127–151	153–185	32–37	38–46
25–29	124–147	149–179	31–36	37–45
30–34	120–143	145–175	30–35	36–44
35–39	117–139	140–170	29–34	35–43
40–44	114–135	137–166	28–33	34–41
45–49	110–131	133–161	28–32	33–40
50–54	108–128	129–156	27–31	32–39
55–59	104–124	126–152	26–30	31–38
60–64	101–120	122–147	25–29	30–37
65–69	98–116	118–142	24–28	29–36
70–74	95–112	114–138	24–27	28–34
75–79	92–109	110–133	23–27	28–33
80–84	88–105	106–128	22–26	27–32

Source: ACSM Guidelines for Exercise Testing and Prescription, 8th edition

2) Commonly used equations to estimate maximal heart rate.[326,327]

Equation*
1) $HR_{max} = 220 - age$ 2) $HR_{max} = 208 - (0.7 \times age)$

*These equations serve as a practical and convenient estimation for maximal heart rate

Table C-2 Classification of relative exercise intensity[254]

Intensity	% HRmax	Perceived exertion (Rating on 6–20 RPE scale)
Very light	< 57	< Very light (RPE < 9)
Light	57–63	Very light-fairly light (RPE 9–11)
Moderate	64–76	Fairly light to somewhat hard (RPE 12–13)
Vigorous	77–95	Somewhat hard to very hard (RPE 14–17)
Near-maximal to maximal	≥ 96	≥ Very hard (RPE ≥ 18)

3) Physical activity strategies

Table C-3 Types of physical activity strategies

Domain type	Work/home	Active transport (commuting)	Leisure-time
Lifestyle Intermittent Light–to-moderate intensity activity	• Doing household chores • Taking the stairs	• 5-min walk to the bus-stop • Going for a stroll • Standing	• Playing catch or Frisbee • Flying a kite • Playing miniature golf
Aerobic Moderate-to-vigorous intensity for more than 10 minutes at a time	• Mopping the floor • Doing manual work	• 15 minute brisk walk (~5 km/h) from the MRT station to home • Carrying groceries • Taking the stairs	• Doing low- impact aerobics • Brisk walking or jogging • Playing soccer

Strength Moderate-to-vigorous intensity using 0 to 10 scale	• Lifting/moving moderately heavy objects	• Carrying groceries • Taking the stairs	• Using hand weights • Using resistance band • Doing Qigong/Tai Chi

For further information on physical activity programmes and educational material, please visit the Health Promotion Board website: www.hpb.gov.sg.

4) Healthy choices

This is an evidence-based convenient and user-friendly point-of-care resource for healthcare professionals. It provides opportunistic lifestyle advice and management of 'at-risk' patients to prevent or better manage chronic conditions by targeting smoking, overweight/obesity and other priority areas such as stress and unsafe sexual practices.

Practice manual for healthcare:
www.hpb.gov.sg/HOPPortal/content/conn/HOPUCM/path/Contribution%20Folders/uploadedFiles/HPB_Online/Programmes/HPB_HealthChoices_Booklet.pdf

Flip chart for patient counselling:
http://www.hpb.gov.sg/HOPPortal/content/conn/HOPUCM/path/Contribution%20Folders/uploadedFiles/HPB_Online/Programmes/HPB_HealthChoices_FlipChart.pdf

Annex C – Glossary for behavioural modifications and related therapy

Body image

Perceptions of one's body shape, size, appearance and competencies, akin to the concept of 'physical self-worth'. This can be an important aspect of overall self-esteem.

Cognitive strategies

'Thinking' strategies, or beliefs, used for behaviour change.

Cognitive behavioural strategies

Thinking and 'planning' strategies used for behaviour change.

Motivation

A personal drive towards a chosen behaviour reflecting persistence, continuation over time, and behavioural intensity.

Motivational interviewing (MI)

A directive, client-centred counselling style for eliciting behaviour change.

Self-efficacy

Belief in one's ability to carry out a behaviour or action.

Social support

Emotional, logistic or other support from others, sometimes directed at specific behaviours.

Transtheoretical model

A model explaining behaviour change. It assumes that people move through 'stages' of decision making and action based on their intentions and behaviours, and these are supported by self-efficacy, a weighing of pros and cons of change and specific strategies (processes) of change.

Relapse

Moving backwards in the behaviour change cycle to a previous stage of thinking or action.

