

## World Gastroenterology Organisation Global Guideline



# Obesity

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# 1 Obesity: the concept

## Introduction and summary

- Obesity has become more prevalent throughout the world in all age groups.
- Obesity is a flag for (and often a precondition for) various important chronic diseases.
- Avoiding obesity may help a person to avoid various chronic diseases; preventing obesity is a better option than trying to control it. As a society, we need to focus on how to prevent obesity in children and adults.
- Obesity needs to be treated in order to prevent comorbid conditions from developing and to manage them better if present.
- The social and psychological aspects of obesity cannot be ignored, especially in connection with preventing childhood obesity. These are important issues for most obese adults as well (with a need to prevent discrimination, stigmatization, ridicule, and loss of willpower).
- Research relating to epidemiology, physiological mechanisms for controlling body weight, the pathophysiology of obesity, and treatment can lead to advances in the management of obesity throughout the world.

## Areas of uncertainty and key management points

### *Areas of uncertainty*

Obesity is a major health issue in both developing and developed countries. It is often associated with significant comorbidities. Obesity has a major impact on a country's health budget and has adverse effects on life expectancy.

While weight loss (i.e., resolving obesity) is an important end point, more immediate goals may be more appropriate in the individual patient—e.g., resolving major comorbidities such as insulin resistance, reducing the number of spells of sleep apnea per night, lowering diastolic blood pressure, and improving joint mobility. In the majority of cases, significant weight loss is associated with alleviation or better control of comorbid conditions.

What are the longer-term outcomes of lifestyle changes, diet, surgery, and combinations of these? How should cultural factors be dealt with?

When can a treatment be considered to have failed and when (at what body mass index value) can different treatment options be started? Should surgery be considered for those with a body mass index (BMI) between 30 and 35? Most guidelines suggest that surgery is not indicated in patients with a BMI < 35.

The role of pharmacotherapy and bariatric surgery in childhood obesity needs to be further evaluated, as there are no data yet on potential long-term adverse effects. Further randomized and controlled trials are also needed for the various treatment options currently available.

### Key management points

- The first treatment step is the basis for every subsequent step and consists of a diet, a less sedentary lifestyle, exercise, and behavioral modification. If weight loss of 5–10% is not achieved within 6 months, the next step is the same basic treatment combined with medication. The last step is again a diet, a less sedentary lifestyle, exercise and behavioral modification, but now combined with bariatric surgery.
- Obesity requires long-term care, and it is important that management should be provided in a multidisciplinary environment with support from physicians, medical specialists (internists), dietitians, and surgeons.
- Providing education and information for children may be the best and least costly way of controlling obesity in the longer term.

### Definitions

- Body mass index (BMI): weight (in kilograms) divided by the square of the individual's height (in meters).
- The International Obesity Task Force (IOTF) definition of obesity (based on Caucasians with a “western” lifestyle) sets cut-off points of 25 kg/m<sup>2</sup> for adult excess weight and 30 kg/m<sup>2</sup> for obesity. These BMI cut-off points are considered to have a more international basis than other definitions.
- The BMI index ranges for children and teenagers should take the normal differences in body fat between boys and girls and differences in body fat at various ages into account:
  - *U.S. Centers for Disease Control and Prevention (CDC) definition:*
    - BMI ≥ 95th percentile for age = “overweight”
    - BMI between the 85th and 95th percentiles = “at risk of overweight”
  - *European Childhood Obesity Group classification:*
    - BMI ≥ 85th percentile for age = “overweight”
    - BMI ≥ 95th percentile for age = “obesity”

## 2 The global picture

### Epidemiology (Table 1, Fig. 1)

Table 1 Global epidemiology, 2005–2015

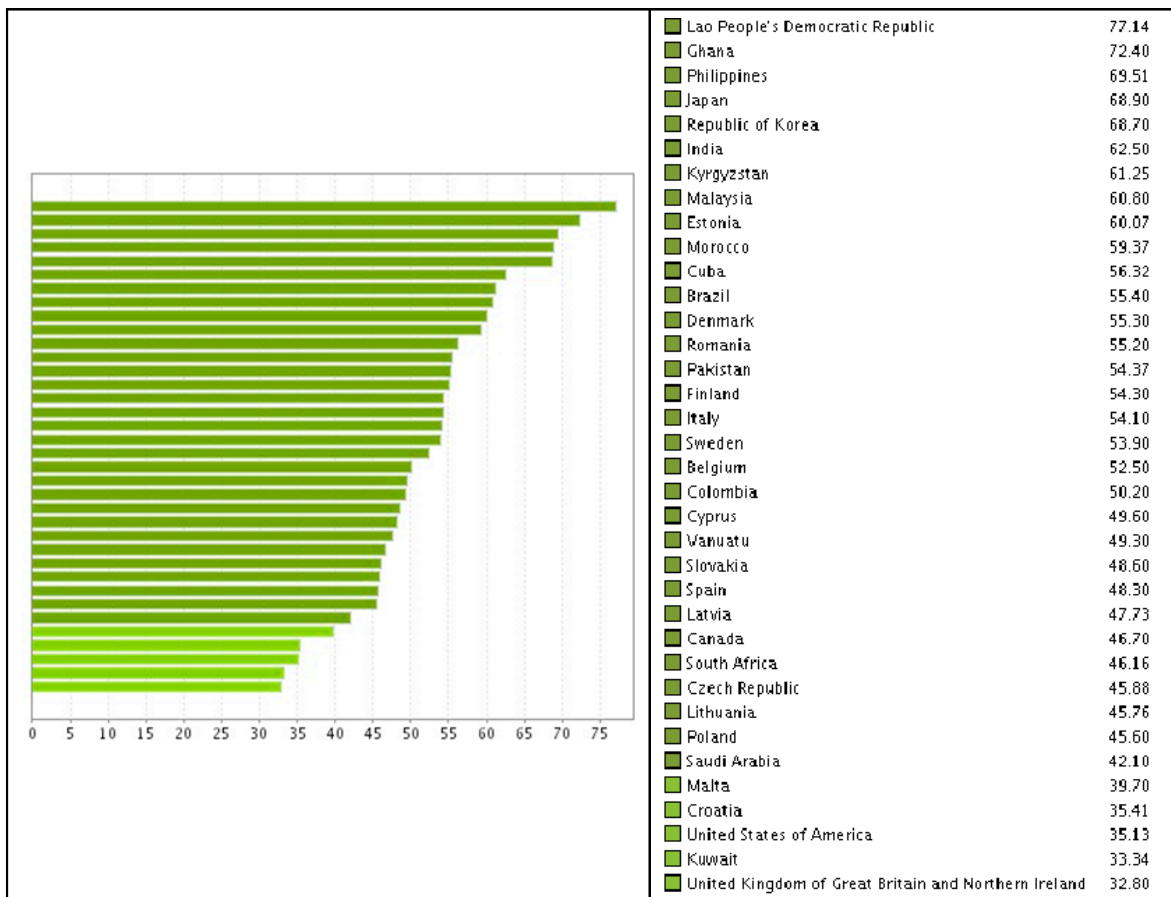
2015	The World Health Organization (WHO) projects that by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese
2008	A report in the <i>Journal of the American Medical Association (JAMA)</i> shows that overall, in 2003–2006: <ul style="list-style-type: none"> <li>• 11.3% of children and adolescents aged 2–19 years were at or above the 97th percentile of the 2000 BMI-for-age growth charts (extreme obesity)</li> <li>• 16.3% were at or above the 95th percentile (obese)</li> </ul>

