Periodic health examination, 1999 update: 1. Detection, prevention and treatment of obesity

Education

Éducation

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Abstract

Objectives: (1) To evaluate the evidence relating to the effectiveness of methods to prevent and treat obesity, and (2) to provide recommendations for the prevention and treatment of obesity in adults aged 18 to 65 years and for the measurement of the body mass index (BMI) as part of a periodic health examination.

Options: In adults with obesity (BMI greater than 27) management options include weight reduction, prevention of further weight gain or no intervention.

Outcomes: The long-term (more than 2 years) effectiveness of (a) methods to prevent obesity and (b) methods to treat obesity.

Evidence: MEDLINE was searched for articles published from 1966 to April 1998 that related to the prevention and treatment of obesity; additional articles were identified from the bibliographies of review articles and the listings of *Current Contents*. Selection criteria were used to limit the analysis to prospective studies with at least 2 years' follow-up.

Benefits, harm and costs: Health benefits of weight reduction were evaluated in terms of alleviation of symptoms, improved management of obesity-related diseases and a reduction in major clinical outcomes. The health risks of weight-reduction methods were briefly evaluated in terms of increased mortality and morbidity.

Values: The recommendations of this report reflect the commitment of the Canadian Task Force on Preventive Health Care to provide a structured, evidence-based appraisal of whether a manoeuvre should be part of a periodic health examination.

Recommendations: (1) *Prevention:* There is insufficient evidence to recommend in favour of or against community-based obesity prevention programs; however, because of considerable health risks associated with obesity and the limited long-term effectiveness of weight-reduction methods, the prevention of obesity should be a high priority for health care providers (grade C recommendation). (2) *Treatment:* (a) For obese adults without obesity-related diseases, there is insufficient evidence to recommend in favour of or against weight-reduction therapy because of a lack of evidence supporting the long-term effectiveness of weight-reduction methods (grade C recommendation); (b) for obese adults with obesity-related diseases (e.g., diabetes mellitus, hypertension), weight reduction is recommended because it can alleviate symptoms and reduce drug therapy requirements, at least in the short term (grade B recommendation). (3) *Detection:* (a) for people without obesity-related diseases, there is insufficient evidence to recommend the inclusion or exclusion of BMI measurement as part of a periodic health examiantion, and therefore BMI measurement is left to the discretion of individual health care providers (grade C recommendation); (b) for people with obesity-related diseases, BMI measurement is recommended because weight reduction should be considered with a BMI of more than 27 (grade B recommendation).

Validation: The findings of this analysis were reviewed through an iterative process by the members of the Canadian Task Force on Preventive Health Care.

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Résumé

Objectifs : 1) Évaluer de façon critique les données probantes qui ont trait à l'efficacité des méthodes de prévention et de traitement de l'obésité et 2) formuler des recommandations sur la prévention et le traitement de l'obésité chez les adultes de 18 à 65 ans et sur la mesure de l'indice de masse corporelle (IMC) pendant un examen médical périodique.

Options : Chez les adultes atteints d'obésité (IMC de plus de 27), les options de prise en charge comprennent la perte de poids, la prévention de toute autre prise de poids, ou aucune intervention.

Résultats : Efficacité à long terme (plus de deux ans) des méthodes de a) prévention et b) traitement de l'obésité.

Données probantes : On a cherché dans MEDLINE des articles sur la prévention et le traitement de l'obésité publiés de 1966 à avril 1998. On a repéré d'autres articles dans les bibliographies d'analyses critiques et les listes de *Current Contents*. On a utilisé des critères de sélection pour limiter l'analyse aux études prospectives comportant un suivi d'au moins deux ans.

Avantages, préjudices et coûts : Les avantages de la réduction du poids pour la santé ont été évalués en fonction de l'atténuation des symptômes, de l'amélioration de la prise en charge des affections liées à l'obésité et d'une réduction des principaux résultats cliniques. Les risques que présentent pour la santé les méthodes de réduction du poids ont été évalués brièvement en fonction de la mortalité et de la morbidité accrues.

Valeurs : Les recommandations contenues dans le rapport reflètent l'engagement du Groupe d'étude canadien sur les soins de santé préventifs de fournir une évaluation structurée fondée sur des données probantes quant à savoir si une manœuvre donnée devrait faire partie d'un examen médical périodique.

Recommandations : 1) *Prévention :* Il n'y a pas suffisamment de données probantes pour formuler des recommandations favorables ou défavorables à des programmes communautaires de prévention de l'obésité, mais à cause des risques considérables pour la santé qu'on associe à l'obésité et de l'efficacité à long terme limitée des méthodes de réduction du poids, la prévention de l'obésité devrait constituer une grande priorité pour les fournisseurs de soins de santé (recommandation de catégorie C). 2) *Traitement :* a) Dans le cas des adultes obèses qui n'ont pas d'affection liée à l'obésité, il n'y a pas suffisamment de données probantes pour formuler des recommandations favorables ou défavorables à un traitement de réduction du poids, parce qu'il n'y a pas de données probantes à l'appui de l'efficacité à long terme des méthodes de réduction du poids (recommandation de catégorie C); b) dans le cas des adultes obèses qui ont une affection liée à l'obésité (p. ex., diabète, hypertension), on recommande une réduction du poids pour atténuer les symptômes et réduire la pharmacothérapie requise, au moins à court terme (recommandation de catégorie B). 3) *Mesure de l'IMC :* a) chez les personnes qui n'ont pas d'affection liée à l'obésité, il n'y a pas suffisamment de données probantes pour recommander l'inclusion ou l'exclusion de la mesure de l'IMC dans le cadre de l'examen médical périodique et c'est pourquoi la mesure de l'IMC est laissée à la discrétion de chaque fournisseur de soins de santé (recommandation de catégorie C); b) dans le cas des personnes qui ont une affection liée à l'obésité, on recommande de mesurer l'IMC parce qu'il faudrait envisager une réduction du poids si l'IMC dépasse 27 (recommandation de catégorie B).