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Self-assessment (MCQs)

After reading the Clinical Practice Guidelines, you can claim one CME point under Category 3A (Self-Study) of the SMC Online CME System. Alternatively, you can claim one CME point under Category 3B (Distance Learning – Verifiable Self Assessment) if you answer at least 60% of the following MCQs correctly. You can submit your answers through the SMJ website at this link: http://smjcme.sma.org.sg/ (the link will only be available once the June 2016 issue of SMJ becomes available). The answers will be published in the SMJ August 2016 issue and at the MOH/HPB webpage for these guidelines after the period for submitting the answers is over.

Instruction: For each of the following statements, please choose "True" or "False".

Questions	True	False
1. When diagnosing and assessing obesity,		
a. The measure used to define obesity in childhood and adolescence is BMI-for-age.	◯	◯
b. BMIs of 23 kg/m^2 and 27.5 kg/m^2 have been recommended as cut-off points for public health action in Asian adults.	◯	◯
c. Adult patients should be assessed for comorbid conditions and stratified according to health risk, in particular for neuromuscular disorders.	◯	◯
d. Waist circumference is the most practical anthropometric measurement for assessing a patient's abdominal fat content before and during weight loss treatment.	◯	◯
2. With regard to diet and physical activity for treating obesity,		
a. An effective weight loss diet is one with reduced fat and total calorie intake, and the ability to maintain prolonged dietary compliance.	◯	◯
b. With regard to the impact of calorie restriction on weight loss, daily energy intake reduction of 24 kcal/day will eventually lead to an approximately 1 kg weight loss with half occurring in about 1 year.	◯	◯

c. Current National Physical Activity Guidelines state that to gain sufficient health benefits, adults need to accumulate 100 minutes of moderate intensity aerobic physical activity per week.

d. Physical activity alone can help in the prevention and control of obesity, but physical activity combined with diet can lead to greater weight loss.

3. With regard to medication and surgery for treating obesity,

a. Long-term clinical trials suggest that orlistat may produce a weight loss of 2.9 kg compared to placebo.

b. Reducing carbohydrates is the only way to reduce weight

c. Bariatric surgery may be considered for the treatment of obese individuals suffering from diabetes mellitus with poor glycaemic control.

d. After bariatric surgery, patients do not need any medical follow-up.

4. When diagnosing and treating obesity in children and adolescents,

a. Weight maintenance or slower weight gain is not an acceptable approach for pre-pubertal children with obesity.

b. BMI-for-age percentile charts for boys and girls are used to classify children and adolescents, where overweight status is defined by 90–95th percentile, and severely overweight (obesity equivalent) is defined as ≥95th percentile in Singapore.

c. A child with recent onset of weight gain and slow linear growth should be referred for assessment of endocrinopathy.

d. Obese Asian children should be screened for Type 2 diabetes if they are pubertal and have acanthosis nigricans.

5. When screening for and managing obesity in pregnant women,

   a. Weight loss is recommended for the morbidly obese women with BMI > 30 kg/m^2 ◯ ◯

   b. A 50 g glucose challenge test is recommended at 24–28 weeks of gestation. ◯ ◯

   c. Post-natal mechanical and pharmacological thromboprophylaxis is necessary for these women after caesarean section. ◯ ◯

   d. For postnatal care, overweight and obese women should be encouraged to lose weight before considering a future pregnancy. ◯ ◯

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Endocrine and Metabolic Society of Singapore

Ministry of Health, Singapore

Obesity & Metabolic Surgery Society of Singapore

Obstetrical & Gynaecological Society of Singapore

Singapore Association for the Study of Obesity

Singapore Nutrition and Dietetics Association

Singapore Paediatric Society

Sports Medicine Association, Singapore

ADDENDUM

This addendum is to update the recommendation statement on page 70 of the Obesity Clinical Practice Guidelines (June 2016) (and page 9 of its Key Guideline Recommendations).

A Phentermine and mazindol may be used for weight management for the short-term (6–12 months). Liraglutide may be used for weight management up to 2 years while orlistat may be used as an anti-obesity drug for long-term therapy (up to 4 years).

Grade A, Level 1+

Mazindol has been recently discontinued, although FDA did not revoke its approval. Higher dose Liraglutide at 3 mg daily is also FDA-approved but is currently not available in Singapore.