Obesity 5

Management of obesity: improvement of health-care training and systems for prevention and care

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Although the caloric deficits achieved by increased awareness, policy, and environmental approaches have begun to achieve reductions in the prevalence of obesity in some countries, these approaches are insufficient to achieve weight loss in patients with severe obesity. Because the prevalence of obesity poses an enormous clinical burden, innovative treatment and care-delivery strategies are needed. Nonetheless, health professionals are poorly prepared to address obesity. In addition to biases and unfounded assumptions about patients with obesity, absence of training in behaviour-change strategies and scarce experience working within interprofessional teams impairs care of patients with obesity. Modalities available for the treatment of adult obesity include clinical counselling focused on diet, physical activity, and behaviour change, pharmacotherapy, and bariatric surgery. Few options, few published reports of treatment, and no large randomised trials are available for paediatric patients. Improved care for patients with obesity will need alignment of the intensity of therapy with the severity of disease and integration of therapy with environmental changes that reinforce clinical strategies. New treatment strategies, such as the use of technology and innovative means of health-care delivery that rely on health professionals other than physicians, represent promising options, particularly for patients with overweight and patients with mild to moderate obesity. The co-occurrence of undernutrition and obesity in low-income and middle-income countries poses unique challenges that might not be amenable to the same strategies as those that can be used in high-income countries.

Published **Online**
February 18, 2015
http://dx.doi.org/10.1016/S0140-6736(14)61748-7

See **Online/Comment**
http://dx.doi.org/10.1016/S0140-6736(15)60163-5

This is the fifth in a **Series** of six papers about obesity

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Introduction

The relatively small caloric gap necessary to return the mean body-mass index (BMI) of children and adolescents to 1970s levels[1] can be readily achieved by the policy initiatives described by other authors of this Series. Environmental changes that bridge the calorie gap will have a substantial effect on prevention, but will not immediately reduce the morbidities and costs associated with obesity. Far greater caloric deficits than those achieved by environmental changes will be necessary to achieve weight reduction in those patients who already have obesity.[2]

The increases in the prevalence of obesity and its complications in low-income and high-income countries[3] emphasise the global need for improved strategies for obesity prevention and control. Current clinical care delivery systems were well suited for the acute diseases that accounted for much of the morbidity and mortality in the early 1900s, but these systems are poorly suited for the prevention and control of chronic conditions, such as obesity, that account for much of the world population's poor health today.[4,5] A combination of effective clinical services to treat obesity and policies, systems, and environmental changes that prevent obesity and sustain weight loss are needed to reduce obesity worldwide. Success will depend on changes in health professional education, attitudes, and practices. The prevalence and

Search strategy and selection criteria

We conducted a systematic review of the published literature on obesity management in adults and children through December, 2013, using "obesity", "treatment", "prevention", "body weight and BMI" and combinations of "medical education", "health professional education", "education", "training", "nurse education" to identify relevant studies. Databases searched included Medline (PubMed), PsycINFO, RePort, ERIC, NHS EED, the Cochrane Database of Systematic Reviews, and the Cochrane Register of Controlled Trials. We also reviewed reference lists of published manuscripts and other relevant reviews and meta-analyses.

Key messages

- Health professionals are poorly prepared to treat obesity
- Policy and environmental changes are unlikely to achieve substantial weight loss in patients with severe obesity
- Training of health-care providers to treat obesity needs to address their biases about patients with obesity, ability to employ behaviour change strategies, and ability to work collaboratively with interprofessional teams
- Multiple therapeutic modalities, including behavioural therapy, pharmacotherapy, and bariatric surgery, can be used in the treatment of adult obesity; fewer options are available for paediatric patients
- Alignment of the intensity of therapy with the severity of the disease is necessary to improve care for obesity
- Integration of clinical and community approaches is necessary for sustained weight loss
- The co-occurrence of obesity and undernutrition in low-income and middle-income countries poses unique challenges

complexity of obesity also needs changes in health-care delivery, including the engagement of interdisciplinary treatment teams.[6] Hospitals, as model employers, can foster changes in social norms through their institutional and community practices. The USA and UK[7,8] have emphasised the need for improved clinical training and clinical–community partnerships.

Education of health professionals

A 2010 *Lancet* Commission article[9] stressed the urgent need for a so-called third generation of educational reforms to address chronic disease management. Existing shortcomings of current health-service delivery include poor teamwork, a mismatch of competencies to the needs of patients and populations, episodic rather than continuous care, and hyperspecialisation. The authors proposed several educational reforms, including the adoption of flexible, competency-based curricula and the promotion of education across professions that break down traditional professional silos. Such recommendations are directly relevant to health professional education in obesity. The challenge has been in implementation of these recommendations.

A scarcity of information exists for undergraduate medical education in obesity, and even less information is available for nursing and allied health professional students. In 2007, the US Association of American Medical Colleges provided recommendations for medical education on overweight and obesity.[10] Implementation of the recommendations appears inadequate; the findings of a 2008–09 survey showed that American medical students had an average of 19·6 contact hours of nutrition instruction in their medical curricula (range 0–70 h), with only 27% of medical schools providing the minimum requirement of 25 h.[11] However, results of an audit[12] of Australian universities in 2006 suggested that the number of contact hours for obesity teaching was broadly comparable with that for diabetes and depression (medical students had a median of 7 h of obesity teaching provided [range 5–30 h] and students studying diet and nutrition had a median of 15 hours [range 6–22 h]). The optimum amount and type of training is unknown.

In the UK, the training of health professionals to prevent and treat overweight and obesity was addressed and widely endorsed in a 2010 report[8] prepared by the Royal College of Physicians. The report emphasised the need for all health-care professionals to identify those at risk of obesity and to manage patients with obesity. It emphasised so-called horizontal integration across disciplines and provided a framework covering both generalist and specialist level competencies, with specific skills for managing adults and children. Results of anecdotal reports[12] suggest that implementation has proven to be patchy and depends on the presence of local clinical champions. The Royal Australian College of General Practitioners is the only specialist training college to include obesity in the prescribed curriculum.