Validation : Les membres du Groupe d'étude canadien sur les soins de santé préventifs ont revu les résultats de cette analyse au moyen d'un exercice d'itération.

Commanditaires : Le Groupe d'étude canadien sur les soins de santé préventifs est financé par un partenariat établi entre les ministères provinciaux et territoriaux de la Santé et Santé Canada.

Obesity, defined by a body mass index (BMI) of more than 27, is a highly prevalent condition that affects 35% of men and 27% of women in Canada.[1,2] Morbid obesity, defined by a BMI of more than 35, is found in 2% of men and 4% of women.[1,2] It is well established that obesity is associated with a substantial burden of illness.[3–6] Obesity is associated with the development of several diseases, including hypertension,[7,8] diabetes mellitus,[9,10] hyperlipidemia,[8,11,12] coronary artery disease,[13–16] obstructive sleep apnea,[17,18] and cancers of the breast,[19,20] uterus,[21] prostate[22,23] and colon.[24] It is also associated with psychological disorders, including depression, anorexia nervosa and bulimia.[25–27] Furthermore, obesity is an independent risk factor for increased mortality.[11,28–30]

To address the importance of obesity as a public health issue, the Canadian Guidelines for Healthy Weights[31] and the Report of the Task Force on the Treatment of Obesity[32] were published in 1988 and 1991 respectively. Both reports recognized that men and women with obesity are at increased risk for health-related problems and recommended interventions for the prevention and treatment of obesity. Although these reports provided useful treatment guidelines, emphasis was placed on the need to regulate dietary methods of treatment, particularly commercially available diets. Weight-reduction methods also include pharmacologic, surgical and behavioural treatments. Also, these reports did not review the effectiveness of methods to prevent and treat obesity.

The objectives of this review by the Canadian Task Force on Preventive Health Care (formerly the Canadian Task Force on the Periodic Health Examination) are (a) to evaluate the evidence relating to the long-term effectiveness of methods to prevent and treat obesity, and (b) to provide recommendations for the prevention and treatment of obesity in adults aged 18 to 65 years and for the measurement of the BMI as part of a periodic health examination.

Methods

MEDLINE was searched for articles in English published from 1966 to April 1998 that related to the prevention and treatment of obesity. The key words used for the search were "obesity" and "body mass index," and the MeSH terms used were "diet therapy," "drug therapy," "prevention and control," "surgery" and "therapy." Additional articles were identified by scanning the bibliographies of review articles and the listings of *Current Contents*. To limit the analysis to studies with the highest methodologic quality, study-selection criteria were developed a priori. Studies were included if they met the following criteria: (a) the study was either a prospective cohort study or a randomized controlled trial investigating the prevention of obesity or the treatment of obesity with dietary, pharmacologic, surgical, dietary counselling or behavioural methods of weight reduction; (b) the duration of patient follow-up was at least 2 years (1 year if the study involved anorectic drugs, because a preliminary scan of these articles revealed that there were only 2 such studies with a follow-up of at least 2 years); (c) the main outcome measure was the effect of the weight-reduction intervention on body weight or BMI; and (d) at least 50 patients were included. Studies meeting those criteria were excluded if (a) there was nonconsecutive selection of patients; (b) there was no documentation of patients lost to follow-up in treatment studies; and (c) the weight-reduction interventions are considered unsafe and are not recommended for use (e.g., complete fasting, jaw wiring, intestinal bypass surgery). In studies with multiple publications, the version with the longest follow-up duration was included in the analysis.

All eligible studies were reviewed and data extraction was performed by one of us (J.D.D.). Part of the literature search, from 1994 to April 1998, and the data extraction from a randomly selected subgroup of included studies was duplicated independently by another author (J.A.) to assess agreement in study selection and outcome reporting. Agreement was evaluated using the κ statistic, and disagreements were resolved by consensus.[33] The grading of the recommendations in this report was based on the grading system established by the Canadian Task Force on Preventive Health Care (Appendix 1).[34,35]

Manoeuvre

In North America the BMI is widely used to distinguish between obese and nonobese adults aged 18 to 65. In this population the BMI is a reliable measure of adiposity because it correlates strongly with body weight while adjusting for height.[36–41] Thus, a taller person, with a large bone and muscle mass, will have a greater BMI than a shorter person only if there is increased adipose tissue to account for the greater body weight. The measurement of the BMI is easily performed, and it has greater reproducibility than other measures of adiposity such as skinfold thickness indices.[38,40,41] One limitation of the BMI is that it cannot distinguish between increased weight due to adiposity or fluid retention, although this should be evident clinically. In recent years, body circumference indices (e.g., waist circumference, waist:height circumference ratio, waist:hip circumference ratio) have been advocated because they can identify adults with a central (android) pattern of obesity, who are at higher risk of obesity-related health problems, independent of the BMI.[42–46] In future, it is likely that body circumference indices will complement the BMI measurement in the

evaluation of the health risks in adults with obesity.[46,47] However, at present, use of these indices is limited by a lack of established normal reference ranges for adult men and women.