- 31.9% were at or above the 85th percentile (overweight)
- Prevalence estimates varied by age and by ethnic group
- Analyses of the trends in high BMI for age showed no statistically significant trend over four periods studied (1999–2000, 2001–2002, 2003–2004, and 2005–2006), for either boys or girls

Today, the mean BMI has increased and the most obese individuals have become much more obese, so that the curve of the normal distribution has shifted to the right

- 2005
- WHO data show that in 2005, approximately 1.6 billion adults (aged 15 or over) were overweight and that at least 400 million adults were obese
  - At least 20 million children under the age of 5 years were overweight globally in 2005
  - Obesity has become an epidemic condition
  - In the United States, obesity among adults increased from 15.3% in 1995 to 23.9% in 2005

Fig. 1 Body mass index (BMI) data by country: percentages of adults with a normal BMI



## A problem in developing countries?

Once considered a problem only in high-income countries, excess weight and obesity are now dramatically increasing in low- and middle-income countries as well, particularly in urban settings, according to the World Health Organization (WHO).

In developing countries, the prevalence of chronic or noncommunicable diseases (such as hypertension, diabetes, and cardiovascular disease) is rising much more rapidly than in the industrialized world. Although the problem of childhood malnutrition is far from having been solved, the new pandemic of obesity and its accompanying noncommunicable diseases are challenging organizations such as the WHO.

Although it is now well recognized that chronic diseases are a growing problem for low- and middle-income countries, limited data are available for these countries and the developing world has been largely ignored in health strategies.

In a recent systematic review, the highest prevalences of childhood excess weight were found in Eastern Europe and the Middle East, while India and Sri Lanka had the lowest prevalence. Studies in developing countries showed a considerable prevalence of metabolic syndrome in adolescents. Developing countries are facing an increasing incidence of childhood obesity and new cases of metabolic syndrome among children. In the near future, this is likely to create a huge socioeconomic and public health burden for poorer nations. The WHO has warned that projected numbers of new cases of diabetes may run into the hundreds of millions within the next two decades.

The globalization process may exacerbate the uneven dietary development between rich and poor: while high-income groups in developing countries enjoy the benefits of a more dynamic marketplace, lower-income groups may experience convergence towards poor-quality diets. Many developing countries are in a “nutrition transition” phase, evident in the rapid rise in obesity and diet-related chronic diseases throughout the world. Although developing countries are still struggling with malnutrition and micronutrient deficiencies, the consumption of foods high in fats and sugars in these countries is increasing. This transition is rooted in the globalization processes that are affecting the nature of agricultural and food systems and altering the quantity, type, cost, and desirability of foods available for consumption. The integration of the global marketplace is affecting specific diet patterns, especially in middle-income countries, as a result of:

- Greater consumption of vegetable oil, made possible by agricultural production and trade policies
- Greater consumption of highly processed foods, facilitated by policies on foreign direct investment and global food marketing

Some of the structural causes of obesity and diet-related chronic diseases throughout the world can be addressed through global food and health policies—especially in groups with low socioeconomic status.

According to the WHO, many low-income and middle-income countries are now facing a “double burden” of disease:

- While still dealing with infectious diseases and undernutrition, at the same time they are facing a rapid upsurge in chronic disease risk factors such as obesity and excess weight.

- Undernutrition and obesity can now be found existing side by side within the same country, the same community, and even within the same household.
- This double burden is caused by inadequate nutrition in the prenatal period and in infants and young children, followed by exposure to high-fat, energy-dense, micronutrient-poor foods and a lack of physical activity.

### 3 Obesity and disease risk

#### Metabolic syndrome (Tables 2, 3)

Obesity plays a central role in the metabolic syndrome. Especially in non-Caucasian populations, genetic predisposition or adverse events in early life may contribute to the insulin resistance and adverse body-fat patterning seen in the metabolic syndrome and its related complications.

- The metabolic syndrome is a common pathophysiologic condition with implications for the development of many chronic diseases.
- Its presence suggests increased risk for diabetes and heart disease.
- Its prevalence is rapidly increasing along with rising rates of childhood obesity and sedentary lifestyles throughout the world.
- It has a high prevalence in the adult population all over the world, and an ethnic predisposition in Asians has been suggested.
- It can be detected as early as in childhood and it is highly prevalent in pediatric populations in Western communities.

Table 2 Features of metabolic syndrome

• Hyperinsulinemia, insulin resistance, glucose intolerance
• Type 2 diabetes mellitus
• Hypertension
• Atherogenic lipoprotein phenotype
• Prothrombotic states
• Increased risk of atherosclerotic cardiovascular disease

Table 3 Biological functions and health consequences

Body fat deposition	→	Excess weight
↕		
Insulin sensitivity	→	Metabolic syndrome
↕		
Regulation of blood glucose levels	→	Diabetes

Source: Grundy et al., *Circulation* 2005;112:2735–52.

Table 4 lists the National Cholesterol Education Program (NCEP) criteria for metabolic syndrome, following on from the WHO criteria, dating back to 2002–2003. In 2005, the International Diabetes Federation (IDF) published new criteria. Table 5 presents the differences between the three existing definitions.

**Table 4** Clinical diagnosis of the metabolic syndrome: three or more of the following abnormalities

Component	Trait	Defining value
Abdominal obesity	Waist circumference	F: > 80 cm M: > 94 cm
Atherogenic dyslipidemia	Triglycerides	> 1.70 mmol/L
	HDL cholesterol	F: < 1.30 mmol/L M: < 1.04 mmol/L or drug treatment
Elevated BP	Ambulatory BP	Systolic $\geq$ 130 mmHg Diastolic $\geq$ 85 mmHg or drug treatment
Elevated FPG	FPG	$\geq$ 100 mg/dL or drug treatment

BP, blood pressure; F, female; FPG, fasting plasma glucose; HDL, high-density lipoprotein; M, male.

Source: Grundy et al., *Circulation* 2005;112:2735–52.

**Table 5** Definitions of metabolic syndrome

WHO 1998	NCEP 2002–2003	IDF 2005
Insulin resistance (hyperinsulinemic clamp, diabetes, IGTT)		Waist circumference ♀ $\geq$ 80 cm ♂ $\geq$ 94 cm
<i>Plus two or more of:</i>	<i>At least three of:</i>	<i>Plus two or more of:</i>
W/H ratio ♀ > 0.85 ♂ > 0.90 or BMI > 30	Waist circumference ♀ > 88 cm ♂ > 102 cm	
Triglycerides $\geq$ 1.7	Triglycerides $\geq$ 1.7	Triglycerides $\geq$ 1.7
Or HDL cholesterol ♂ < 0.9 ♀ < 1.0	HDL cholesterol ♂ $\leq$ 1.0 ♀ $\leq$ 1.3	HDL cholesterol ♂ $\leq$ 1.0 ♀ $\leq$ 1.3
	Fasting glucose > 6.1	Fasting glucose > 5.6
RR > 140/90	RR > 130/85	RR > 130/85
Or Rx for microalbuminuria	Or Rx	Or specific treatment

BMI, body mass index; HDL, high-density lipoprotein; IDF, International Diabetes Foundation; IGTT, intravenous glucose tolerance test; NCEP, National Cholesterol Education Program (Adult Treatment Panel III); RR, Riva–Rocci (blood pressure); Rx, drug prescription; W/H, waist/height; WHO, World Health Organization.