Findings of surveys and qualitative studies[13,14] of primary and secondary level care medical practitioners suggest that they feel poorly prepared to manage patients with obesity. Commonly identified areas for additional training in the care of adults with obesity include motivational interviewing, the comanagement of bariatric surgery patients, and nutrition and exercise counselling.[15] Paediatricians also describe inadequate training in such areas as the management of obesity-related comorbidities, behavioural techniques related to diet and physical activity, and motivational interviewing.[16]

Overall, the level of implementation of health professional education in obesity at all levels appears inadequate in several countries. The results of a systematic review[14] addressing medical student education in obesity identified few obesity-related educational programmes and only five of the included studies reported outcome measures. Findings of a 2010 Cochrane review that assessed the effectiveness of strategies to change the behaviour of health professionals to promote weight reduction in people with obesity, revealed that most trials had weaknesses in methods or reporting. Evidence from a meta-analysis[17] of three studies indicated that, compared with standard care, educational interventions aimed at general practitioners could reduce the average weight of patients by 1·2 kg in 1 year.

Novel approaches to training health professionals in obesity assessment and management have used simulated patients (ie, the parents of children with obesity).[18] Simulated patient ratings of doctor performance, but not doctor self-ratings, predicted both parent ratings of real-life consultations and subsequent clinical outcomes. Cost and sustainability might limit the use of such approaches.

Weight bias in medical education

Weight bias by preclinical and medical students includes attitudes that patients with obesity are lazy, non-compliant with treatment, less responsive to counselling, responsible for their condition, have no willpower, and deserve to be targets of derogatory humour, even in the clinical-care environment.[19,20] These biases can also lead to views that obesity treatment is futile[21] and feelings of discomfort, which students report as a barrier to discussing weight with patients,[22] both of which are likely to impair care.

Educational strategies that emphasise the complex aetiology of obesity can help reduce weight stigmatisation among medical students. For example, information about obesity that indicates contributing factors beyond personal control (eg, biological and genetic contributors) as well as the difficulties in obtaining clinically significant and sustainable weight loss, has been shown to reduce negative bias and stereotypes among preclinical and medical students[23] and improve self-efficacy for counselling patients with obesity.[24] These

approaches have been delivered and tested using different formats and indicate that bias-reduction interventions can be feasibly integrated in health-related curricula and clinical training settings.

Weight bias in medical settings

Widespread explicit and implicit negative weight biases have been shown in large samples of physicians, even in health professionals who specialise in the treatment of obesity.[25] Negative stereotypes expressed by health professionals parallel those by medical students and residents.[26]

Weight biases by health-care professionals can impair the quality of health-care delivery. Providers spend less time in appointments,[27] provide less education about health,[28] and are more reluctant to do some screening tests in patients with obesity.[29] Furthermore, physicians report less respect for their patients with obesity,[11] perceive them as less adherent to medications,[30] express less desire to help their patients, and report that treating obesity is more annoying and a greater waste of their time than is the treatment of their thinner patients.[27]

Weight bias in the medical setting might restrict health-care utilisation and contribute to avoidance of health care by individuals with obesity. Among the heaviest women, 68% reported delaying use of health-care services because of their weight, due to previous experiences of disrespectful treatment from health-care providers, embarrassment about being weighed, and medical equipment that was too small for their body size.[31] Results of an American study[32,33] showed that 19% of adults and 24% of parents would avoid future medical appointments if they perceived a doctor had stigmatised them or their child because of their weight. The delay in diagnosis and treatment for obesity-related comorbidities can impair the quality of care for individuals with obesity and might ultimately contribute to the costs of the disease. To address these concerns, several evidence-based methods and resources have been developed to reduce weight bias in care delivery (appendix).

Management of adult obesity

The figure provides an algorithm for the management of adult obesity. In adults, both BMI and waist circumference are used to assess the risks of cardiovascular disease, including hypertension, stroke, dyslipidaemia, non-alcoholic fatty liver disease, and type 2 diabetes. The Edmonton obesity staging system (EOSS) has been used to provide additional guidance for therapeutic interventions in individual patients (table 1).[34] EOSS provides a practical method to address the treatment paradigm. In principle, EOSS stages 0 and 1 should be managed in a community and primary care setting. Recent data[35] from the USA suggest that 8% of patients with severe obesity (BMI ≥35 kg/m²) account for 40% of the total costs of obesity, whereas the more prevalent grade 1 obesity accounts for a third of costs. These findings suggest that greater priority should be accorded to EOSS stages 3 and 4, resulting in greater focus on pharmacological and surgical management delivered in specialist centres. Criteria for the establishment of such centres include specialised health professionals and specialised equipment and facilities.[36]

