Screening and Interventions for Obesity in Adults: Summary of the Evidence for the U.S. Preventive Services Task Force

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Obesity is an increasingly significant U.S. health problem. Over 4 decades, the prevalence of obesity (body mass index [BMI], kilograms of weight divided by height in meters squared [kg/m^2], ≥ 30) has increased from 13% to 31% in adults and the prevalence of overweight (BMI 25–29.9 kg/m^2) has increased from 31% to 34%.[1] Concurrent increases occurred in adolescents and children.[2–4] Obesity is especially common in African Americans, some Hispanic populations, and Native Americans and some health sequelae reflect similar ethnic differences.[5,6] Obesity is more common in women, and overweight is more common in men.[5] Obesity is a risk factor for major causes of death, including cardiovascular disease, numerous cancers, and diabetes,[7] and is linked with markedly diminished life expectancy.[8,9] Osteoarthritis, gall bladder disease, sleep apnea, respiratory impairment, diminished mobility, and social stigmatization are associated with obesity.[10]

Health risk is better established for obese persons than for overweight persons. However, overweight status also carries risk[11]; even mild-to-moderate overweight in young adults predicts subsequent obesity,[12] and weight gain is associated with adverse outcomes.[13] Visceral fat versus subcutaneous fat is particularly linked with adverse cardiovascular profiles in diverse ethnic and racial groups.[14–20] Body composition varies with race and ethnicity (eg, Asians may be more likely[21] and African Americans less likely to accumulate visceral fat than whites[15,22,23]); health implications may also vary.[14–20]

Estimated direct obesity costs are 5.7% of total U.S. health expenditures.[24] Expected lifetime costs for cardiovascular disease and its risk factors increase by 20% with mild obesity, by 50% with moderate obesity, and by nearly 200% with severe obesity.[25]

We reviewed the medical literature for effectiveness of adult obesity screening—the conscious measurement of weight status to clinically address body weight—and treatment. Although obesity may seem obvious, only 42% of obese U.S. adults report receiving health care advice to lose weight.[26]

In 1996, the U.S. Preventive Services Task Force (USPSTF) recommended periodic height and weight measurement.[7] Increased obesity prevalence, therapeutic changes, and accumulating evidence of associated health risk necessitate an update. The

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Research Triangle Institute (RTI)–University of North Carolina Evidence-based Practice Center developed a systematic review of evidence to assist the USPSTF in this process.

Methods

We developed an analytic framework of obesity screening components, with key questions, and eligibility criteria (Appendix Table 1). Randomized controlled trials (RCTs) or systematic reviews of RCTs were preferred evidence: when lacking, we evaluated cohort and nonrandomized controlled studies. Because of limited long-term data, we accepted pharmacotherapy efficacy trials with 6 months minimum follow-up; otherwise, we required at least 12 months. Study quality was rated using USPSTF criteria (Appendix Table 2).[27]

We examined the USPSTF's 1996 review,[7] then searched MEDLINE® and the Cochrane Library for articles published in English between January 1994 and February 2003.[27] We evaluated well-done systematic reviews from the National Institutes of Health (NIH),[11] the Canadian Task Force on Preventive Health Care (CTFPHC),[28] the University of York for the U.K. National Health Service (NHS),[29] the National Task Force on the Prevention and Treatment of Obesity,[30] and the *British Medical Journal's Clinical Evidence*.[31] We used the last as the sole systematic review source for drug efficacy, as the comprehensive reviews were outdated.

To compare treatment efficacy across reviews, we extracted data from each review's evidence tables on studies with current interventions and at least 1-year follow-up. We also drew from their general conclusions. We then reviewed primary literature not covered by prior reviews. At least 2 authors independently reviewed abstracts and articles, excluding those not meeting eligibility criteria, then abstracting eligible articles. We abstracted or calculated 95% confidence intervals (CIs) for treatment efficacy from available data whenever possible. When sample size was not reported with variance,[32,33] baseline sample was used.

Role of the Funding Sources

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Results

Although no RCTs evaluated obesity screening efficacy, we found studies that address obesity's health risks, treatment efficacy, and weight loss' health implications.