Findings

Of 813 retrieved studies, 68 satisfied the inclusion criteria, of which 29 were excluded because of one or more exclusion criteria; this left 39 studies in the analysis.[48–86] Three studies investigated the effectiveness of obesity prevention,[48–50] and 36 investigated the effectiveness of weight-reduction interventions (14 dietary, 8 anorectic drug therapy, 9 dietary counselling or behavioural therapy, 5 surgical).[51–86] There was moderate to high interrater agreement in the selection of studies (κ value 0.70) and the documentation of outcomes (κ value 0.66).[87]

Effectiveness of obesity prevention

Three studies investigated the effectiveness of community-based health promotion programs aimed at reducing the prevalence of cardiovascular risk factors such as obesity, and encouraging weight reduction (Table 1).[48–50] All used a prospective cohort design in which experimental communities were exposed to a health promotion intervention that included seminars, mailed educational packages and mass media participation, with demographically similar control communities that were not exposed to these interventions. In all of the studies, the mean weight of the intervention and control communities did not differ significantly during a 3- to 7-year follow-up period. However, there were several methodologic problems that limit the conclusions of these studies. None of the 3 studies defined criteria for a successful outcome, and only one reported on weight reduction achieved in different age and gender groups in the intervention and control communities.[49] Other methodologic limitations included a high rate of patient withdrawal, reliance on self-reported body weights to monitor weight changes during the follow-up period and a lack of information relating to the costs and feasibility of implementing these programs.

Effectiveness of obesity treatment

Dietary therapy

Dietary therapy for obesity has been investigated usually in combination with other weight-reduction methods, including behavioural therapy, dietary counselling and exercise programs. The 2 main types of dietary therapy are a low-calorie diet, which provides 800 to 1500 kcal (3300 to 6300 kJ) of energy daily, and a very-low-calorie diet, which provides less than 800 kcal of energy daily and usually consists of a protein-enriched liquid. Eight randomized controlled trials and 6 prospective cohort studies were included in this analysis (Table 2).[51–64]

In the randomized controlled trials weight reduction was most effective during the period of supervised dietary treatment, but across studies there was a pattern of gradual weight regain during the subsequent unsupervised follow-up period. At the end of follow-up the mean weight reduction was relatively modest in most studies (2–6 kg). One study reported a considerable mean weight reduction of 8.7 kg after a 7-year follow-up in men who were randomly assigned to receive a low-calorie diet and long-term dietary and lifestyle counselling.[54] However, women allocated to the same treatment group only achieved a mean weight reduction of 3.5 kg. Of the 6

Table 1: Studies of the effectiveness of community-based programs for obesity prevention

Study	Study populations	Length of follow-up	Patients lost to follow-up	Intervention groups	Mean baseline BMI	Mean weight loss/gain at follow-up, kg	Comments
Fortmann et al[48]	3 North California communities: 2 intervention (n = 748), 1 control (n = 365)	2 yr	NA	A: Education (mass media, group seminars and literature, cookbooks) (B: Control)	NA	NA	Mean weight in control group 1% higher than in intervention groups
Barr-Taylor et al[49]	4 North California communities: 2 intervention (n = 2504), 2 control (n = 2504)	6 yr	54% (mainly due to migration)	A: Education (mass media, workshops and literature) (B: Control)	A: 25.2 B: 24.8	A: +0.6 B: +1.2	Mean BMI did not differ significantly between groups A and B
Jeffery[50]	6 Minnesota communities: 3 intervention (n = 3527), 3 control (n = 3445)	7 yr	NA	A: Education (mass media, community advisory board, physician-based education, restaurant programs) (B: Control)	A: 25.6 B: 25.8	A: +0.5 B: +0.7	Mean BMI did not differ significantly between groups A and B

Note: NA = data not available for individual intervention groups, BMI = body mass index.

prospective cohort studies, one reported a mean weight regain of 52% after 2 years[62] and another a mean weight regain of 61% among women and 64% among men after 42 months.[63] In 2 other cohort studies with similar follow-up durations (2 and 2.5 years), weight loss varied widely, with reported mean weight losses of 5.8 kg[60] and 13.1 kg.[61] In another prospective cohort study with a 5-year follow-up,[59] one patient group that received a very-low-calorie diet and behavioural therapy had a mean weight reduction of 16.9 kg, but this was observed in only 13 of 59 patients who completed follow-up. Among the patients in this group who did not complete the 5-year follow-up, the mean net weight gain was 5.2 kg. Another study reported a considerable mean weight reduction of 10.6 kg in a cohort of 56 patients during a 10- to 12-year follow-up.[64] This group received a very-low-calorie diet along with behavioural therapy and dietary counselling throughout the follow-up period. Overall,