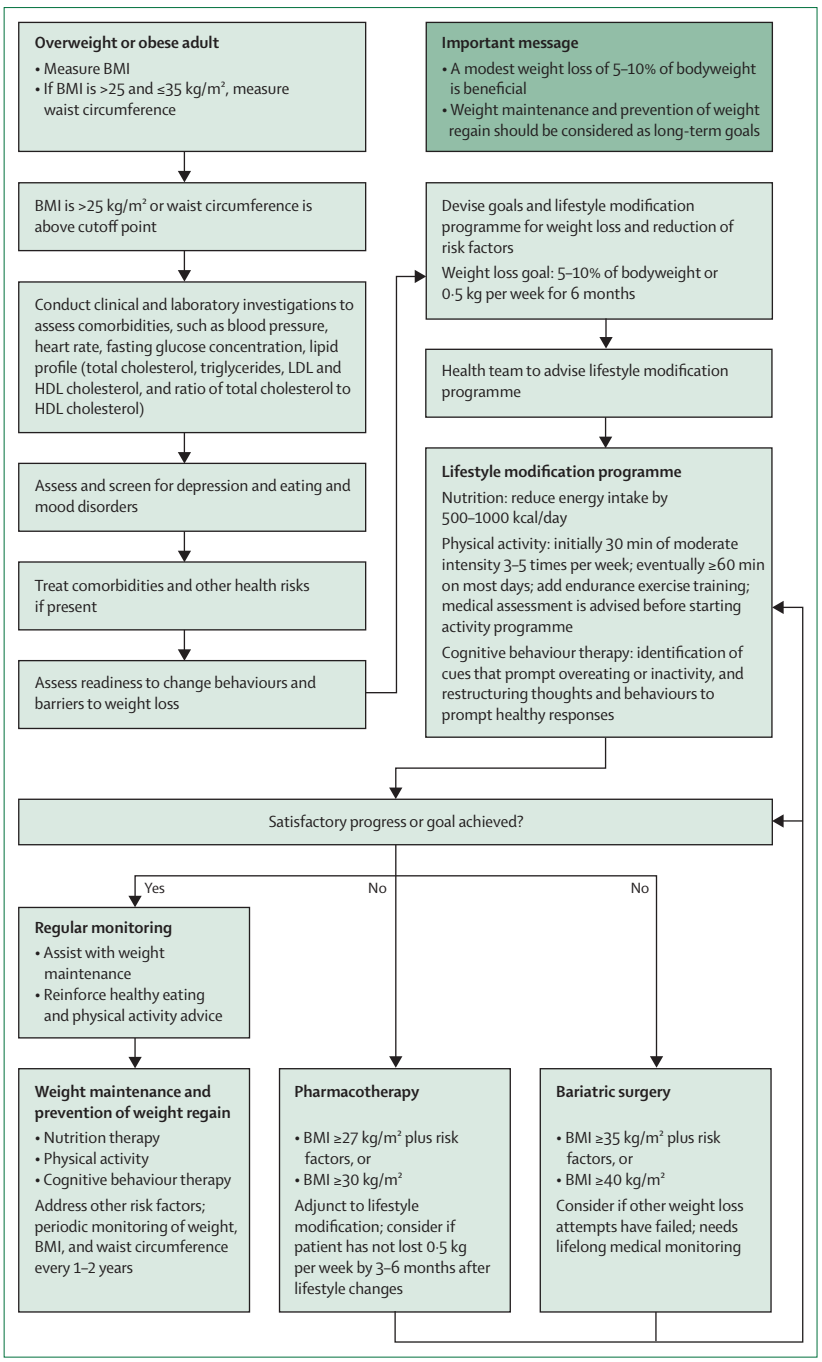

Figure: **Algorithm for the stepwise management of adult patients with overweight or obesity**

See Online for appendix

	Symptoms	Management
Stage 0	No apparent obesity-related risk factors (eg, blood pressure, serum lipids, fasting glucose within normal range), no physical symptoms, no psychopathology, no functional limitations or impairment of wellbeing	Identification of factors contributing to increased bodyweight; counselling to prevent further gain through lifestyle measures, including healthy eating and increased physical activity
Stage 1	Presence of obesity-related subclinical risk factors (eg, borderline hypertension, impaired fasting glucose, elevated liver enzymes), mild physical symptoms (eg, dyspnoea on moderate exertion, occasional aches and pains, fatigue), mild psychopathology, mild functional limitations, or mild impairment of wellbeing	Investigation for (non-weight-related) contributors to risk factors; more intense lifestyle interventions, including diet and exercise to prevent further weight gain; monitoring of risk factors and health status
Stage 2	Presence of established obesity-related chronic disease (eg, hypertension, type 2 diabetes, sleep apnoea, osteoarthritis, reflux disease, polycystic ovary syndrome, anxiety disorder), moderate limitations in activities of daily living or wellbeing	Initiation of obesity treatments, including consideration of all behavioural, pharmacological, and surgical treatment options; close monitoring and management of indicated comorbidities
Stage 3	Established end-organ damage, such as myocardial infarction, heart failure, diabetic complications, incapacitating osteoarthritis, clinically significant psychopathology, clinically significant functional limitations, or impairment of wellbeing	More intensive treatment, including consideration of all behavioural, pharmacological, and surgical treatment options; aggressive management of indicated comorbidities
Stage 4	Severe (potentially end-stage) disabilities from obesity-related chronic diseases, severe disabling psychopathology, severe functional limitations, or severe impairment of wellbeing	Aggressive obesity management as deemed feasible; palliative measures, including pain management, occupational therapy, and psychosocial support

The Edmonton obesity staging system is a stronger predictor of mortality than body-mass index and provides better differentiation of mortality risk than body-mass index alone.

Table 1: **The Edmonton obesity staging system and stratified management scheme**[34,47]

A stratified system for obesity management: the interventional approach

The chronic and relapsing nature of obesity and its related diseases argues for comprehensive management approaches to achieve long-term weight reduction. Sound evidence supports an intensive lifestyle intervention characterised by dietary restriction, increased physical activity, and behavioural management as the first line of therapy.[37] A comprehensive management plan includes specific treatment of comorbidities, such as hypertension, dyslipidaemia, type 2 diabetes, and sleep apnoea. Table 2 lists pooled data from several trials[38–51] of 12 months or longer that evaluated weight loss from different treatment interventions.

A 5% weight loss has substantial health benefits. However, patients' goals for weight loss are usually considerably greater.[52] Although results of a meta-analysis did not find a significant effect of goal weight on weight outcomes,[53] the gap between expected and actual weight loss might affect weight loss maintenance, relapse, or patient satisfaction. Emphasis on the health benefits, rather than the cosmetic impact of weight loss, might help modify expectations and improve satisfaction with the outcome.

