

## These guidelines have been withdrawn

MOH clinical practice guidelines are considered withdrawn five years after publication unless otherwise specified in individual guidelines. Users should keep in mind that evidence-based guidelines are only as current as the evidence that supports them and new evidence can supersede recommendations made in the guidelines.



# CLINICAL PRACTICE GUIDELINES

## Obesity



Ministry  
of Health



Singapore Association  
for the Study of Obesity

**Apr 2004**

**MOH Clinical Practice Guidelines 5/2004**

## Levels of evidence and grades of recommendation

### Levels of evidence

Level	Type of Evidence
<b>Ia</b>	Evidence obtained from meta-analysis of randomised controlled trials.
<b>Ib</b>	Evidence obtained from at least one randomised controlled trial.
<b>IIa</b>	Evidence obtained from at least one well-designed controlled study without randomisation.
<b>IIb</b>	Evidence obtained from at least one other type of well-designed quasi-experimental study.
<b>III</b>	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
<b>IV</b>	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

### Grades of recommendation

Grade	Recommendation
<b>A</b> (evidence levels Ia, Ib)	Requires at least one randomised controlled trial, as part of the body of literature of overall good quality and consistency, addressing the specific recommendation.
<b>B</b> (evidence levels IIa, IIb, III)	Requires availability of well conducted clinical studies, but no randomised clinical trials on the topic of recommendation.
<b>C</b> (evidence level IV)	Requires evidence obtained from expert committee reports or opinions, and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.
<b>GPP</b> (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

# **CLINICAL PRACTICE GUIDELINES**

## **Obesity**

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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, nor should they be construed as including all proper methods of care or excluding 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.

## **Foreword**

There is a global epidemic of obesity. In Singapore, the prevalence of obesity has been increasing. As obesity is a risk factor for the development of diseases such as coronary heart disease, hypertension and diabetes, obesity is therefore a major public health concern in Singapore and throughout the world. The primary care physician will have to manage patients with this condition on a daily basis.

These guidelines discuss the evidence-base for all aspects of managing obesity, ranging from diet, physical activity, behaviour management, medical treatment and surgery. The management of obesity in children and adolescents is also covered. These guidelines also describe Body Mass Index (BMI) cut-off points for defining overweight and obesity that are currently in use. While these BMI cut-off values are being reviewed in the light of new data in Asian populations and may be changed in the future, the general approaches and management options in these guidelines would still be relevant.

I hope you will find these guidelines useful in your practice.

**PROFESSOR TAN CHORH CHUAN  
DIRECTOR OF MEDICAL SERVICES**

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## Executive summary of recommendations

Details of recommendations can be found in the main text at the pages indicated.

### Diagnosis & Clinical Evaluation

**B** Body mass index (BMI) is the recommended index to define overweight and obesity. It is minimally correlated with height, and highly correlated with body fat percentage and levels of disease risk of co-morbidities. Body weight alone can be used to follow weight loss and to determine efficacy of therapy. (pg 16)

**Grade B, Level III**

**C** Current WHO and international guidelines recommend BMI cut-offs of 25 and 30 kg/m<sup>2</sup> to define overweight and obesity respectively. Based on body fat equivalence and co-morbid disease risk, BMIs of 23 and 27.5 kg/m<sup>2</sup> respectively have been recommended as cut-off points for public health action in Asians. (pg 18)

**Grade C, Level IV**

N.B. BMI cut-off points are currently being reviewed in the light of new data.

**B** Waist circumference is the most practical anthropometric measurement for assessing a patient's abdominal fat content before and during weight loss treatment. Gender-specific waist circumference cut-offs should be used in conjunction with BMI to identify increased disease risk. (pg 19)

**Grade B, Level III**

**C** 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 and our National Health Survey and co-morbid disease risk, cut-offs of 90 and 80 cm respectively are probably more appropriate for Asians. (pg 20)

**Grade C, Level IV**

**B** Historically, weight-for-height charts have been used to classify weight status in children. BMI-for-age and gender charts are recommended for use in children. (pg 21)

**Grade B, Level III**

**GPP** In clinical evaluation of patients, practitioners should consider and exclude predisposing factors for, and secondary causes of obesity. (pg 24)

**GPP**

**C** Overweight and obese adults should be screened for co-morbid conditions, and should be stratified according to their health risks, in particular for cardiovascular disease, prior to the commencement of treatment. (pg 25)

**Grade C, Level IV**

## **Overview of Weight Management**

**C** Patient motivation is an important prerequisite of weight loss management and should be relatively high before initiating therapy. Proper evaluation of issues related to motivation should be undertaken (pg 27)

**Grade C, Level IV**

**C** It is important to set realistic goals for weight loss, and provide sound advice on lifestyle modification. Modest weight loss, e.g. 10% body weight over 6 months, is more realistic and attainable than aiming for weight reduction to ideal body weight, and does result in a reduction in obesity morbidity. (pg 28)

**Grade C, Level IV**

**C** A multifaceted or multidisciplinary strategy should be utilized to achieve and maintain weight loss. Depending on patient response, this could be adequately achieved at the primary health care level or tertiary level. (pg 28)

**Grade C, Level IV**

## **Lifestyle modification**

**A** The combination of dietary caloric restriction, physical activity and behavioural modification results in greater and more sustained weight loss than the individual modalities. (pg 29)

**Grade A, Level Ib**

**A** The most important dietary component of weight loss and maintenance is a decrease in caloric intake. Typically, a 500 to 1000 kcal per day reduction produces the recommended 0.5 to 1 kg per week weight loss. In the absence of physical activity, a diet that contains ~1400-1500 kcal/day, regardless of macronutrient content, results in weight loss. Sustained dietary modification is necessary to maintain weight loss. (pg 30)

**Grade A, Level Ib**

**C** Diets containing different proportions of the major macronutrients, such as moderate-fat balanced nutrient-reduction diets, high-fat low-carbohydrate diets and low- or very-low-fat high-carbohydrate diets have all been shown to reduce weight. Weight loss appears to be more associated with reduced caloric intake and increased diet duration, rather than the macronutrient content per se. A diet moderately restricted in total fat, moderate to high in complex carbohydrates, and moderate in protein is the most widely recommended diet. (pg 32)

**Grade C, Level IV**

**C** The distribution of food intake should be as even as possible throughout the day, and meals should not be skipped as a weight control method. Meals should be adequately sized so that snacks are not needed between meals. (pg 35)

**Grade C, Level IV**

**A** Low-calorie (LCD) and very low-calorie diets (VLCD) may be useful shorter term adjuncts (up to 6 months) for weight loss, but sustained modification of food intake is necessary to maintain weight loss. The use of these diets as part of a meal replacement strategy appears useful. The combination of a controlled energy diet (LCD or VLCD), increased physical activity, and behaviour therapy appears to provide the most successful outcome for weight loss and maintenance. (pg 38)

**Grade A, Level Ib**

**A** Current physical activity contributes to weight loss, reduces cardiovascular risk factors (e.g. hypertension and diabetes mellitus) and the risk for coronary heart disease, increases cardio-respiratory fitness independent of weight loss, and decreases body and abdominal fat. (pg 41)

**Grade A, Level Ib**

**C** The current recommendation of moderate-intensity physical activity for 30 min, 3-5 days per week is largely aimed at reducing cardiovascular disease and overall mortality. (pg 42)

**Grade C, Level IV**

**C** To prevent unhealthy weight gain, moderate-intensity physical activity for 45-60 min on most days or every day has been recommended. Preventing weight gain after substantial weight loss probably requires about 60-90 minutes per day. Starting at low-to-moderate physical activity for 30-45 min, 3-5 days per week, the intensity, duration and frequency should be increased gradually. (pg 43)

**Grade C, Level IV**

**A** A program of diet plus non-structured, moderate-intensity lifestyle activity appeared as effective as diet plus structured aerobic activity for reducing weight in obese women. Any increase in daily physical activity is likely to have some benefit in obese women. (pg 44)

**Grade A, Level Ib**

**B** The presence of depression and binge eating disorders in obese patients must be evaluated for, with appropriate referral for psychiatric treatment. (pg 46)

**Grade B, Level IIa**

**A** Weight loss programs incorporating cognitive behavioural interventions are helpful in achieving weight loss and weight maintenance in the range of up to 10% for between 1 to 5 years of follow-up. (pg 46)

**Grade A, Level Ib**

**A** It is recommended that subjects continue with up to 12 months of the weight maintenance program combining behaviour therapy, a low calorie diet and exercise, after the initial weight loss treatment. (pg 49)

**Grade A, Level Ib**

## **Medical treatment**

**C** As obesity is a chronic condition that requires lifelong management, pharmacotherapy should be adjunct to an individual's long-term obesity management strategy. (pg 50)

**Grade C, Level IV**

**A** Drug therapy may be effective if given without lifestyle modification, but is most effective when combined with diet, physical activity and behaviour modification. (pg 50)

**Grade A, Level Ib**

**C** Drug therapy should be considered when BMI  $\geq 30$  kg/m<sup>2</sup>, or when BMI is 27-29.9 kg/m<sup>2</sup> in patients with co-morbidities or complications of obesity such as hypertension, type 2 diabetes mellitus, hyperlipidemia, coronary artery disease and sleep apnea. Commensurate BMI thresholds for action among Asians may be 27.5 and 25-27.4 kg/m<sup>2</sup> respectively (see Chapter 4 of main text). (pg 50)

**Grade C, Level IV**

N.B. BMI cut-off points are currently being reviewed in the light of new data.

**A** The drugs with the widest efficacy and safety data are orlistat (up to 4 years) and sibutramine (up to 2 years). Other drugs which appear relatively safe and effective for 6-12 month therapy include phentermine and mazindol. There is little data on the effectiveness of combining anti-obesity agents. Metformin is the drug of choice in obese diabetics and has been effectively combined with either sibutramine or orlistat for 1 year. (pg 53)

**Grade A, Level Ib**

## **Bariatric Surgery**

**A** Bariatric surgery is the most effective method to reduce weight and maintain weight loss in the severely or morbidly obese. (pg 54)

**Grade A, Level Ib**

**C** Because surgery has significant technical issues, complications, and cost, and requires extensive pre- and peri-operative preparation, it is usually considered in those with more severe obesity who have failed to control weight by other means, and who remain at high risk of medical co-morbidities. Post-operative lifestyle modifications, as well as follow-up for complications of surgery, are life-long. (pg 54)

**Grade C, Level IV**

**B** Indications for considering bariatric surgery are: (pg 56)

- Extreme or morbid obesity (BMI  $\geq 40$  kg/m<sup>2</sup>) or severe obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) with medical co-morbidities or complications of obesity. Commensurate BMI thresholds for action among Asians may be 37.5 and 32.5 kg/m<sup>2</sup> respectively.
- Failure of significant non-surgical attempts at weight reduction.

**Grade B, Level III**

## Weight Loss Maintenance

**B** Common behavioral strategies which may enhance successful long-term weight loss maintenance include eating a calorie-restricted, low-to-moderate fat diet, frequent self-monitoring of body weight, recording food intake and physical activity, and maintaining high levels of regular physical activity. (pg 59)

**Grade B, Level III**

## Obesity in Childhood and Adolescence

**C** A full clinical evaluation and possible treatment should be considered in children with a BMI  $\geq 95^{\text{th}}$  percentile or a BMI  $\geq 85^{\text{th}}$  percentile and complications of obesity. Alternatively, BMIs-for-age and gender equivalent to adult WHO BMI cut-offs for obese and overweight (at  $\geq 30.0$  or  $\geq 25.0$  kg/m<sup>2</sup>) respectively can be used as thresholds, although BMI cut-offs for action among Asians of 27.5 and 23.0 kg/m<sup>2</sup> respectively may eventually be used. (pg 62)

**Grade C, Level IV**

N.B. BMI cut-off points are currently being reviewed in the light of new data.

**C** In children, less restrictive diets should be used, rather than diets consisting of drastically altered portions of various nutrients, very low calorie diets or protein sparing modified fast regimens. (pg 62)

**Grade B, Level III**

**B** Appropriately increased physical activity is recommended. Younger children generally need age-appropriate creative activities with generous periods of free play. Weight bearing activities are recommended for overweight children, non-weight bearing activities for obese children and preferably supervised activities for severely obese children. In the

older obese pre-adolescent and adolescent, decreased time on sedentary pursuits and increased activity such as a moderate intensity, progressive exercise program with increasing levels of obesity are recommended. (pg 63)

**Grade B, Level III**

**B** Behaviour-treatment programs have shown consistent success in weight loss. (pg 64)

**Grade B, Level IIa**

**B** Interventions for obesity in children should be directed at both the parents and the child, rather than the child alone. (pg 64)

**Grade B, Level III**

**C** There is no data on the long term efficacy and safety of medication in childhood and adolescent obesity. (pg 65)

**Grade C, Level IV**

**B** Bariatric surgery cannot be recommended for most adolescents, but only for those at the highest risk of mortality from obesity, and with both patient and parental understanding of the consequences of surgery. (pg 65)

**Grade B, Level III**

# 1 Introduction

## 1.1 Aim and scope of guideline

The clinical practice guidelines on obesity are intended to assist health care professionals who have a role in managing overweight or obese patients. These guidelines provide current evidence-based clinical practice recommendations on various aspects of obesity management found across various medical disciplines.

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

- assist doctors in the management of overweight and obesity without restricting the physician's individual judgement
- provide a review of the various medical, surgical and ancillary intervention modalities in the management of obesity
- aid primary care physicians in basic management of obesity and subsequent referrals to specialists for more resistant cases

## 1.2 Guideline development

The obesity guidelines were developed by a workgroup appointed by the Ministry of Health. Its members comprised experts in their area of specialty. The workgroup formulated these guidelines by reviewing published international guidelines and current evidence available in the research literature, and taking into consideration the local population's characteristics. Feedback from relevant professional organizations was also sought in the process.

## 1.3 Target group

These guidelines would be useful for medical practitioners, both in the primary and tertiary health care sectors, since the problems with obesity have repercussion in all areas of medicine and surgery, as well as nutritionists, exercise and behavioural therapists.

The individuals for whom these guidelines are recommended are primarily those who are overweight or obese.

## **1.4 Review of Guidelines**

Evidence-based clinical practice guidelines are only as current as the evidence that supports them. Users must keep in mind that new evidence could supersede recommendations in these guidelines. The workgroup advises that these guidelines be scheduled for review 4 years after publication, or if new evidence appears that requires substantive changes to the recommendations.

## 2 Epidemiology of Obesity

### 2.1 The Epidemiology of Obesity

Obesity can be defined as a situation where excess body fat has accumulated to the extent that health may be adversely affected.<sup>1,2</sup> This excess body fat also has an important impact on psychological well-being.

Obesity has been associated with various chronic diseases including cardiovascular disease, hypertension, diabetes mellitus, sleep apnea, arthritis and cancer. These are discussed in greater detail in Chapter 3 of these guidelines. Significant emotional suffering has also been experienced by obese individuals as a consequence of discrimination in a society that places great emphasis on physical appearance.<sup>3</sup>

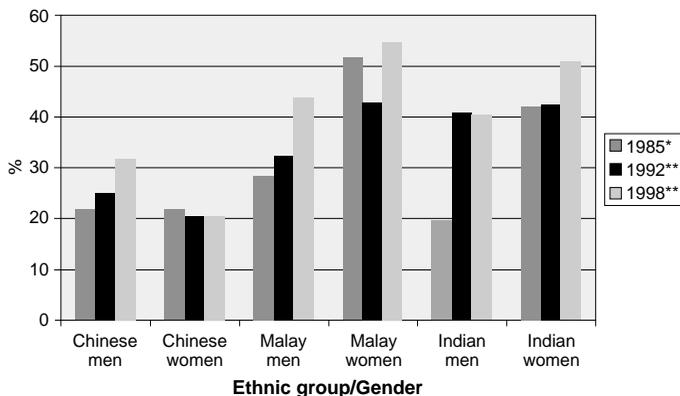
It is estimated that the costs of obesity are 2 to 7% of total health costs in developed countries.<sup>4</sup> These costs include direct costs attributable primarily to the treatment of the associated chronic complications. In addition, there are also indirect costs associated with lost productivity, absenteeism and loss of future earnings, which may occur due to premature mortality.

### 2.2 Overweight and Obesity in Singaporean Adults

The prevalence of overweight in Singapore among adults has shown an increasing trend between the years 1985 and 1998.<sup>5-7</sup> Figure 1 shows the prevalence of overweight among Singaporeans aged 18-69 years based on existing World Health Organization (WHO) classifications.<sup>2</sup> Those with a body mass index (BMI)  $\geq 25$  kg/m<sup>2</sup> were classified as overweight and included both the pre-obese and the obese.

The prevalence of obesity (defined as BMI  $\geq 30$  kg/m<sup>2</sup>) in 1998 is shown in Figure 2.<sup>5</sup> Significant differences between men and women as well as between ethnic groups were noted. Compared to 1992, the prevalence of obesity was not significantly different except in Malay women who showed a significant increase in prevalence.<sup>6</sup>

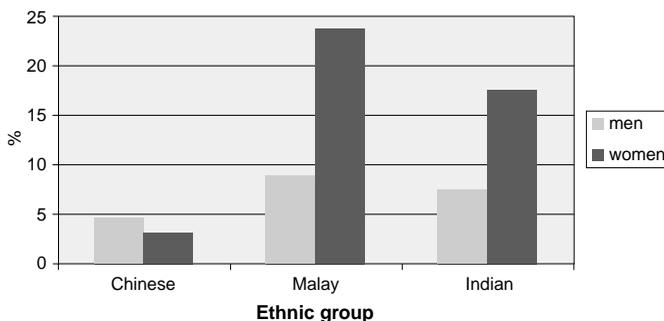
**Figure 1 Prevalence of Overweight (BMI  $\geq$  25 kg/m<sup>2</sup>) among Singaporeans from 1985-1998**



\* Data from the Singapore Thyroid and Heart Study.<sup>7</sup> Data not weighted to account for Singapore population structure.

\*\* Data from 1992 and 1998 National Health Surveys from the Ministry of Health in Singapore. Data is weighted to age, ethnic group and gender distribution of the Singapore population at the time of the survey.

**Figure 2 Prevalence of Obesity (BMI  $\geq$  30 kg/m<sup>2</sup>) among Singaporeans in 1998**



## 2.3 Obesity in Childhood and Adolescence in Singapore

The increase in obesity in adults has been accompanied by a high prevalence of obesity in childhood. Lim et al reported a rise in BMI among 18-year old National Service recruits between the years 1967 to 1991.<sup>8</sup> In 1993, Quek et al reported the prevalence of obesity amongst Chinese children and this is summarized in Table 1.<sup>9</sup>

**Table 1 Prevalence of Obesity among Chinese Children in Singapore<sup>9</sup>**

Age group (years)	Prevalence of obesity* (%)	
	Male	Female
3 - 6	14.3	13.6
7 - 9	9.5	13.0
10 - 12	12.5	23.1
13 - 16	14.6	12.9

\* *obesity is defined as relative weight index (ratio of the observed body weight to the standard weight-for-height expressed as a percentage) >120%*

In the year 2000, the School Health Survey in Singapore reported that the prevalence of obesity was 10.8% in children aged 6-7 years, 14.7% in those aged 12-13 years and 13.1% in those aged 15-16 years.<sup>10</sup>

This is of particular concern because the early onset of obesity leads to an increased likelihood of obesity in later life as well as an increased prevalence of obesity-related disorders.<sup>11,12</sup>

## 2.4 Conclusion

Overweight and obesity are a growing problem in Singapore, even amongst children and adolescents. Strategies to reduce the degree in our population are required to reduce the morbidity and mortality attributable to obesity.

## **3 Significance of Obesity**

### **3.1 Importance of addressing obesity**

Obesity is a chronic, relapsing disease that should no longer be considered merely as a problem of aesthetics or image, because there is good evidence that it is associated with significant medical illnesses and consequences.<sup>13,14</sup>

Increasing body mass index or weight has been associated with increased mortality,<sup>15-17</sup> mainly from cardiovascular complications, and reduced life-span of between 1 to 13 years.<sup>18,19</sup> It is therefore not a benign condition that can be ignored even if patients are prepared to live with the problem.

Obesity is a risk factor for the development of diseases such as coronary heart disease, hypertension and diabetes, and co-exists with these as part of a complex syndrome.<sup>14</sup> Diseases associated with obesity are not simply related to amount of fat in the body, but more significantly, with the distribution of the fat, abdominal or visceral fat being more likely to be associated with complications of obesity.<sup>14</sup>

### **3.2 Complications & co-morbidities of obesity**

#### **a. Cardiovascular disease**

Obesity is an independent risk factor for cardiovascular disease in both men and women.<sup>13,14,16,20</sup> These include myocardial infarction, coronary heart disease, sudden death and stroke.

Weight gain in later years is positively associated with an increased incidence of cardiovascular disease in both sexes.<sup>21</sup> Weight loss reduces that risk primarily by its beneficial effect on risk factors such as blood pressure, glucose tolerance and lipid profile.<sup>13</sup>

Obesity is also implicated as a cause of hypertension: weight gain is closely related to the development of hypertension and weight loss is associated with decreases in systolic and diastolic blood pressure.<sup>13,22</sup> The relationship between obesity and stroke remains unclear, but may be causally related to hypertension instead.

## **b. Metabolic and Endocrine problems**

The greatest burden of obesity is possibly related to its role in triggering abnormal glucose metabolism and insulin resistance, leading to impaired glucose tolerance<sup>23</sup> and diabetes mellitus,<sup>24-26</sup> both of which increase the risk of cardiovascular disease. Diabetes mellitus is now considered a coronary heart disease equivalent. Modest weight loss through lifestyle intervention has been shown to reduce the risk of progression from impaired glucose tolerance to a diabetic state.<sup>27,28</sup>

Obesity, through insulin resistance, can also impair lipid metabolism, leading to a higher prevalence of hyperlipidemia.<sup>20</sup> The presence of the metabolic syndrome is associated with reduced high density lipoprotein (HDL) cholesterol and raised triglyceride levels, and obesity.<sup>14</sup>

Obesity-related disturbance in glucose, insulin and lipid metabolism can also have an impact on steroid hormone activity, resulting in increased androgenicity and virilization in women. Insulin resistance and obesity, especially abdominal obesity, are predisposing factors for the polycystic ovary syndrome.<sup>29</sup> Decreased progesterone in women and decreased testosterone in men can result in decreased fertility.