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## 4 Assessment of obese patients

It is generally agreed that control of portion size, consumption of a diet low in fat and energy density, and regular physical activity protect against obesity. As obesity is difficult to treat, public health efforts need to be directed toward prevention.

### Patient history

- Comprehensive nutritional history: patterns of food intake (including binge eating)
- Comprehensive weight history:
  - Weight gain and maximum body weight
  - Weight trends
- Family history:
  - Excess weight and obesity
  - Premature heart disease (myocardial infarction or sudden death of father or other male first-degree relative  $\leq 55$  years of age, or of the mother or other female first-degree relative  $\leq 65$  years)
- Physical activities
- Medication history:
  - Corticosteroids
  - Antipsychotic agents
  - Antidepressants
  - Oral contraceptives
  - Oral hypoglycemic agents
  - Other drugs associated with weight gain
- Cigarette smoking
- Coexisting conditions:
  - Sleep apnea: very loud snoring, cessation of breathing during sleep, often followed by a loud clearing breath and brief awakening
- Stress incontinence
- Patient's motivation and willingness to reduce weight
  - Previous weight loss efforts
  - Perceived obstacles to successful weight management

### Physical examination

Percentage of excess weight/obesity:

- Body weight and height
- Percentage of body fat



- Body mass index (Table 6):
  - Most practical way to evaluate the overall degree of excess weight
  - BMI  $\geq 30$  is associated with increased risks of death from all causes and from cardiovascular disease
  - Most patients with a BMI  $\geq 30$ , and many with a BMI of 25–30, have at least one coexisting condition
- Waist circumference:
  - Most practical measure of central adiposity – a good indicator of abdominal fat
  - Predicts the risk for developing heart disease and other diseases
  - Increased risk  $> 100$  cm ( $> 40$  inches) in men and  $> 87.5$  cm ( $> 35$  inches) in women
  - Measurement is not particularly useful in persons with a BMI  $> 40$
  - Waist circumference is an independent predictor of patient outcome
- Skinfold thickness

**Table 6** The international classification of adult underweight status, overweight status, and obesity relative to body mass index (BMI)

Classification	Principal BMI cut-off points (kg/m <sup>2</sup> )
Underweight	$< 18.50$
Severe thinness	$< 16.00$
Moderate thinness	16.00–16.99
Mild thinness	17.00–18.49
Normal range	18.50–24.99
Overweight	$\geq 25.00$
Pre-obese	25.00–29.99
Obese	$\geq 30.00$
Class I	30.00–34.99
Class II	35.00–39.99
Class III	$\geq 40.00$

### Assessment for accompanying conditions

- Diabetes:
  - Presence of acanthosis nigricans as a sign of insulin resistance
  - Impaired fasting glucose (IFG), between 5.55 mmol/L and 6.94 mmol/L. IFG is an independent risk factor for cardiovascular (macrovascular) disease and is a risk factor for type 2 diabetes
- Hypertension:
  - Systolic blood pressure of  $\geq 140$  mmHg or diastolic blood pressure

≥ 90 mmHg

— Current use of antihypertensive agents

- Coronary artery disease:
  - Baseline electrocardiogram
  - History of myocardial infarction
  - Angina pectoris
  - Coronary artery surgery
  - Coronary artery procedures (e.g., angioplasty)
- Presence of other atherosclerotic diseases:
  - Peripheral arterial disease
  - Abdominal aortic aneurysm
  - Symptomatic carotid artery disease
- Musculoskeletal disease: osteoarthritis
- Other obesity-associated diseases:
  - Cancer screening
  - Pulmonary hypertension
  - Gynecological abnormalities (e.g., menorrhagia, amenorrhea)
  - Gallstones

### Additional diagnostic tests

Baseline and diagnostic laboratory tests:

- Fasting blood glucose
- Uric acid
- Electrolytes
- Liver function tests
- Complete blood counts
- Blood lipids:
  - Total cholesterol
  - Low-density lipoprotein
  - High-density lipoprotein
  - Triglyceride
- Thyroid-stimulating hormone or thyroid function tests

Laboratory studies, to be performed as guided by the initial evaluation:

- Glycemia/insulinemia—blood glucose control:
  - Fasting plasma glucose
  - Glycosylated hemoglobin
  - 75 g oral glucose tolerance test (2-h plasma glucose)
- Cholesterol—targets based on risk factors for coronary heart disease (CHD):
  - Low-density lipoprotein (LDL) target levels:
    - 0–1 risk factors: 4.16 mmol/L
    - 2 risk factors: 3.38 mmol/L
    - Patient has CHD or equivalent: 2.60 mmol/L
    - Patient at high risk: 1.82 mmol/L

- Non-HDL target levels:
  - 0–1 risk factors: 4.94 mmol/L
  - 2 risk factors: 4.16 mmol/L
  - Patient has CHD or equivalent: 3.38 mmol/L
  - Triglyceride level
- Liver function:
  - Aspartate aminotransferase
  - Alanine aminotransferase
  - Alkaline phosphatase
- Obstructive sleep apnea: nocturnal pulse oximetry or formal sleep study
- Heart function:
  - Chest film
  - Electrocardiogram
  - Additional diagnostic studies
- Cardiovascular assessment
- Cancer screening
- Screening for secondary causes:
  - Cushing’s syndrome
  - Hypothyroidism
  - Hypothalamic disease
  - Leptin deficiency

## 5 Treatment: lifestyle approaches

### Diets

A recent meta-analysis summarized current outcomes (Table 7).

**Table 7** Meta-analysis of diets in maintenance of weight loss: 29 studies with a follow-up period of at least 2 years

	Follow-up (y)	Studies (n)	Weight loss (kg)	WLM (kg)	WLM (%)	Weight reduction (%)
All	4.5	13	14.0	3.0	23.4	3.15
Men	4.4	5	18.3	4.7	30.5	4.48
Women	4.4	6	16.6	4.66	23.6	4.67
VLCD	4.5	4	24.1	7.05	29.4	6.59
HBD	4.5	8	8.8	1.99	17.8	2.11
Lower exercise	2.7	6	22.0	7.47	27.2	6.66
Higher exercise	2.7	6	20.9	14.99	53.8	12.49

HBD, hypoenergetic balanced diet; VLCD, very low-calorie diet; WLM, weight loss maintenance.

Source: Anderson et al., *American Journal of Clinical Nutrition* 2001;73:579–83.

The long-term efficacy of diets requires further study; currently available results are listed in Table 8.

**Table 8** Long-term efficacy of diets in 17 studies including 3030 patients, with a follow-up period of at least 3 years and an attrition rate of less than 50%—median follow-up 5 y (range 3–14 y) in 2131 patients (70%) and with maintenance of all weight loss or at least 9–11 kg of initial weight loss

		Range
Initial weight loss (median)	11 kg	4–28 kg
Successful weight maintenance	15%	0–49%
Influence of initial treatment		
Diet + group therapy	27%	14–31%
Diet alone	15%	6–28%
Diet + behavioral therapy	14%	0–49%
Influence of energy level of initial diet		
VLCD (300–600 kcal)	14%	6–49%
Conventional diet (800–1800 kcal)	18%	0–31%
Influence of intensity of follow-up		
Active approach	19%	13–49%
Passive approach	10%	0–31%
VLCD + behavioral therapy + active follow-up	38%	27–49%

VLCD, very low-calorie diet.