Table 2: Studies of the effectiveness of dietary therapy for obesity

Study	No. of patients (no. of women)	Length of follow-up	Patients lost to follow-up	Intervention groups	Mean baseline BMI or weight	Mean weight loss/gain at follow-up, kg	Comments
Randomized controlled trials							
Hakala et al[51]	60 (40)	5 yr	7	A: LCD + group counselling B: LCD + individual counselling	BMI 41.7–43.6	A: –2.1 to –3.0 B: –3.4 to –12.9	A: Regain: 86% of weight loss among women, 80% among men B: Regain: 71% of weight loss among women, 50% among men
Miura et al[52]	70 (46)	2 yr	0	A: VLCD B: VLCD + BT C: BT	Weight 37%–65% above ideal	A: –4.5 B: –1.3 C: No change	–
Wadden et al[53]	76 (76)	5 yr	21	A: VLCD B: VLCD + BT C: BT	BMI 39.4	A: +1.0 B: +2.7 C: +2.9	64% regained all weight loss, 18% maintained loss of 0.1–5.0 kg, 18% maintained loss of > 5 kg
Karvetti et al[54]	189 (147)	7 yr	110	A: LCD B: LCD + counselling	A: BMI 33.5 B: BMI 34.3	A: NA B: –3.5 women; –8.7 men	–
Skender et al[55]	127 (61)	2 yr	66	A: LCD B: Exercise C: LCD + Exercise	A: 98.5 kg B: 93.1 kg C: 100.1 kg	A: +0.9 B: –2.7 C: –2.2	–
Torgerson et al[56]	113 (74)	2 yr	26	A: VLCD + counselling B: Counselling	A: 116.2 kg B: 116.6 kg	A: –9.2 B: –6.3	A: 45% of women, 75% of men had weight loss > 5 kg B: 50% of women, 40% of men had weight loss > 5 kg
Ryttig et al[57]	81 (44)	26 mo	39	A: VLCD + BT B: VLCD + LCD C: VLCD + VLCD	A: 116.2 kg B: 113.2 kg C: 113.2 kg	A: –5.5 B: –5.9 C: –5.7	–
King et al[58]	103 (0)	2 yr	30	A: LCD + counselling B: LCD C: Exercise + counselling D: Exercise	A: 85.7 kg B: 83.4 kg C: 91.0 kg D: 86.2 kg	A: –4.4 B: –3.3 C: –3.7 D: –1.6	–
Prospective cohort studies							
Pekkarinen et al[59]	59 (34)	5 yr	8	A: VLCD + BT B: BT	A: 131.2 kg B: 134.2 kg	A: –16.9 B: –4.9	Mean weight gain among patients who did not complete treatment (A: +5.2 kg [*n* = 12], B: +13.0 kg [*n* = 3])
Pekkarinen et al[60]	62 (57)	2 yr	5	VLCD	99.0 kg	–5.8	19 patients did not regain weight, 24 regained 70% of lost weight, and 13 regained 100% of lost weight
Nunn et al[61]	60 (44)	2.5 yr	3	VLCD + BT	104.3 kg	–13.1	–
Anderson et al[62]	80 (55)	2 yr	34	VLCD + BT + counselling	BMI > 40	NA	Mean regain 52% of lost weight
Anderson et al[63]	100 (71)	42 mo	42	VLCD + BT + counselling	Women 93.7 kg; Men 115.7 kg	Women –7.3; Men –7.2	Mean regain 61% of lost weight among women and 64% among men
Bjorvell et al[64]	68 (53)	10–12 yr	12	VLCD + BT + counselling + exercise	BMI 41.0	–10.6	–

Note: LCD = low-calorie diet, VLCD = very-low-calorie diet, BT = behavioural therapy.

the magnitude of weight reduction and the proportion of patients with sustained weight reduction was better in the observational (cohort) studies, although in all studies there was a consistent pattern of initial weight loss followed by gradual weight regain.

Anorectic drug therapy

Appetite suppressants investigated for the treatment of obesity include fluoxetine, a selective serotonin re-uptake inhibitor, fenfluramine and dexfenfluramine, which are serotonergic agents, and phenteramine and mazindol, which are noradrenergic agents. Eight randomized controlled trials of the long-term (at least 1 year) effectiveness of anorectic drug therapy were included in this analysis (Table 3).[65–72] In these studies all patients received some form of weight-reduction therapy and were randomly assigned, either as part of a single-phase or a multiphase crossover protocol, to receive an appetite suppressant or placebo. In 7 of the 8 studies with a 1- to 2-year follow-up,[66–68,70–72] there was a statistically significant difference in weight reduction during the initial phase of treatment (first 12 to 24 weeks) in favour of the appetite suppressant group, but after this period there was a general regaining of weight in all patient groups. At the end of follow-up, 2 studies reported a statistically significant difference in the mean weight between the treatment and placebo groups.[66,67] In the remaining study, which had a 52-month follow-up, 121 patients received either a combination of fenfluramine and phenteramine or placebo as part of a multiphase, randomized crossover study design.[69] At the end of follow-up, 48 of the patients were still participating in the study, of whom 13 had maintained a weight reduction of 5% or more of their baseline weight. In general, although the combination of diet and appetite suppressants appears to be effective during the first 6 months of treatment, long-term effectiveness beyond 1 year has not been demonstrated except in a small proportion of patients from a single study.[69]

Surgery

Bariatric or weight-reduction surgery is usually considered for people with morbid obesity who are refractory to other weight-reduction interventions.[88] Bariatric surgery consists of several techniques, each of which may vary depending on the surgeon or clinical centre with this expertise. In general, currently accepted surgical procedures fall into 2 categories: gastric bypass, which involves complete gastric partitioning with anastomosis of the proximal gas-

Table 3: Randomized controlled trials of the effectiveness of the pharmacologic treatment of obesity