## **c. Obstructive Sleep Apnea**

Obesity is also an important contributory cause to obstructive sleep apnea. Regional body fat distribution is thought to predict the presence and degree of obstructive sleep apnea.<sup>30</sup> An increase of one standard deviation in any standard measure of body habitus is related to a 1.2 to 2.5-fold increase in the occurrence of sleep apnoea.<sup>31</sup> Sleep apnea itself increases cardiovascular risk through various mechanisms, one of which is insulin resistance, independent of obesity.<sup>32</sup> Weight loss is associated with improvements in severity indices of sleep apnea.<sup>33</sup>

## **d. Cancers**

A number of cancers are more prevalent in obese individuals.<sup>34,35</sup> The obesity-related cancers with higher rates of death include colorectal, esophageal, gallbladder, pancreatic, liver, and kidney cancer in both genders, stomach and prostate cancers in men, and cancer of the breast, uterus, cervix and ovary in women.<sup>34,35</sup> Changes in hormone production

by the ovaries and testes may contribute to cancer risk in some obese subjects. The high colorectal cancer risk is possibly related to increased fat intake among obese subjects.

**e. Orthopedic problems**

Osteoarthritis is a common complication of obesity, commonly involving the knees, carpometacarpal joints of the hand, and the hip.<sup>36,37</sup> While osteoarthritis of the knee is contributed by mechanical trauma associated with excess body weight,<sup>36</sup> the arthritis of non-weight-bearing joints is probably due to some systemic factors secreted in obese persons causing abnormalities of bone and cartilage metabolism.<sup>37</sup> In severe osteoarthritis, knee and hip replacement may be necessary to allow mobility. There could also be excessive stress place on the lower spine, resulting in back problems.

**f. Gallbladder disease**

Obesity is associated with increased prevalence of gallbladder disease in both males and females.<sup>38</sup> Recent data has suggested that the presence of central obesity is also associated with gallbladder disease in females but not in males.<sup>39</sup>

**g. Psychosocial problems**

As a consequence of the obesity, social pressures are brought into play on affected individuals. Many suffer from loss of self-esteem, which may result in depression or loss of motivation. Obese individuals are subject to ridicule by society, and discrimination and bias in job applications, all of which can lead to mental health problems.

## 4 Diagnosis and Classification

### 4.1 Adults

The WHO defines obesity as a condition of excessive fat accumulation in the body to the extent that health and well-being are adversely affected.<sup>1,2</sup> While accurate methods to measure body fat exist, the techniques are often expensive, require special skills and are not readily available clinically.

#### a. Body Mass Index (BMI)

The use of BMI or Quetelet's index (derived from weight, height<sup>2</sup>, measured in kg/m<sup>2</sup>) to compare the physique of man was first advocated in the 19<sup>th</sup> century.<sup>40</sup> This index has been found to be the most suitable for assessing weight status as compared to other weight-height indices as it is minimally correlated with height while being highly correlated with body fat percentage.<sup>41,42</sup>

In a 1997 consultation, the WHO classified weight categories in adults using BMI<sup>2</sup> (see Table 2), based on the presence of excessive body fat and adverse effects on health (mortality and morbidity).

**B** Body mass index (BMI) is the recommended index to define overweight and obesity. It is minimally correlated with height, and highly correlated with body fat percentage and levels of disease risk of co-morbidities. Body weight alone can be used to follow weight loss and to determine efficacy of therapy.

Grade B, Level III

However the studies supporting these cut offs had been conducted among Caucasian populations. The WHO acknowledged that BMI may not correspond to the same degree of fatness in different populations.<sup>2</sup> Indications that the relationship between BMI and body fat percentage (BF%) differed across population groups surfaced in 1994.<sup>43</sup> Asians living in New York were found to have lower BMI but higher BF% compared to age-matched Caucasians.<sup>44</sup> Recent studies in Indonesia, Singapore, Japan and Hong Kong demonstrated that Asian residents had higher levels of BF% compared to age- and sex-matched Caucasians with the same BMI.<sup>45-48</sup> More importantly, the populations

in many Asian countries such as Singapore,<sup>49</sup> Hong Kong,<sup>50,51</sup> China,<sup>52,53</sup> Japan,<sup>54</sup> Korea<sup>55</sup> and India<sup>56</sup> have higher prevalence of cardiovascular risk factors at levels of BMI considered to be normal by the WHO.

**Table 2 The WHO classification of adults according to BMI<sup>2</sup>**

Category	BMI (kg/m <sup>2</sup> )	Risk of co-morbidities
Underweight	<18.5	Low*
Normal range	18.5 to 24.9	Average
Overweight	≥25.0	
Pre-Obese	25.0 to 29.9	Increased
Obese class I	30.0 to 34.9	Moderate
Obese class II	35.0 to 39.9	Severe
Obese class III	≥40.0	Very severe

\* *but increased risk of other clinical problems*

**Table 3 Proposed BMI cut-off points for public health action in Asians (adapted from a WHO report)<sup>57</sup>**

Cardiovascular disease risk	Asian BMI cut-off points for action (kg/m <sup>2</sup> )	Current WHO BMI cut-off points (kg/m <sup>2</sup> )
	<18.5	<18.5
Low	18.5 to 22.9	18.5 to 24.9
Moderate	23.0 to 27.4	25.0 to 29.9
High	27.5 to 32.4	30.0 to 34.9
Very high	32.5 to 37.4	35.0 to 39.9
	≥37.5	≥40.0

Recognizing the need to define cut-offs to serve as triggers for action at various risk levels among Asian populations, the WHO convened an expert consultation in July 2002. Data from various Asian countries (China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia,

Philippines, Singapore, Thailand and Taiwan) were analyzed. Table 3 shows the proposed cut-off points for public health action in Asians, although the expert panel recommended retaining the existing WHO BMI cut-offs as the international classification for defining weight category.<sup>57</sup>

**C Current WHO and international guidelines recommend BMI cut-offs of 25 and 30 kg/m<sup>2</sup> to define overweight and obesity respectively. Based on body fat equivalence and co-morbid disease risk, BMIs of 23 and 27.5 kg/m<sup>2</sup> respectively have been recommended as cut-off points for public health action in Asians.**

**Grade C, Level IV**

N.B. BMI cut-off points are currently being reviewed in the light of new data.

## **b. Excess Weight**

The BMI classification has largely superseded the definition of obesity based on ideal weight according to standard height-weight tables (e.g. 1959 or 1983 Metropolitan Life Insurance tables). In these tables, overweight was defined as 20% or more, and severe overweight as 40% or more over ideal weight. Morbid obesity was defined as a weight of 45 kg (100 lb) or more or 100% over ideal weight, and superobese was defined as 90 kg (200 lb) or more over ideal weight.

There are several disadvantages of using weight alone to define obesity. Ideal body weight tables were developed primarily from white, higher socio-economic status populations, not documented to reflect body fat content in the whole population, are gender-specific and were based on mortality rather than morbidity outcomes. However, weight alone could be used to track changes in response to interventions.<sup>58</sup>

## **c. Abdominal Obesity**

Excessive accumulation of body fat in the abdominal region (abdominal adiposity) is associated with cardiovascular risks of the metabolic syndrome, including type 2 diabetes, hypertension and hyperlipidemia, and is an independent predictor of morbidity.<sup>14</sup> Computed tomography, dual energy x-ray absorptiometry and magnetic resonance imaging are more accurate at determining intra-abdominal fat, but are impractical

for routine clinical use. A visceral fat area of more than 30 cm<sup>2</sup> is associated with metabolic disease in Caucasians, while an area of less than 110 cm<sup>2</sup> suggests low risk.<sup>59</sup>

The most practical way of assessing abdominal adiposity is the use of waist circumference, an approximate index of intra-abdominal fat mass and total body fat, which correlates closely with BMI.<sup>60</sup> It is unrelated to height.<sup>61</sup> It is important to include waist measurement in obesity management, and is a simple method of assessing a patient’s abdominal fat content before and during weight loss treatment.<sup>14</sup> A description of the methodology is provided in section 5.2.

For overweight and obese adult patients, gender-specific waist circumference cut-offs should be used in conjunction with BMI to identify increased disease risk.<sup>58</sup>

**B Waist circumference is the most practical anthropometric measurement for assessing a patient’s abdominal fat content before and during weight loss treatment. Gender-specific waist circumference cut-offs should be used in conjunction with BMI to identify increased disease risk.**

**Grade B, Level III**

The recommended cut-offs for waist circumference by the WHO<sup>2</sup> is shown in Table 4. Again, recent studies in Asia have shown that these cut offs are unlikely to be appropriate for Asian populations,<sup>49</sup> and different thresholds have been recommended.<sup>59</sup>

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

Guideline	Waist circumference (cm)	
	Men	Women
WHO <sup>2</sup>	≥ 102	≥ 88
Asia-Pacific Consensus <sup>59</sup>	≥ 90	≥ 80

**C 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 and our National Health Survey and co-morbid disease risk, cut-offs of 90 and 80 cm respectively are probably more appropriate for Asians.**

Grade C, Level IV

A reduction in waist measurement, even without weight loss may result in significant cardiovascular risk reduction.<sup>62</sup>

The waist/hip ratio (WHR) is another clinical method of determining abdominal obesity. The cut-offs indicative of increased risk of metabolic complications are for men >1.0 and women >0.85.<sup>59</sup> However, waist circumference is a better marker of abdominal fat content than WHR and is preferred.<sup>58</sup>

#### **d. Body Composition Analysis**

There are several methods for the analysis of body composition and estimation of body fat, including skinfold measurements, bioimpedance analysis (BIA), isotope dilution techniques (such as deuterium oxide dilution), densitometry (using underwater weighing or air plethysmography), dual energy x-ray absorptiometry and 4-compartment estimation (using a combination of methods to assess the content of water, lean tissue, mineral and fat).

Skinfold measurements have the advantage of being inexpensive, after the outlay for skinfold callipers, but have limitations in validity as a predictor of body fat percentage and central adiposity, and reproducibility, being dependent on the skill and experience of the tester.<sup>63-65</sup> BIA measures mostly extracellular and intracellular water, and not fat mass directly.<sup>63,66</sup> Fat mass estimates vary and are instrument dependent,<sup>67</sup> and there is a lack of standardization in BIA.<sup>67</sup> Racial differences exist in the interpretation of skinfold and BIA measurements.<sup>68</sup>

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

## 4.2 Children (7 to 18 years)

### a. Weight-for-height

Currently, school children are classified into various weight status based on percentage of mean weight-for-height specific for age and gender. These charts were computed based on a study in 1993, and are published in the Health Booklet for children.

### b. BMI-for-age

BMI in children is strongly dependent on gender and age (unlike adults). BMI-for-age and gender charts to measure childhood obesity are recommended for the classification of weight status by various international bodies,<sup>69-71</sup> and are useful tools for tracking and monitoring weight status from childhood to adulthood.<sup>72</sup> BMI  $\geq 85^{\text{th}}$  percentile<sup>73</sup> and  $\geq 95^{\text{th}}$  percentile<sup>69,73</sup> correlated with clinical risk factors for cardiovascular disease including hyperlipidemia, elevated insulin and high blood pressure.

A recent anthropometric cum body composition study in 2002 has defined the BMI percentile curves for male and female Singapore children and teenagers up to 20 years of age, computed based on the LMS method which summarizes the data in terms of three smooth age-specific curves called L (lambda), M (mu) and S (sigma).<sup>74</sup> Centile curves and BMI-for-age and gender have been matched to adult cut-offs for overweight and obesity at 25 and 30 kg/m<sup>2</sup> respectively, positioned at age 18 years.<sup>70</sup> However, the equivalent Asian cut-off points for public health action in adults are 23 kg/m<sup>2</sup> and 27.5 kg/m<sup>2</sup> in relation to the risk for morbidity,<sup>57</sup> and the BMI percentiles corresponding to these cut-off points may eventually be used in the definition of obese children in Singapore.

**B** Historically, weight-for-height charts have been used to classify weight status in children. BMI-for-age and gender charts are recommended for use in children.

Grade B, Level III

## 5 Risk Factors & Clinical Evaluation

### 5.1 Risk Factors

#### a. Predisposing factors for obesity

##### i. Environmental factors

Factors increasing or decreasing the risk of obesity are summarized in Table 5.<sup>75</sup> A knowledge of these largely lifestyle factors would allow potential avenues for intervention where relevant.

**Table 5 Predisposing factors increasing or decreasing the risk of obesity**

(modified from Diet, nutrition and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation. World Health Organ Tech Rep Ser 2002; 916:1-108)

Strength of Evidence	Predisposing factors	
	Increases risk	Decreases risk
Convincing	<ul style="list-style-type: none"> <li>• Sedentary lifestyle</li> <li>• High intake of energy-dense micronutrient-poor foods* (processed foods high in fat and/or sugar)</li> </ul>	<ul style="list-style-type: none"> <li>• Regular physical activity</li> <li>• High intake of non-starch polysaccharides (dietary fibre)</li> </ul>
Probable	<ul style="list-style-type: none"> <li>• Heavy marketing of energy-dense foods and fast-food outlets</li> <li>• Sugar-sweetened soft drinks and fruit juices</li> <li>• Adverse social and economic conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Home and school environments that support healthy food choices for children</li> <li>• Breastfeeding</li> </ul>
Possible	<ul style="list-style-type: none"> <li>• Large portion sizes</li> <li>• High proportion of food prepared outside the home</li> <li>• 'Rigid restraint / periodic disinhibition' eating patterns</li> </ul>	<ul style="list-style-type: none"> <li>• Low glycemic index foods</li> </ul>
Insufficient	<ul style="list-style-type: none"> <li>• Alcohol</li> </ul>	<ul style="list-style-type: none"> <li>• Increased eating frequency</li> </ul>

\* The protein content of the diet does not appear to have any relationship to the risk of obesity.

## ii. Neuroendocrinology of obesity & genetic factors

The neural mechanisms involved in feedback regulation of appetite and energy balance are complex. Disorders affecting these mechanisms may result in obesity. The elements of the feedback loop comprise the afferent, central processing and efferent systems,<sup>76-78</sup> with signals affecting appetite or energy expenditure. These signals include hormones and neuroendocrine transmitters arising from the:

- gastrointestinal tract, e.g. ghrelin, cholecystikinin, glucagon, neurotensin, bombesin, amylin, glucagon-like peptide 1 (GLP-1)
- endocrine system, e.g. cortisol, insulin, androgens, estrogens, peptide YY, progesterone, growth hormone-releasing hormone, somatostatin
- peripheral and sympathetic nervous system, e.g. epinephrine, norepinephrine, acetylcholine
- central nervous system, e.g. galanin, opioids such as  $\beta$ -endorphins, dynorphin A and enkephalins, dopamine,  $\gamma$ -aminobutyric acid, serotonin, neuropeptide Y, pro-opiomelanocortin,  $\alpha$ -melanocyte-stimulating hormone, Agouti-related protein
- adipose tissue, e.g. leptin.

Some recent interesting research findings include:

- a sharp rise in plasma ghrelin levels shortly before and a fall shortly after every meal, elevated levels after diet-induced weight loss, and markedly depressed levels after gastric bypass surgery.<sup>79</sup>
- In children, plasma ghrelin levels were inversely correlated with BMI and insulin levels, and were elevated in patients with the Prader-Willi syndrome.<sup>80</sup>
- Signalling via melanocortin receptors modulates anorexigenic neural pathways. Defects in these receptors may lead to obesity. Melanocortin receptor-4 mutations are believed to be the most common genetic defect in obesity.<sup>81</sup>

Family studies indicate that as much as 80% of the variance in BMI is attributable to genetic factors. Heritability is estimated to be as high as 30-40% for factors such as adipose tissue distribution, physical activity, resting metabolic rate, changes in energy expenditure in response to

overeating, eating behaviour, food preferences, lipoprotein lipase activity, maximal insulin-stimulated glyceride synthesis, and basal rates of lipolysis,<sup>78</sup> and may account for the wide inter-individual variations in body habitus and responses to feeding and food restriction.

## **b. Secondary causes of obesity**

Although infrequently found, it is important to be alert to the possible secondary causes of obesity (< 5% in most series) such as:

- concomitant medications such as glucocorticoids (including traditional medicines), sulphonylureas and insulin, contraceptives, some antipsychotics (e.g. phenothiazines, clozapine and olanzapine), antidepressants (e.g. tricyclic antidepressants, lithium), anti-epileptic agents (e.g. valproate);
- endocrine disorders such as hypothyroidism, Cushing's disease, hypogonadism;
- genetic disorders like Prader-Willi, Bardet-Beidl, Cohen and Alstrom syndromes.

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

**GPP**

## **c. Clinical risks of obesity**

Patient assessment should incorporate evaluation for the many comorbid conditions associated with obesity, such as:

- risk factors for cardiovascular disease including hypertension,<sup>13,22</sup> diabetes mellitus,<sup>24-26</sup> hyperlipidaemia,<sup>20</sup> cigarette smoking<sup>20</sup>
- coronary heart and cardiovascular disease<sup>13,14,16,20</sup>
- polycystic ovarian disease<sup>29</sup>
- osteoarthritis<sup>36</sup>
- cancers<sup>34,35</sup>
- sleep apnea<sup>31,33</sup>

**C Overweight and obese adults should be screened for co-morbid conditions, and should be stratified according to their health risks, in particular for cardiovascular disease, prior to the commencement of treatment.**

Grade C, Level IV

## 5.2 Clinical Evaluation

Wherever possible, each patient should be assessed for the degree of obesity (see Tables 2-4), predisposing factors, possible underlying secondary causes and potential clinical sequelae. Baseline clinical evaluation should include:

### a History

- Detailed history of obesity and previous weight loss attempts
- Current motivation for and barriers to weight loss
- Current and past medical history, including psychiatric history
- Current and past medical therapy, including over-the-counter and traditional medications
- Lifestyle factors, including details on dietary habits, exercise, smoking and alcohol intake
- Family history of medical disease and obesity
- Social history, including family, co-worker and financial support

### b Physical examination

#### i. Anthropometry

- Weight & height.
- Calculate:  $BMI = \text{weight} \div \text{height}^2$  (measured in  $\text{kg}/\text{m}^2$ )  
For weight definitions based on BMI, see Table 2 and Table 3. These BMI definitions are not valid in children, the elderly, athletic or muscular individuals, and pregnant or lactating women.<sup>2,58,59</sup>
- Waist circumference  
Waist circumference is obtained with the measuring tape at the mid-point between the lower margin of the ribs and the iliac crest in an upright individual with the abdomen relaxed, with arms at the sides and feet 12-15 cm apart. The tape should be horizontal and not compressing the skin and the measurement should be repeated until within 0.5 cm.<sup>2,58</sup> For thresholds, see Table 4.

- Hip circumference (optional)  
The hip measurement is the widest circumference between the waist and the crotch, usually over the buttocks. The measurement should be repeated until within 0.5 cm,<sup>2</sup> and is used to calculate waist:hip ratio.

**ii. Physical signs**

- Blood Pressure
- Physical examination for evidence of goitre, Cushing's syndrome, hypogonadism and dysmorphism.

### **5.3 Laboratory Evaluation**

- Fasting lipids
- Fasting blood glucose
- Thyroid function tests: free T<sub>4</sub>, TSH
- For Cushing's syndrome if clinically suspected, or if there is a history of weight gain with unaccounted medication, including traditional medicines: refer to Endocrinologist for evaluation.
- Electrocardiogram
- Chest radiograph

## 6 Overview of Weight Management and Treatment Goals

### 6.1 The Problem of Weight Management

The increase in the prevalence of overweight and obesity has serious public health implications. In the US, despite most adults trying to lose or maintain weight,<sup>82</sup> increasing obesity trends are seen. Most of those attempting weight loss were not using the recommended combination of reducing caloric intake and increasing physical activity.<sup>82</sup> Although 70-80% reported using at least one strategy over a 4-year period, the duration of engaging in these activities was brief.<sup>83</sup>

Although obesity-related conditions are improved with modest weight loss of 5-10%,<sup>58</sup> there is a discrepancy from obese patients' goals and perceptions. Weight loss of 16% was considered disappointing, and 38% was considered ideal.<sup>84</sup> The most important factors that influenced the selection of these weights were appearance and physical comfort, rather than improvement in medical condition or physician-recommended weight. This may explain the popularity of new diets promising quick, dramatic results more in line with desired goals and expectations, which require minimal effort,<sup>85</sup> as opposed to the more disciplined, measured efforts to achieve gradual but sustained weight loss recommended by most expert scientific panels.

### 6.2 Patient Motivation

Successful weight reduction often requires a major investment of time, effort and expense on the part of patient and health care provider. An important prerequisite of weight loss management is proper evaluation of patient motivation, which includes issues such as the patient's understanding of obesity, readiness for, and attitudes and barriers towards sustained lifestyle modification, time availability, social support framework and financial status. Patient motivation, should be relatively high before initiating therapy.<sup>58</sup>

**C Patient motivation is an important prerequisite of weight loss management and should be relatively high before initiating therapy. Proper evaluation of issues related to motivation should be undertaken.**

Grade C, Level IV

It is important to set realistic goals for weight loss, and provide sound advice on lifestyle modification.<sup>84</sup> In most studies, weight loss has been in the order of 10% or less, yet positive benefits have been demonstrated on glycemic control, blood pressure, other cardiovascular risk factors, energy levels, sleep and mobility, and the development of chronic diseases such as diabetes and hypertension.<sup>13,22,27,28,58,86</sup>

It is generally suggested that weight loss be gradual.<sup>58</sup> However, there is some data indicating that greater initial weight loss improves long-term weight loss maintenance.<sup>87</sup>

**C It is important to set realistic goals for weight loss, and provide sound advice on lifestyle modification. Modest weight loss, e.g. 10% body weight over 6 months, is more realistic and attainable than aiming for weight reduction to ideal body weight, and does result in a reduction in obesity morbidity.**

Grade C, Level IV

### 6.3 Multifaceted / Multidisciplinary Approach

A multifaceted strategy should be utilized to achieve and maintain weight loss.<sup>58</sup> This could be adequately achieved at the primary health care level for many patients, but may require multidisciplinary expertise at primary or tertiary level to address individual aspects in more difficult or resistant cases. The multifaceted approach addresses weight control from several angles, not all of which need to be employed, but rather, depending on the evaluation of the patient's requirements.

**C A multifaceted or multidisciplinary strategy should be utilized to achieve and maintain weight loss. Depending on patient response, this could be adequately achieved at the primary health care level or tertiary level.**

Grade C, Level IV

These facets include:

- a. **Dietary therapy:** See Chapter 7 & 8
- b. **Physical activity:** See Chapter 9

- c. **Behaviour therapy:** See Chapter 10
- d. **Combination lifestyle therapy**

Physical activity contributes to greater weight loss when combined with dietary therapy than with either alone.<sup>88,89</sup> Weight loss programs which employ a combination of diet, physical activity and behaviour therapy result in greater weight loss and less weight regain over an interval of 1 to 5 years.<sup>90-92</sup>

**A The combination of dietary caloric restriction, physical activity and behavioural modification results in greater and more sustained weight loss than the individual modalities.**

Grade A, Level Ib

Although these basic strategies will not differ for most people, individualized adaptations may be needed for patients with comorbidities, e.g. supervised exercise sessions for patients with ischemic heart disease, non-weight bearing exercise for patients with painful degenerative joint disease, and adjustment of diabetic medications as glycemic control improves.