Source: Ayyard and Anderson, *Obesity Review* 2000;1:113–9.

The minimum energy required by a normal-weight adult who stays in bed is approximately 0.8 kcal/min (1150 kcal/day).

- This maintains body temperature, function of the heart and other organs, and tissue repair.
- High levels of physical activity can increase energy expenditure 4–8-fold.
- As a guideline, a normal adult needs approximately 22–25 kcal/kg nutrient intake to maintain 1 kg of body weight.

For weight loss to occur, energy intake must be less than energy expenditure.

- Predicted weight loss: 0.5–1.0 kg/week, based on a calorie deficit of 500–1000 kcal/day with no changes in physical activity.
- In general, diets < 800 kcal/day are not recommended.

Reduced-calorie diets include those specifying caloric intakes:

- Very low (less than 800 kcal/day)
  - To be used only when more rapid weight loss is needed
  - Medical monitoring is necessary

- Low (800–1500 kcal/day)
- Moderate (about 500 kcal less than typical daily intake)
- Lowering energy intake either by reducing the appetite or by lowering the energy density of the foods eaten is able to facilitate body weight reduction—more controlled intervention trials are needed to assess whether the effects on body weight are also sustained in the longer term.

### *Low-fat diets*

Low-fat diets are still controversial, although epidemiologic and ecologic data have indicated an association between reduced fat intake and stabilizing or lower body weight.

- Low-fat diets: < 30% of total calories from fat
- Very-low-fat diet: restrict dietary fats to < 15% of total calories, 15% of calories from protein and 70% from carbohydrates; hard to maintain in the long term

### *Low-carbohydrate diets*

These show better 6-month results than with low-fat diets, but the differences are no longer significant at 12 months.

- < 60 g of carbohydrates daily.
- Many diets (such as the Atkins and South Beach diets) start with < 20 g of carbohydrates daily and gradually increase the quantity.

### *High-fiber diets (legumes, vegetables, wholemeal diets)*

### *Low-glycemic index (LGI) or low glycemic load diets*

Lowering the glycemic load of the diet may be an effective method for achieving weight loss.

- LGI diets improve lipid profiles and can be easily incorporated into a person's lifestyle.
- Studies show that body mass, total fat mass, body mass index, total cholesterol, and LDL cholesterol can all decrease significantly with LGI treatment.
- A recent Cochrane systematic review concluded that overweight and obese people lost more weight on LGI diets than on high glycemic index or other weight-reduction diets and that their cardiovascular risk marker profile improved.
- More research is needed in order to determine the long-term effects and improvement in quality of life.

### *High-protein diets*

In randomized trials, substituting protein for carbohydrates in calorie-restricted diets was found to result in more weight loss.

- Diets high in protein are usually high in fat.

- The rationale is that protein may enhance satiety, increase meal-induced thermogenesis, protect lean body mass, and decrease energy efficiency.

### *Specific commercial diets*

In randomized trials, these diets appear to show similar losses of body fat and weight, similar reductions in blood pressure, and only modest differences in their effects on total cholesterol and fasting glucose levels.

- Mediterranean diet (fruit and vegetables, olive oil, nuts, red wine, very little red meat, fish)
- Atkins (carbohydrate restriction)
- Zone (40% carbohydrates, 30% fat, 30% protein)
- WeightWatchers or another, similar program (calorie restriction)
- Ornish (fat restriction to 10%)
- Rosemary Conley

### **Potential adjuncts to effective dietary management**

- Using meal replacements—enhanced weight loss in randomized trials
- Involvement of dietitians—improved weight reduction in primary-care settings
- Eating breakfast
- Adding dietary fiber

### **Physical activity**

- Exercise is recommended as a weight loss intervention, particularly when combined with dietary change.
- The combination of increases in physical activity and caloric restriction results in more weight reduction and body composition changes (fat versus lean mass) than diet or physical activity alone.
- Exercise is associated with improved cardiovascular disease risk factors even if no weight is lost:
  - It reduces abdominal adipose tissue and improves insulin resistance.
  - It increases plasma high-density lipoprotein (HDL) cholesterol levels and reduces triglyceride levels and blood pressure.
  - Resistance training may be particularly beneficial in modifying body composition.
  - Adults should set a long-term goal of a minimum of 30 min of moderate-intensity physical activity per day.
  - Exercise is a predictor of weight maintenance.

### **Behavioral modification and counseling**

Behavioral therapy (Table 9) may result in an 8–10% loss in body weight at 6 months.

Table 9 Behavioral therapy: studies published 1990–2000

Duration of behavioral therapy (months)	Studies (n)	Average weight loss (kg)
5	12	10.4 (11.1%)
18	7	8.2 (9.5%)
24	2	7.1 (7.0%)
12	USPSTF RCTs	3.7–5.7

RCT, randomized controlled trial; USPSTF, United States Preventive Services Task Force.

Sources: Wing RR, “Behavioral approaches to the treatment of obesity,” in: Bray GA, Bouchard C, James WPT, editors, *Handbook of obesity*, 2nd ed. (New York: Dekker, 1998), pp. 855–74; McTigue et al., *Annals of Internal Medicine* 2003;139:933–49; Kushner, *Surgery for Obesity and Related Diseases* 2005;1:120–2.

- Psychological interventions, particularly behavioral and cognitive-behavioral strategies, enhance weight reduction.
- Mainly useful when combined with dietary and exercise strategies.
- Long-term maintenance programs may facilitate lasting behavioral changes that work against weight regain.
- Psychotherapy-related approaches—e.g., relaxation therapy or hypnotherapy—failed to demonstrate decisive positive outcomes.

Behavioral treatment is generally provided in individual or small-group sessions held weekly for 6 months. Its key features include:

- Goal-setting and dietary advice
- Self-monitoring—with a self-recorded food diary
- Stimulus control
- Cognitive restructuring—perception of emotional eating behavior and eating habits
- Relapse prevention

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## 6 Pharmacotherapy

### Introduction

Generally, drugs only play a role in settings in which resources are not a key issue. The medicines available for combating obesity are limited in number and effectiveness (Table 10). Nevertheless, weight loss medications can help patients adhere to lifestyle advice, and may result in clinically significant and meaningful improvement of symptoms, risk factors, and quality of life. An understanding of the benefits and risks associated with each of the available drugs is required in order to allow appropriate selection and use of weight-management drugs.

The drug trials have generally only covered short periods, and no studies of long-term administration have been published. Most studies have reported treatment

periods of 1–2 years. All medication is interrupted after 1–2 years, and as obesity is an incurable disease, it recurs in the same way as diabetes insulin treatment is stopped.

In randomized trials of medications approved by the United States Food and Drug Administration (FDA) combined with changes in lifestyle, in comparison with placebo and changes in lifestyle alone, it was found that the reduction from the initial weight was 3–5% greater with the medications.