Study	No. of patients (no. of women)	Length of follow-up	Patients lost to follow-up	Intervention groups	Mean baseline weight or BMI	Mean weight loss/gain at follow-up, kg	Comments
Goldstein et al[65]	458 (371)	12 mo	245	A: LCD + fluoxetine 60 mg once daily B: LCD + placebo	A: BMI 36.2 B: BMI 35.8	A: –1.7 B: –2.1	–
Guy-Grand et al[66]	882 (662)	12 mo	339	A: LCD + dexfenfluramine 15 mg bid B: LCD + placebo	A: 96.6 kg B: 98.0 kg	A: –9.8 B: –7.2	–
Mathus-Vliegen et al[67]	75 (64)	12 mo	10	A: LCD + dexfenfluramine 15 mg bid B: LCD + placebo	A: BMI 39.9 B: BMI 38.2	A: –10.7 B: –8.0	A: 8% of male patients with > 20% weight loss B: 5% of patients with > 20% weight loss
Enzi et al[68]	158 (47)	12 mo	49	A: Mazindol B: LCD C: Placebo (multiphase crossover study)	Weight > 50% above ideal	A: –10.2 B: –7.2 C: –9.5	–
Weintraub[69]	121 (90)	52 mo	73	A: LCD + phenteramine 15 mg once daily + fenfluramine 60 mg once daily B: Placebo (multiphase crossover study)	A: weight 55% above ideal B: weight 54% above ideal	NA	All patients: 13 of 48 remaining in study had weight reduction of > 5% of baseline weight
O'Connor et al[70]	60 (39)	12 mo	26	A: LCD + dexfenfluramine 15 mg bid B: LCD + placebo	A: BMI 34.8 B: BMI 35.6	A: –6.0 B: –6.2	–
Stunkard et al[71]	134 (NA)	24 mo	54	A: BT B: Fenfluramine C: BT + fenfluramine	NA	A: –9.0 B: –6.3 C: –4.6	–
Manning et al[72]	147 (77)	12 mo	49	A: Counselling (clinic) B: BT C: Dexfenfluramine 15 mg bid D: Counselling (clinic, home)	A: BMI 31.2 B: BMI 32.2 C: BMI 33.4 D: BMI 32.0	A: –2.0 B: –3.1 C: –3.1 D: –1.0	–

tric segment to a jejunal loop, and gastroplasty, which involves partial gastric partitioning at the proximal gastric segment with placement of a gastric outlet stoma of fixed diameter. Both methods are intended to create an upper gastric pouch that reduces gastric luminal capacity and causes early satiety. Four randomized controlled trials and one prospective cohort study were included in this analysis (Table 4).[73–77] All studies reported long-term success in sustaining initial weight reduction that occurred during the first 3 to 6 months following surgery. In general, the magnitude of weight loss with surgical therapy was greater than that observed with dietary or drug treatments. In the studies that reported the mean weight loss in the study population, it was 27.6 to 45.5 kg. In the 5 studies postoperative mortality was low, with one surgery-related death overall. Postoperative morbidity was usually secondary to infection (wound-related, subphrenic abscess, pneumonia) or pulmonary complications (atelectasis, pulmonary edema) and occurred in less than 5% of patients across the studies. The need for reoperation either because of a surgery-related complication (revision of procedure) or a complication related to weight loss (acute cholecystitis) varied widely across the studies, from 1.7% to 7.1% in 3 studies,[73,76,77] and from 20.3% to 33.3% in the 2 other studies.[74,75]

Dietary counselling and behavioural therapy

Dietary counselling usually consists of individual or group sessions dealing with dietary and lifestyle modifications as well as reinforcement of behavioural therapy principles. Behavioural therapy, which consists of cognitive behaviour modification and behavioural skills training, is aimed at modifying eating and physical activity habits as a means of preventing regain of weight lost and is often used as an adjunct to dietary therapy. Five randomized trials and 4 prospective cohort studies were included in this analysis (Table 5).[78–86] Overall, the mean weight reduction across the studies was modest (1 to 5 kg), with a pattern of weight loss during the initial 6 to 12 months followed by gradual weight regain during the subsequent follow-up period. However, in 2 studies that reported on the proportion of patients that achieved a predetermined weight-reduction goal, 39% and 34% of the patients sustained a 4.5-kg weight loss over 4 years.[80,82] Thus, modest weight loss appears to be sustainable over the long-term in a small proportion of patients who receive long-term dietary counselling with or without behavioural therapy.

Methodologic quality of obesity treatment studies

Despite our attempts to identify studies with the highest methodologic quality, most studies in this analysis had methodologic problems that limited the interpretation of their results and strength of their conclusions.

First, in all but 2 of the 33 studies[59,65] the effectiveness of weight reduction, as determined by the change in weight or BMI, was reported only for patients who remained in the study at the end of follow-up. This may exaggerate the effectiveness of weight-reduction methods if patients who achieved greater weight reduction were more likely to remain in the study.