- e. **Pharmacotherapy:** See Chapter 11
- f. **Bariatric surgery:** See Chapter 12

## 7 Dietetic Aspects of Obesity

### 7.1 The concept of caloric balance

**A** The most important dietary component of weight loss and maintenance is a decrease in caloric intake.<sup>58</sup> Typically, a 500 to 1000 kcal per day reduction produces the recommended 0.5 to 1 kg per week weight loss.<sup>58</sup> In the absence of physical activity, a diet that contains ~1400-1500 kcal/day, regardless of macronutrient content, results in weight loss.<sup>58,85,93-98</sup> Sustained dietary modification is necessary to maintain weight loss.

Grade A, Level Ib

Individuals vary in their ability to adjust intakes. A limitation in studies of the various diets has been differing degrees of adherence to the study diets.<sup>85</sup> Overweight individuals have difficulty maintaining dietary restrictions over a long period of time. Nutritional counselling should be highly individualized to provide advice on achieving a calorie-restricted diet which the patient can maintain long-term.

### 7.2 Types of diet

A plethora of diets, with varying proportions of the major macronutrients of carbohydrate, fat and protein, has been suggested to achieve caloric reduction<sup>85,96</sup> (see Table 6).

### 7.3 Effects of various diets on weight loss

Diets have been classified according to fat content, although the role of dietary fat remains controversial. Proponents suggest that a 10% reduction in energy from fat in the diet is associated with a 16 g/day reduction in weight (corresponding to 9 kg in 18 months).<sup>99</sup> Opponents note that fat consumption within the range of 18-40% of energy has consistently had little, if any, effect on body fatness.<sup>100</sup>

**Table 6** Examples of popular diets<sup>85,93,96</sup>

(Please note that this list is not exhaustive, and is not an endorsement of the diets mentioned.)

Type of diet	Examples	Content (% kcal)		
		Fat	CHO*	Protein
High-fat, low CHO*	Dr Atkins' New Diet Revolution Zone Diet Sugar Busters The Carbohydrate Addict's Diet Dr Bernstein's Diabetes Solution Protein Power Life Without Bread	55-65	<20% (<100g)	25-30
Moderate- fat, balanced nutrient reduction	USDA Food Guide Pyramid DASH (Dietary Approaches to Stop Hypertension) Diet National Cholesterol Education Program (NCEP) Step I and II Diets American Dietetic, Diabetes and Heart Associations American Cancer Society Shape Up America! Jenny Craig Nutri-Systems Weight-Watchers Mediterranean Diet	20-30            40	55-60            40	15-20            15-20
Low-fat and very-low-fat (VLF)	Dr Dean Ornish's Program for Reversing Heart Disease Volumetrics Eat More, Weigh Less The New Pritikin Program	<10-19	>65	10-20

\* CHO: carbohydrate

Individuals consuming *high-fat, high-protein, low-carbohydrate* diets may lose weight because of fluid loss, overall caloric restriction (as the intake of protein and fat is self-limiting), and ketosis-induced appetite suppression.<sup>85,93,94,96,97</sup> These diets appear safe in short term studies, with greater weight loss compared to conventional diets at 6 months,<sup>101-103</sup> but no difference at 12 months.<sup>101</sup> Long-term efficacy and safety data is lacking.<sup>93</sup> These diets are often deemed as attractive and palatable, encouraging food choices restricted in other weight reduction diets. By restricting other healthful foods, nutritional balance may be compromised.<sup>85,93</sup>

Most dietary guidelines of major professional bodies recommend balanced nutrition reduction diets *moderately restricted in total fat, moderate in carbohydrates* (mainly complex carbohydrates), and *moderate in protein*.<sup>85</sup> These diets result in loss of body weight and body fat, as overall caloric intake is reduced.<sup>85,98</sup>

*Low-fat* and *very-low-fat* diets contain a high proportion of complex carbohydrates, fruits, and vegetables, which are naturally high in fibre and low in caloric density, resulting in weight loss.<sup>85,94,95,104</sup> Lower fat diets without targeted caloric reduction produce weight loss primarily by decreasing caloric intake.<sup>58</sup> Fat-restricted diets are no better than calorie restricted diets in achieving long term weight loss in overweight or obese people.<sup>95</sup> Lower fat diets coupled with total caloric reduction produce greater weight loss than lower fat diets alone.<sup>58</sup>

Overall, it appears that weight loss is more associated with reduced caloric intake and increased diet duration, rather than reduced carbohydrate<sup>85,97</sup> or fat content<sup>100</sup> per se.

**C Diets containing different proportions of the major macronutrients, such as moderate-fat balanced nutrient-reduction diets, high-fat low-carbohydrate diets and low- or very-low-fat high-carbohydrate diets have all been shown to reduce weight. Weight loss appears to be more associated with reduced caloric intake and increased diet duration, rather than the macronutrient content per se. A diet moderately restricted in total fat, moderate to high in complex carbohydrates, and moderate in protein is the most widely recommended diet.**

Grade C, Level IV

### 7.3 Effects of various diets on body composition

Weight loss involves loss of body fat and lean body mass. An optimal weight loss diet maximizes loss of body fat and minimizes loss of lean body mass.<sup>85</sup> All low calorie diets result in loss of body weight and body fat,<sup>58</sup> seemingly regardless of macronutrient composition.<sup>95,97</sup> In the short term, low-carbohydrate, ketogenic diets cause a greater loss of body water than body fat, but eventually, all reduced calorie diets result in loss of body fat if sustained long term.<sup>85</sup> Physical activity may enhance the favourable body composition changes of dieting.<sup>105</sup>

### 7.4 Effects of various diets on metabolic parameters

Blood lipid levels, e.g. total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL) and triglyceride (TG), decrease as body weight decreases.<sup>58</sup> Weight loss from diets that are low in saturated fatty acids results in greater decreases in LDL. *Moderate-fat*, balanced nutrient reduction diets reduce LDL and normalize the HDL/TC ratio.<sup>85</sup> *Very-low-fat, high-carbohydrate* diets may result in decreased LDL, but increased TG levels, which may be attenuated using high-fibre foods.<sup>104</sup> *High-fat, low-carbohydrate* diets result in lower TG levels<sup>101-103</sup> and higher HDL levels<sup>101</sup> than conventional diets.

Energy restriction, independent of dietary macronutrient composition, improves glycemic and blood pressure control.<sup>86</sup> Weight loss is associated with reductions in plasma insulin and plasma leptin.<sup>106</sup>

*High fat, low-carbohydrate* diets result in ketosis,<sup>85</sup> but did not increase blood uric acid concentrations,<sup>102</sup> although those with higher protein contents may do so.<sup>93</sup>

### 7.5 Nutritional adequacy of various diets

The *moderate-fat* balanced nutrient reduction diet, with proper food choices, is optimal for ensuring adequate nutritional intake, although poor food choices may still result in micronutrient deficiencies, e.g. calcium, iron and zinc.<sup>85</sup>

*High-fat, low-carbohydrate* diets are nutritionally inadequate; high in saturated fat and cholesterol, and low in vitamins A, B<sub>1</sub>, B<sub>6</sub>, E, folate, calcium, magnesium, iron, potassium and dietary fibre, and require supplementation.<sup>85</sup>

*Very-low-fat* diets are deficient in vitamin B<sub>12</sub>, E and zinc because meat intake is low.<sup>85</sup>

## **7.6 Hunger and compliance to weight loss maintenance**

Many factors influence hunger, appetite and subsequent food intake. These include macronutrient content of food, neurochemical factors, gastric signals, genetic, environmental, and emotional factors, and gastronomic preference.<sup>85</sup>

There does not seem to be an optimal diet for reducing hunger. All fat-restricted diets, which are high in fibre and water content and low in caloric density, provide a high degree of satiety. Subjects who consume these diets develop a distaste for fat which may be useful in long term adherence to reduced fat, low-calorie diets.<sup>85</sup> However, it is unclear if long-term fat-restricted diets are superior to long-term carbohydrate-restricted ones, because compensatory mechanisms, for example increases in other macronutrients, may attenuate the effects.<sup>100</sup>

Successful weight loss maintainers generally use healthy eating habits and adhere to calorie-controlled, moderate-fat diets for longer periods.<sup>98,107,108</sup> The effort and use of strategies required to maintain weight loss appeared to lessen with increasing duration of weight loss maintenance.<sup>107</sup>

Long-term dietary compliance is more likely a function of psychological issues, rather than macronutrient composition.<sup>85</sup> Long-term success appears to be related to maintenance of behavioural changes, frequency of dietary counselling, coping with emotional eating, group and social support, being conscious of one's behaviour, confronting problems directly, using personally-developed strategies, and positive belief systems.<sup>85,108,109</sup>

## 7.7 Making food choices

Despite the plethora of dietary options available, it is important to bear in mind a few important principles.

The fat and water content of foods are the main determinants of the energy density of the diet.<sup>75</sup> A *lower consumption* of energy-dense food (high-fat, high-sugar, high-starch), and energy-dense drinks (high free sugar) contributes to a reduction in total energy intake.

Conversely, a *higher intake* of energy-dilute foods (vegetables, fruits) and foods high in non-starch polysaccharides (whole grain cereals) contributes to a reduction in total energy intake and an improvement in micronutrient intake.<sup>75</sup> It is probably most reasonable and sensible to maintain a diet that is high in vegetables, fruit and complex carbohydrates (whole grains and legumes, brown rice), and low in sugar, starch and fat, e.g. low-fat dairy.

Protein-rich foods are particularly satiating. Adequate amounts of low energy density, lean protein (e.g. chicken breast, fish, egg white, beans and tofu) can help control hunger when calories are restricted, resulting in short-term weight loss. 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 relevant to locally-available foods. Annex A lists some nutritional information on common, selected local foods.

**C The distribution of food intake should be as even as possible throughout the day, and meals should not be skipped as a weight control method. Meals should be adequately sized so that snacks are not needed between meals.<sup>59</sup>**

Grade C, Level IV

Caution has to be exercised when making choices on processed food and food products. For example, currently available so-called ‘low-fat’ products may actually contain large quantities of simple carbohydrates, and hence may not have lower caloric content. Canned fruits and dried fruits are fairly energy dense, so portions need to be kept small.

## 8 Modified Diets & Non-traditional Therapies

### 8.1 Low calorie diets and very low calorie diets

A major strategy in inducing and maintaining weight loss in overweight patients is to reduce energy intake.<sup>58,97</sup> This may take the form of diets for weight loss, which may be divided into low calorie diets (LCDs), typically ranging from 800 to 1500 kcal/day, and very-low calorie diets (VLCDs) of <800 kcal/day.<sup>58,94,105</sup>

Various commercial LCD and VLCD preparations are available (Table 7).

LCDs are food-based strategies that are designed to lower caloric intake by 500-1000 kcal/day. They can be divided into 3 categories:<sup>110</sup>

- a traditional reduced calorie diet (RCD) plan that utilizes a food regimen;
- a meal plan of pre-packaged foods and snacks that are vitamin/mineral fortified, and
- a partial meal replacement (PMR) plan that prescribes 1 or 2 portion-controlled, vitamin/mineral fortified meal replacements along with traditional reduced calorie meals and snacks.

VLCDs use calorie-controlled, vitamin/mineral-fortified liquid meals taken as the sole nutrient source, replacing all meals to achieve very low caloric intakes. VLCDs could also be used in partial meal replacement.

LCDs reduce total body weight by an average of 8 percent and reduce abdominal fat content over a period of approximately 6 months.<sup>58</sup>

Among LCD strategies, partial meal replacement plans appear superior to reduced calorie diet plans at maintaining greater weight loss at 3 months (-6.5 kg vs -4.0 kg), and at 1 year (-7.0 kg vs -4.4 kg).<sup>110</sup>

**Table 7 Examples of commercially available modified diets**

(Please note that this list is not exhaustive, and is not an endorsement of the products mentioned.)

<b>Modified diet</b>	<b>kcal /serving</b>	<b>Servings/day</b>	<b>kcal/day</b>
The Cambridge diet®	137 /sachet	3-4 sachet (sole source)	411
Weight Care® Mini Diet Intensive	100-300 /meal or snack	3 meals + 1 snack (sole source)	500
Weight Care® Gourmet Mini-Diet	100-300 /meal	6 meals (sole source)	800
Scan Diet®	160 /packet	A: 5 packets + fruit/vegetable B: 3 packets + 2 meals + fruit/vegetable C: 1 packet + 3 meals + fruit/vegetable	A: 1200 B: 1500 C: 1800
Slimline®	388 /100g powder 54 /14g sachet	2 sachets + 250 ml orange juice per meal. Could be used as short term sole source	864
TummiTrim Body Delight®	112 /serving	2-3 per day	800-1000
Slimfast® Shakes	220 /ready-made-drink	1-2 per day	Aiming at 1200
Enteral products e.g. Ensure®, Glucerna®, etc	~ 235 /ready made drink	Variable	Variable
Myoplex Lite®	190 /sachet	2-3 per day	380-570
Portion-controlled entrees, e.g. Healthy choice®, Lean Cuisine®	Healthy choice: 200-500, Lean cuisine: 200-300	Variable	Variable

VLCDs either alone or with behavioural therapy result in greater weight loss than LCDs during the active intervention phase lasting 3-6 months, but at 1 year, the degree of weight loss is similar.<sup>58</sup>

However, short-term VLCDs in structured weight loss programs result in greater weight reductions and maintenance at 5 years than using hypoenergetic balanced diets in similar programs.<sup>111</sup> Greater initial weight loss and higher levels of physical activity also correlate with greater weight loss.<sup>87,111</sup>

**A Low-calorie (LCD) and very low-calorie diets (VLCD) may be useful shorter term adjuncts (up to 6 months) for weight loss, but sustained modification of food intake is necessary to maintain weight loss. The use of these diets as part of a meal replacement strategy appears useful. The combination of a controlled energy diet (LCD or VLCD), increased physical activity, and behaviour therapy appears to provide the most successful outcome for weight loss and maintenance.**

Grade A, Level Ib

VLCDs appear to be effective (albeit short term) in weight reduction and glycemic control in type 2 diabetes, where dose reduction of diabetes drugs is usually required.<sup>112,113</sup> Dyslipidemia and blood pressure improve with weight loss from VLCDs,<sup>114</sup> as does sleep apnea.<sup>115</sup> VLCDs reduce weight pre-operatively in patients preparing for bariatric surgery.<sup>116</sup> Side effects from VLCDs are generally minor.<sup>114</sup>

**C VLCDs may be considered in patients with BMI  $\geq 30$  kg/m<sup>2</sup> (commensurate Asian cut-point may be 27.5 kg/m<sup>2</sup>), who have failed more conservative weight loss attempts, or those in whom rapid weight loss is a medical necessity.<sup>59,114</sup>**

Grade C, Level IV

**C VLCDs should be avoided in patients with BMI  $\leq 30$  kg/m<sup>2</sup> (commensurate Asian cut-point may be 27.5 kg/m<sup>2</sup>), where loss of lean body mass may be excessive, children or younger adolescents, and elderly patients over 65 years old, except in specialized treatment programs.<sup>114</sup>**

Grade C, Level IV

**C** VLCDs are not recommended for pregnant or breastfeeding women, patients with severe systemic or organ diseases, or with significant psychiatric or eating disorders.<sup>114</sup>

Grade C, Level IV

Compliance to VLCDs tends to be poor, and varying amounts of weight regain usually occurs.<sup>114</sup>

## 8.2 Non-prescription and off-label weight loss supplements

There is generally a lack of good quality research or published data on many of the non-prescription weight loss supplements. Most advertising claims are likely to be misleading.

### Compounds demonstrating weight loss in several trials

- Ephedrine/Ma Huang/Caffeine/Guarana<sup>117</sup> (see Section 11.2 a)

### Compounds demonstrating weight loss in small, single studies

- 5-hydroxytryptophan (5-HT)<sup>118</sup>
- Glucomannan<sup>119</sup>
- Hydroxycitric acid/Brindleberry (*Garcinia cambogia/indica*)<sup>120</sup>
- Cimetidine<sup>121</sup>
- Pyruvate<sup>122</sup>

### Compounds with questionable or no weight loss results

- Calcium supplementation or increased dairy consumption.<sup>123</sup> Although there is emerging observational data that higher calcium intakes are associated with lower body weights,<sup>124,125</sup> intervention trials with calcium or dairy supplementation do not show significant weight reduction.<sup>123</sup>
- Thyroxine, triiodothyronine, thyroid extract. Although weight loss is a recognized feature of correction of hypothyroidism with thyroid hormone replacement, few studies have been done on the use of thyroid hormone in weight reduction, and have been limited to triiodothyronine<sup>126</sup> which is not beneficial.
- Guar gum (*Cyamopsis tetragonolobus*).<sup>127,128</sup>
- Conjugated linoleic acid (CLA): Most studies showed some reduction in body fat mass,<sup>129,130</sup> but generally no reduction in weight.

- Chitosan.<sup>131</sup>
- Chromium.<sup>132</sup>
- Cellasene (containing Ginkgo biloba, sweet clover, sea-weed, grape seed oil, lecithins and evening primrose oil).<sup>133</sup>

### **Compounds with little or no data on weight loss**

- Green tea (Catechin)
- St John's wort (*Hypericum perforatum*)
- Melatonin
- Capsaicin
- L-Carnitine
- Marine brown seaweed (*Fucus vesiculosus*)
- Pectin
- DHEA
- Guggul (*Commiphora molmol/erlangeriana/mukul/wightii*)

## **8.3 Acupuncture/acupressure**

There is little published controlled trial data demonstrating the usefulness of acupuncture or acupressure in the management of obesity.<sup>134,135</sup> Acupuncture may facilitate weight loss by suppressing the desire for excess food and improving mood, and probably works via caloric reduction. The acupuncture points selected depend on individual factors such as fat distribution, emotional status and eating habits. Auricular (ear) acupuncture is the most frequently used method. Among the few controlled trials with positive results, the effects are modest and the interpretation of these results is limited by short duration, inadequate placebo controls and non-standard treatment protocols.<sup>135</sup>

## 9 Physical Activity

### 9.1 Benefits of exercise

Aerobic exercise reduces the risk of developing coronary heart disease<sup>136-138</sup> and increases cardio-respiratory fitness independent of weight loss. Among obese men, aerobic exercise reduced the risk of cardiovascular and all-cause death below that of non-obese men who did not exercise.<sup>139,140</sup>

Current physical activity contributes to weight loss and reduces cardiovascular risk factors. Aerobic exercise, as a major component of lifestyle alteration, reduces total body mass, reduces total and abdominal fat mass,<sup>141,142</sup> reduces blood pressure and the risk of developing hypertension<sup>22,143</sup> and type II diabetes,<sup>27,28</sup> and has resulted in increased HDL and reduced triglyceride levels, and favourable shifts in LDL, VLDL and HDL particle sizes.<sup>144</sup>

**A Current physical activity contributes to weight loss, reduces cardiovascular risk factors (e.g. hypertension and diabetes mellitus) and the risk for coronary heart disease, increases cardio-respiratory fitness independent of weight loss, and decreases body and abdominal fat.**

Grade A, Level Ib

Aerobic exercise alone can contribute to weight loss provided energy intake is held constant.<sup>145</sup> Appetite is suppressed during and immediately after exercise, but increases about an hour later. Prospective studies evaluating physical activity and weight have showed mixed results probably because of compensatory increases in energy intake resulting from exercise,<sup>145</sup> and low adherence to long-term changes in physical activity.<sup>75</sup>

Screening patients prior to participation in an exercise program may be useful, using tools such as the Physical Activity Readiness Questionnaire (PAR-Q, <http://www.csep.ca/pdfs/par-q.pdf>).

### 9.2 Exercise prescription: type, amount and intensity

It is important to consider the type, amount (frequency and duration) and intensity of exercise that should be recommended for weight loss,

as distinct from the amount necessary to improve cardiovascular fitness.<sup>105,146</sup> The recommended level of exercise for sedentary adults during the initial phase of weight loss should be progressively increased and differentiated from the amount of exercise that can be achieved at later stages in the weight loss process.<sup>105</sup> Annex B lists the caloric expenditure in a 30-minute period of performing various activities for individuals of different body weights.<sup>147</sup>

#### **a. Exercise type**

Aerobic or endurance exercise is the main form of exercise for weight loss.