- Reductions in risk factors for cardiovascular disease are generally related to the amount of weight reduction.
- The criteria for pharmacologic therapy in combination with lifestyle approaches to facilitate weight loss and prevent weight regain are:
  - BMI > 30
  - BMI > 27 plus coexisting conditions

**Table 10** Drugs prescribed for weight loss

Drug Generic name, proprietary name (manufacturer)	FDA approval	Schedule I V controlled substance	Mechanism	Dosage	Weight loss beyond that with placebo	Side effects	Comments
Phentermine E.g.: Adipex-P (Gate); Fastin (Hi- Tech); Ionamin (Celltech)	Approve d for weight loss	Yes	Sympatho- mimetic mechanism	15, 30, or 37.5 mg/d	4%	Dry mouth, insomnia, dizziness, mild increase in blood pressure (rarely more severe) and heart rate	Insufficient data from RCTs; increased risk of pulmonary hypertension probably not a concern; pregnancy category C; available as generic; requires blood- pressure monitoring
Diethylpropion Tenuate (Sanofi- Aventis)	Approve d for weight loss	Yes	Sympatho- mimetic mechanism	25 mg 3 × a day or 75 mg controlled- release daily	3%	Dry mouth, insomnia, dizziness, mild increase in blood pressure and heart rate	Has minimal effect; excreted by kidneys; pregnancy category B; requires blood- pressure monitoring
Sibutramine Meridia (Abbott)	Approve d for weight loss	No	Inhibition of norepinephrine and serotonin reuptake	5, 10, or 15 mg/day	5%	Mild increase in blood pressure and heart rate (rarely more severe), palpitations	Pregnancy category C; requires blood- pressure monitoring
Orlistat Xenical (Roche); Alli (GlaxoSmithKline)	Approve d for weight loss	No	Lipase inhibition in gastrointestinal tract	120 mg 3 × a day (Xenical) or 60 mg 3 × a day;	3%	Oily spotting, flatus with discharge, fecal	Side effects decrease with time; may work better when



Drug Generic name, proprietary name (manufacturer)	FDA approval	Schedule I V controlled substance	Mechanism	Dosage	Weight loss beyond that with placebo	Side effects	Comments
				available over the counter (Alli)		urgency	fat remains in diet, but this results in increased side effects; decreases LDL cholesterol; pregnancy category B
Rimonabant Acomplia (Sanofi- Aventis)	Not approved	n.a.	Inhibition of cannabinoid receptor CB1	20 mg/day	5%	Nausea, diarrhea, anxiety, depression	Prototype of a new class of prescription drugs. No longer available in Europe

FDA, Food and Drug Administration (United States); RCT, randomized controlled trial; LDL, low-density lipoprotein; n.a., not available. *Schedule IV controlled substance*: so listed under the Controlled Substances Act (1970) in the United States.

### Phentermine and diethylpropion

- Randomized trials show a 3–4% greater weight reduction in comparison with placebo. (The drugs are no longer available in Europe.)
- Adrenergic stimulants enhance norepinephrine release in certain brain regions, leading to reduced food intake, but only limited data are available on efficacy and safety.
- Blood pressure should be closely monitored in patients who have prehypertension or are receiving treatment for hypertension.
- There is a potential (although low) risk of dependency and drug abuse (the agents are classified by the Drug Enforcement Agency in the United States as Schedule IV controlled substances).
- Approved for short-term use only; limited data suggest these stimulants may be effective for > 10 years.

### Sibutramine

- Sibutramine is modestly effective in reducing weight, with differing effects on cardiovascular risk and various adverse effect profiles.
- Treatment with sibutramine reduced body weight but not blood pressure.
- Randomized trials have shown a 5% greater weight reduction in comparison with placebo (but only short-term trials have been carried out; administration of the drug for more than 18 months is not allowed).
- The drug is a serotonin–norepinephrine reuptake inhibitor that reduces appetite. Combination with lifestyle modification resulted in more weight loss at

12 months (combination: 12.1 kg; sibutramine alone 5.0 kg; lifestyle intervention alone 6.7 kg).

- Patients who had the greatest initial weight loss and were most physically active were most likely to maintain weight loss successfully.
- Common side effects: hypertension and tachycardia (related to adrenergic properties).

### Orlistat

- Orlistat is modestly effective in reducing weight, with differing effects on cardiovascular risk and various adverse effect profiles.
- In patients with essential hypertension, therapy with a weight loss diet or orlistat treatment reduced body weight and blood pressure.
- One study of orlistat plus lifestyle changes reported a weight reduction of approximately 3% more than with lifestyle intervention alone.
- The drug is a triacylglycerol lipase inhibitor and causes a 30% reduction in dietary fat absorption in the intestinal lumen.
- It is available over the counter at lower dosages in the United States (60 mg, three times a day).
- It has been shown to result in about 2% more weight loss in comparison with placebo over a period of 4–24 months.
- The pharmacologic effect depends on the presence of dietary fat, but a low-fat diet is recommended for patients receiving orlistat.
- Major side effects (usually short-lived) include oily spotting, flatus with discharge, and fecal urgency.

### Rimonabant

- Rimonabant administration produces modest weight loss of approximately 5% after 1 year.
- The drug is a selective cannabinoid receptor CB1 blocker. The cannabinoid system contributes to the regulation of food intake, energy balance, and body weight.
- Modest amounts of weight loss may still be potentially beneficial.
- It is a new medication; better-quality studies with longer follow-up periods after treatment are needed before definitive recommendations can be made.
- It has been approved for the treatment of obesity in most of Europe and in Mexico and Argentina.
- It has not approved by the FDA due to concerns about side effects (including depression, anxiety, nausea and diarrhea, suicidal ideation, and suicide).
- In Europe, it is contraindicated in patients with severe depression and/or patients receiving treatment with antidepressive medications.
- It is not recommended for patients with other untreated psychiatric conditions.

- It is only allowed to be taken for a maximum of 2 years.

### Other drugs

- Fluoxetine (for obese patients with sleep apnea, night-time binges, and bulimia)
- Topiramate (for obese patients with bipolar disorder)
- Bupropion (for obese patients who are smokers)
- Metformin (for obese patients with diabetes, obese women with polycystic ovaries, and obese individuals receiving antipsychotic drugs that produce insulin resistance)
- Venlafaxine (for binge eating)

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## 7 Other treatment options

### Intragastric balloon

- A soft, saline-filled balloon is placed in the stomach endoscopically. It promotes a feeling of satiety and restriction.
- Obesity treatment with an intragastric balloon (IGB) itself, and the technique of positioning the balloon, appear to be safe.
- Placement is temporary (6 months) and the method can be used prior to surgery in patients with morbid obesity.
- There appears to be little additional benefit of the intragastric balloon in relation to weight loss.
- IGB placement is reported to enhance motivation and encourage patients to change eating habits, following a well-organized diet and a program of behavioral modification. IGB may serve as an adjuvant factor in achieving and maintaining weight loss.
- Balloon treatment is permitted for a maximum period of 6 months; removal of the balloon leads to recurrence of the disease.

### Liposuction

- Liposuction involves the removal of fat by aspiration after an injection of physiologic saline.
- The treatment can result in a significant reduction in fat mass and weight. However, recent research has shown that abdominal liposuction does not significantly improve obesity-associated metabolic abnormalities and that reducing adipose tissue mass alone does not achieve the metabolic benefits of weight loss.
- No clear positive influence on insulin sensitivity or risk factors for coronary heart disease has been reported.