Second, methods of patient recruitment were not clearly specified in all studies. Of 17 studies that did specify recruitment methods, 5 involved random selection of patients from a clinic population,[57,78,80–82] 10 recruited pa-

Table 4: Studies of the effectiveness of surgical treatment of obesity

Study	No. of patients (no. of women)	Length of follow-up	Patients lost to follow-up	Intervention groups	Mean baseline weight or BMI	Mean weight loss/gain at follow-up, kg	Comments
Randomized controlled trials							
Andersen et al[73]	57 (50)	5 yr	1	A: VLCD B: LCD + gastroplasty	A: 115 kg B: 120 kg	A: –26.8 B: –18.2	A: 21/30 patients regained most weight loss (within 1 kg of baseline weight) B: 16/27 patients regained most weight loss (within 1 kg of baseline weight)
Hall et al[74]	310 (288)	3 yr	52	A: Gastric bypass B: Gastroplasty C: Gastrogastrostomy	A: 110 kg B: 112 kg C: 115 kg	A: –17 B: –31 C: –39	66% of patients in group A, 44% in group B and 16% in group C had > 50% excess weight loss
Naslund et al[75]	57 (51)	2 yr	0	A: Gastric bypass B: Gastroplasty	A: 117.7 kg B: 117.8 kg	A: –42.9 B: –27.6	–
Lechner et al[76]	112 (NA)			A: Gastric bypass B: Gastroplasty	A: 119.9 kg B: 118.6 kg	A: –45.5 B: –28.8	–
Prospective cohort study							
Ashley et al[77]	114 (96)	6–48 mo	5	Gastroplasty	BMI 44.8	NA	31 of 47 patients followed up for 2 yr regained > 50% of lost weight

tients using media advertisements,[51,56,58,60,61,65,71,79,84,86] and 2 studies excluded patients who were considered to have "unrealistic" weight-reduction expectations.[66,67] Furthermore, 5 studies provided patients with a financial incentive to remain in the weight-reduction program.[61,71,84–86] These factors may have resulted in preferential selection of a well-motivated group of participants who would be more likely to be successful with a weight-reduction program and who are not representative of the general obese population.

Third, the interpretation of the effectiveness of weight-reduction treatments was limited because in all but 7 studies[53,56,57,74,80,82,86] results were expressed as the change in the mean weight or BMI for an entire cohort of patients rather than the proportion who achieved a predetermined weight-reduction target.

Fourth, only 3 studies investigated the effects of weight reduction on rates of major clinical outcomes.[80,81,83] In these studies, deaths and major morbid events (myocardial infarction and stroke) were infrequent, with no significant difference in rates between the weight-reduction and control groups.

Finally, only 3 studies evaluated the effects of weight-reduction interventions on psychological or other quality-of-life parameters.[59,60,76]

Health benefits and risks associated with obesity treatment

In reviewing the evidence relating to the health benefits of obesity treatment, we also evaluated studies that were excluded from the analysis because of limited patient follow-up (less than 2 years) or study design (retrospective study).

In obese adults with diseases that may be causally linked with obesity, there is sufficient evidence that weight reduction can provide health benefits, at least in the short term (within 2 years after starting a weight-reduction program). In patients with obesity and diabetes, 3 prospective cohort studies found that weight reduction with dietary

Table 5: Studies of the effectiveness of nutritional counselling or behavioural therapy for obesity

Study	No. of patients (no. of women)	Length of follow-up	Patients lost to follow-up	Intervention groups	Mean baseline weight or BMI	Mean weight loss/gain at follow-up, kg	Comments
Randomized controlled trials							
Trials of Hypertension Prevention[78]	2382 (NA)	36 mo	98.1%–99.3% completed trial	A: Counselling B: Sodium restriction C: Counselling + sodium restriction (D: Control)	NA	A: –0.2 B: +1.7 C: –0.3 D: +1.8	–
Hakala[79]	52 (42)	5 yr	–	A: Counselling at rehabilitation centre B: Individual counselling	A: Men 104.0 kg; women 121.9 kg B: Men 104.3 kg; women 120.2 kg	A: Men +0.3; women –6.8 B: Men +0.5; women +0.2	–
Stamler et al[80]	189 (69)	4 yr	8	A: Counselling + stop antihypertensive drugs B: Stop antihypertensive drugs (C: Control)	A: 77.6 kg B: 76.7 kg C: 77.4 kg	A: –1.8 B: +2.0 C: +2.0	39% of group A patients maintained 4.5-kg weight loss
Hypertension Prevention Trial[81]	841 (292)	3 yr	90%–94%	A: Counselling B: Sodium restriction C: Counselling + sodium restriction (D: Control)	A: 87.4 kg B: 84.2 kg C: 84.1 kg D: 83.4 kg	A: –1.6 B: +0.7 C: –0.1 D: +1.9	–
Elmer et al[82]	902 (354)	4 yr	85% at 2 yr	Counselling + BT for all patients (randomly assigned to receive 1 of 4 antihypertensive drugs or placebo)	85.1 kg	–2.6	After 4 yr, 70% of patients remained below baseline weight and 34% had at least 4.5-kg weight loss
Prospective cohort studies							
Erikkson et al[83]	222 (0)	5 yr	32	Exercise + counselling	BMI 26.6–27.7	–2.0 to –3.3	–
Jeffery et al[84]	89 (0)	2 yr	9	Exercise + counselling	100.4 kg	–5.1	–
Kramer et al[85]	200 (12)	4 yr	48	Exercise + counselling	101.1 kg	–2.8 to –4.0	–
Adams et al[86]	125 (108)	12–36 mo	83	BT	93.8 kg	NA	33 patients regained weight; 25 sustained weight loss