Strength or resistance exercise does not appear to add to or be superior to endurance exercise for weight loss, although it may improve muscular strength in overweight adults, facilitating improved functional tasks, e.g. getting out of a chair, and hence, adoption of a more active lifestyle. Resistance training does not prevent the decline in resting energy expenditure that occurs with diet-induced weight loss.<sup>105</sup>

#### **b. Exercise amount**

The current physical activity guideline for adults is at least 30 min of moderate intensity physical activity on most, preferably all, days of the week.<sup>75,105,146</sup> This has been typically interpreted as a minimum of 150 min per week (5 days, 30 min per day), translating to 700-1100 kcal energy per week in a 100-kg subject. It is based primarily on the effects of exercise in reducing chronic diseases, such as cardiovascular disease and diabetes mellitus, and overall mortality.<sup>75,105,146</sup>

**C The current recommendation of moderate-intensity physical activity for 30 min, 3-5 days per week is largely aimed at reducing cardiovascular disease and overall mortality.**

**Grade C, Level IV**

Moderate intensity activity lasting 45-60 min per day is required to prevent unhealthy weight gain, and the transition to overweight or obesity.<sup>75,146</sup> Prevention of weight regain after substantial weight loss may require 60-90 min of moderate intensity activity daily.<sup>75,146</sup> Starting at low-to-moderate physical activity for 30-45 min, 3-5 days per week, the intensity, duration and frequency should be increased gradually.<sup>105</sup>

Overweight adults may need to progress to 200 to 300 min (or >2000 kcal) of exercise per week<sup>98,105,142,146,148</sup> to lose weight or maintain weight loss, although this may pose a significant challenge.<sup>105</sup>

**C To prevent unhealthy weight gain, moderate-intensity physical activity for 45-60 min on most days or every day has been recommended. Preventing weight gain after substantial weight loss probably requires about 60-90 minutes per day. Starting at low-to-moderate physical activity for 30-45 min, 3-5 days per week, the intensity, duration and frequency should be increased gradually.**

Grade C, Level IV

Intermittent exercise, defined as the accumulation of 30-40 min daily through participation in multiple 10 to 15 min exercise sessions, did improve cardiorespiratory fitness and coronary risk.<sup>105</sup> Although not superior in weight reduction compared to continuous exercise, intermittent exercise may increase the initial adoption of exercise in overweight adults who dislike continuous exercise.<sup>148</sup>

### c. Exercise intensity

Moderate-intensity exercise (55-69% of maximal heart rate), e.g. brisk walking at 6-7 km/h, appears sufficient for the management of body weight.<sup>105,148</sup> Some data exists to support more vigorous intensity exercise ( $\geq 70\%$  of maximal heart rate), e.g. jogging or running at  $>8$  km/h, which may allow shorter duration of exercise.<sup>142,149</sup>

Men appear to benefit more from greater amounts of exercise of high intensity in relation to cardiovascular benefits<sup>136,137</sup> and weight maintenance<sup>98</sup> compared to women.<sup>98,138</sup>

Gauging the intensity of exercise relative to the patient's current exercise capacity using measures such as the rate perceived exertion (RPE) scale appears to be an effective way of determining exercise intensity for positive cardiovascular benefit (see Annex C).<sup>150</sup>

Another method of characterizing exercise intensity is based on the standard of a metabolic equivalent (MET), used to estimate the amount of oxygen used by the body during physical activity. 1 MET represents a resting energy expenditure of 1 kcal/h/kg body weight (or 3.5 ml

oxygen uptake/min/kg), equivalent to the energy expenditure during quiet sitting.<sup>146,147</sup> Any activity that burns 3 to 6 METs is considered moderate-intensity physical activity. Any activity that burns > 6 METs is considered vigorous-intensity physical activity.<sup>147</sup>

### 9.3 Lifestyle activity and weight loss

Lifestyle activity may be an effective option for increasing fitness and modifying body weight in overweight adults. A program of using a self-selected, low-fat, low-calorie diet of 1200 kcal/d, plus non-structured, lifestyle activity (increasing moderate intensity physical activity by 30 min per day on most days of the week) appeared as effective as diet plus structured aerobic activity (expending 450-500 kcal per step aerobic workout thrice weekly) for reducing weight in obese women.<sup>151</sup>

Increased daily walking from around 5,000 steps/day to 10,000 steps/day for 8 weeks, using pedometers to tally steps, resulted in improvement of glucose tolerance and blood pressure in obese diabetic women,<sup>152</sup> although weight and waist circumference did not improve.

**A A program of diet plus non-structured, moderate-intensity lifestyle activity appeared as effective as diet plus structured aerobic activity for reducing weight in obese women. Any increase in daily physical activity is likely to have some benefit in obese women.**

Grade A, Level Ib

## 10 Behavioural Aspects

### 10.1 The importance of addressing psychological issues

In the management of obesity, behavioural and psychological aspects need to be taken into consideration. Behaviour therapy helps to overcome psychological barriers and improve compliance with diet and physical activity. Psychological aspects, such as socio-cultural beliefs, denial and motivation, can “make or break” treatment results. Psychiatric disorders that contribute to obesity, or that may interfere with progress, should be excluded and treated if present.

### 10.2 Psychological evaluation

#### a. Evaluation of Motivation

Patient motivation is a crucial component for weight loss treatment to succeed. Obesity treatment workers frequently encounter high treatment failure and drop-out rates. Besides medical criteria recommended in other chapters, patient selection is also made based on the individual’s readiness to lose weight. Table 8 shows the internal (psychological) and external (practical resources) factors determining this state of readiness, which, it is important to note, occurs in an interchangeable flux state.

**Table 8 Factors determining the state of readiness for weight loss treatment**

<b>Internal factors</b>	<b>External factors</b>
<ul style="list-style-type: none"><li>• Personal reasons and motivations to lose weight</li><li>• Previous attempts to lose weight</li><li>• Understanding of risks and benefits</li><li>• Attitudes towards diet and exercise</li></ul>	<ul style="list-style-type: none"><li>• Support from family &amp; friends</li><li>• Time availability</li><li>• Financial circumstance</li><li>• Other potential barriers</li></ul>

## b. Evaluation of Mental Health

Fat stigmatization has been described as “the last socially acceptable form of prejudice”. Obese persons face prejudice and discrimination from a young age,<sup>153</sup> at work,<sup>154</sup> and even from medical carers.<sup>155</sup>

Despite this, studies consistently show no difference in the general psychological well-being of obese and non-obese individuals,<sup>156,157</sup> the majority of obese individuals having normal psychological functioning.

Significant exceptions occur, which can contribute to obesity and hinder its treatment. Obese women are 37% more likely to have *Major Depression Disorder* than average weight women.<sup>158</sup> *Binge Eating Disorder (BED)* occurs in 30% of obese individuals, compared to 3% of the general population.<sup>159</sup> The core symptom of BED is uncontrollable over-eating of large amounts of food.

**B The presence of depression and binge eating disorder must be evaluated for in obese patients, with appropriate referral for psychiatric treatment.**<sup>160</sup>

Grade B, Level IIa

## 10.3 Behaviour therapy

Weight loss programs should employ a combination of diet, physical activity and behaviour therapy. Randomized controlled trials indicate that behaviour therapy can produce such changes in diet and exercise so as to achieve weight loss in the range of up to 10% for between 1 to 5 years of follow-up.<sup>90-92,161</sup>

**A Weight loss programs incorporating cognitive behavioural interventions are helpful in achieving weight loss and weight maintenance in the range of up to 10% for between 1 to 5 years of follow-up.**

Grade A, Level Ib

An integrative approach is applied; i.e. the use of behaviour therapy in combination with a low calorie diet and increased physical activity.

Effective and useful features of Behaviour Treatment for weight loss and maintenance are:

- Multimodal treatment
- Intensive intervention (e.g. frequent contacts)
- Extended lengths of therapy

Behaviour Therapy is based on the Learning Theory. Its hypothesis is that most behaviour, including eating and exercise, have a learned component (reinforcement). Thus, those behaviours which can lead to obesity can be relearned and modified, and the environmental triggers can be altered.

It adopts a simple, problem-solving approach, taking into account personal experiences, beliefs and feelings. Attainable goals with realistic increments are set, using specific tasks for patients to achieve, like for caloric intake and activity.

The therapist displays a non-judgmental attitude, expressing empathy and concern for health risks. In order to develop a successful partnership with the patient, the health care professional must examine one's own reaction to obese people and embrace the disease concept. One can then avoid unrealistic expectations and blame attribution.

Examples of behaviour therapy tools are:

**a. Motivational interviewing**

E.g. having the patient list the effects of weight intervention on his health in 5 years, or the pros and cons of being overweight. This helps to further facilitate behaviour change and increase motivation level.

**b. Goal setting and plans of action**

E.g. formulating mutually agreed upon target goals and specific plans of action to achieve the goals, such as brisk walking for 20 min on 4 specified days per week at 6:30 p.m. for 2 weeks. Goals should be objective, attainable yet challenging. When a milestone has been achieved, it is always good to encourage a small non-food reward.

**c. Self-monitoring of eating habits and exercise / activity**

E.g. recording a Food Diary reflecting every food or beverage intake and the activity prior to intake, or recording an Activity and Exercise Diary reflecting the duration and intensity of each activity. This helps to increase personal insight, and to recognize patterns of eating and exercise behaviour.

**d. Cognitive restructuring**

E.g. identifying the patient's false beliefs about weight loss and body image and helping the patient challenge these false beliefs by evaluating the evidence for, effects of, and ways to deal with these beliefs. This helps to expose unrealistic expectations which may lead to self-defeating thoughts and feelings.

**e. Stimulus control**

E.g. listing specific situations which might trigger the patient's urge to eat, and strategies to cope when these situations arise. This helps to identify and limit exposure to high-risk situations.

**f. Pre-planning and relapse prevention**

E.g. exploring and learning from the circumstances and reasons for previous relapses, and drawing up alternative plans of action which may succeed under similar situations in future. This utilizes the identified stimuli to help formulate plans for relapse prevention.

**g. Stress management, including coping strategies and relaxation techniques**

This can prevent stress-induced overeating.

More extended methods involve self-rewards (non-food), group meetings, telephone and short messaging (SMS) and e-mail contacts.

## 10.4 Behaviour therapy for weight maintenance

The weight loss achieved by the combination of behaviour therapy, low calorie diet and exercise is not well-maintained beyond a period of one year. Patients on such a program for 40 weeks maintained a greater weight loss at 40 and 72 weeks than those on the program for 20 weeks.<sup>162</sup> This appears to be linked to the cessation of continued behavioural intervention, leading to a falling-off of behavioural strategies.

**A It is recommended that subjects continue with up to 12 months of the weight maintenance program combining behaviour therapy, a low calorie diet and exercise, after the initial weight loss treatment.**

Grade A, Level Ib

Weight regain of more than 5kg over a short interval may warrant re-admission into a weight loss treatment program.<sup>163</sup>

## 10.5 Size and self-acceptance

Only a small minority of obese individuals will lose weight to normal BMI ranges. While a weight loss of 5 to 10% of original weight constitutes medically defined success and has direct medical benefits, it may still leave the person with feelings of frustration and dissatisfaction over a socially unacceptable body size. Such individuals can be helped to realize self-acceptance of their larger size and to repair and restore their self-respect. They can be encouraged to focus on maintaining lost weight, improving physical health and fitness levels and reinforcing healthier psychological status, thereby adding to their quality of life.<sup>164</sup>

## 11 Medical Treatment

### 11.1 Initiating therapy

**C** As obesity is a chronic condition that requires lifelong management, pharmacotherapy should be adjunct to an individual's long-term obesity management strategy.<sup>58</sup>

Grade C, Level IV

**A** Drug therapy may be effective if given without lifestyle modification,<sup>165,166</sup> but is most effective when combined with diet, physical activity and behaviour modification.<sup>165</sup>

Grade A, Level Ib

**C** Drug therapy should be considered when BMI  $\geq 30$  kg/m<sup>2</sup>, or when BMI is 27-29.9 kg/m<sup>2</sup> in patients with co-morbidities or complications of obesity such as hypertension, type 2 diabetes mellitus, hyperlipidemia, coronary artery disease and sleep apnea.<sup>58</sup> Commensurate BMI thresholds for action among Asians may be 27.5 and 25-27.4 kg/m<sup>2</sup> respectively.<sup>57</sup> (see Chapter 4)

Grade C, Level IV

N.B. BMI cut-off points are currently being reviewed in the light of new data.

To date, there is little efficacy and safety data on the long term use of anti-obesity drugs. Long-term data on maintaining weight loss after discontinuation of anti-obesity agents is also lacking.

### 11.2 Anti-obesity drugs

Anti-obesity drugs can be classified into two broad groups: (1) those acting on the central nervous system to influence appetite and (2) those acting on the gastrointestinal system to influence absorption or metabolism.<sup>167</sup> Of these, only *sibutramine* and *orlistat* have been approved for long-term use.

## a. Drugs acting on the central nervous system

### i) Drugs acting via serotonergic and noradrenergic pathways

- *Sibutramine* is a serotonin and noradrenaline re-uptake inhibitor whose weight-loss effects of enhanced satiety and increased resting metabolic rate are primarily mediated by its noradrenergic action.<sup>168</sup> Several large, short-term trials of sibutramine at doses of between 10 and 20 mg daily for up to 2 years resulted in around 5 kg (between 3.8-7.6%) greater weight loss than placebo.<sup>170,171</sup> Intermittent administration (12 weeks on, 12 weeks off) has been reported to be as effective as continuous use.<sup>172</sup> Adverse effects included mild increases in blood pressure and pulse rate, dry mouth, headache, insomnia and constipation. Sibutramine appeared effective and safe in stable hypertensives,<sup>173,174</sup> type 2 diabetics,<sup>175</sup> dyslipidemic patients<sup>176</sup> and in maintenance of weight loss after VLCDs.<sup>177</sup>

### ii) Drugs acting via noradrenergic pathways

- *Phentermine* is an amphetamine derivative which suppresses appetite via noradrenergic pathways.<sup>168</sup> Studies using doses of between 15 and 30 mg daily have generally been few, small and short-term (3 to 8 months), and have shown weight reduction in the region of 5 kg (between 3.4-12.9%) from placebo.<sup>171,178</sup> Side effects include dry mouth, insomnia, palpitations, euphoria.<sup>167</sup>
- *Mazindol* is structurally related to tricyclic antidepressants and suppresses appetite by inhibiting norepinephrine uptake.<sup>168</sup> Small, 12-week studies using 1-3 mg/day reported 2-4 kg (between 1.7-10.7%) greater weight loss than placebo.<sup>171,179,180</sup> Side effects include insomnia, agitation and dizziness. Mazindol enhances weight loss after VLCDs.<sup>181,182</sup>
- *Ephedrine* is a sympathomimetic agent which induces weight loss by increasing thermogenesis.<sup>167</sup> It is often combined with *caffeine*, and occasionally with *caffeine* and *aspirin*, in unregulated, over-the-counter nutrition supplements, the easy availability and potential for abuse being major drawbacks. Short-term studies using varying doses of ephedrine 60-150 mg with caffeine 150-600 mg daily have reported 1-3 kg greater weight loss than placebo.<sup>117</sup> Many reports of adverse psychiatric, autonomic, gastrointestinal, cardiac effects,

and death, have been associated with the use of ephedrine alkaloid-containing products.<sup>117,183</sup>

- There is very little data with *pseudoephedrine* and weight loss.<sup>184</sup>

### iii) Drugs acting via serotonergic pathways

- *Fluoxetine* is a selective serotonin reuptake inhibitor (SSRI) which has been studied for weight loss.<sup>167,168,171</sup> A 1-year, multicentre study using 60 mg showed greater weight loss of 3 kg than placebo at 20 weeks, but no difference at 1 year.<sup>185</sup> In type 2 diabetics, short-term studies have showed benefit,<sup>186</sup> but not at 1 year.<sup>187</sup>
- *Sertraline* is another SSRI which has enhanced weight loss when used in conjunction with cognitive behavioural therapy,<sup>188</sup> and transiently with VLCDs<sup>189</sup> at doses of 150-200 mg/day over 6-12 months. When used alone, however, non-significant weight gain occurred.<sup>190</sup>
- *Fenfluramine* and *dexfenfluramine* inhibit serotonin uptake non-selectively and increase serotonin release. Small, 12-week to 1-year studies reported between 2.1-5.6% greater weight loss than placebo.<sup>171</sup> They have been withdrawn from the market because of associations with valvular heart disease<sup>191</sup> and pulmonary hypertension.<sup>192</sup>

### iv) Anti-epileptic drugs

- *Topiramate*, has multifactorial modes of action on voltage-dependent sodium channels, GABAergic transmission and AMPA receptors.<sup>193</sup> It has been used in epilepsy,<sup>193</sup> migraine,<sup>194</sup> depression, obese patients with binge eating disorders<sup>195</sup> and obese patients per se.<sup>196</sup> Short-term weight reduction to the order of 6 kg has been demonstrated. Side effects include paresthesia, diarrhea, somnolence and dysgeusia.<sup>194</sup>
- *Zonisamide*, an anti-epileptic with serotonergic and dopaminergic activity in addition to sodium and calcium channel blockade, resulted in weight loss of 5 kg over placebo at doses of 400-600 mg/day.<sup>197</sup> The main side effect was fatigue.

## b. Drugs acting on the gastrointestinal tract

- i) Drugs that reduce nutrient absorption
  - *Orlistat* inhibits gastrointestinal lipases and blocks the absorption of 30% of ingested fat.<sup>167,168</sup> At a dose of 120 mg tds for 2-4 years, sustained weight loss in the region of 1.3-4.8% over placebo has been demonstrated at 1, 2 and 4 years,<sup>171,198,199</sup> and it has been shown to be effective in Asians.<sup>166</sup> In obese individuals, orlistat reduces the risk of developing diabetes.<sup>199</sup> Orlistat has been used in type 2 diabetics,<sup>198,200</sup> slows the development of and progression to diabetes,<sup>201</sup> and reduces cardiovascular risk factors.<sup>199,202</sup> Orlistat has been shown to augment weight loss in individuals whose weight has remained stable after adjustable gastric banding.<sup>203</sup> Patients on orlistat who are non-compliant to a reduced fat diet may experience oily diarrhea with urgency.
- ii) Oral hypoglycemic agents
  - *Metformin* is the drug of choice for controlling glycemia in obese type 2 diabetic patients because of the relative lack of weight gain compared to other hypoglycemic agents.<sup>204</sup> *Sibutramine*<sup>205</sup> or *orlistat*,<sup>200</sup> used in combination with *metformin* over a period of 1 year, enhanced weight and glycemic control.

## c. Combinations of anti-obesity agents

- The addition of *orlistat* to *sibutramine* did not induce further weight loss in individuals already on *sibutramine*.<sup>206</sup>
- *Phentermine* with *fluoxetine*, have been used in overweight binge eaters.<sup>207</sup>
- *Ephedrine* with *caffeine* and/or *aspirin*: discussed above.
- *Phentermine* with *fenfluramine* appeared effective. However, *fenfluramine* has been withdrawn as discussed above.

**A** The drugs with the widest efficacy and safety data are *orlistat* (up to 4 years) and *sibutramine* (up to 2 years). Other drugs which appear relatively safe and effective for 6-12 month therapy include *phentermine* and *mazindol*. There is little data on the effectiveness of combining anti-obesity agents. *Metformin* is the drug of choice in obese diabetics and has been effectively combined with either *sibutramine* or *orlistat* for 1 year.

Grade A, Level Ib

## 12 Bariatric Surgery

### 12.1 Role of Bariatric Surgery

Bariatric Surgery is defined as gastro-intestinal surgery to help severely obese patients lose weight.

**A Bariatric surgery is the most effective method to reduce weight and maintain weight loss in the severely or morbidly obese.**<sup>208</sup>

Grade A, Level Ib

Whereas medical treatments have a low long-term success rate of weight loss (between 5-8% weight loss at 2 years and 1% weight gain at 8 years), bariatric surgery has resulted in average weight losses of between 16-35% over the same period.<sup>208</sup>

**C Because surgery has significant technical issues, complications, and cost, and requires extensive pre- and peri-operative preparation, it is usually considered in those with more severe obesity who have failed to control weight by other means,<sup>209-211</sup> and who remain at high risk of medical co-morbidities (see Chapter 3.2). Post-operative lifestyle modifications, as well as follow-up for complications of surgery, are life-long.**

Grade C, Level IV

Weight reduction surgery has been reported to improve several comorbid conditions such as sleep apnea and obesity-associated hypoventilation, glucose intolerance, type 2 diabetes mellitus, hypertension, dyslipidemia and the metabolic syndrome.<sup>208,209,211-213</sup> Whether beneficial effects in the various metabolic disorders are maintained long enough to prevent end-organ damage (e.g., renal disease, stroke, myocardial infarction, and heart failure) is not known.

Many patients report improvement in mood, other aspects of psychosocial functioning, and health-related quality of life after these operative procedures.<sup>208,212,214</sup> The degree to which these improvements are sustained is unknown.

## 12.2 Bariatric Surgical Procedures

Bariatric operations can be broadly categorized into two types: restrictive and malabsorptive.<sup>208,211</sup> Currently accepted restrictive procedures include gastric banding, adjustable gastric banding (AGB), and horizontal- and vertical-banded gastroplasty. Malabsorptive procedures include biliopancreatic diversion and jejunioileal bypass (which is no longer being used because of serious metabolic derangements).<sup>208,211</sup> Roux-en-Y gastric bypass (RYGB) or resectional gastric bypass combine both restrictive and malabsorptive techniques. RYGB is the preferred method of gastric bypass, with superior weight loss results than those of other gastric restrictive operations.<sup>211</sup> Laparoscopic approaches are available for most bariatric procedures, and have lower mortality and morbidity than open approaches, although specialized skills and equipment are required.<sup>210</sup> Laparoscopic RYGB is technically demanding, and is presently only being performed in a few centres.<sup>215</sup> AGB (Lap-Band and Swedish Band) has become the most frequently performed laparoscopic bariatric operation in Singapore, as in many parts of the world.<sup>216-218</sup> Table 9 summarizes the effectiveness and limitations of the various bariatric procedures.

**Table 9 Comparative summary of bariatric surgical procedures<sup>208,211,216,218,219</sup>**

Parameter	Surgical Procedure					
	AGB	VBG	HBG	GB	RYGB	BP
% weight loss						
- 12 months	21	22-33	16-29	36	33-38	
- 24 months	25-29	22-33	23	36	33-38	36
- 36 months	31	20-29			32-34	
- 48 months	31	23				35
- 60 months	35	28				
% complication	7-12	15	12-42	28	7-32	10-50
% reoperation	10-13	9-43	12-40	0-16	2-23	2
% mortality	0	0	0-2	0	0-5	0.5

AGB = Adjustable gastric banding  
 VBG = Vertical-banded gastroplasty  
 HBG = Horizontal-banded gastroplasty

GB = Gastric bypass  
 RYGB = Roux-en-Y gastric bypass  
 BP = Biliopancreatic diversion

Endoscopic insertion of intragastric balloons (silicone balloons filled with saline or air, designed to occupy gastric volume and increase satiety) have resulted in up to 16% weight loss,<sup>220</sup> although in a controlled trial, it was not superior to medical management with VLCDs.<sup>221</sup> However, from various studies, discontinuation in 25% of patients, balloon failure in 45%,<sup>220</sup> complications in 31%<sup>222</sup> and dissatisfaction in 49%<sup>223</sup> suggests that its use may be limited to short-term weight loss prior to definitive surgery.

## 12.3 Candidates for Bariatric Surgery

**B** Indications for considering bariatric surgery are:<sup>58,208-211</sup>

- **Extreme or morbid obesity (BMI  $\geq 40$  kg/m<sup>2</sup>) or severe obesity (BMI  $\geq 35$  kg/m<sup>2</sup>) with medical co-morbidities or complications of obesity. Commensurate BMI thresholds for action among Asians may be 37.5 and 32.5 kg/m<sup>2</sup> respectively.<sup>57</sup>**
- **Failure of significant non-surgical attempts at weight reduction.**

Grade B, Level III

Criteria for patient selection:<sup>58,209-211</sup>

- Has given informed consent after understanding bariatric surgical concepts, accepts the risks, undergone pre-operative psychological evaluation.
- Motivated and capable of participating in life-long follow-up.