Both patient education and engagement are necessary if these approaches are to succeed. For example, although many American parents rank childhood obesity as the leading child health concern,[54] many parents do not recognise that their child has obesity.[55] Improved training in behaviour change therapies and reducing weight bias among health-care providers will increase the effectiveness of counselling so as to increase patient awareness of obesity and its attendant risks. Clinical counselling will also help to engage patients and change behaviour, but environmental changes that increase healthy choices and reinforce clinical efforts are essential to help promote and sustain weight loss. Patients cannot make healthy choices unless there are healthy choices to make.

Energy intake changes needed for weight loss versus maintenance after weight loss

Current regulatory guidance for obesity therapeutics[56,57] places an efficacy target of at least 5% weight loss compared with placebo over a period of at least 1 year. 6 months defines the practical time allotted to achieve the effectiveness target because non-surgical approaches to weight loss typically plateau after that time.[57] Less emphasis is placed on development of drugs that target long-term maintenance of lost weight, but this goal might be more achievable because the energy deficit needed to achieve rapid weight loss is substantially greater than that needed to subsequently maintain lost weight. Furthermore, because subsequent weight regain is highly prevalent, long-term maintenance of lost weight might be a more important goal than short-term weight loss, which can readily be achieved through several methods.

During ongoing weight loss, resting and total energy expenditure decrease beyond that expected based on measured bodyweight and composition change.[58,59] Improved energy efficiency seems to persist after energy balance is re-established at a lower bodyweight,[60] although the magnitude of the persistent effect is smaller than during active weight loss.[61] Validated mathematical models quantitatively integrate data from a large number of human studies and accurately simulate the dynamic phase of weight loss and long-term maintenance of lost weight.[62] One model[63] was used to generate data that illustrate the energy intake changes required to achieve

the efficacy target of 5% weight loss in 6 months, compared with the energy intake changes needed to subsequently maintain this lost weight over the long term (table 3). For example, an average woman with a BMI of 40 kg/m² needs to eliminate about 350 kcal per day from her usual diet to achieve 5% weight loss in 6 months. By contrast, eating about 90 kcal per day less than the baseline diet is sufficient to maintain the lost weight. Different rates and degrees of weight loss can be simulated using a free online tool.

The disparity between the short-term versus long-term energy intake has practical implications regarding the therapeutic dose in clinical trials of obesity drugs. To achieve the short-term weight loss efficacy targets required by regulatory agencies, clinical drug trials might use high doses with a correspondingly increased risk of complications and side-effects. However, targeting long-term maintenance of lost weight might require a low drug dose and an improved risk profile. At present, regulatory guidance provides little incentive to investigate the therapeutic potential of a weight loss maintenance drug.

Dietary intervention for obesity

Many patients with obesity, although calorie replete, might have clinically significant nutritional deficiencies (eg, vitamin D, iron) that need to be considered as part of a holistic dietary approach. Dietary programmes that involve alteration of macronutrients include low-carbohydrate diets, which provide 20 g per day of carbohydrate (eg, Atkins diet), low-fat diets that provide 10–20% of calories from fat (eg, Ornish diet), diets that provide a higher intake of unsaturated fats (Mediterranean diet), and low-glycaemic load diets. The outcome of trials examining the effect of macronutrient composition on weight loss and obesity-related comorbidities has shown that a particular diet might result in greater weight loss at 6 months, but continuing follow-up at 12–24 months finds no significant difference between diets.[39]

Ultimately, the choice of diet should address a patient's preference and ease of adherence. Strategies should be directed towards long-term lifestyle changes that include eating patterns that are practical, achievable, and sustainable.

Although commercial programmes have been available for more than 50 years, great variation remains in their scientific soundness, efficacy, cost, and support. Long-term trials provide evidence of benefit from the three largest commercial providers—Weight Watchers, Jenny Craig, and Nutrisystem—but continuing adherence and cost challenge an individual's success.[38]

Physical activity and weight management

The most variable component of energy expenditure is physical activity, representing 20–40% of total energy expended. Nonetheless, populations in much of the world have become increasingly sedentary. Sedentary behaviours, such as television-watching or desk work, are adversely associated with health outcomes, including cardiovascular risk and diabetes, irrespective of bodyweight.[64] A recent *Lancet* series identified physical inactivity as a major contributor to death and disability from non-communicable diseases (NCDs) worldwide and confirmed the importance of increasing levels of physical activity as a priority to combat NCDs. However, recognition of the importance of physical activity and development and implementation of population-based strategies to improve and sustain physical activity have been slow.[65]

WHO's Physical Activity Guidelines[66] recommend a minimum of 150 min of moderate-intensity physical activity per week and muscle strengthening activities two or more times per week for all adults. Regular

	Average weight reduction in kg after 12 months (from selected studies)
Low glycaemic	−4·0
Ornish	−3·3
Low carbohydrate, high protein	−5·5
Low fat, high protein	−4·1
Mediterranean	−4·4
Commercial programmes	
Jenny Craig	−8·0
Weight Watchers	−7·0
Pharmacotherapy	
Belviq (lorcaserin; Arena Pharmaceuticals GmbH, Zofingen, Switzerland)	−5·8
Contrave (combined bupropion plus naltrexone; Orexigen Therapeutics, La Jolla, CA, USA)	−5·8
Qnexa (combined phentermine plus topiramate; Vivus Inc, Mountain View CA, USA)	−10·2
Bariatric surgery	
Gastric bypass	−29·4
Sleeve gastrectomy	−25·1

Table 2: **Pooled average weight loss recorded from interventional trials of dietary programmes lasting 12 months or longer**[38-51]