## 8 Treatment: surgery

### Introduction and key points

It is difficult to compare different treatment options with surgery, as there have been few trials. Most results reported for diets and medications are short-term results. Although there are some data for medication that show results up to 2 years, a proper comparison of different options would need to include 5-year or even 10-year results when available or state that there are no long-term results. Studies of surgical treatment do report long-term results, with follow-up periods of 1, 3, 5, and even 10 years in some instances. Larger numbers of randomized studies using intention-to-treat analysis are needed.

The type of surgical intervention used depends on BMI and available resources. Adjustable gastric bands are the least invasive, safest, and most effective intervention and this is therefore probably the preferred surgical approach. When finances do not permit this approach, a gastric bypass is the next best operation. For patients with a BMI > 60, gastric bypass is the best surgical procedure, although there have been some reports that gastric bands are also effective. However, the choice of surgery should always take account of individual circumstances and can never be based on BMI alone.

### Bariatric surgical procedures

Bariatric surgical procedures reduce caloric intake by modifying the anatomy of the gastrointestinal tract. In the United States, the Roux-en-Y gastric bypass (open or laparoscopic) is the most commonly used operation. Bariatric operations can be classified into three types: restrictive procedures, malabsorptive procedures, and combined restriction–malabsorption procedures.

*Restrictive procedures* limit intake by creating a small gastric reservoir with a narrow outlet to delay emptying. These include:

- Gastric stapling (gastroplasty)—a recently developed method involving vertical restrictive (sleeve) gastrectomy (Fig. 2b). Partial gastric resection leaves a narrow tube of stomach as an alimentary conduit.
- Adjustable gastric banding (Fig. 2a). This operation is performed laparoscopically and has been in use since 1995. It includes insertion of a subcutaneous reservoir. The extent of gastric restriction can be adjusted using injections of saline into the reservoir.

*Malabsorptive procedures* bypass varying portions of the small intestine, where nutrient absorption occurs.

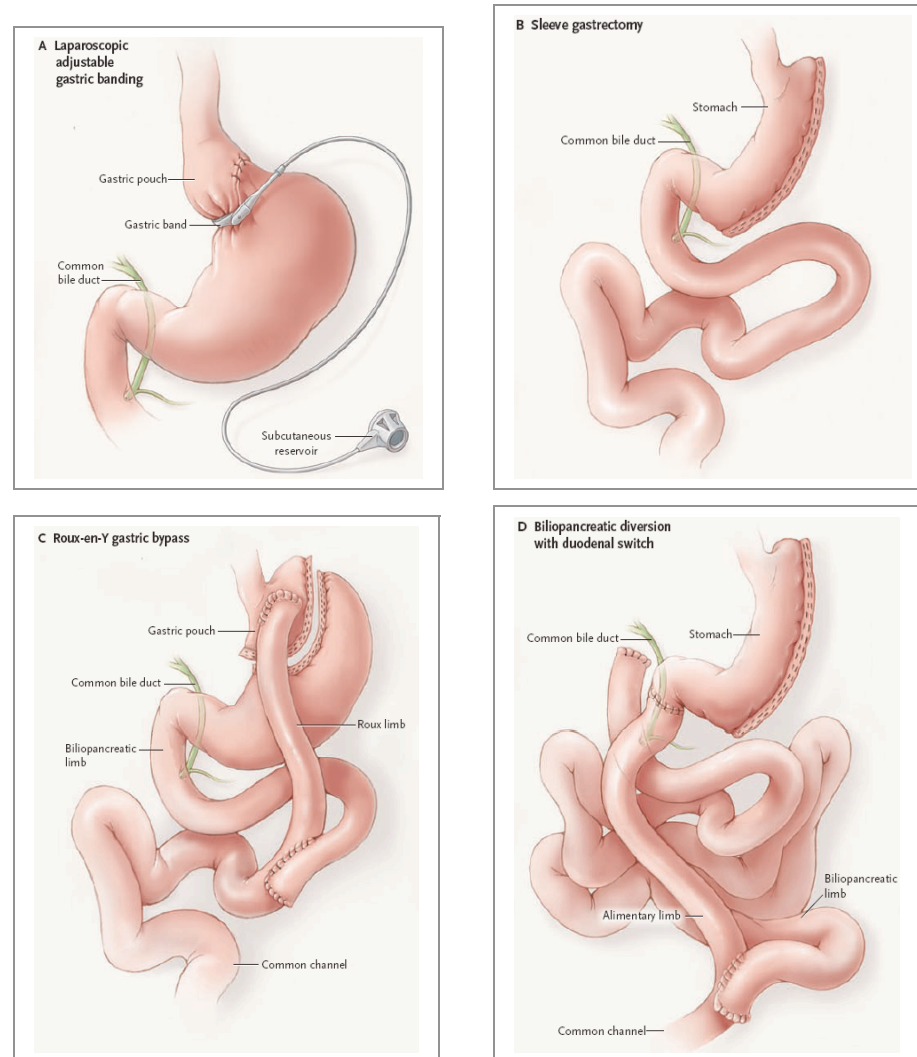
*Combination restriction–malabsorption procedures:*

- Proximal Roux-en-Y gastric bypass (Fig. 2c). This is the procedure most commonly used in the United States.
  - Food only comes into contact with pancreatic and biliary secretions below an anastomosis.
  - The shorter the alimentary part of the small-intestine segment, the less absorption will occur and the better the results will be.

- Biliopancreatic diversion (Fig. 2d)
  - Causes less gastric restriction than the Roux-en-Y procedure.
  - The duodenal switch procedure usually includes sleeve (vertical) gastrectomy.

Combination procedures are sometimes performed as staged operations, with restriction followed by a Roux-en-Y procedure after initial weight loss has made surgery less difficult and reduced the operative risk.

Fig. 2 Classification of bariatric surgery



## Contraindications, associated risks, and complications

### Contraindications:

- Mental or cognitive impairment (precluding informed consent)
- Severe coexisting medical conditions
- Unstable coronary artery disease
- Advanced liver disease with portal hypertension

### Mortality risks associated with bariatric surgery:

- 30-day mortality rate 0.05–2.0%

- Common causes of death:
  - Pulmonary embolism
  - Anastomotic leaks
- Factors that contribute to increased mortality:
  - Lack of experience of the surgeon or hospital
  - Patient's age
  - Male sex
  - Severe obesity—BMI  $\geq$  50
  - Coexisting conditions

*Perioperative complications:*

- 13% of patients in the Swedish Obese Subjects (SOS) trials had perioperative complications.
- Pulmonary thromboembolism is the major cause of operative mortality; anticoagulant prophylaxis is imperative.
- Anastomotic leaks.
- Wound infections.
- Bleeding.
- Incidental splenectomy.
- Incisional and internal hernias.
- Early small-bowel obstruction.