Contraindications to bariatric surgery are:<sup>209,211</sup>

- Excessively high risk for surgery
- Major psychiatric illness
- Presence of illnesses such as endocrine cause for obesity, inflammatory bowel disease, chronic pancreatitis, cirrhosis, portal hypertension, congenital abnormalities of the gastrointestinal tract, active malignancy
- Regular use of NSAIDs or corticosteroids
- Alcohol or substance abuse
- Pregnancy
- Children

The usual age range in which bariatric surgery has been undertaken is between 18 to 55 years.<sup>209</sup> However, bariatric surgery has been performed with reasonable safety and efficacy in adolescents 12-18 years,<sup>224-226</sup> and adults more than 55 years up to 70 years.<sup>227</sup>

## 12.4 Pre-Operative through Post-Operative Management

Bariatric surgery is a serious undertaking with a peri-operative mortality ranging from 0-5%, and post-operative complications in up to 50% of patients, a proportion being chronic,<sup>208</sup> and requiring a life-long commitment to lifestyle change, especially significant dietary adjustments, and follow-up.

Patients undergoing bariatric surgery should be attended to by a team of doctors experienced in bariatric surgery and the management of its complications. A thorough pre-operative evaluation and patient preparation is essential. Adequate post-operative support should be ensured.<sup>209,210,214</sup>

Pre-operative preparation should include:

- adequate visits for the patient to understand the operation, benefits, risks, long-term consequences and follow-up requirements, including dietary and exercise instructions
- control co-morbidities and optimise for surgery, effecting respiratory, cardiac, endocrine, anesthetic or other evaluations, where indicated,
- effecting pediatric and psychological evaluation in adolescents.
- effecting psychiatric or psychological evaluation in patients with previous psychiatric illness requiring treatment or admission, or are currently under the care of a psychiatrist.

Peri-operatively, the surgeon needs to be aware of the needs of severely obese patients in terms of facilities, supplies, equipment, staff and procedures.

Post-operatively, life-long follow-up by a practitioner familiar with bariatric surgery is required in:

- continued nutritional counselling and specialized nursing care
- biochemical surveillance, e.g. for anemia, calcium deficiency

- assessing effectiveness of procedure, complications and need for revision, e.g. incisional hernias, pouch dilation, outlet stenosis, band slippage, port-related complications
- continued management of co-morbidities and psychological assistance

## 12.5 Bariatric Surgery in Pregnancy

**C** Like all elective procedures, bariatric surgery should not be performed during pregnancy.

Grade C, Level IV

**C** Women of child-bearing age should practice secure contraception during the period of rapid loss following bariatric surgery.<sup>58,210</sup>

Grade C, Level IV

**B** Previous bariatric surgery is not a contraindication to pregnancy.<sup>228,229</sup>

Grade B, Level IIa

**B** Adjustable gastric bands should be deflated during pregnancy to allow for ‘normal weight gain of pregnancy’.<sup>229</sup>

Grade B, Level III

## 12.6 Bariatric Surgery in the Elderly

Although morbidly obese older individuals have obtained similar benefits on weight loss as younger individuals post-bariatric surgery,<sup>227</sup> the impact of overweight on mortality appears less clear in the elderly,<sup>230</sup> suggesting that the threshold for considering surgery in the elderly may be higher.<sup>231</sup>

## 13 Long-term Weight Loss Maintenance

### 13.1 Weight Regain

Clinical trials with long-term follow up indicate that most lost weight is regained within 5 years,<sup>111</sup> contributing to the perception that long-term reduction in body weight is difficult. Physicians and patients need to recognize that obesity is a chronic condition that requires lifelong treatment. Continued professional contact and strategies such as structured commercial programs may help to sustain weight loss over time.<sup>232,233</sup>

### 13.2 Weight Loss Maintenance after Medical Therapy

Data from the U.S. National Weight Control Registry show that successful long-term weight loss maintainers (average weight loss of 30 kg for an average of 5.5 years) appear to share common behavioral strategies. These include: (1) eating a low-calorie (~1400 kcal/day) diet, low in fat (~25%),<sup>98</sup> (2) frequent self-monitoring of body weight (3) recording of food intake and physical activity, and (4) maintaining high levels of regular physical activity.<sup>234</sup> An interesting observation was that the regular consumption of breakfast was also beneficial.<sup>235</sup> If weight loss has been successfully maintained for 2-5 years, the chances of longer-term success greatly increase.<sup>234</sup>

**B Common behavioral strategies which may enhance successful long-term weight loss maintenance include eating a calorie-restricted, low-to-moderate fat diet, frequent self-monitoring of body weight, recording food intake and physical activity, and maintaining high levels of regular physical activity.**

Grade B, Level III

In another review of long-term efficacy of dietary treatment of obesity over 5 years, conventional diet therapy appeared most effective when combined with group therapy. The use of VLCDs was most efficacious in conjunction with behaviour modification and active follow-up.<sup>91</sup>

The use of very low energy diets (<800 kcal/day) appears to be more effective at sustaining weight loss at every annual interval over 5 years than hypoenergetic balanced diets.<sup>111</sup>

## **13.2 Weight Loss Maintenance after Surgical Therapy**

Bariatric surgery appears to be associated with greater maintenance of weight loss for up to 8 years.<sup>236</sup> Post-surgical patients were able to maintain weight loss despite higher fat intake and less physical activity compared to medically treated patients.<sup>237</sup>

## 14 Special Groups: Obesity in Childhood and Adolescence

### 14.1 Introduction

The prevalence of childhood and adolescent obesity is increasing in developing countries, and childhood obesity is an important predictor of adult obesity.<sup>238</sup> As a consequence, many chronic diseases are now appearing in childhood and adolescence, and will contribute to morbidity and mortality in adulthood.

### 14.2 Epidemiology

The persistence of obesity into adulthood depends on the age at which the child becomes obese, the severity of obesity, and the presence of obesity in at least one parent.<sup>72</sup> Overweight in a child under 3 years of age does not predict future obesity, unless at least one parent is also obese. After 3 years, the likelihood that obesity persists increases with advancing age of the child, and is higher in children with severe obesity in all age groups. The presence of obesity in at least one parent increases the risk of persistence in children at every age.<sup>72</sup>

### 14.3 Clinical Evaluation

Clinical assessment of obese children and adolescents should include determination of the BMI or BMI percentile (for age and sex, where possible), a careful evaluation to identify possible causes of obesity such as genetic syndromes and endocrine disorders, and complications of obesity, including hypertension, dyslipidemias, orthopedic disorders, sleep disorders and insulin resistance.<sup>69</sup> Children should undergo a full clinical evaluation and possible treatment: when BMI  $\geq 95^{\text{th}}$  percentile or BMI  $\geq 85^{\text{th}}$  percentile with complications of obesity;<sup>69</sup> or when BMIs correspond to adult BMI cut-offs for overweight ( $\geq 25.0$  kg/m<sup>2</sup>) and obese ( $\geq 30.0$  kg/m<sup>2</sup>) at 18 years.<sup>70</sup> A recent anthropometric study in 2002 has defined the BMI percentile curves for Singapore children and teenagers up to 20 years of age. However, the equivalent Asian cut-off points for public health action in adults are 23 kg/m<sup>2</sup> for moderate risk and 27.5 kg/m<sup>2</sup> for high risk of morbidity,<sup>57</sup> and the BMI percentiles corresponding to these cut-off points may eventually be used in the definition of obese children in Singapore.

**C** A full clinical evaluation and possible treatment should be considered in children with a BMI  $\geq$  95<sup>th</sup> percentile or a BMI  $\geq$  85<sup>th</sup> percentile and complications of obesity. Alternatively, BMIs-for-age and gender equivalent to adult WHO BMI cut-offs for obese and overweight (at  $\geq$  30.0 or  $\geq$  25.0 kg/m<sup>2</sup>) respectively can be used as thresholds, although BMI cut-offs for action among Asians of 27.5 and 23.0 kg/m<sup>2</sup> respectively may eventually be used.

Grade C, Level IV

N.B. BMI cut-off points are currently being reviewed in the light of new data.

## 14.4 Management

The primary goal of childhood and adolescent obesity interventions is to adopt and maintain healthy lifestyle behaviours, so as to decrease morbidity. However, these interventions should allow height growth to continue, so that height eventually becomes appropriate for weight, or the BMI percentile becomes reduced. The management of childhood and adolescent obesity incorporates the following components:

### a. Dietary changes

All diets should be nutritionally balanced and designed to meet growth requirements. Calories should not be restricted in infants; rather, prevention of overfeeding should be emphasised<sup>239</sup>. Diets consisting of drastically altered portions of various nutrients may be dangerous and should be avoided.<sup>240</sup>

Very low calorie diets and protein sparing modified fast regimens do not clearly offer significant improvements in long-term outcome compared with less restrictive diets.<sup>241</sup>

**C** In children, less restrictive diets should be used, rather than diets consisting of drastically altered portions of various nutrients, very low calorie diets or protein sparing modified fast regimens.

Grade B, Level III

## **b. Physical activity**

Regular exercise encourages long-term continuation, and is an essential component of the weight management program.<sup>240</sup> Initial recommendations should be small, and exercise levels should be increased slowly to avoid discouragement.

Since younger children are generally incapable of focussed activity for long periods of time, they need creative activities appropriate for their age, with generous periods of free play.<sup>240,242</sup>

For overweight children, weight-bearing activities such as brisk walking and field sports is recommended. For obese children, exercises should be primarily non-weight bearing, including swimming, cycling and interval walking (walking with frequent rests, gradually working up to longer walking periods with fewer rest stops). For severely obese children, weekly supervision by trained exercise professionals is preferable, incorporating only non-weight bearing activities such as swimming or cycling.

In the older obese pre-adolescents and adolescents, a moderate-intensity progressive exercise program with increasing levels of obesity has been recommended.<sup>243,244</sup>

Decreasing the time spent in sedentary pursuits (e.g. watching television, video games, computer use) and substituting this with alternative forms of physical activity, is a useful strategy for weight loss.<sup>245,246</sup> Encouraging a decrease in sedentary time helps children identify their own areas of interest regarding physical activity, and improves compliance.

**B Appropriately increased physical activity is recommended. Younger children generally need age-appropriate creative activities with generous periods of free play. Weight bearing activities are recommended for overweight children, non-weight bearing activities for obese children and preferably supervised activities for severely obese children. In the older obese pre-adolescent and adolescent, decreased time on sedentary pursuits and increased activity such as a moderate intensity, progressive exercise program with increasing levels of obesity are recommended.**

**Grade B, Level III**

### c. Behaviour modification

**B Behaviour-treatment programs have shown consistent success in weight loss.**<sup>247</sup>

Grade B, Level IIa

However, the implementation requires a multi-disciplinary team which not only provides knowledge about diet and physical activity, but more importantly, has a consistent focus on principles of behaviour change.

The components of behaviour modification include:<sup>248,249</sup>

- i) Educating the parents and children on the need for lifestyle changes
- ii) Setting achievable weight maintenance and weight loss goals
- iii) Teaching skills for weight loss
- iv) Self-monitoring using food and activity logs, which increase awareness of eating and exercise patterns
- v) Stimulus control, which includes limiting the amount of unhealthy food stocked at home
- vi) Reinforcement through contracts, praise for behaviours, and rewards (but do not use food as a reward)

### d. Family involvement

Familial aggregation of risk factors for obesity is common. The long term effects of a weight control program (diet, physical activity, behaviour modification) are significantly improved when the intervention is directed at both the parents and the child, rather than the child alone.<sup>249,250</sup> This also avoids stigmatization of the obese child, and provides social support and encouragement.

**B Interventions for obesity in children should be directed at both the parents and the child, rather than the child alone.**

Grade B, Level III

With regards to other strategies in the management of obesity:

**e. Pharmacotherapy**

**C There is no data on the long term efficacy and safety of medication in childhood and adolescent obesity.**

Grade C, Level IV

**f. Bariatric surgery**

There is no role for bariatric surgery in childhood obesity. In limited case series, bariatric surgery has been performed in severely obese older adolescents who achieved significant post-operative weight reduction and improvement in co-morbid conditions,<sup>224-226</sup> but were at increased risk of developing post-operative nutritional deficiencies.<sup>225,251</sup>

**B Bariatric surgery cannot be recommended for most adolescents, but only for those at the highest risk of mortality from obesity, and with both patient and parental understanding of the consequences of surgery.**<sup>226</sup>

Grade B, Level III

## 15 Quality Indicators

### 15.1 Structure Indicators

- a. To prevent and check the increasing trend of obesity in the Singapore population, the Workgroup recommends that resources and facilities to promote weight loss and maintenance should be available both in the community and health-care setting
- b. Health-care service for weight management for affected and at risk individuals should be structured and organized around a multi-disciplinary weight management team.
- c. The core weight management team members should comprise primary-care doctors, nurse-educators, nutritionists, exercise therapist, behavioral therapist and endocrinologist. Other specialists that provide important support to the team should include respiratory physicians, cardiologists, and surgeon.
- d. Health care staff directly involved in weight management should be provided specialized training in weight management.

### 15.2 Performance Indicators

Performance Parameter	Recommended Frequency
Patient education and counseling	at diagnosis and quarterly
Body weight, waist circumference, BMI	at diagnosis and at least quarterly
Blood pressure	at diagnosis and at least quarterly
Blood glucose	at diagnosis and at least annually
Lipid profile	at diagnosis and at least annually

### 15.3 Outcome indicators

Data on outcome of weight management programs should be obtained from the overweight/obese individuals and at the population level.

#### a. Weight Loss

- Successful: Loss of 5-10% body weight

- Very successful: Loss of 10-20% body weight
- Exceptional: Loss of >20% body weight

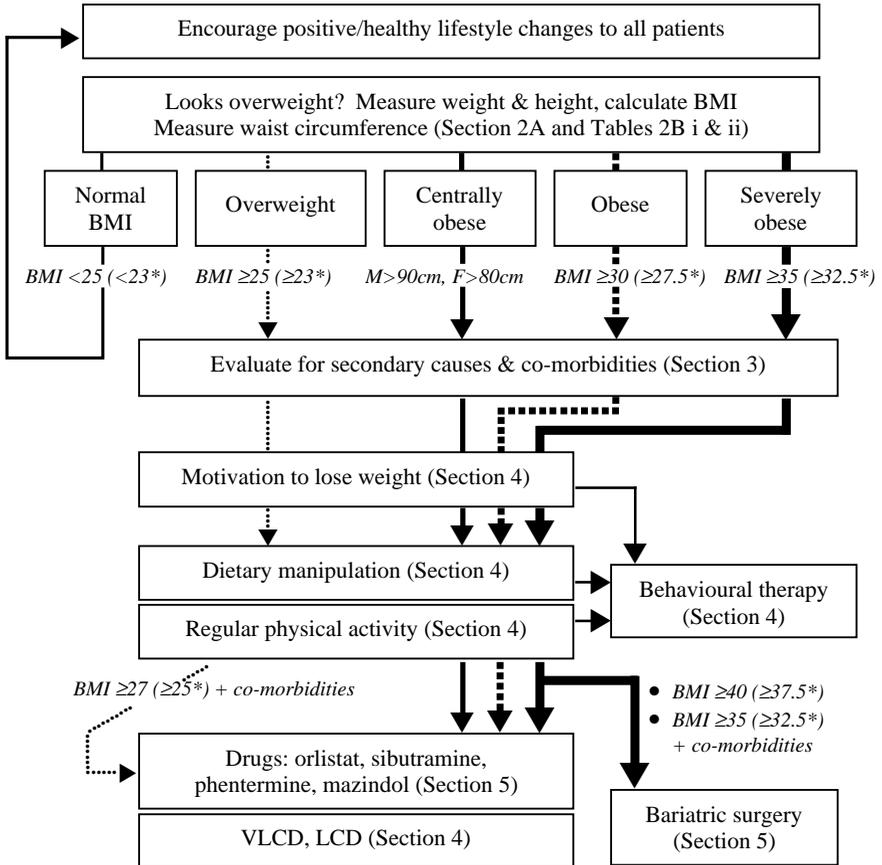
**b. Weight Maintenance**

- Weight regain of less than 3 kg in 2 years or in the long term.

**c. Risk Factor Reduction**

- Blood pressure <130/80 mmHg
- Lipid: LDL-C cholesterol <3.4 mmol/L
- Blood glucose <5.5 mmol/L (fasting) and <7.8 mmol/L (random)

## 16 Algorithm for Management of Obesity



\* Proposed commensurate Asian BMI cut-points for action (in  $\text{kg/m}^2$ ), currently under review.

## References

1. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser 2000; 894:i-xii, 1-253.
2. World Health Organisation. Obesity: Preventing and managing the global epidemic. Report on a WHO Consultation on Obesity, Geneva, 3-5 June, 1997. WHO/NUT/NCD/98.1. Geneva, 1998.
3. Rand CS, Macgregor AM. Successful weight loss following obesity surgery and the perceived liability of morbid obesity. *Int J Obes* 1991; 15:577-9.
4. Thompson D, Wolf AM. The medical-care cost burden of obesity. *Obes Rev* 2001; 2:189-97.
5. National Health Survey 1998. Epidemiology and Disease Control Department, Ministry of Health, Singapore. 1999.
6. Cutter J, Tan BY, Chew SK. Levels of cardiovascular disease risk factors in Singapore following a national intervention programme. *Bull World Health Organ* 2001; 79:908-15.
7. Hughes K, Yeo PP, Lun KC, et al. Obesity and body mass indices in Chinese, Malays and Indians in Singapore. *Ann Acad Med Singapore* 1990; 19:333-8.
8. Lim MK, Liam BL, Ng D, et al. Twenty-five years of national service—changes in height, weight and body mass index. *Ann Acad Med Singapore* 1994; 23:770-4.
9. Quek CM, Koh K, Lee J. Parental body mass index: a predictor of childhood obesity? *Ann Acad Med Singapore* 1993; 22:342-7.
10. Annual Report. Singapore: School Health Services, Singapore;. 2000.
11. Kotani K, Nishida M, Yamashita S, et al. Two decades of annual medical examinations in Japanese obese children: do obese children grow into obese adults? *Int J Obes Relat Metab Disord* 1997; 21:912-21.

12. Dietz WH. Critical periods in childhood for the development of obesity. *Am J Clin Nutr* 1994; 59:955-9.
13. Willett WC, Dietz WH, Colditz GA. Guidelines for healthy weight. *N Engl J Med* 1999; 341:427-34.
14. Janssen I, Katzmarzyk PT, Ross R. Body mass index, waist circumference, and health risk: evidence in support of current National Institutes of Health guidelines. *Arch Intern Med* 2002; 162:2074-9.
15. Lew EA, Garfinkel L. Variations in mortality by weight among 750,000 men and women. *J Chronic Dis* 1979; 32:563-76.
16. Manson JE, Willett WC, Stampfer MJ, et al. Body weight and mortality among women. *N Engl J Med* 1995; 333:677-85.
17. Lee IM, Manson JE, Hennekens CH, et al. Body weight and mortality. A 27-year follow-up of middle-aged men. *JAMA* 1993; 270:2823-8.
18. Fontaine KR, Redden DT, Wang C, et al. Years of life lost due to obesity. *JAMA* 2003; 289:187-93.
19. Peeters A, Barendregt JJ, Willekens F, et al. Obesity in adulthood and its consequences for life expectancy: a life-table analysis. *Ann Intern Med* 2003; 138:24-32.
20. Jonsson S, Hedblad B, Engstrom G, et al. Influence of obesity on cardiovascular risk. Twenty-three-year follow-up of 22,025 men from an urban Swedish population. *Int J Obes Relat Metab Disord* 2002; 26:1046-53.
21. Hubert HB, Feinleib M, McNamara PM, et al. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation* 1983; 67:968-77.
22. Stevens VJ, Obarzanek E, Cook NR, et al. Long-term weight loss and changes in blood pressure: results of the Trials of Hypertension Prevention, phase II. *Ann Intern Med* 2001; 134:1-11.

23. Harris MI. Impaired glucose tolerance in the U.S. population. *Diabetes Care* 1989; 12:464-74.
24. Colditz GA, Willett WC, Rotnitzky A, et al. Weight gain as a risk factor for clinical diabetes mellitus in women. *Ann Intern Med* 1995; 122:481-6.
25. Ford ES, Williamson DF, Liu S. Weight change and diabetes incidence: findings from a national cohort of US adults. *Am J Epidemiol* 1997; 146:214-22.
26. Mokdad AH, Bowman BA, Ford ES, et al. The continuing epidemics of obesity and diabetes in the United States. *JAMA* 2001; 286:1195-200.
27. Tuomilehto J, Lindstrom J, Eriksson JG, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 2001; 344:1343-50.
28. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346:393-403.
29. Poretsky L, Cataldo NA, Rosenwaks Z, et al. The insulin-related ovarian regulatory system in health and disease. *Endocr Rev* 1999; 20:535-82.
30. Schafer H, Pauleit D, Sudhop T, et al. Body fat distribution, serum leptin, and cardiovascular risk factors in men with obstructive sleep apnea. *Chest* 2002; 122:829-39.
31. Ip MS, Lam B, Lauder IJ, et al. A community study of sleep-disordered breathing in middle-aged Chinese men in Hong Kong. *Chest* 2001; 119:62-9.
32. Ip MS, Lam B, Ng MM, et al. Obstructive sleep apnea is independently associated with insulin resistance. *Am J Respir Crit Care Med* 2002; 165:670-6.

33. Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. *Am J Respir Crit Care Med* 2002; 165:1217-39.
34. Garfinkel L. Overweight and cancer. *Ann Intern Med* 1985; 103:1034-6.
35. Calle EE, Rodriguez C, Walker-Thurmond K, et al. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N Engl J Med* 2003; 348:1625-38.
36. Hartz AJ, Fischer ME, Bril G, et al. The association of obesity with joint pain and osteoarthritis in the HANES data. *J Chronic Dis* 1986; 39:311-9.
37. Felson DT. Weight and osteoarthritis. *J Rheumatol Suppl* 1995; 43:7-9.
38. Haffner SM, Diehl AK, Stern MP, et al. Central adiposity and gallbladder disease in Mexican Americans. *Am J Epidemiol* 1989; 129:587-95.
39. Ruhl CE, Everhart JE. Relationship of serum leptin concentration and other measures of adiposity with gallbladder disease. *Hepatology* 2001; 34:877-83.
40. Quetelet LA. *Physique Social*. In: Muquardt C, ed. Vol. 2. Brussels, 1869:92.
41. Keys A, Fidanza F, Karvonen MJ, et al. Indices of relative weight and obesity. *J Chronic Dis* 1972; 25:329-43.
42. Norgan NG, Ferro-Luzzi A. Weight-height indices as estimators of fatness in men. *Hum Nutr Clin Nutr* 1982; 36:363-72.
43. Norgan NG. Population differences in body composition in relation to the body mass index. *Eur J Clin Nutr* 1994; 48 Suppl 3:S10-25; discussion S26-7.
44. Wang J, Thornton JC, Russell M, et al. Asians have lower body mass index (BMI) but higher percent body fat than do whites: comparisons of anthropometric measurements. *Am J Clin Nutr* 1994; 60:23-8.