For the **weight loss simulator** see http://bwsimulator.niddk.nih.gov

	Men		Women	
	Energy deficit (kcal/day) required for 5% weight loss in 6 months	Energy deficit (kcal/day) required for 5% weight loss maintenance	Energy deficit (kcal/day) required for 5% weight loss in 6 months	Energy deficit (kcal/day) required for 5% weight loss maintenance
25 kg/m²	−230	−100	−200	−80
30 kg/m²	−290	−110	−250	−80
35 kg/m²	−350	−110	−300	−90
40 kg/m²	−410	−110	−350	−90
45 kg/m²	−470	−120	−400	−100
50 kg/m²	−530	−130	−450	−100

Table 3: **Comparison of the energy deficit required for weight loss with the energy deficit to maintain weight after weight loss, by initial body-mass index**

physical activity reduces blood pressure and improves plasma lipid profile, and decreases visceral (abdominal) fat without clinically significant weight loss. A reduction in visceral fat improves insulin sensitivity and glucose tolerance.[40] The findings of a recent review[67] suggest that a variety of mild-to-moderate intensity exercises that include both aerobic and resistance training results in additional metabolic benefits in people with obesity or type 2 diabetes. Although weight loss is minimal, body composition improves. These exercise regimens proved easy for patients to maintain and could be progressively increased in intensity.

The conclusion of two systematic reviews was that weight regain following weight loss is reduced by physical activity equivalent to 60 min of brisk walking daily.[41,42] Lifestyle activity that increases energy expenditure throughout the day without concern for the intensity or duration can be as effective for weight control as jogging, swimming, or cycling.[43] Nonetheless, many health professionals might not be familiar with the physical activity guidelines, and many fail to discuss the benefits of increasing physical activity. The Exercise Is Medicine website offers a useful instrument to promote physical activity.

For **Exercise Is Medicine** see http://exerciseismedicine.org

Behavioural management

Behavioural approaches help individuals with obesity modify and sustain changes to their eating, activity, and thinking habits. Key components include setting goals for behaviour change that specify what, when, where, how, and for how long patients will engage in the behaviour.[34] Self-monitoring requires detailed records of food intake, physical activity, and bodyweight. Motivational interviewing is a directive and individually centred counselling style for eliciting behaviour change by helping patients explore and resolve their lack of readiness to change their behaviours and enhances adherence to behaviour intervention.[68] The success of behaviour management depends on trained and engaged professionals.

Strategies for weight maintenance in adults

Almost 25% of adults with obesity achieve 5% or greater weight loss annually.[69] People who successfully maintain weight loss engage regularly in around 1 hour of daily physical activity, consume a low-calorie and low-fat diet, eat breakfast regularly, self-monitor weight, and maintain a consistent eating pattern across weekdays and weekends.[41] If successfully maintaining lost weight for 2–5 years, long-term success greatly increases.[70] Continued adherence to diet and exercise strategies, low levels of depression, medical reasons for weight loss, and use of meal replacements are also associated with long-term success.[70]

Pharmacological treatment of obesity

In the past decade, the withdrawal of three major anti-obesity agents (fenfluramine, sibutramine, and rimonabant) from clinical practice due to safety concerns has made medical practitioners and regulatory agencies cautious about the use of drugs. Drug treatment in general leads to 5–10% weight loss, and should only be considered by both patient and physician as an adjunct to lifestyle change requiring long-term follow-up. A major gap in the use of drug therapy is the absence of clinical trials in adolescents with severe obesity. Drugs in current use for adults are shown in the panel 1.

Long-term outcome from anti-obesity drugs

Long-term use of anti-obesity drugs was previously associated with tachyphylaxis or tolerance. The absence of indisputable evidence that drug treatment reduces obesity-related comorbidities makes health-care providers or patients reluctant to fund all or part of the cost of what must be a long-term treatment. The history of drug treatment for obesity shows unanticipated adverse events that have led to early discontinuation of treatment and in some cases drug withdrawal, which emphasises that the risks of drug therapy must be balanced against the risks of continuing obesity.

Surgical treatment of obesity

Bariatric surgery achieves greater and more sustained weight loss than non-surgical management in patients with severe obesity. Irrespective of the type, surgery improves comorbidities such as diabetes, hypertension, and health-related quality of life.[72,73] For example, the results of a recent study[51] of patients with obesity and type 2 diabetes confirmed that the combination of 12 months of medical therapy and bariatric surgery achieved glycaemic control in significantly more patients than did medical therapy alone. Mortality from diabetes, heart disease, and cancer 7 years after gastric bypass surgery was significantly reduced, although deaths from other causes were higher in the surgical group than in controls.[74] Nonetheless, few studies have compared the three most common surgical procedures (panel 2). Evidence[75] suggests a greater weight loss following Roux-en-Y gastric bypass compared with laparoscopic adjustable gastric banding, but a similar weight loss compared with laparoscopic (or open) sleeve gastrectomy. Open surgery poses a higher risk of adverse events compared with laparoscopic surgery, but no clear evidence that any one procedure leads to larger improvements in comorbidities or superior quality of life exists. Many studies are restricted by low levels of patient follow-up and inconsistent reporting of adverse events. The more immediate adverse events from surgery include anastomosis leakage, pneumonia, pulmonary embolism, band slippage, and band erosion. The operative mortality reported in the Swedish Obese Subjects Study was 0·25%.[72]

The findings of a recent review of bariatric surgery in the UK[76] emphasises the importance of additional research to explore the optimum evaluation of candidates for bariatric surgery, including psychological evaluation

and psychiatric treatment, so-called aggressive follow-up after surgery,[74] and a recommendation that surgery should only be done in specialist centres after review and evaluation by a weight assessment and management team. The team can assure that the patient is an appropriate candidate for surgery, provide more intensive medical management, or refer the patient back to the referring physician for ongoing care if the patient is not ready for more intensive medical management.[77]

Management of paediatric obesity

Recent American and Scottish guidelines provide recommendations for the assessment, prevention, and management of childhood obesity.[78,79] The recommendations provide guidance to clinicians on how to structure care delivery and emphasise the need for both primary and tertiary care approaches to managing paediatric obesity in children aged 2–17 years.