*Postoperative gastrointestinal complications:*

- Nausea and vomiting occur in > 50% of patients undergoing restrictive procedures:
  - Due to eating too much or too rapidly
  - Due to anastomotic strictures
- Dumping syndrome occurs in 70% of patients after Roux-en-Y gastric bypass. There is a complex of neurohormonally mediated symptoms:
  - Facial flushing
  - Light-headedness
  - Palpitations
  - Fatigue
  - Diarrhea
- Nutrient deficiencies may occur after procedures with a component of malabsorption. These require regular monitoring and replacement:
  - Iron
  - Calcium
  - Folate
  - Vitamin B<sub>12</sub>
  - Protein malnutrition
  - Fat-soluble vitamins A, D, E, and K
- Other complications include:
  - Dehydration
  - Bowel obstruction
  - Anastomotic leaks

- Strictures and adhesions
- Erosions and ulcers
- Internal and incisional hernias
- Cholelithiasis

*Psychosocial factors have also been associated with a suboptimal surgical outcome:*

- Disturbed eating habits (e.g., binge eating)
- Substance abuse
- Low socioeconomic status
- Limited social support
- Unrealistic expectations of surgery
- Psychiatric disorders: a majority of patients presenting for bariatric procedures have one or more psychiatric disorders.

Patients often require readmission or reoperation for complications or treatment of coexisting conditions. The risks require a multidisciplinary assessment including the following fields:

- Medical
- Surgical
- Nutritional
- Psychological

## Results

*Patient outcome:*

- The potential benefit of bariatric surgery for patients with mild obesity (BMI 30–35) remains unclear. One randomized study reported significant benefits of surgery using an adjustable gastric band in comparison with medical therapy and behavior modification.
- The safety and efficacy of laparoscopic adjustable gastric banding (LAGB) have been demonstrated as a surgical therapy for morbid obesity in the short term. Recent research on LAGB with the Swedish Adjustable Gastric Band (SAGB) shows that it is effective in achieving a mean sustainable weight loss of > 50% at 8 years after surgery, with an acceptably low morbidity rate.
- It is uncertain whether patients with extremely severe obesity are appropriate candidates for bariatric surgery.
  - The operative risk may be greater for these patients, and surgical access may be difficult to impossible. Mortality rates may be higher among patients with a BMI  $\geq$  70.
  - In the obese, bariatric surgery may be risky, but the risk of not reducing their weight may well be greater than the risks of the operation. This will continue to be an area of uncertainty until the results of further trials become available.
- The effectiveness of procedures varies and there are limited long-term outcome data:
  - No large, randomized trials have compared current bariatric surgical techniques with medical management of severe obesity.

— A 2005 Cochrane Review suggests a typical weight loss of 20–50 kg (44–110 lb) with various bariatric procedures, in comparison with a modest weight gain in medically treated patients.

— The Swedish Obese Subjects (SOS) trial showed weight changes that were significantly greater in the surgical group than in the control group. However, the gain in life expectancy observed in the SOS study was modest.

— In general, weight loss with malabsorptive procedures tends to be greater than weight loss with solely restrictive procedures.

— Improvement in obesity-associated conditions—including diabetes, hyperlipidemia, hypertension, and sleep apnea—is reported after bariatric surgery.

— The SOS data suggest that some of these benefits, although still significant, are less marked at 10 years than at 2 years.

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## 9 Treatment: decision scheme and summary

### Management of obesity

- Ensure optimal medical care for patients who are obese:
  - Educate staff about treating patients with respect.
  - Offer obese patients the same level of care as nonobese patients, providing general preventive services and monitoring and treating ongoing medical conditions.
- Encourage healthy behavior and self-acceptance, even in the absence of weight loss:
  - Record weight without comments.
  - Ask patients if they wish to discuss their weight or health.
  - Review barriers among health-care providers—e.g., the perception that obesity is mainly due to the patient’s lack of willpower.
- Determine the obesity class—the level of excess weight:
  - Assess overall fatness and central adiposity – calculate BMI and measure waist circumference.
- Assess comorbidities and risk status.
- Is weight loss indicated?
  - Prevent (further) weight gain.
  - Prevent the complications of obesity.
  - The goal is to favorably influence coexisting conditions associated with obesity by reducing excess weight, maintaining a lower body weight, and controlling associated risk factors.
  - What is the recommended minimum weight loss?
  - Assess the patient’s expectations.
- Evaluation of the patient’s readiness:
  - Reasons and motivation for weight loss.
  - Previous attempts at weight loss.
  - Support expected from family and friends.
  - Understanding of risks and benefits.



- Attitudes toward physical activity.
- Time availability.
- Potential barriers to the patient's adoption of change.
- Discuss the patient's preferences regarding diet and physical activity.
- Decide which treatment or combination of treatments is best:
  - Which diet should be recommended?
  - Discuss a physical activity goal.
- Is the patient a candidate for surgery?
  - BMI of 40 or higher.
  - BMI of 35 or higher, with comorbidities.
  - Severe sleep apnea.
  - Obesity-related cardiomyopathy.
  - Severe diabetes mellitus.
  - Severe joint disease.
  - Failure of medical weight control. Patients should have made previous attempts to lose weight.
  - Absence of medical or psychological contraindications.
  - No risks, or acceptable risks, for surgery.
  - The patient should receive full information about the anticipated risks and results of the operation, understand the procedure and its risks, and be strongly motivated to comply with the postsurgical regimen.
  - Medical and surgical care should be provided by a multispecialty team with experience in bariatric surgery and in perioperative and follow-up care.
- Consider weight-loss medication:
  - Orlistat: combine with daily multivitamin treatment (possible malabsorption of fat-soluble vitamins). Inform the patient about side effects.
- Phentermine or sibutramine:
  - If hypertension is well-controlled.
- Rimonabant (if approved by the local regulatory agency):
  - In the presence of features of a metabolic syndrome.
  - Drug therapy should only be provided as part of a program that includes diet, physical activity, and behavior therapy.
- Manage coexisting conditions:
  - Hypertension: lower elevated blood pressure.
  - Type 2 diabetes: lower elevated blood glucose levels
- Dyslipidemia:
  - Lower elevated levels of total cholesterol, LDL cholesterol, and triglycerides.
  - Raise low levels of HDL cholesterol by encouraging physical exercise.
- Discuss strategies for weight maintenance.
- Encourage the patient to set realistic goals.
- Record keeping has been shown to be one of the most successful behavioral techniques for weight loss and maintenance. The patient should:
  - Record food intake and energy expenditure.
  - Keep track of body weight (at least once a week).
- Use fat-reduced, fiber-enriched diets.

- Expand physical activity in line with the current fitness level and obesity-associated conditions:
  - Walking.
  - Joining a gym.
  - Developing a home-based program of aerobic and resistance training.

### Treatment outcome

#### *General:*

- A 5–10% reduction in weight may be sufficient for favorable modification of waist circumference, blood pressure, circulating cytokines, and (variably) fasting levels of glucose, triglycerides, and HDL cholesterol.
- A change in the treatment regimen should be considered if weight loss is less than 5% in the first 6 months.
- Willingness to achieve weight reduction is important in predicting success.

*Lifestyle intervention.* Studies have shown that in comparison with standard care, lifestyle intervention:

- Significantly reduces body weight and cardiovascular risk factors.
- Has favorable effects, which are maintained for up to 3 years.

Physical activity without a reduced calorie intake leads to limited weight loss results.

*Treatment combinations.* Dietary and lifestyle interventions, along with pharmacologic weight loss treatment, provide modest weight loss and may improve markers of cardiovascular risk factors, although these benefits occur mainly in patients with cardiovascular risks.

### Maintenance of weight reduction

The body has multiple mechanisms for modifying the energy balance to reestablish the original body weight. Weight loss induces a reduction in energy expenditure, hindering maintenance of weight loss. Failure to maintain weight loss is a common problem.