45. Deurenberg-Yap M, Schmidt G, van Staveren WA, et al. The paradox of low body mass index and high body fat percentage among Chinese, Malays and Indians in Singapore. *Int J Obes Relat Metab Disord* 2000; 24:1011-7.
46. Gurrici S, Hartriyanti Y, Hautvast JG, et al. Relationship between body fat and body mass index: differences between Indonesians and Dutch Caucasians. *Eur J Clin Nutr* 1998; 52:779-83.
47. Gallagher D, Heymsfield SB, Heo M, et al. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. *Am J Clin Nutr* 2000; 72:694-701.
48. Ko GT, Tang J, Chan JC, et al. Lower BMI cut-off value to define obesity in Hong Kong Chinese: an analysis based on body fat assessment by bioelectrical impedance. *Br J Nutr* 2001; 85:239-42.
49. Deurenberg-Yap M, Chew SK, Lin VF, et al. Relationships between indices of obesity and its co-morbidities in multi-ethnic Singapore. *Int J Obes Relat Metab Disord* 2001; 25:1554-62.
50. Lee ZS, Critchley JA, Ko GT, et al. Obesity and cardiovascular risk factors in Hong Kong Chinese. *Obes Rev* 2002; 3:173-82.
51. Ko GT, Chan JC, Cockram CS, et al. Prediction of hypertension, diabetes, dyslipidaemia or albuminuria using simple anthropometric indexes in Hong Kong Chinese. *Int J Obes Relat Metab Disord* 1999; 23:1136-42.
52. Li G, Chen X, Jang Y, et al. Obesity, coronary heart disease risk factors and diabetes in Chinese: an approach to the criteria of obesity in the Chinese population. *Obes Rev* 2002; 3:167-72.
53. Zhou B, Wu Y, Yang J, et al. Overweight is an independent risk factor for cardiovascular disease in Chinese populations. *Obes Rev* 2002; 3:147-56.
54. Ishikawa-Takata K, Ohta T, Moritaki K, et al. Obesity, weight change and risks for hypertension, diabetes and hypercholesterolemia in Japanese men. *Eur J Clin Nutr* 2002; 56:601-7.

55. Moon OR, Kim NS, Jang SM, et al. The relationship between body mass index and the prevalence of obesity-related diseases based on the 1995 National Health Interview Survey in Korea. *Obes Rev* 2002; 3:191-6.
56. Reddy KS, Prabhakaran D, Shah P, et al. Differences in body mass index and waist: hip ratios in North Indian rural and urban populations. *Obes Rev* 2002; 3:197-202.
57. WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 2004; 363:157-63.
58. NHLBI Obesity Education Initiative. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. National Institutes of Health, 1998. [http://www.nhlbi.nih.gov/guidelines/obesity/ob\\_gdlns.pdf](http://www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.pdf).
59. The Asia-Pacific perspective: Redefining obesity and its treatment. Melbourne: WHO Western Pacific Regional Office, IASO, IOTF, 2000. <http://www.obesityasiapacific.com/pdf/obesity.pdf>.
60. Lean ME, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. *BMJ* 1995; 311:158-61.
61. Han TS, Seidell JC, Currall JE, et al. The influences of height and age on waist circumference as an index of adiposity in adults. *Int J Obes Relat Metab Disord* 1997; 21:83-9.
62. Han TS, Richmond P, Avenell A, et al. Waist circumference reduction and cardiovascular benefits during weight loss in women. *Int J Obes Relat Metab Disord* 1997; 21:127-34.
63. Fogelholm M, van Marken Lichtenbelt W. Comparison of body composition methods: a literature analysis. *Eur J Clin Nutr* 1997; 51:495-503.
64. De Lorenzo A, Bertini I, Candeloro N, et al. Comparison of different techniques to measure body composition in moderately active adolescents. *Br J Sports Med* 1998; 32:215-9.

65. Ravaglia G, Forti P, Maioli F, et al. Measurement of body fat in healthy elderly men: a comparison of methods. *J Gerontol A Biol Sci Med Sci* 1999; 54:M70-6.
66. Schoeller DA. Bioelectrical impedance analysis. What does it measure? *Ann N Y Acad Sci* 2000; 904:159-62.
67. Ellis KJ, Bell SJ, Chertow GM, et al. Bioelectrical impedance methods in clinical research: a follow-up to the NIH Technology Assessment Conference. *Nutrition* 1999; 15:874-80.
68. Deurenberg P, Deurenberg-Yap M. Validation of skinfold thickness and hand-held impedance measurements for estimation of body fat percentage among Singaporean Chinese, Malay and Indian subjects. *Asia Pac J Clin Nutr* 2002; 11:1-7.
69. Barlow SE, Dietz WH. Obesity evaluation and treatment: Expert Committee recommendations. *Pediatrics*. Vol. 102: The Maternal and Child Health Bureau, Health Resources and Services Administration and the Department of Health and Human Services, 1998:E29. <http://www.pediatrics.org/cgi/content/full/102/3/e29>.
70. Cole TJ, Bellizzi MC, Flegal KM, et al. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000; 320:1240-3.
71. Dietz WH, Robinson TN. Use of the body mass index (BMI) as a measure of overweight in children and adolescents. *J Pediatr* 1998; 132:191-3.
72. Whitaker RC, Wright JA, Pepe MS, et al. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med* 1997; 337:869-73.
73. Freedman DS, Dietz WH, Srinivasan SR, et al. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics* 1999; 103:1175-82.
74. Cole TJ. The LMS method for constructing normalized growth standards. *Eur J Clin Nutr* 1990; 44:45-60.

75. Diet, nutrition and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation. World Health Organ Tech Rep Ser 2002; 916:1-108.  
[ftp://ftp.fao.org/es/esn/nutrition/diet\\_prevention\\_disease.pdf](ftp://ftp.fao.org/es/esn/nutrition/diet_prevention_disease.pdf).
76. Lustig RH. The neuroendocrinology of obesity. *Endocrinol Metab Clin North Am* 2001; 30:765-85.
77. Kalra SP, Dube MG, Pu S, et al. Interacting appetite-regulating pathways in the hypothalamic regulation of body weight. *Endocr Rev* 1999; 20:68-100.
78. Rosenbaum M, Leibel RL, Hirsch J. Obesity. *N Engl J Med* 1997; 337:396-407.
79. Cummings DE, Weigle DS, Frayo RS, et al. Plasma ghrelin levels after diet-induced weight loss or gastric bypass surgery. *N Engl J Med* 2002; 346:1623-30.
80. Haqq AM, Farooqi IS, O'Rahilly S, et al. Serum ghrelin levels are inversely correlated with body mass index, age, and insulin concentrations in normal children and are markedly increased in Prader-Willi syndrome. *J Clin Endocrinol Metab* 2003; 88:174-8.
81. Farooqi IS, Keogh JM, Yeo GS, et al. Clinical spectrum of obesity and mutations in the melanocortin 4 receptor gene. *N Engl J Med* 2003; 348:1085-95.
82. Serdula MK, Mokdad AH, Williamson DF, et al. Prevalence of attempting weight loss and strategies for controlling weight. *JAMA* 1999; 282:1353-8.
83. French SA, Jeffery RW, Murray D. Is dieting good for you?: Prevalence, duration and associated weight and behaviour changes for specific weight loss strategies over four years in US adults. *Int J Obes Relat Metab Disord* 1999; 23:320-7.
84. Foster GD, Wadden TA, Phelan S, et al. Obese patients' perceptions of treatment outcomes and the factors that influence them. *Arch Intern Med* 2001; 161:2133-9.

85. Freedman MR, King J, Kennedy E. Popular diets: a scientific review. *Obes Res* 2001; 9 Suppl 1:1S-40S.
86. Heilbronn LK, Noakes M, Clifton PM. Effect of energy restriction, weight loss, and diet composition on plasma lipids and glucose in patients with type 2 diabetes. *Diabetes Care* 1999; 22:889-95.
87. Astrup A, Rossner S. Lessons from obesity management programmes: greater initial weight loss improves long-term maintenance. *Obes Rev* 2000; 1:17-9.
88. Wing RR. Physical activity in the treatment of the adulthood overweight and obesity: current evidence and research issues. *Med Sci Sports Exerc* 1999; 31:S547-52.
89. Fogelholm M, Kukkonen-Harjula K, Nenonen A, et al. Effects of walking training on weight maintenance after a very-low-energy diet in premenopausal obese women: a randomized controlled trial. *Arch Intern Med* 2000; 160:2177-84.
90. Pekkarinen T, Mustajoki P. Comparison of behavior therapy with and without very-low-energy diet in the treatment of morbid obesity. A 5-year outcome. *Arch Intern Med* 1997; 157:1581-5.
91. Ayyad C, Andersen T. Long-term efficacy of dietary treatment of obesity: a systematic review of studies published between 1931 and 1999. *Obes Rev* 2000; 1:113-9.
92. Lantz H, Peltonen M, Agren L, et al. A dietary and behavioural programme for the treatment of obesity. A 4-year clinical trial and a long-term posttreatment follow-up. *J Intern Med* 2003; 254:272-9.
93. St Jeor ST, Howard BV, Prewitt TE, et al. Dietary protein and weight reduction: a statement for healthcare professionals from the Nutrition Committee of the Council on Nutrition, Physical Activity, and Metabolism of the American Heart Association. *Circulation* 2001; 104:1869-74.
94. Hadjuk CL, Roberts SB, Saltzman E. Dietary treatment of obesity. *Curr Opin Endocrinol Diabetes* 2001; 8:240-6.

95. Pirozzo S, Summerbell C, Cameron C, et al. Advice on low-fat diets for obesity. *Cochrane Database Syst Rev* 2002;CD003640.
96. Anderson JW, Konz EC, Jenkins DJ. Health advantages and disadvantages of weight-reducing diets: a computer analysis and critical review. *J Am Coll Nutr* 2000; 19:578-90.
97. Bravata DM, Sanders L, Huang J, et al. Efficacy and safety of low-carbohydrate diets. *JAMA* 2003; 289:1837-50.
98. Klem ML, Wing RR, McGuire MT, et al. A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *Am J Clin Nutr* 1997; 66:239-46.
99. Bray GA, Popkin BM. Dietary fat intake does affect obesity! *Am J Clin Nutr* 1998; 68:1157-73.
100. Willett WC. Dietary fat plays a major role in obesity: no. *Obes Rev* 2002; 3:59-68.
101. Foster GD, Wyatt HR, Hill JO, et al. A randomized trial of a low-carbohydrate diet for obesity. *N Engl J Med* 2003; 348:2082-90.
102. Samaha FF, Iqbal N, Seshadri P, et al. A low-carbohydrate as compared with a low-fat diet in severe obesity. *N Engl J Med* 2003; 348:2074-81.
103. Brehm BJ, Seeley RJ, Daniels SR, et al. A randomized trial comparing a very low carbohydrate diet and a calorie-restricted low fat diet on body weight and cardiovascular risk factors in healthy women. *J Clin Endocrinol Metab* 2003; 88:1617-23.
104. Lichtenstein AH, Van Horn L. Very low fat diets. *Circulation* 1998; 98:935-9.
105. Jakicic JM, Clark K, Coleman E, et al. American College of Sports Medicine position stand. Appropriate intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc* 2001; 33:2145-56.

106. Havel PJ, Kasim-Karakas S, Mueller W, et al. Relationship of plasma leptin to plasma insulin and adiposity in normal weight and overweight women: effects of dietary fat content and sustained weight loss. *J Clin Endocrinol Metab* 1996; 81:4406-13.
107. Klem ML, Wing RR, Lang W, et al. Does weight loss maintenance become easier over time? *Obes Res* 2000; 8:438-44.
108. Ogden J. The correlates of long-term weight loss: a group comparison study of obesity. *Int J Obes Relat Metab Disord* 2000; 24:1018-25.
109. McGuire MT, Wing RR, Klem ML, et al. Behavioral strategies of individuals who have maintained long-term weight losses. *Obes Res* 1999; 7:334-41.
110. Heymsfield SB, van Mierlo CA, van der Knaap HC, et al. Weight management using a meal replacement strategy: meta and pooling analysis from six studies. *Int J Obes Relat Metab Disord* 2003; 27:537-49.
111. Anderson JW, Konz EC, Frederich RC, et al. Long-term weight-loss maintenance: a meta-analysis of US studies. *Am J Clin Nutr* 2001; 74:579-84.
112. Wing RR, Blair E, Marcus M, et al. Year-long weight loss treatment for obese patients with type II diabetes: does including an intermittent very-low-calorie diet improve outcome? *Am J Med* 1994; 97:354-62.
113. Williams KV, Mullen ML, Kelley DE, et al. The effect of short periods of caloric restriction on weight loss and glycemic control in type 2 diabetes. *Diabetes Care* 1998; 21:2-8.
114. Mustajoki P, Pekkarinen T. Very low energy diets in the treatment of obesity. *Obes Rev* 2001; 2:61-72.
115. Kansanen M, Vanninen E, Tuunainen A, et al. The effect of a very low-calorie diet-induced weight loss on the severity of obstructive sleep apnoea and autonomic nervous function in obese patients with obstructive sleep apnoea syndrome. *Clin Physiol* 1998; 18:377-85.

116. Pekkarinen T, Mustajoki P. Use of very low-calorie diet in preoperative weight loss: efficacy and safety. *Obes Res* 1997; 5:595-602.
117. Shekelle PG, Hardy ML, Morton SC, et al. Efficacy and safety of ephedra and ephedrine for weight loss and athletic performance: A meta-analysis. *JAMA* 2003; 289:1537-45.
118. Cangiano C, Ceci F, Cascino A, et al. Eating behavior and adherence to dietary prescriptions in obese adult subjects treated with 5-hydroxytryptophan. *Am J Clin Nutr* 1992; 56:863-7.
119. Walsh DE, Yaghubian V, Behforouz A. Effect of glucomannan on obese patients: a clinical study. *Int J Obes* 1984; 8:289-93.
120. Mattes RD, Bormann L. Effects of (-)-hydroxycitric acid on appetitive variables. *Physiol Behav* 2000; 71:87-94.
121. Stoa-Birketvedt G. Effect of cimetidine suspension on appetite and weight in overweight subjects. *BMJ* 1993; 306:1091-3.
122. Stanko RT, Reynolds HR, Hoyson R, et al. Pyruvate supplementation of a low-cholesterol, low-fat diet: effects on plasma lipid concentrations and body composition in hyperlipidemic patients. *Am J Clin Nutr* 1994; 59:423-7.
123. Barr SI. Increased dairy product or calcium intake: is body weight or composition affected in humans? *J Nutr* 2003; 133:245S-248S.
124. Heaney RP. Normalizing calcium intake: projected population effects for body weight. *J Nutr* 2003; 133:268S-270S.
125. Teegarden D. Calcium intake and reduction in weight or fat mass. *J Nutr* 2003; 133:249S-251S.
126. Koppeschaar HP, Meinders AE, Schwarz F. Metabolic responses in grossly obese subjects treated with a very-low-calorie diet with and without triiodothyronine treatment. *Int J Obes* 1983; 7:133-41.
127. Pittler MH, Ernst E. Guar gum for body weight reduction: meta-analysis of randomized trials. *Am J Med* 2001; 110:724-30.

128. Tai ES, Fok AC, Chu R, et al. A study to assess the effect of dietary supplementation with soluble fibre (Minolest) on lipid levels in normal subjects with hypercholesterolaemia. *Ann Acad Med Singapore* 1999; 28:209-13.
129. Blankson H, Stakkestad JA, Fagertun H, et al. Conjugated linoleic acid reduces body fat mass in overweight and obese humans. *J Nutr* 2000; 130:2943-8.
130. Smedman A, Vessby B. Conjugated linoleic acid supplementation in humans—metabolic effects. *Lipids* 2001; 36:773-81.
131. Ho SC, Tai ES, Eng PH, et al. In the absence of dietary surveillance, chitosan does not reduce plasma lipids or obesity in hypercholesterolaemic obese Asian subjects. *Singapore Med J* 2001; 42:006-10.
132. Lukaski HC. Magnesium, zinc, and chromium nutriture and physical activity. *Am J Clin Nutr* 2000; 72:585S-93S.
133. Lis-Balchin M. Parallel placebo-controlled clinical study of a mixture of herbs sold as a remedy for cellulite. *Phytother Res* 1999; 13:627-9.
134. Ernst E. Acupuncture/acupressure for weight reduction? A systematic review. *Wien Klin Wochenschr* 1997; 109:60-2.
135. Lacey JM, Tershakovec AM, Foster GD. Acupuncture for the treatment of obesity: a review of the evidence. *Int J Obes Relat Metab Disord* 2003; 27:419-27.
136. Sesso HD, Paffenbarger RS, Jr., Lee IM. Physical activity and coronary heart disease in men: The Harvard Alumni Health Study. *Circulation* 2000; 102:975-80.
137. Tanasescu M, Leitzmann MF, Rimm EB, et al. Exercise type and intensity in relation to coronary heart disease in men. *JAMA* 2002; 288:1994-2000.
138. Manson JE, Greenland P, LaCroix AZ, et al. Walking compared with vigorous exercise for the prevention of cardiovascular events in women. *N Engl J Med* 2002; 347:716-25.

139. Wei M, Kampert JB, Barlow CE, et al. Relationship between low cardiorespiratory fitness and mortality in normal-weight, overweight, and obese men. *JAMA* 1999; 282:1547-53.
140. Lee CD, Blair SN, Jackson AS. Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men. *Am J Clin Nutr* 1999; 69:373-80.
141. American College of Sports Medicine Position Stand. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc* 1998; 30:975-91.
142. Donnelly JE, Hill JO, Jacobsen DJ, et al. Effects of a 16-month randomized controlled exercise trial on body weight and composition in young, overweight men and women: the Midwest Exercise Trial. *Arch Intern Med* 2003; 163:1343-50.
143. Whelton SP, Chin A, Xin X, et al. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Ann Intern Med* 2002; 136:493-503.
144. Kraus WE, Houmard JA, Duscha BD, et al. Effects of the amount and intensity of exercise on plasma lipoproteins. *N Engl J Med* 2002; 347:1483-92.
145. Ross R, Freeman JA, Janssen I. Exercise alone is an effective strategy for reducing obesity and related comorbidities. *Exerc Sport Sci Rev* 2000; 28:165-70.
146. Saris WH, Blair SN, van Baak MA, et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. *Obes Rev* 2003; 4:101-14.
147. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc* 2000; 32:S498-504.

148. Jakicic JM, Winters C, Lang W, et al. Effects of intermittent exercise and use of home exercise equipment on adherence, weight loss, and fitness in overweight women: a randomized trial. *JAMA* 1999; 282:1554-60.
149. Erlichman J, Kerbey AL, James WP. Physical activity and its impact on health outcomes. Paper 2: Prevention of unhealthy weight gain and obesity by physical activity: an analysis of the evidence. *Obes Rev* 2002; 3:273-87.
150. Lee IM, Sesso HD, Oguma Y, et al. Relative intensity of physical activity and risk of coronary heart disease. *Circulation* 2003; 107:1110-6.
151. Andersen RE, Wadden TA, Bartlett SJ, et al. Effects of lifestyle activity vs structured aerobic exercise in obese women: a randomized trial. *JAMA* 1999; 281:335-40.
152. Swartz AM, Strath SJ, Bassett DR, et al. Increasing daily walking improves glucose tolerance in overweight women. *Prev Med* 2003; 37:356-62.
153. Staffieri JR. A study of social stereotype of body image in children. *J Pers Soc Psychol* 1967; 7:101-4.
154. Roehling MV. Weight-based discrimination in employment: psychological and legal aspects. *Personnel Psychol* 1999; 52:969-1016.
155. Olson CL, Schumaker HD, Yawn BP. Overweight women delay medical care. *Arch Fam Med* 1994; 3:888-92.
156. Stewart AL, Brook RH. Effects of being overweight. *Am J Public Health* 1983; 73:171-8.
157. Friedman MA, Brownell KD. Psychological correlates of obesity: moving to the next research generation. *Psychol Bull* 1995; 117:3-20.
158. Carpenter KM, Hasin DS, Allison DB, et al. Relationships between obesity and DSM-IV major depressive disorder, suicide ideation, and suicide attempts: results from a general population study. *Am J Public Health* 2000; 90:251-7.

159. Spitzer RL, Devlin MJ, Walsh BT, et al. Binge eating disorder: a multisite field trial of the diagnostic criteria. *Int J Eat Disord* 1992; 11:191-203.
160. Stunkard AJ, Allison KC. Two forms of disordered eating in obesity: binge eating and night eating. *Int J Obes Relat Metab Disord* 2003; 27:1-12.
161. Leermakers EA, Perri MG, Shigaki CL, et al. Effects of exercise-focused versus weight-focused maintenance programs on the management of obesity. *Addict Behav* 1999; 24:219-27.
162. Perri MG, Nezu AM, Patti ET, et al. Effect of length of treatment on weight loss. *J Consult Clin Psychol* 1989; 57:450-2.
163. Wadden TA, Sarwer DB, Berkowitz RI. Behavioural treatment of the overweight patient. *Baillieres Best Pract Res Clin Endocrinol Metab* 1999; 13:93-107.
164. Sarwer DB, Wadden TA. The treatment of obesity: what's new, what's recommended. *J Womens Health Gend Based Med* 1999; 8:483-93.
165. Wadden TA, Berkowitz RI, Sarwer DB, et al. Benefits of lifestyle modification in the pharmacologic treatment of obesity: a randomized trial. *Arch Intern Med* 2001; 161:218-27.
166. Tong PC, Lee ZS, Sea MM, et al. The effect of orlistat-induced weight loss, without concomitant hypocaloric diet, on cardiovascular risk factors and insulin sensitivity in young obese Chinese subjects with or without type 2 diabetes. *Arch Intern Med* 2002; 162:2428-35.
167. Yanovski SZ, Yanovski JA. Obesity. *N Engl J Med* 2002; 346:591-602.
168. Glazer G. Long-term pharmacotherapy of obesity 2000: a review of efficacy and safety. *Arch Intern Med* 2001; 161:1814-24.
169. James WP, Astrup A, Finer N, et al. Effect of sibutramine on weight maintenance after weight loss: a randomised trial. *STORM Study Group. Sibutramine Trial of Obesity Reduction and Maintenance. Lancet* 2000; 356:2119-25.