Recommendations for primary care include assessment of BMI, nutrition, and physical activity counselling to promote maintenance of healthy weight, and screening for hypertension, glucose intolerance, dyslipidaemia, and abnormal liver function. Regular visits to primary health-care providers during childhood allow the assessment of BMI trajectories and offer opportunities for prevention and treatment. In 2010, the US Preventive Services Task Force recommended[80,81] that clinicians use BMI to screen children older than 6 years of age for obesity and reaffirmed that screening and evaluation of children for obesity is an important prelude to effective treatment.

The US Expert Committee[79] proposed four stages of paediatric obesity care, beginning with brief counselling in primary care for children with mild obesity. Subsequent stages intensify efforts tailored to the severity of obesity, from multidisciplinary and structured weight management to pharmacotherapy or bariatric surgery. The US Preventive Services Task Force also found that comprehensive and intensive behavioural interventions improve weight status. When such interventions exceed the capacity of a primary-care setting within the typical visit structure, primary health-care providers could partner with specialists and community centres to provide medium-intensity to high-intensity behavioural interventions (26 contact hours).[82]

Finally, because severe obesity in youth is increasing and is unresponsive to behavioural intervention, the Expert Committee supported the use of bariatric surgery for this subset of adolescents.[79] Either Roux-en-Y gastric bypass or vertical sleeve gastrectomy are offered for youth in selected bariatric surgery centres. Bariatric surgery generally leads to substantial weight loss and improvement in obesity-related comorbidities.[83] However, perioperative risks, post-procedure nutritional risks, and the necessity of lifelong commitment to altered eating make this approach inappropriate for many. Proposed selection criteria include either BMI of at least

Panel 1: Drugs for the treatment of obesity

Drugs acting on the gastrointestinal system: pancreatic lipase inhibitors

Orlistat inhibits pancreatic and gastric lipase and thereby decreases hydrolysis of ingested triglycerides. Orlistat produces a dose-dependent reduction in dietary fat absorption and weight loss in obese patients who reduce fat intake to avoid gastrointestinal effects, such as steatorrhoea, and leakage of stool. Reduced doses of the drug have been granted a so-called over-the-counter licence in Europe and the USA. The weight loss through the use of orlistat is modest, and weight regain when the drug is stopped occurs frequently.[46] Similar to the rise in blood pressure or cholesterol following the cessation of specific therapy, weight gain is likely to occur after an anti-obesity drug is stopped.

Anti-obesity drugs targeting the CNS

Lorcaserin (Belviq; Arena Pharmaceuticals GmbH, Zofingen, Switzerland), fixed dose combination of phentermine plus topiramate (Qsymia; Vivus, Inc, Mountain View, CA, USA), and bupropion plus naltrexone (Contrave; Orexigen Therapeutics, La Jolla, CA, USA) are three drugs for obesity that act on the CNS and which have been submitted to the US Food and Drug Association (FDA) and European Medicines Agency (EMA) for regulatory assessment.

Lorcaserin is a 5-HT_{2C} agonist that provokes hypophagia by a specific action on central neural receptors. Results of several phase 3 clinical trials confirm that the modest weight loss caused by lorcaserin is comparable to that of fenfluramine.[47] Common adverse events associated with lorcaserin are consistent with its serotonergic mechanism of action and include increased incidence of blurred vision, dry mouth, dizziness, gastrointestinal disturbance, and nausea. The drug was approved for the treatment of obesity by the FDA in June, 2012, but the marketing application to EMA has been withdrawn.

Phentermine plus topiramate (Qsymia) is a fixed dose combination of phentermine, a non-selective monoamine-releasing agent licensed for 4 decades as a short-term appetite suppressant, combined with topiramate, licensed as an anticonvulsant and for migraine prevention. Results of clinical trials of combined phentermine plus topiramate in obese patients have shown greater weight loss than seen previously with orlistat, sibutramine, or rimonabant. Results of trials in obese patients with comorbidities have shown equally favourable outcomes.[48] Combined phentermine plus topiramate was approved by the FDA for the treatment of obesity in July, 2012, but was rejected by EMA because of concerns about long-term psychiatric effects and effects on the heart and blood vessels.

Bupropion plus naltrexone (Contrave) is a fixed dose combination of bupropion, a selective dopamine-reuptake inhibitor used to aid smoking cessation and treatment of depression, and naltrexone, a non-selective opioid receptor antagonist used to treat opiate-dependence and alcohol-dependence syndromes. Results of trials of combined bupropion plus naltrexone use in obesity have shown modest weight loss.[49] However, in treated patients, expected decreases in blood pressure did not occur despite weight loss, which led the FDA to require a cardiovascular outcome trial prior to a resubmission for approval.

Drugs acting on the gastrointestinal system and the CNS

Liraglutide is a glucagon-like peptide receptor agonist licensed for the treatment of type 2 diabetes. Weight reduction with liraglutide is probably a combination of effects on both the gut and the brain. Use of liraglutide, in a 20 week double-blind-placebo controlled randomized trial, followed by an 84 week open-label extension in patients with obesity with or without type 2 diabetes, caused significant weight loss compared to placebo and metformin and improved certain obesity-related risk factors. At 2 years, the incidence of prediabetes and metabolic syndrome was significantly reduced in patients given liraglutide, and blood pressure and plasma lipids decreased.[50,71] Major shortcomings are the drug cost, which is related to the dosage required to initiate and maintain weight loss and the need for a daily subcutaneous injection.

Panel 2: **Common bariatric surgical procedures**

Laparoscopic adjustable gastric banding
An adjustable silicone band is placed around the upper stomach, creating a small pouch above the band and a narrowing between the pouch and the main part of the stomach below. The diameter of the outlet can be changed by injection of or removal of saline through a portal under the skin that is connected to the band.