treatment was associated with improved glycemic control and a reduction in oral hypoglycemic drug and insulin requirements.[89–91] In patients with obesity and hypertension, 5 randomized controlled trials and 6 prospective cohort studies found that weight reduction resulted in reduced systolic and diastolic pressures, and a reduced need for antihypertensive drugs.[80–82,92–96] In patients with obesity and hyperlipidemia, 4 prospective cohort studies found that weight reduction improved the serum lipid profile.[90,97–99] Furthermore, improvements in blood pressure control, blood glucose levels and serum lipid levels were found to occur with modest weight reductions (less than 5 kg).[80–82,99,100] Three prospective cohort studies found that weight reduction in obese adults alleviated symptoms of obstructive sleep apnea.[17,101,102] In obese and non-obese adults with coronary artery disease 4 randomized controlled trials reported that a multiple risk reduction program (e.g., low-fat diet, aerobic exercise, smoking cessation), that also was associated with weight reduction or weight maintenance, resulted in slower progression[103–105] or regression[106] of coronary atherosclerosis and fewer angina symptoms.[104,105]

Despite convincing evidence supporting the short-term effectiveness of obesity treatments, there is only limited evidence that weight reduction is associated with a reduction in major clinical outcomes (e.g., myocardial infarction, stroke and cardiovascular death). In a retrospective analysis of the Framingham community cohort, people with a history of intentional weight loss of at least 10% of their total body weight had, on average, a decrease of 6.6 mm Hg in systolic blood pressure, 0.28 mmol/L in serum cholesterol and 20% in fasting serum glucose.[14] It was postulated that these changes could result in a 20% reduction in the incidence of symptomatic coronary artery disease. In a prospective population-based study of obese women who never smoked, a history of intentional weight loss was associated with a 20% reduction in all-cause mortality (relative risk [RR] 0.80, 95% confidence interval [CI] 0.68 to 0.94).[107] This reduction was primarily due to reduced cancer-related mortality, and there was a statistically nonsignificant reduction of 9% in cardiovascular deaths. However, in a subgroup of women with diabetes, a history of intentional weight loss was associated with a 44% mortality reduction (RR 0.56, 95% CI 0.38 to 0.82). In a retrospective study involving 263 obese patients with diabetes, those with a history of intentional weight reduction had a longer survival than those in a matched group without previous weight reduction.[108] Thus, although it is plausible that weight-reduction interventions in obese adults will reduce the incidence of major clinical outcomes, this has not been demonstrated in prospective clinical trials.

A comprehensive evaluation of the potential adverse effects of weight-reduction interventions is beyond the scope of this review. Briefly, a very-low-calorie diet is associated with fatigue, dizziness, hair loss, menstrual irregularities, cholelithiasis, gouty arthritis and cardiac arrhythmias.[109–111] Anorectic drug therapy is associated with drowsiness, fatigue, nausea, diarrhea, urinary retention, dry mouth and a small but clinically important increased risk of pulmonary hypertension and valvular heart disease.[112,113] Surgical therapy is associated with several postoperative complications depending on the procedure, including gastric leakage, gastric outlet obstruction, staple-line breakdown and other complications related to surgery in the morbidly obese patient, including wound dehiscence, infection, pneumonia and venous thromboembolism.[114,115] Also, weight-reduction interventions are associated with an increased risk of major depression, bulimia and other eating disorders.[116,117] Despite earlier concerns about the risks associated with repeated episodes of weight loss and weight regain (weight cycling),[118,119] recent reviews have found that weight cycling is not associated with increased mortality.[120–122]

Conclusions

In this review we evaluated the evidence relating to the effectiveness of methods used to prevent and treat obesity. Our recommendations appear in Table 6. Based on our analysis we conclude that (a) community-based obesity prevention methods are ineffective, (b) obesity treatment methods are ineffective over the long term (beyond 2 years) except in a small proportion of people who receive dietary or surgical treatments, and (c) in patients with obesity and selected obesity-related diseases (diabetes, hypertension, coronary artery disease, hyperlipidemia or obstructive sleep apnea) weight reduction has been shown to improve symptoms in the short term and to reduce the need for drug therapy for the related diseases.

The lack of studies relating to the prevention of obesity and the methodologic limitations of the available studies precludes strong recommendations for the prevention of obesity. However, because of the considerable health risks associated with obesity and the limited long-term effectiveness of weight-reduction methods, we believe that priority should be given to the prevention of obesity and long-term maintenance of a stable weight over weight-reduction interventions. In the studies of obesity treatment we reviewed, there was an overall pattern in which weight reduction was effective in most patients during the first 6 to 12 months after the start of treatment, followed by a period of gradual weight regain. Surgical treatments were found to be associated with greater long-term weight reduction, but they are restricted for use in adults

with morbid obesity and can be associated with clinically important postoperative complications.

In an unselected population of obese adults without obesity-related diseases, there is insufficient evidence to recommend in favour of or against weight-reduction interventions. To date, there is insufficient evidence that long-term weight reduction in this patient group can be achieved so as to result in reduced rates of death and major morbid events. Furthermore, there is insufficient evidence that in the short term, weight reduction will alleviate symptoms and improve quality of life. In a high-risk group of obese adults with selected diseases that may be causally linked to obesity (hypertension, diabetes, coronary artery disease, hyperlipidemia or obstructive sleep apnea), there is sufficient evidence to recommend weight reduction. In this group, even a modest weight loss (less than 5 kg) may improve quality of life by alleviating symptoms and may reduce drug therapy requirements for obesity-related diseases.

Based on these findings, there is insufficient evidence to recommend in favour of or against inclusion of BMI measurement as part of a periodic health examination for the general population, but BMI measurement should be performed in patients with diseases that may be causally linked to obesity.