170. O'Meara S, Riemsma R, Shirran L, et al. The clinical effectiveness and cost-effectiveness of sibutramine in the management of obesity: a technology assessment. *Health Technol Assess* 2002; 6(6):1-97. <http://www.hta.nhsweb.nhs.uk/fullmono/mon606.pdf>.
171. Halpern A, Mancini MC. Treatment of obesity: an update on anti-obesity medications. *Obes Rev* 2003; 4:25-42.
172. Wirth A, Krause J. Long-term weight loss with sibutramine: a randomized controlled trial. *JAMA* 2001; 286:1331-9.
173. McMahon FG, Weinstein SP, Rowe E, et al. Sibutramine is safe and effective for weight loss in obese patients whose hypertension is well controlled with angiotensin-converting enzyme inhibitors. *J Hum Hypertens* 2002; 16:5-11.
174. Sramek JJ, Leibowitz MT, Weinstein SP, et al. Efficacy and safety of sibutramine for weight loss in obese patients with hypertension well controlled by beta-adrenergic blocking agents: a placebo-controlled, double-blind, randomised trial. *J Hum Hypertens* 2002; 16:13-9.
175. Finer N, Bloom SR, Frost GS, et al. Sibutramine is effective for weight loss and diabetic control in obesity with type 2 diabetes: a randomised, double-blind, placebo-controlled study. *Diabetes Obes Metab* 2000; 2:105-12.
176. Dujovne CA, Zavoral JH, Rowe E, et al. Effects of sibutramine on body weight and serum lipids: a double-blind, randomized, placebo-controlled study in 322 overweight and obese patients with dyslipidemia. *Am Heart J* 2001; 142:489-97.
177. Apfelbaum M, Vague P, Ziegler O, et al. Long-term maintenance of weight loss after a very-low-calorie diet: a randomized blinded trial of the efficacy and tolerability of sibutramine. *Am J Med* 1999; 106:179-84.
178. Weintraub M, Hasday JD, Mushlin AI, et al. A double-blind clinical trial in weight control. Use of fenfluramine and phentermine alone and in combination. *Arch Intern Med* 1984; 144:1143-8.

179. Enzi G, Baritussio A, Marchiori E, et al. Short-term and long-term clinical evaluation of a non-amphetaminic anorexiant (mazindol) in the treatment of obesity. *J Int Med Res* 1976; 4:305-18.
180. Inoue S, Egawa M, Satoh S, et al. Clinical and basic aspects of an anorexiant, mazindol, as an antiobesity agent in Japan. *Am J Clin Nutr* 1992; 55:199S-202S.
181. Yoshida T, Sakane N, Umekawa T, et al. Usefulness of mazindol in combined diet therapy consisting of a low-calorie diet and Optifast in severely obese women. *Int J Clin Pharmacol Res* 1994; 14:125-32.
182. Nishikawa T, Iizuka T, Omura M, et al. Effect of mazindol on body weight and insulin sensitivity in severely obese patients after a very-low-calorie diet therapy. *Endocr J* 1996; 43:671-7.
183. Haller CA, Benowitz NL. Adverse cardiovascular and central nervous system events associated with dietary supplements containing ephedra alkaloids. *N Engl J Med* 2000; 343:1833-8.
184. Greenway F, Herber D, Raum W, et al. Double-blind, randomized, placebo-controlled clinical trials with non-prescription medications for the treatment of obesity. *Obes Res* 1999; 7:370-8.
185. Goldstein DJ, Rampey AH, Jr., Enas GG, et al. Fluoxetine: a randomized clinical trial in the treatment of obesity. *Int J Obes Relat Metab Disord* 1994; 18:129-35.
186. Daubresse JC, Kolanowski J, Krzentowski G, et al. Usefulness of fluoxetine in obese non-insulin-dependent diabetics: a multicenter study. *Obes Res* 1996; 4:391-6.
187. Breum L, Bjerre U, Bak JF, et al. Long-term effects of fluoxetine on glycemic control in obese patients with non-insulin-dependent diabetes mellitus or glucose intolerance: influence on muscle glycogen synthase and insulin receptor kinase activity. *Metabolism* 1995; 44:1570-6.
188. Ricca V, Mannucci E, Di Bernardo M, et al. Sertraline enhances the effects of cognitive-behavioral treatment on weight reduction of obese patients. *J Endocrinol Invest* 1996; 19:727-33.

189. Wadden TA, Bartlett SJ, Foster GD, et al. Sertraline and relapse prevention training following treatment by very-low-calorie diet: a controlled clinical trial. *Obes Res* 1995; 3:549-57.
190. Fava M, Judge R, Hoog SL, et al. Fluoxetine versus sertraline and paroxetine in major depressive disorder: changes in weight with long-term treatment. *J Clin Psychiatry* 2000; 61:863-7.
191. Connolly HM, Crary JL, McGoon MD, et al. Valvular heart disease associated with fenfluramine-phentermine. *N Engl J Med* 1997; 337:581-8.
192. Abenhaim L, Moride Y, Brenot F, et al. Appetite-suppressant drugs and the risk of primary pulmonary hypertension. International Primary Pulmonary Hypertension Study Group. *N Engl J Med* 1996; 335:609-16.
193. Perucca E. A pharmacological and clinical review on topiramate, a new antiepileptic drug. *Pharmacol Res* 1997; 35:241-56.
194. Mathew NT. Antiepileptic drugs in migraine prevention. *Headache* 2001; 41 Suppl 1:S18-24.
195. McElroy SL, Arnold LM, Shapira NA, et al. Topiramate in the treatment of binge eating disorder associated with obesity: a randomized, placebo-controlled trial. *Am J Psychiatry* 2003; 160:255-61.
196. Bray GA, Hollander P, Klein S, et al. A 6-month randomized, placebo-controlled, dose-ranging trial of topiramate for weight loss in obesity. *Obes Res* 2003; 11:722-33.
197. Gadde KM, Franciscy DM, Wagner HR, et al. Zonisamide for weight loss in obese adults: a randomized controlled trial. *JAMA* 2003; 289:1820-5.
198. O'Meara S, Riemsma R, Shirran L, et al. A rapid and systematic review of the clinical effectiveness and cost-effectiveness of orlistat in the management of obesity. *Health Technol Assess* 2001; 5(18):1-87. <http://www.hta.nhsweb.nhs.uk/fullmono/mon518.pdf>.

199. Torgerson JS, Hauptman J, Boldrin MN, et al. XENical in the prevention of diabetes in obese subjects (XENDOS) study: a randomized study of orlistat as an adjunct to lifestyle changes for the prevention of type 2 diabetes in obese patients. *Diabetes Care* 2004; 27:155-61.
200. Miles JM, Leiter L, Hollander P, et al. Effect of orlistat in overweight and obese patients with type 2 diabetes treated with metformin. *Diabetes Care* 2002; 25:1123-8.
201. Heymsfield SB, Segal KR, Hauptman J, et al. Effects of weight loss with orlistat on glucose tolerance and progression to type 2 diabetes in obese adults. *Arch Intern Med* 2000; 160:1321-6.
202. Reaven G, Segal K, Hauptman J, et al. Effect of orlistat-assisted weight loss in decreasing coronary heart disease risk in patients with syndrome X. *Am J Cardiol* 2001; 87:827-31.
203. Zoss I, Piec G, Horber FF. Impact of orlistat therapy on weight reduction in morbidly obese patients after implantation of the Swedish adjustable gastric band. *Obes Surg* 2002; 12:113-7.
204. DeFronzo RA. Pharmacologic therapy for type 2 diabetes mellitus. *Ann Intern Med* 1999; 131:281-303.
205. McNulty SJ, Ur E, Williams G. A randomized trial of sibutramine in the management of obese type 2 diabetic patients treated with metformin. *Diabetes Care* 2003; 26:125-31.
206. Wadden TA, Berkowitz RI, Womble LG, et al. Effects of sibutramine plus orlistat in obese women following 1 year of treatment by sibutramine alone: a placebo-controlled trial. *Obes Res* 2000; 8:431-7.
207. Devlin MJ, Goldfein JA, Carino JS, et al. Open treatment of overweight binge eaters with phentermine and fluoxetine as an adjunct to cognitive-behavioral therapy. *Int J Eat Disord* 2000; 28:325-32.
208. Clegg AJ, Colquitt J, Sidhu MK, et al. The clinical effectiveness and cost-effectiveness of surgery for people with morbid obesity: a systematic review and economic evaluation. *Health Technol Assess* 2002;6(12):1-153.  
<http://www.hta.nhsweb.nhs.uk/fullmono/mon612.pdf>.

209. Gastrointestinal surgery for severe obesity: National Institutes of Health Consensus Development Conference Statement. *Am J Clin Nutr* 1992; 55:615S-619S.
210. Guidelines for laparoscopic and conventional surgical treatment of morbid obesity. *Surg Endosc* 2001; 15:1251-2.  
[http://www.asbs.org/html/lab\\_guidelines.html](http://www.asbs.org/html/lab_guidelines.html).
211. Brodin RE. Bariatric surgery and long-term control of morbid obesity. *JAMA* 2002; 288:2793-6.
212. O'Brien PE, Dixon JB, Brown W, et al. The laparoscopic adjustable gastric band (Lap-Band): a prospective study of medium-term effects on weight, health and quality of life. *Obes Surg* 2002; 12:652-60.
213. Gazzaruso C, Giordanetti S, La Manna A, et al. Weight loss after Swedish Adjustable Gastric Banding: relationships to insulin resistance and metabolic syndrome. *Obes Surg* 2002; 12:841-5.
214. Vallis MT, Ross MA. The role of psychological factors in bariatric surgery for morbid obesity: identification of psychological predictors of success. *Obes Surg* 1993; 3:346-359.
215. Higa KD, Boone KB, Ho T. Complications of the laparoscopic Roux-en-Y gastric bypass: 1,040 patients—what have we learned? *Obes Surg* 2000; 10:509-13.
216. Ren CJ, Horgan S, Ponce J. US experience with the LAP-BAND system. *Am J Surg* 2002; 184:46S-50S.
217. Cadiere GB, Himpens J, Hainaux B, et al. Laparoscopic adjustable gastric banding. *Semin Laparosc Surg* 2002; 9:105-14.
218. Chevallier JM, Zinzindohoue F, Elian N, et al. Adjustable gastric banding in a public university hospital: prospective analysis of 400 patients. *Obes Surg* 2002; 12:93-9.
219. Scopinaro N, Gianetta E, Adami GF, et al. Biliopancreatic diversion for obesity at eighteen years. *Surgery* 1996; 119:261-8.

220. Mathus-Vliegen EM, Tytgat GN. Intra-gastric balloons for morbid obesity: results, patient tolerance and balloon life span. *Br J Surg* 1990; 77:76-9.
221. Mathus-Vliegen EM, Tytgat GN, Veldhuyzen-Offermans EA. Intra-gastric balloon in the treatment of super-morbid obesity. Double-blind, sham-controlled, crossover evaluation of 500-milliliter balloon. *Gastroenterology* 1990; 99:362-9.
222. Evans JD, Scott MH. Intra-gastric balloon in the treatment of patients with morbid obesity. *Br J Surg* 2001; 88:1245-8.
223. Totte E, Hendrickx L, Pauwels M, et al. Weight reduction by means of intra-gastric device: experience with the bioenterics intra-gastric balloon. *Obes Surg* 2001; 11:519-23.
224. Rand CS, Macgregor AM. Adolescents having obesity surgery: a 6-year follow-up. *South Med J* 1994; 87:1208-13.
225. Strauss RS, Bradley LJ, Brolin RE. Gastric bypass surgery in adolescents with morbid obesity. *J Pediatr* 2001; 138:499-504.
226. Sugerman HJ, Sugerman EL, DeMaria EJ, et al. Bariatric surgery for severely obese adolescents. *J Gastrointest Surg* 2003; 7:102-8.
227. Nehoda H, Hourmont K, Sauper T, et al. Laparoscopic gastric banding in older patients. *Arch Surg* 2001; 136:1171-6.
228. Wittgrove AC, Jester L, Wittgrove P, et al. Pregnancy following gastric bypass for morbid obesity. *Obes Surg* 1998; 8:461-4; discussion 465-6.
229. Dixon JB, Dixon ME, O'Brien PE. Pregnancy after Lap-Band surgery: management of the band to achieve healthy weight outcomes. *Obes Surg* 2001; 11:59-65.
230. Taylor DH, Jr., Ostbye T. The effect of middle- and old-age body mass index on short-term mortality in older people. *J Am Geriatr Soc* 2001; 49:1319-26.

231. Heiat A, Vaccarino V, Krumholz HM. An evidence-based assessment of federal guidelines for overweight and obesity as they apply to elderly persons. *Arch Intern Med* 2001; 161:1194-203.
232. Lowe MR, Miller-Kovach K, Phelan S. Weight-loss maintenance in overweight individuals one to five years following successful completion of a commercial weight loss program. *Int J Obes Relat Metab Disord* 2001; 25:325-31.
233. Heshka S, Anderson JW, Atkinson RL, et al. Weight loss with self-help compared with a structured commercial program: a randomized trial. *JAMA* 2003; 289:1792-98.
234. Wing RR, Hill JO. Successful weight loss maintenance. *Annu Rev Nutr* 2001; 21:323-41.
235. Wyatt HR, Grunwald GK, Mosca CL, et al. Long-term weight loss and breakfast in subjects in the National Weight Control Registry. *Obes Res* 2002; 10:78-82.
236. Torgerson JS, Sjostrom L. The Swedish Obese Subjects (SOS) study-rationale and results. *Int J Obes Relat Metab Disord* 2001; 25 Suppl 1:S2-4.
237. Klem ML, Wing RR, Chang CC, et al. A case-control study of successful maintenance of a substantial weight loss: individuals who lost weight through surgery versus those who lost weight through non-surgical means. *Int J Obes Relat Metab Disord* 2000; 24:573-9.
238. Deckelbaum RJ, Williams CL. Childhood obesity: the health issue. *Obes Res* 2001; 9 Suppl 4:239S-243S.
239. Gidding SS, Leibel RL, Daniels S, et al. Understanding obesity in youth. A statement for healthcare professionals from the Committee on Atherosclerosis and Hypertension in the Young of the Council on Cardiovascular Disease in the Young and the Nutrition Committee, American Heart Association. Writing Group. *Circulation* 1996; 94:3383-7.

240. Committee on Nutrition, American Academy of Pediatrics: Obesity in children. In: *Pediatric Nutrition*. Oak Grove, IL: American Academy of Pediatrics, 1998.
241. Yanovski JA. Intensive therapies for pediatric obesity. *Pediatr Clin North Am* 2001; 48:1041-53.
242. Bailey RC, Olson J, Pepper SL, et al. The level and tempo of children's physical activities: an observational study. *Med Sci Sports Exerc* 1995; 27:1033-41.
243. Sothorn MS, Loftin JM, Udall JN, et al. Inclusion of resistance exercise in a multidisciplinary outpatient treatment program for preadolescent obese children. *South Med J* 1999; 92:585-92.
244. Sothorn MS, Hunter S, Suskind RM, et al. Motivating the obese child to move: the role of structured exercise in pediatric weight management. *South Med J* 1999; 92:577-84.
245. Epstein LH, Valoski AM, Vara LS, et al. Effects of decreasing sedentary behavior and increasing activity on weight change in obese children. *Health Psychol* 1995; 14:109-15.
246. Faith MS, Berman N, Heo M, et al. Effects of contingent television on physical activity and television viewing in obese children. *Pediatrics* 2001; 107:1043-8.
247. Epstein LH, Roemmich JN, Raynor HA. Behavioral therapy in the treatment of pediatric obesity. *Pediatr Clin North Am* 2001; 48:981-93.
248. Moran R. Evaluation and treatment of childhood obesity. *Am Fam Physician* 1999; 59:861-8, 871-3.
249. Epstein LH, Valoski A, Wing RR, et al. Ten-year follow-up of behavioral, family-based treatment for obese children. *JAMA* 1990; 264:2519-23.
250. Epstein LH. Family-based behavioural intervention for obese children. *Int J Obes Relat Metab Disord* 1996; 20 Suppl 1:S14-21.

251. Brolin RE, Kenler HA, Gorman RC, et al. The dilemma of outcome assessment after operations for morbid obesity. *Surgery* 1989; 105:337-46.
252. Heber D. The Trigger Food Strategy. In: James L, ed. *The Resolution Diet*. New York: Avery Publishing Group, 1999:37-58.
253. *Singapore Food Facts*. Food and Nutrition Department, Ministry of Health, Singapore. 1999

## Annex A Nutritional information for selected foods

### High-calorie trigger foods

Some authors suggest identifying and minimizing “trigger foods”<sup>252</sup> which are high in refined sugar or processed fat. Individuals often have difficulty gauging the amounts of these products that they have consumed as they are tasty. This tends to undermine portion control and prevent weight loss. Examples of trigger foods include:

- *Nuts*, including peanuts, macadamia nuts, sunflower seeds, peanut butter
- *Crisps, chips, fries and crackers*, including potato & flour
- *Biscuits and cookies*
- *Cakes, pastries and muffins*, especially if made with vegetable oil, butter or other fat.
- *Ice cream and flavoured yogurt*, including non-fat frozen yogurt and sweetened yogurt desserts
- *Cheese and cheese pizza*, including non-fat cheese
- *Salad dressings*, including non-fat salad dressing
- *Mayonnaise, margarine, and butter*, including fat-free spreads

### Caloric and fat content for selected foods

The information in the following tables has been derived from a publication of the Food and Nutrition Department, Ministry of Health, Singapore.<sup>253</sup> The examples were chosen on the basis of being more popular food choices available at hawker centres or restaurants. A lower fat content suggests that the rest of the calories are made up by higher carbohydrate and/or protein content. Reducing portion sizes would lower total caloric content. Choosing appropriate food would facilitate a measure of control of fat content.

**Table A-1 Caloric and fat content for selected local food items**

<b>Selected Local Food Items</b>	<b>Weight per portion (g) / Portion size</b>	<b>Total Calories (kcal)</b>	<b>Fat grams (g)</b>	<b>% Calories from fat</b>
Rice, chicken	390	618	23.3	33.9
Rice, char siew	370	602	15.9	23.8
Rice, duck	420	706	30.0	38.2
Rice, fried, Chinese	420	511	20.2	35.6
Rice, claypot	595	896	36.9	37.0
Rice, pineapple, Thai	438	815	26.7	29.5
Noodles, beef, dry	390	394	4.3	9.8
Noodles, pork ribs, dry	591	696	25.8	33.4
Noodles, mushroom and minced pork, dry	311	511	22.7	39.9
Noodles, chicken mushroom, dry	397	439	14.6	29.9
Noodles, chicken curry	532	756	48.6	57.9
Noodles, duck, dry	327	498	15.0	27.1
Noodles, duck, soup	539	506	18.8	33.4
Noodles, wonton, dry	330	407	11.9	26.3
Noodles, shrimp dumplings, dry	365	503	23.0	41.1
Noodles, fish ball, dry	325	368	8.1	19.8
Noodles, prawn, soup	575	294	2.3	7.0
Noodles, prawn, fried, Hokkien	375	617	30.0	43.8
Noodles, seafood, claypot	555	680	43.3	57.3
Noodles, fried Hong Kong	408	693	37.1	48.2
Ban Mian, soup	528	476	21.8	41.2
Lor Mee	540	381	11.3	26.7
Ee Mee, seafood, fried	685	1010	60.6	54.0
Sheng mian	470	536	25.0	42.0
Hor fun	660	708	21.1	26.8
Hor fun, beef	405	585	22.1	34.0
Char kway teow	385	742	38.5	46.7
Beehoon, with mixed seafood, pork and chye sim, in gravy, fried	571	645	19.0	26.5
Beehoon satay	455	766	37.8	44.4
Beehoon, vegetarian, fried	365	550	16.8	27.5

<b>Selected Local Food Items</b>	<b>Weight per portion (g) / Portion size</b>	<b>Total Calories (kcal)</b>	<b>Fat grams (g)</b>	<b>% Calories from fat</b>
Laksa lemak	540	587	31.9	48.9
Kway Chap	610	646	26.2	36.5
Carrot cake, with egg, fried	290	466	24.4	47.1
Omelette, oyster	253	645	49.3	68.8
Egg fuyong	256	661	57.6	78.4
You tiao	50	192	8.6	40.3
You tiao, with cuttlefish filling	185	560	35.0	56.3
Poh piah	106	142	8.4	53.2
Ngoh Hiang, mixed items	355	805	44.4	49.6
Yong Tau Foo, mixed items (without noodles)	175	165	8.4	45.8
Tofu, hotplate	416	780	71.3	82.3
Tofu, hong siew	411	563	46.0	73.5
Chicken kung po	165	363	25.7	63.7
Chicken claypot	412	379	22.6	53.7
Peking duck, with pancake	393	1871	120.7	58.1
Pork chop, fried	193	387	14.8	34.4
Preserved vegetable, with pork, steamed	195 g / 1 rice bowl	385	39.2	91.6
Pork, sweet and sour	295	587	33.6	51.5
Spare ribs, barbequed	241	634	50.7	72.0
Bah kut teh (without rice)	485	342	24.8	65.3
Pig's trotter, with mushroom, braised	284	364	24.1	59.6
Satay, pork with peanut sauce	200	445	26.0	52.6
Luncheon meat, with egg, fried	137	405	35.9	79.8
Crab, butter	288 g / 1 crab	388	28.4	65.9
Crab, chilli	535 g / 1 crab	378	22.7	54.1
Prawn fritter, deep fried	145	393	26.0	59.5
Udon, tempura	616	574	28.7	45.0
Sushi, California roll	35 g / 1 piece	48	1.2	22.5
Mee chiang kuih, peanut filling	85	186	3.7	17.9
Bubor Cha Cha	565	390	9.6	22.1
Chendol	715	593	25.0	37.9

<b>Selected Local Food Items</b>	<b>Weight per portion (g) / Portion size</b>	<b>Total Calories (kcal)</b>	<b>Fat grams (g)</b>	<b>% Calories from fat</b>
Satay chicken, no peanut gravy	10 sticks	240	5.0	18.8
Mee rebus	515	555	19.1	31.0
Mee siam	490	520	14.7	25.4
Mee soto	540	434	13.0	27.0
Lontong	417	390	21.3	49.2
Nasi lemak	195	279	12.6	40.6
Tahu, telur	317	810	65.5	72.8
Gado gado	450	702	42.8	54.9
Curry puff, mutton	120	366	19.0	46.7
Roti Prata, plain	41	122	3.8	28.0
Murtabak, chicken	455	697	29.1	37.6
Chapati, plain	46	144	5.0	31.3
Thosai, plain	91	196	4.1	18.8
Naan	131	356	9.5	24.0
Indian rojak, flour dough, deep fried	1 piece	135	4.5	30.0
Nasi briyani with chicken	490	880	34.9	35.7
Egg noodles, fried, Indian	419	719	31.3	39.2
Beef serunding	220	711	60.9	77.1
Murtabak, mutton	410	418	33.6	72.3
Curry chicken	330	450	30.9	61.8
Curry fish head	414	385	25.4	59.4
Muruku	120 g / 1 pack	600	36.2	54.3
Cheese burger	1 burger	330	14.0	38.2
French fries, large pack	1 pack	540	26.0	43.0
Fish and chips	268	848	47.3	50.2
Foie Gras, pate, canned	13 g / 1 tablespoon	60	6.0	90.0