Roux-en-Y gastric bypass
A small pouch is created from the original stomach which remains attached to the oesophagus at one end and, at the other end, is connected to a small section of the small intestine, thus bypassing the remaining stomach and the initial loop of small intestine. The procedure can be performed either laparoscopically or by open surgery.

Laparoscopic or open sleeve gastrectomy
A procedure that involves division of the stomach vertically, reducing its size by 75%. The pyloric valve at the bottom of the stomach is left intact such that stomach function and digestion remain unaltered. The procedure is not reversible and might be a first stage procedure to Roux-en-Y gastric bypass or duodenal switch.

40 kg/m² in addition to a medical condition or a BMI of at least 50 kg/m², physical maturity (for girls, this requires minimum 13 years of age; for boys, minimum 15 years of age), emotional and cognitive maturity, and weight loss efforts for at least 6 months in a behaviour-based treatment programme.[83] Adolescents who undergo bariatric surgery need careful evaluation before surgery and potentially lifelong nutritional and psychological support after surgery.

Shortcomings in paediatric obesity assessment

Since 1998, when the first American recommendations on the assessment and treatment of childhood obesity were released, paediatric health professionals have often failed to diagnose childhood obesity and only inconsistently use BMI[84] or provide nutrition and physical activity counselling.[85] Recent trends confirm that whereas more parents reported having been told that their child was overweight or obese in 2007–08 than in 1999–2000, only a quarter of parents of overweight children were told that their child was overweight.[86] System-wide changes to encourage adoption of standardised practice approaches to obesity management in primary care can address these gaps.[6,87]

Innovative strategies for delivery and management of obesity care in children and adults

US federal funding has supported the use of information technology to improve the diagnosis, counselling, and referral of children with obesity.[88] To improve diagnosis and counselling in primary care, the American Government has collaborated with the American Academy of Pediatrics in the Let's Move in the Clinic initiative to give health professionals internet-based resources for BMI, diet, and activity screening in primary care in addition to counselling and advocacy methods.[89] Innovations in obesity management also include shared care approaches, such as the Australian HopSCOTCH study, which tested comanagement of obesity by paediatric obesity specialists and primary health-care providers.[90] Although this approach was well received, outcomes in the intervention and control groups were similar, perhaps because the intervention lacked sufficient intensity.

Care for adults with severe obesity has generally been delivered in tertiary-care centres. Although such programmes are efficacious, they are poorly suited to address the number of patients with severe obesity. Alternative approaches for the management of adults with severe obesity include primary-care settings or community settings to deliver care. The results of a clinical trial[91] that trained primary-care health professionals in the treatment of severe obesity showed that 31% of patients in an intensive intervention group achieved weight loss of at least 5%, and 7% of patients achieved weight loss of at least 20%. Transition from efficacy to effectiveness will require substantial and challenging changes in how primary care is delivered. Practices often lack the organisational structure, such as patient registries and methods for systematic tracking to assess clinical interventions, care teams to manage patients with chronic illnesses, or health information systems that support the use of evidence-based practices at the point-of-care to provide longitudinal care for chronic illnesses.[92]

Programmes, such as the Mind, Exercise, Nutrition, Do it (MEND) Programme[93] and a multi-component community-based childhood obesity intervention known as EPODE,[94] have effectively improved child weight status and could serve as scalable community-based programmes that extend the reach of health-care delivery systems. The results of the Diabetes Prevention Program,[95] a randomised clinical trial that found more weight loss with lifestyle modification than medication, have been successfully replicated in the YMCA.[96] This model is scalable[97] and appears to save costs.[98] The success of this trial was attributable to dedicated support from multiprofessional teams and a departure from the acute care model.

Technological innovations in obesity care and management

Innovative uses of health information technology, such as electronic health records, can accelerate improvement of adult and childhood obesity management.[99,100] Although many medical practices do not have fully functional electronic health records, they are likely to become widely used in the next decade, and innovative strategies that

take advantage of this new technology can assess and improve quality of care. In management of paediatric obesity, rates of documented counselling approached 97% after 1 year of electronic health records enhancement.[101]

Telephone support has been employed to deliver motivational interviewing for behaviour change.[102] Strategies based on mobile technology, such as text messaging, have been used to provide outreach and support for behaviour change to patients. Text messages and other remote technologies have also been used for self-monitoring and as a means to communicate educational messages for management of obesity.[103] The authors of a review of interactive electronic interventions for the prevention or treatment of obesity in youth concluded that, although the studies were generally of poor quality and intervention effects were modest, electronic approaches seemed promising.[104]

Other new technologies include wi-fi scales, which automatically transmit weight from scale to server, and smartphones and tablets with weight loss applications to simplify monitoring of food intake, physical activity, and weight. The effectiveness of innovative weight-loss interventions in clinical practice has been compared. Weight loss achieved by patients involved in remote interventions by telephone, study-specific website, and email was similar to that achieved by face-to-face support. Remote support offers flexibility to patients and practitioners and can be scaled up or down according to patients' needs.[105]

Hospitals and health professionals as role models

As with social norms related to tobacco, physicians and hospitals could play a major part in changing social norms related to nutrition, physical activity, and obesity. The decision of physicians to stop smoking and that of hospitals to discontinue the sales of cigarettes in vending machines and gift shops sent an important message to patients and the public, and probably contributed to the change in social norms related to smoking. Just as physicians who smoke are less likely to counsel about tobacco cessation,[106] a physician's own BMI predicts the likelihood that they will counsel patients with obesity.[107]

Hospitals can also model healthy institutional behaviours, such as the provision of healthy food choices for patients, employers, and communities. An innovative programme in Boston, MA, USA, showed that labelling of drinks sold in hospital cafeterias as red, yellow, or green shifted consumption towards more healthy beverages.[108] In North Carolina, USA, a programme instituted in hospitals throughout the state provides access to healthy foods at all times, using standard nutrition criteria, promotes healthy items with pricing incentives, and actively promotes, markets, and labels healthy foods to staff and visitors.[109] Concerns about the positioning of fast-food outlets in hospital foyers have also been raised, and a campaign to remove such outlets from hospital premises has been launched.[110]