There are 2 limitations of this review. First, we acknowledge that our analysis of the effectiveness of methods used to prevent and treat obesity was mainly descriptive. We were unable to perform a quantitative meta-analysis of results across studies because of heterogeneity of patients, weight-reduction methods, outcome measures and follow-up durations. However, pooling of results across studies would be unlikely to influence our recommendations because of the suboptimal methodologic quality of studies and the observation of a pattern of initial weight loss followed by gradual weight regain in most of the studies. Second, we did not attempt to provide a comprehensive evaluation of all methods of

Table 6: Summary of manoeuvres, effectiveness, levels of evidence and recommendations for the prevention and treatment of obesity in adults

Manoeuvre	Effectiveness	Levels of evidence*	Recommendation*
Detection			
BMI measurement	In general adult population, BMI measurement is a reliable and valid method of determining body fat content and diagnosing obesity	Cohort studies (II-2)[35–39]	Because of lack of evidence supporting long-term effectiveness of weight-reduction interventions, there is insufficient evidence to recommend for or against BMI measurement in the periodic health examination of the general population (C)
	For obese adults with obesity-related disease,† weight reduction should be considered if BMI is > 27	RCTs (I);[80–82,86,94] cohort studies (II-2)[89–93,96–102]	There is fair evidence to recommend BMI measurement in the periodic health examination of obese adults with obesity-related disease (B)
Prevention			
Community-based obesity prevention programs	These programs have not been proven effective in promoting weight reduction. Methodologic limitations in studies preclude definitive conclusions relating to the prevention of obesity	Nonrandomized trials (II-1)[48–50]	There is insufficient evidence to recommend for or against community-based obesity prevention programs (C)‡
Treatment			
Weight-reduction therapy (dietary, pharmacologic, surgical or behavioural)	For obese adults without obesity-related disease,† weight reduction is not effective in long term; methodologic limitations in studies preclude definitive conclusions relating to treatment of obesity	RCTs (I);[51–56,65–76,78–82] nonrandomized trial (II-1);[65] cohort studies (II-2)[60–64,77,83–86]	There is insufficient evidence to recommend for or against weight-reduction therapy in obese adults without obesity-related disease (C)
	For obese adults with obesity-related disease,† weight reduction, at least in short term, can alleviate symptoms and reduce need for drug therapy for related diseases	RCTs (I);[80–82,94,95,103,104,109] nonrandomized trials (II-1)[89–93,96–102]	There is fair evidence to recommend weight-reduction therapy in obese adults with obesity-related disease (B)

Note: RCTs = randomized controlled trials.
*See Appendix 1 for definitions of the levels of evidence and grades of recommendations.
†Diabetes mellitus, hypertension, coronary artery disease, hyperlipidemia, obstructive sleep apnea.
‡Because of considerable health risks associated with obesity and the limited long-term effectiveness of weight reduction methods, the prevention of obesity should be a high priority for health care providers.

weight reduction because our analysis was limited to studies that satisfied predetermined selection criteria. Thus, we excluded several studies of intragastric balloon placement, physical exercise and behavioural weight-reduction methods. In general, these treatments have been found to be ineffective unless combined with dietary or pharmacologic weight-reduction methods.[123–127] In addition, we did not evaluate novel treatments (e.g., lipase inhibitors), which are being investigated and which may be found to have a considerable impact on the treatment of obesity.[128]

In summary, because of a lack of strong evidence that methods of obesity treatment are effective over the long term, we cannot make a grade A or B recommendation relating to the inclusion of BMI measurement as part of a periodic health examination in the general population. The grade C recommendation of this review implies that the decision to include BMI measurement as part of a periodic health examination should be at the discretion of individual health care providers based on their assessment of a patient's risk of becoming obese and developing obesity-related diseases.

Research priorities

1. To develop effective primary prevention methods for individuals and communities to reduce the prevalence of obesity in the general population.
2. To investigate the long-term effectiveness of weight-reduction interventions with well-designed clinical trials that use predetermined criteria of successful outcomes.
3. To determine if weight-reduction methods are effective in reducing the incidence of major clinical outcomes (e.g., myocardial infarction, stroke and cardiovascular death).

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Appendix 1: Levels of evidence and grades of recommendations of the Canadian Task Force on Preventive Health Care

Levels of evidence

I	Evidence from at least one well-designed randomized controlled trial
II-1	Evidence from well-designed controlled trials without randomization
II-2	Evidence from well-designed cohort or case–control analytic studies, preferably from more than one centre or research group
II-3	Evidence from comparisons between times and places with or without the intervention; dramatic results from uncontrolled studies (e.g., results of treatment with penicillin in 1940s)
III	Opinions of respected authorities, based on clinical experience; descriptive studies or reports of expert committees

Grades of recommendations

A	There is good evidence to support the recommendation that the condition or manoeuvre be specifically considered in a periodic health examination
B	There is fair evidence to support the recommendation that the condition or manoeuvre be specifically considered in a periodic health examination
C	There is poor evidence relating to the inclusion or exclusion of a condition or manoeuvre in a periodic health examination, but recommendations can be made on other grounds
D	There is fair evidence to support the recommendation that a condition or manoeuvre be specifically excluded from a periodic health examination
E	There is good evidence to support the recommendation that a condition or manoeuvre be specifically excluded from a periodic health examination