**Table A-2 Caloric and fat content for meat**

Meat	Calories	Fat (grams)	% Calories from fat
<b>High-Fat meats (6 oz)</b>			
Dark-meat chicken (without skin)	388	16	37.1
Veal, average cut	397	19	43.1
Dark-meat chicken (with skin)	430	26	54.4
Pork Chop	380	26	61.6
Sirloin steak, broiled	458	29	57.0
Ground beef, broiled	462	32	62.3
Pork loin, braised	532	35	59.2
Duck, roasted with skin	573	48	75.4
<b>Low-Fat meats (6 oz)</b>			
Turkey breast	269	5	16.7
Chicken breast (without skin)	276	7	22.8

**Table A-3 Caloric and fat content for fish**

Fish	Calories	Fat (grams)	% Calories from fat
<b>High-Fat Fish (8 oz)</b>			
Salmon, farmed, broiled	420	21	45.0
Fish, fried	462	21	40.9
Fish fillet, sandwich, Fast food	560	28	45.0
Catfish, breaded, fried	517	31	54.0
Shrimp, fried	594	30	45.5
Tuna salad sandwich with mayo	720	43	53.8
Fried seafood combo	554	28	45.5
<b>Low-Fat Fish (8 oz.)</b>			
Fin fish, broiled (Cod, Haddock, halibut, flounder)	280	7	22.5
Scallops, broiled or grilled (6 oz.)	200	4	18.0
Shrimp, cocktail	300	3	9.0
Lobster, steamed	222	1.4	5.7
Crab, steamed	231	4	15.6
Tuna, canned in water	309	5	14.6

**Table A-4 Caloric and fat content for snacks**

Snacks	Calories	Fat (grams)	% Calories from fat
<b>High-fat cookies and pastries</b>			
Oatmeal raisin cookies (4)	235	8	30.6
Butter cookies (10 small)	229	9	35.4
Danish (1 small)	161	9	50.3
Peanut butter cookies (4)	200	10	45.0
Chocolate chip cookie, large	190	11	52.1
Oreo cookies (6)	300	12	36.0
Doughnut, glazed old-fashioned	310	18	52.3
Cream puff, with custard filling	303	18	53.5
Croissant, almond	377	23.9	57.1
<b>Low-fat cookies and pastries</b>			
Animal crackers (5)	56	1	16.1
Graham crackers (6)	180	3	15.0

## Annex B Caloric expenditure in physical activity

**Table B-1 Approximate caloric expenditure in 30 minutes for a given body weight in kcal<sup>147</sup>**

Gym activities	Body weight (kg)					
	50	60	70	80	90	100
Aerobics: moderate	149	177	206	234	263	291
Bicycling: 16 km/h	163	195	226	258	289	321
Bicycling: 21 km/h	238	283	329	375	421	466
Calisthenics	119	143	166	190	214	238
Circuit training: average	211	253	296	338	380	422
Rowing: light	149	177	206	234	263	291
Rowing: moderate	230	275	319	363	407	452
Running: 8 km/h	195	232	270	307	345	382
Running: 10 km/h	260	310	360	410	460	510
Running: 12 km/h	319	381	442	504	565	627
Stair machine: average	158	190	222	253	285	317
Stretching, Hatha yoga	106	127	148	169	190	211
Walking: normal 4 km/h	78	93	108	123	138	153
Walking: brisk 6 km/h	111	132	154	174	196	217
Walking: brisk 7 km/h	149	177	206	234	263	291
Weight lifting: average	79	95	111	127	143	158
<b>Sports activities</b>						
Badminton	119	143	166	190	214	238
Basketball game	211	253	296	338	380	422
Bicycling: mountain	224	269	314	359	404	449
Billiards	66	79	92	106	119	132
Bowling	79	95	111	127	143	158
Dancing	145	174	203	232	261	290
Golf	78	93	108	123	138	153
Martial arts, kickboxing	264	317	370	422	475	528
Rollerblading	185	222	259	296	333	370
Rope jumping	264	317	370	422	475	528
Running: cross-country	238	285	333	380	428	475
Soccer	185	222	259	296	333	370
Swimming 25 m/min	123	146	170	193	217	240
Swimming 40 m/min	178	213	247	281	315	350

<b>Sports activities (cont'd)</b>	<b>Body weight (kg)</b>					
	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>	<b>100</b>
Tai chi	106	127	148	169	190	211
Tennis	185	222	259	296	333	370
Volleyball	79	95	111	127	143	158
<b>Home &amp; daily activities</b>						
Child care: walk/run	100	120	140	160	180	200
Child care: standing	70	84	98	112	126	140
Cooking	66	79	92	106	119	132
Heavy cleaning	119	143	166	190	214	238
Heavy moving	185	222	259	296	333	370
Mopping or vacuuming	88	105	123	140	158	175
Sitting: reading, TV	25	30	35	40	45	50
Sleeping	17	20	23	26	30	33
Standing	33	40	46	53	59	66
Walking : normal	75	90	105	120	135	150
<b>Occupational activities</b>						
Building roads	150	180	210	240	270	300
Carrying loads e.g. bricks	200	240	280	320	360	400
Driving taxi	50	60	70	80	90	100
Fieldwork (walking)	75	90	105	120	135	150
Heavy machine operator	66	79	92	106	119	132
Light office work	38	45	53	60	68	75
Student attending class	38	45	53	60	68	75

## Annex C Rating of Perceived Exertion

**Table C-1 Rating of Perceived Exertion (RPE) Scales during exercise**

HR*	Borg scale		10-point category-ratio (CR-10) scale		Talk Test (while exercising)
60	6	No exertion at all	0	Nothing at all	
70	7	Extremely light	0.5	Very, very weak	
90	9	Very light	1	Very weak	
110	11	Light	2	Weak	Can sing
120	12		3	Moderate	
130	13	Somewhat hard	4	Somewhat strong	Effortless talk
150	15	Hard	5	Strong	Talk relatively easy
160	16		6		Slightly breathless
170	17	Very hard	7	Very strong	Not keen to talk
180	18		8		Difficulty talking
190	19	Extremely hard	9	Very, very strong	Monosyllables
200	20	Maximal exertion	10	Maximal exertion	

\*HR approximate heart rate during activity. The actual heart rate can vary significantly depending on age and physical condition

**Table C-2 Relative intensity of exercise, comparing  $VO_{2max}$ , heart rate and RPE**

Intensity	Relative intensity				General comments during exercise
	$VO_{2max}$ (%)	%HR <sub>max</sub> *	Borg	CR-10	
Very light	<20	<35	<10	≤1	Normal walking pace
Light	20-39	35-54	10-11	2	
Moderate	40-59	55-69	12-13	3-4	Can go on comfortably
Hard	60-84	70-89	14-16	5-6	
Very hard	>85	>90	17-19	7-9	Tired, must push hard
Maximal	100	100	20	10	Most strenuous ever

\* %HR<sub>max</sub> percent of maximal heart rate. Maximal heart rate = 220 – age

## Self-assessment (MCQs)

After reading the Clinical Practice Guidelines, you can claim one CME point under Category III (Self-Study) of the SMC Online CME System. Before you login to claim the CME point, we encourage you to evaluate whether you have mastered the key points in the Guidelines by completing this set of MCQs. This is an extension of the learning process and is not intended to “judge” your knowledge and is not compulsory. The answers can be found at the end of the questionnaire.

*Instruction: Choose the right answer(s). There may be more than one answer for some questions.*

1. Overview of obesity:
  - A. Obesity is a condition of excessive fat accumulation to the extent that health is adversely affected.
  - B. Secondary causes of obesity account for <5% of all cases in most series
  - C. Low glycemic index foods increase the risk of obesity
  - D. Co-morbidities of obesity include polycystic ovarian disease and obstructive sleep apnea
  - E. Childhood obesity is associated with an increased likelihood of obesity and obesity-related disorders in later life.
  
2. In the clinical evaluation of obese individuals:
  - A. BMI is highly correlated with body fat percentage.
  - B. BMI definitions are not valid in children, muscular individuals, and pregnant or lactating women
  - C. The most practical way of assessing abdominal obesity is by waist circumference measurements.
  - D. Waist circumference is measured at the level of the umbilicus.
  - E. Skinfold measurements and bioimpedance analysis are highly reliable and reproducible measures of body fat.

3. Trials on the management of obesity show that:
  - A. Although most adults attempted weight loss, most were not using the recommended combination of reducing caloric intake and increasing physical activity.
  - B. Those attempting weight loss engaged in weight loss activities for adequately long periods.
  - C. In obese patients' perceptions, weight loss of 16% was considered disappointing, and 38% was ideal.
  - D. The most important factors influencing target weights were improvement in medical conditions or physician-recommended weight, rather than appearance and physical comfort.
  - E. Sustained weight loss in the order of 5-10% has been associated with positive benefits on obesity co-morbidities, and would be a more realistic and attainable target.
  
4. In the dietary management of obesity:
  - A. A 500-1000 kcal/day reduction in caloric intake leads to a 0.5-1 kg per week weight loss.
  - B. Most expert panels of major professional bodies recommend a diet which is moderately restricted in total fat, moderate to high in complex carbohydrate and moderate in protein content.
  - C. Low carbohydrate and low fat diets are ineffective in short-term weight loss.
  - D. The long-term metabolic effects and nutritional adequacy of low carbohydrate or low fat diets remains to be determined.
  - E. Food products which are labelled 'low fat' or 'low cholesterol' are always low in caloric content and are more nutritious.
  
5. With regards to exercise in weight management:
  - A. Exercises that do not result in weight loss are not beneficial in improving cardiovascular risk factors such as hypertension and diabetes.
  - B. The exercise duration that has been estimated to be required for weight loss is 200-300 min per week.
  - C. Exercise without caloric intake restriction is effective in weight management.
  - D. The aerobic exercise intensity usually required to achieve weight loss is 55-69% of maximal heart rate.

- E. Non-weight bearing, non impact exercises that are appropriate for overweight individuals with lower limb joint pain but seeking to lose weight include cycling, rowing, swimming, aqua-aerobics, and arm-cranking.
6. Obese patients going for weight loss treatment should be assessed for the presence of which psychiatric co-morbidity?
- A. anorexia nervosa
  - B. anxiety
  - C. binge eating disorder
  - D. extreme shyness
  - E. schizophrenia
7. Which of these strategies is NOT part of Behaviour Therapy?
- A. cognitive restructuring
  - B. punishment
  - C. relapse prevention
  - D. self-monitoring
  - E. support group meetings
8. In the treatment of obesity:
- A. Pharmacotherapy is the first-line strategy in the long-term management of obesity.
  - B. Drug therapy should be initiated in uncomplicated overweight patients with BMIs of less than 27 kg/m<sup>2</sup>.
  - C. Most anti-obesity drugs are effective and do not require lifestyle modification for long-term weight reduction.
  - D. The degree of weight loss at one year with very low calorie diets (VLCDs) either alone or with behavioural therapy is similar to that achieved with low calorie diets (LCDs).
  - E. Partial meal replacement using low calorie preparations has been shown to be effective at maintaining weight loss
  - F. VLCDs are contraindicated in obese patients with diabetes.

9. With regards to anti-obesity drugs:
- A. Only sibutramine and orlistat have been studied in longer-term anti-obesity trials lasting up to 2 years.
  - B. Sibutramine is effective in reducing weight, but causes dry mouth and headache, and must be used with caution in patients with poorly controlled hypertension.
  - C. Orlistat results in modest weight loss, and causes mostly adverse gastrointestinal side-effects.
  - D. There is good safety data for the long-term, continuous use of phentermine and mazindol.
  - E. Antidepressants such as fluoxetine and sertraline are effective in long-term weight reduction.
  - F. There is good evidence that combinations of anti-obesity agents such as sibutramine with phentermine are effective and safe for the treatment of obesity.
10. Among over-the-counter (OTC) weight loss preparations and non-traditional therapies:
- A. Ephedrine/caffeine containing compounds are effective in weight loss, but have been associated with adverse psychiatric, autonomic, gastrointestinal and cardiac effects, e.g. tachycardia, hypertension, insomnia and jitteriness, and death.
  - B. There is good evidence that thyroid hormone augmentation results in sustained weight loss.
  - C. Chitosan, by binding fat in the intestine thus preventing its absorption, is effective for weight loss.
  - D. Many OTC drugs contain herbal laxatives (e.g. sennosides) and diuretics (e.g. *Fucus vesiculosus*) that induce temporary weight loss via loss of body fluids.
  - E. Acupuncture is an effective and proven method for achieving weight loss.

11. Bariatric surgery
  - A. The most effective method to reduce weight and maintain weight loss in the severely or morbidly obese is bariatric surgery, resulting in average weight loss of around 25%.
  - B. In experienced hands, laparoscopic adjustable gastric banding has lower mortality and morbidity than open approaches.
  - C. Bariatric surgery should be considered as an alternative in obese individuals who lack the motivation to start and maintain diet and exercise to control weight.
  - D. Only minor adjustments in dietary intake are needed after bariatric surgery.
  - E. Previous bariatric surgery is a contraindication to pregnancy.
  
12. Regarding childhood and adolescent obesity,
  - A. protein sparing modified fast regimens are recommended.
  - B. behaviour modification programmes have shown success in weight loss.
  - C. orlistat is recommended in the severely obese adolescent.
  - D. gastric bypass surgery is the treatment of choice for the severely obese adolescent.

## **Answers**

1. A, B, D, E
2. A, B, C
3. A, C, E
4. A, B, D
5. B, D, E
6. C
7. B
8. D, E
9. A, B, C
10. A, D
11. A, B
12. B

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The members of the workgroup, who were appointed in their personal professional capacity, are:

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# MOH CLINICAL PRACTICE GUIDELINES 5/2004

## Obesity



Ministry  
of Health



Singapore Association  
for the Study of Obesity

### 1 Definition

Obesity is defined as a condition of excessive fat accumulation in the body to the extent that health and well-being are adversely affected.

*World Health Organization 2000*

### 2 Diagnosis

#### A Measures of Obesity

##### i) Anthropometric

1. Body weight
2. Body mass index (BMI)  
Calculated as  $BMI (kg/m^2) = \text{Weight in kg} \div [\text{Height in m}]^2$   
Correlated to amount of body fat and is the clinical technique of choice for *defining obesity*. Not applicable for children, the elderly, pregnant or lactating women, and muscular individuals.
3. Waist circumference  
Correlated to intraabdominal fat mass and is the clinical technique of choice for determining *central obesity*. Measured at the mid-point between the lower margin of the ribs and the iliac crest in an upright individual with the abdomen relaxed, with arms at the sides and feet 12-15 cm apart. The tape should be horizontal and not compressing the skin and the measurement should be repeated until within 0.5 cm.
4. Waist to hip ratio

##### ii) Body fat estimation

1. Skinfold thickness
2. Bioelectrical impedance
3. Imaging: DXA, CT, MRI
4. Isotopic dilution techniques (e.g. deuterium oxide)
5. Densitometry (using underwater weighing or air plethysmography)
6. 4-compartment estimation (using a combination of methods)

##### iii) Disease end-points

1. Propensity to disease or risk factors e.g. coronary heart disease, diabetes mellitus and hypertension.

## B Classifications in Obesity

- i) The WHO classification of adults according to BMI, and the proposed BMI cut-off points for public health action in Asians.

WHO classification	WHO BMI cut-off points for definition (kg/m <sup>2</sup> )	Cardio-vascular disease risk	Proposed Asian BMI cut-off points for action* (kg/m <sup>2</sup> )
Underweight	<18.5		<18.5
Normal range	18.5 to 24.9	Low	18.5 to 22.9
Overweight	≥25.0		
Pre-Obese	25.0 to 29.9	Moderate	23.0 to 27.4
Obese class I	30.0 to 34.9	High	27.5 to 32.4
Obese class II	35.0 to 39.9	Very high	32.5 to 37.4
Obese class III	≥40.0		≥37.5

- Although the cut-points for action based on the risk of co-morbid diseases are lower among Asians, retention of the international WHO classification to define weight category in Asians has been recommended.

- ii) Waist circumference: high-risk, gender-specific thresholds.

Guideline	Waist circumference (cm)	
	Men	Women
WHO	≥ 102	≥ 88
Asia-Pacific Consensus	≥ 90	≥ 80

## 3 Evaluation

### A Clinical considerations

- Exclude secondary causes of obesity, such as medications, e.g. steroids (including traditional medicine), antidiabetic, antipsychotic, antidepressant drugs; endocrine disorders, e.g. hypothyroidism; genetic disorders.
- Evaluate co-morbid conditions: cardiovascular disease, hypertension, diabetes mellitus, hyperlipidemia, polycystic ovarian disease, osteoarthritis, cancers, sleep apnea.

### B Laboratory Investigations

- Fasting lipids
- Fasting blood glucose
- Thyroid function tests: free T<sub>4</sub>, TSH
- For Cushing's syndrome (endogenous or exogenous), if clinically suspected
- Electrocardiogram
- Chest radiograph

## 4 Management

### 1. Approach:

- Motivation level to lose weight should be evaluated and enhanced.
- Set realistic goals, e.g. 10% body weight reduction over 6 months, sustained long-term with minimal weight regain.
- A multi-faceted or multi-disciplinary strategy is recommended.

### 2. Dietary therapy:

- Caloric reduction by 500-1000 kcal or intake of 1400-1500 kcal daily.
- Diets with differing macronutrient content, e.g. low, moderate or high fat, have all been shown to reduce weight in the short-term. The balanced, nutrient reduction diet seems most effective in longer-term weight maintenance.
- Low- or very low-calorie diets (LCD or VLCD) in a meal replacement strategy could be used.

### 3. Physical activity:

- Moderate intensity, aerobic or endurance exercise on most, if not all, days in a week:
  - 30 min/day for cardiovascular fitness
  - 45-60 min/day to prevent unhealthy weight gain
  - 60-90 min/day to prevent weight regain

### 4. Behavioural aspects:

- Address psychological issues, e.g. socio-cultural beliefs, stress, denial.
- Basic behaviour modification to enhance motivation and compliance.

### 5. Medical therapy:

- Consider drug therapy when BMI  $\geq 30$  ( $\geq 27.5^*$ ) kg/m<sup>2</sup>, or  $\geq 27$  ( $\geq 25^*$ ) kg/m<sup>2</sup> with obesity co-morbidities, in combination with diet, physical activity and behaviour modification.
- Drugs (based on efficacy and safety):
  - Orlistat (up to 4 years) and sibutramine (up to 2 years)
  - Others for short term use: phentermine and mazindol (6-12 mths)
  - Little data on the effectiveness of combining anti-obesity drugs
  - Obese diabetics: metformin

### 6. Bariatric surgery:

- Consider surgery when BMI  $\geq 40$  ( $\geq 37.5^*$ ) kg/m<sup>2</sup>, or  $\geq 35$  ( $\geq 32.5^*$ ) kg/m<sup>2</sup> with obesity co-morbidities and complications, and after failure of significant non-surgical attempts at weight reduction.
- Extensive pre-, peri- and post-operative intervention is required.

\* Proposed commensurate Asian BMI cut-points for action, currently under review.

## 5 Response

### Weight loss:

- 5-10% : Successful
- 10-20% : Very successful
- >20% : Exceptional

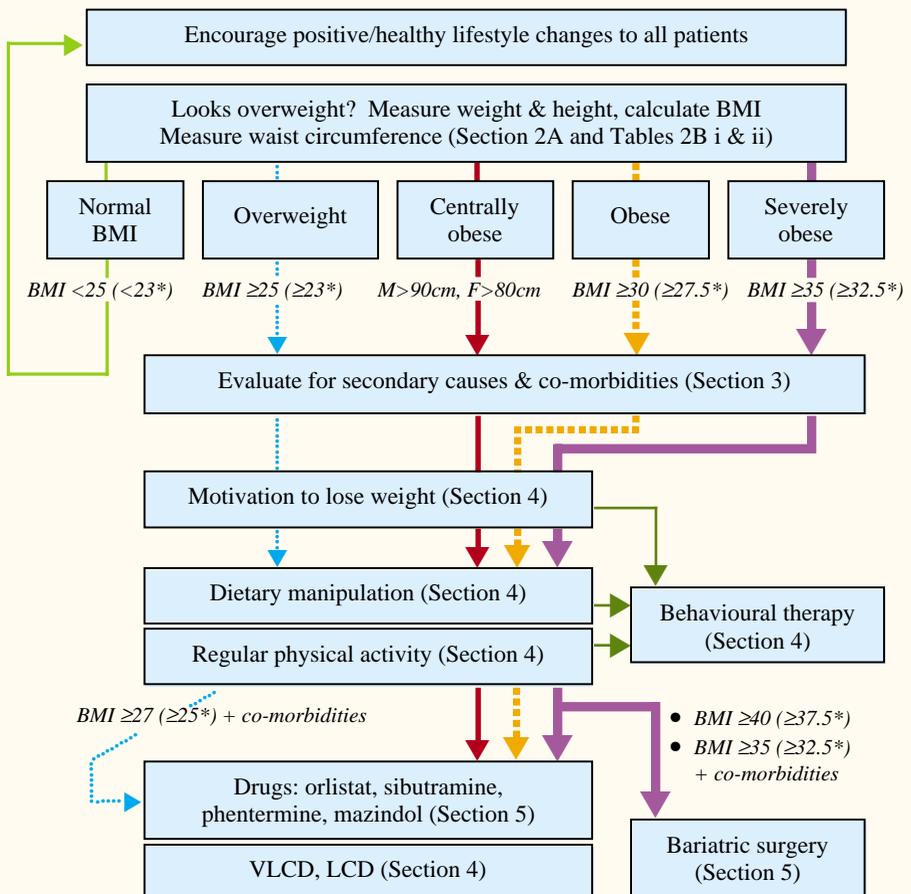
### Risk factor reduction:

- BP <130/80 mmHg
- LDL cholesterol <3.4 mmol/L
- Blood glucose <5.5 mmol/L (fasting) and <7.8 mmol/L (random)

### Weight maintenance:

- Regain <3 kg in 2 years

## 6 Algorithm for Management of Obesity



\* Proposed commensurate Asian BMI cut-points for action (in  $\text{kg}/\text{m}^2$ ), currently under review.