While short-term weight loss depends on caloric restriction, maintenance of weight loss mostly depends on the level of physical activity. For most people, long-term success is still difficult to achieve and current therapies for obesity do not provide sufficient support for patients in adhering to the required lifestyle changes.

*Predictive factors for maintaining weight loss* include:

- Eating a low-fat, fiber-enriched, protein-rich diet
- Frequent self-monitoring of body weight and food intake
- High levels of physical activity
- Long-term patient–provider contact
- Weight loss of more than 2 kg in 4 weeks
- Frequent/regular attendance at a weight loss program
- Patient’s belief that body weight can be controlled
- Behavioral interventions (may be helpful)

*Protective factors against weight regain:* expending about 2500 kcal/week, either through:

- Moderate activity for approximately 80 min/day (brisk walking)
- Vigorous activity for 35 min/day (jogging)

*Treatment and support options:*

- Primary-care setting
- Commercial programs
- Internet-based weight maintenance programs

### Risks of weight loss

Some studies have concluded that intentional weight loss reduces mortality, whereas unintentional weight loss was associated with an increased risk of mortality.

Due to an increased flux of cholesterol through the biliary system, weight loss may increase the chances of cholelithiasis developing. Diets with moderate amounts of fat that trigger gallbladder contraction may reduce this risk. Slow weight loss—e.g., 0.5–1.0 kg/week—has been shown to prevent the formation of gallstones seen in patients with higher weight loss rates. Weight loss with adjustable gastric bands is associated with an incidence of gallstone formation that is no different from that in the normal population.

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## 10 Cascades

### Stakeholders and management options

Which of the obesity treatment or prevention approaches (Table 11) is resource-dependent? All stakeholders need to take action at global, regional, and local levels. Excess weight and obesity, as well as the related chronic diseases, are largely preventable.

*Individual level.* The patient should avoid energy-dense foods, limit the intake of alcohol, remember the nonsatiating effects of foods rich in calories such as fat and alcohol (alcohol having an additional disinhibitory effect on eating), and bear in mind the better satiation and satiety effects of proteins followed by complex carbohydrates.

- Achieve energy balance and a healthy weight.
- Limit energy intake from total fats and shift fat consumption away from saturated fats to unsaturated fats.
- Increase consumption of fruit and vegetables, as well as legumes and whole grains.
- Limit the intake of sugars (particularly in beverages).
- Increase physical activity.

*Governments, international partners, civil society and nongovernmental organizations, and the private sector should:*

- Shape healthy environments.

- Make healthier diet options affordable and easily accessible.
- Facilitate and promote physical exercise.

*The food industry should:*

- Reduce the fat and sugar content of processed foods and also the portion sizes.
- Increasingly introduce innovative, healthy, and nutritious choices (low energy density, fiber-rich, functional foods).
- Review current marketing practices to accelerate health gains throughout the world.

**Table 11** Decision scheme for weight-loss treatment

		Obesity level			
		Grade 1	Grade 2	Grade 3	
<b>Western countries</b>					
BMI	25.0–26.9	27.0–29.9	30.0–34.9	35.0–39.9	≥ 40
Waist (cm)					
Male	94–102	94–102	≥ 102	≥ 102	
Female	80–88	80–88	≥ 88	≥ 88	
<b>Eastern/Asian countries*</b>					
BMI	23.0–24.9	25.0–29.9	30.0–34.9	≥ 35	≥ 35
Waist (cm)					
Male	< 90	< 90	≥ 90	≥ 90	
Female	< 80	< 80	≥ 80	≥ 80	
<b>Treatment options</b>					
No comorbidity	Diet	Diet	Diet	Pharmacotherapy <sup>†</sup>	Surgery <sup>‡</sup> if supervised diets with or without pharmacotherapy <sup>†</sup> fail
	Exercise	Exercise	Exercise	Supervised diets	
			Behavioral therapy	If these fail: surgery <sup>‡</sup>	
Comorbidity present	Diet	Diet	Diet	Pharmacotherapy <sup>†</sup>	Surgery <sup>‡</sup> if supervised diets with or without pharmacotherapy <sup>†</sup> fail
	Exercise	Exercise	Exercise	Supervised diets	
	Behavioral therapy	Behavioral therapy	Behavioral therapy	Surgery <sup>‡</sup> §	
			Pharmacotherapy <sup>†</sup> §		

BMI, body mass index; F, female; M, male. *Source:* Adapted from guidelines from the U.S. National Heart, Lung, and Blood Institute.

\* Asians are at greater risk, and decisions are taken one step earlier in these patients.

† Only in patients with obesity-related disease who are unable to achieve adequate weight loss with available conventional lifestyle modifications and have no absolute contraindications for drug therapy.

‡ Only in patients with obesity-related disease who are unable to lose weight with available conventional therapy and have no absolute contraindications for surgery.

¶ While there is no evidence for surgery in patients with BMI 30–35 and no complications, exceptions are possible when there is significant comorbidity.

§ There is evidence for surgery in patients with BMI 35–40 and comorbidities; according to experts, the cut-off point is likely to be lowered to 30 during the next few years.

## Management options relative to available resources (Tables 12–14)

Table 12 Management cascade relative to available resources

Resources	Management options by BMI			
	25–30	30–35	35–40	> 40
High/affluent	DEB	DEB + M	DEB M + SD	DEB SD + surgery
		+/- Surgery	+/- Surgery	+/- Surgery
Medium/normal	DEB	DEB	DEB SD	DEB SD +/- surgery
Low/absent	DEB	DEB	DEB	DEB +/- surgery

DEB, diet, exercise, and behavior change (must be supervised); M, medication—only effective in case of moderate increase in BMI (must be supervised); SD, strictly supervised diets.

### Notes:

1. Whatever treatment is given, diet, exercise, and behavioral changes should always be prescribed.
2. “+/- Surgery” is added to indicate that if the other strategies fail, then this is an option. Even in low-resourced countries, surgery is an option if obesity needs to be addressed. An open gastric bypass is not an expensive operation.
3. In the United States, there are cheap medications (phentermine, diethylpropion) and more expensive (sibutramine) ones, with orlistat being the most expensive.

Table 13 Diet: cascade relative to the resources available

Resources	Diet types
	There should always be an energy restriction of at least 600 kcal below everyday needs, which is in practice even more restricted than the 600 kcal (since to maintain 1 kg in body weight, 20–25 kcal is needed, so that someone weighing 120 kg needs to eat at least 2400 kcal in order not to slim)
High/affluent	High-protein diets Low-carbohydrate diets
Medium/normal	High-fiber diets Low glycemic index diets
Low/absent	No energy-dense foods Reduced-fat diets

N.B.: The costs of the diet differ in countries in which fruits and vegetables are plentiful but meat is more expensive, and the reverse may be true elsewhere. It is of course difficult to emphasize energy restriction or reduction first, before discussing in detail the changes in macronutrients and diet composition.

Table 14 Surgery: cascade relative to the resources available

Resources available	Surgical procedure
High	Biliopancreatic diversion with duodenal switch
Normal	Laparoscopic gastric bypass Adjustable gastric band Sleeve gastrectomy
Low	Open gastric bypass; in severe obesity, a long-limb gastric bypass Vertical banded gastroplasty Sleeve gastrectomy