Institutions and community partnerships

Environmental changes will probably not achieve the caloric deficits necessary to treat severe obesity, but they will help to sustain weight loss after it occurs. Therefore, both public health and clinical strategies need to become mutually reinforcing, beginning with interprofessional education and extending to integrated partnerships between the clinic and community. Although the primary-care setting provides an important site for obesity intervention and prevention, maximum effectiveness will need structured and scalable interventions within large health-care systems that extend to settings where patients spend most of their time, which is mainly their homes and communities. The most promising approaches for childhood obesity prevention and management are the sustainable and multisectoral strategies that support change at the individual and community levels, but few have been tested. Finally, although general agreement exists in guidelines that obesity care should be family-centred, involve effective communication strategies, and be informed by tenets of behaviour change theory, good models do not exist or show little effectiveness.[111]

In the USA, several efforts are underway to increase participation of medical care providers in obesity-related community-based initiatives. A Community Paediatric Training Initiative,[112] sponsored by the American Academy of Pediatrics, has developed a public health curriculum for residency training programmes that engages paediatric residents in community programmes. Be Our Voice[113] is a joint programme, administered by the National Initiative for Children's Healthcare Quality and the American Academy of Pediatrics, that provides advocacy training for health-care providers to manage obesity in their communities. Such efforts are not yet widespread, and few assessments of these programmes have been done.

In addition to modelling healthy practices, hospitals could invest in community programmes. Kaiser Permanente's community programmes[114] directed at obesity provide an excellent example of the effect of such investments. An important adaptation of EPODE in the Netherlands has linked health care and obesity prevention by including health professionals in community-based initiatives to increase healthy eating and physical activity.[115]

Challenges in low-income and middle-income countries

The approach to obesity in low-income and middle-income countries is complicated by major nutritional transitions in the past several decades.[116] In these environments, stunting of child growth persists, but obesity has become the most prevalent form of undernutrition. Moreover, both stunting and obesity constitute a double burden that can affect the same population and the same individual. The double burden is characterised by undernourished infants who do not develop their full height but also have an increased BMI and increased central adiposity, with its attendant metabolic complications.

For the **WHO growth reference curves** see http://www.who.int/childgrowth/mgrs/en/

As in high-income countries, prevention needs monitoring of early growth. The new normative WHO reference curves provide a standard for optimum growth for 0–2-year-old children. The measurement of stature is at least, if not more, important than weight because feeding energy-dense and micronutrient-poor diets to stunted paediatric populations might promote obesity.[116] Later in childhood, the standards for ideal growth in youth approximate those in high-income countries. Standard cutpoints for the identification of adult overweight (BMI 25·0–29·9) and obesity (BMI ≥30) are generally the same in low-income and high-income countries. However, adverse consequences of increased weight are seen at lower BMIs in some Asian countries suggesting that cutpoints for overweight and obesity for certain populations may need to be revised.

Because public health programmes and health professionals in low-income and middle-income countries focus on the prevention of undernutrition, educational efforts need to be directed towards obesity and its associated disease burden. Experience with the prevention and treatment of obesity in stunted children is scarce and must be approached cautiously to preserve linear growth while simultaneously controlling excess weight gain. Feeding programmes that promote calorie-dense diets need to recognise that protein and caloric requirements are much lower than the norms established for malnourished patients.[117] For example, low protein consumption in infants participating in a randomised clinical trial was associated with no significant differences in linear growth at age 2 years.[118] However, weight-for-length *Z* scores were lower in children on a low-protein formula than they were in infants fed the high-protein formula and did not differ significantly from those in breastfed infants.

Medical and public health approaches are common to both high-income and low-income countries. As in developed countries, physicians and other relevant health-care professionals need to become part of a team that will guide treatment and prevention. Moreover, access to medical care and obesity treatment without actions to modify the food and physical activity environments that promote healthful diets and active living will not achieve lasting changes in food intake and physical behaviour.

Conclusion

Therapy for obesity will need changes in the clinical delivery system to accommodate the prevalence of the disease and improvement of training to equip health-care providers with the skills necessary for treatment. Efforts to train professionals with behavioural skills, ability to work in teams, and to link clinical and community resources have just begun. Strategies to reduce the health professional bias that impairs care have not been widely disseminated. The most elemental skills, such as sensible wording with patients about their bodyweight and an ability to assess readiness to change, do not appear to have been widely instituted. Successful clinical interventions exist, but innovative approaches to delivery of care have only just begun. Taxpayers, agencies, and governments need to redefine professional competencies and licensing that address obesity, provide incentives for care, and nurture and reward innovative approaches to the prevention and management of obesity. Lower-income and middle-income countries need to balance the challenge of reduction of the nutritional determinants of stunting in children, without increasing the likelihood of obesity, and reorient adult heath care towards the prevention and treatment of obesity.

Contributors

WHD conceived the overall scope of the report and assembled and edited the early and final drafts. WHD and PK were primarily responsible for the revisions and resubmission of the report, with contributions from LAB (education of health professionals), KH (energy intake needed for weight loss and weight maintenance after loss), RMP (weight bias), EMT (paediatric obesity), RU (challenges of obesity prevention, and treatment in developing countries), and PK (obesity management in adults). All of the authors reviewed and approved the final draft.

Declaration of interests

WHD declares consulting fees and travel reimbursement from the JPB Foundation, the Institute of Medicine, the Cardinal Health Foundation, and the State of Kansas: and honoraria and travel support from the Kansas Health Foundation, Case Western Reserve University, Cleveland Town Hall, and the National Institute for Health Care Management. KH has a patent pending for the personalised dynamic feedback control of body weight. LAB, RMP, EMT, RU, and PK declare no competing interests.

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