Weight and Health Risk

Longitudinal data showed J-shaped or U-shaped relationships between absolute mortality and BMI[34–45]; elevated risk at low BMI may partly reflect smoking,[35,37,42] or BMI's limitations in approximating fat mass.[46] BMI of lowest mortality risk varied, but was generally within the normal range for men and the normal-to-overweight range for women.[34–45] Morbidity risk increased fairly linearly with BMI. Risk was strongest for cardiovascular disorders.[37,43,47] Breast, colon, uterine, and ovarian cancer incidence increased with BMI.[44,48]

In the United States, the association between excess body weight and mortality may be weaker for African Americans than for whites.[41,42,49] However, race-specific data are rare, and sample size concerns limit conclusions. Mortality risk from excess weight may lessen with age; health risks from obesity are unclear beyond age 74.[50]

Approaches to Screening

BMI, the most common screening test for obesity, is easy to measure, highly reliable, and closely correlated (0.7–0.8) with adult body fat.[7,51,52] Validity may vary by population characteristics, including ethnicity[53–55] and possibly age.[51,56] Clinical relevance is established by prospective links with diverse health outcomes.[37,40–43,47,57]

Waist circumference and the waist-to-hip ratio may capture the increased cardiovascular risk for

central adiposity—even among non-obese persons.[44,58–61] Of these, waist circumference more closely approximates visceral adiposity, particularly in African Americans.[15,20] Skinfold thickness measurement requires training for accuracy, so was judged undesirable.[7] We focused on BMI because BMI is linked with the broadest range of health outcomes, entry criteria for most treatment studies are BMI-based, and such trials typically report weight or BMI change.

Effect of Counseling and Behavioral Interventions on Body Weight

Counseling aims to promote change in diet and/or exercise; behavioral interventions are strategies to help patients acquire the skills, motivations, and support to change diet and exercise patterns. For comparison with other treatments, we consider counseling for diet, exercise, or some combination, potentially with behavioral theory, in aggregate. Importantly, each counseling component includes diverse options, possibly in combination. Also, while primary-care-based physical activity counseling has uncertain efficacy,[62] physical activity has diverse health benefits[63] and obesity's cardiovascular risk may be reduced by fitness.[64] Prior systematic reviews found modest counseling and behavioral intervention effects, while more recent RCTs showed consistent findings (Table 1).

In 29 trials with at least 1-year follow-up, the NIH review found average weight change in diet and/or physical activity groups (some including behavioral therapy) of 1.9 kg to –8.8 kg (mean, –3.3 kg), corrected for change in controls (Table 1).[11] Counseling for low-calorie diets (1,000–1,200 kilocalories [kcal] per day) reduced body weight by an average 8% over 3 to 12 months and decreased abdominal fat. Although very-low-calorie diets produced greater initial weight loss than low-calorie diets, results were similar beyond 1 year. Counseling for physical activity (24 RCTs) led to 2% to 3% loss of weight and reduced abdominal fat. Combined diet and physical activity counseling produced greater reduction of weight and abdominal fat than either approach alone. Behavior therapy was a useful adjunct to diet and/or physical activity counseling. Longer-term efficacy depended on continued intervention.

The U.K. NHS review found that behavioral interventions, combined with diet or exercise, appeared effective and long-term maintenance strategies useful.[29] In 24 studies, mean net weight change (intervention arms corrected for controls) was –3 kg over 12 to 60 months (Table 1). The CTFPHC review found weight reduction was most effective during supervised dietary treatment, with subsequent gradual weight regain.[28] In 6 trials, net weight change was –0.2 kg to –4.5 kg after 24 to 84 months.

We identified 17 additional counseling RCTs.[65–82] We examined weight loss and loss maintenance trials separately.[67,73] Limitations included loss to follow-up (5%–38%) and differential attrition between treatments. External validity concerns included volunteer enrollment versus random community sampling and poor gender and ethnic diversity.

To compare diverse programs (Appendix Table 3), we assessed intervention mode (group or individual), components (diet, exercise, behavioral), and intensity (low, moderate, high). Intensity was rated by frequency of person-to-person contact in the first 3 months. Moderate intensity was defined as monthly contact, high intensity was defined as more frequent contact, and low intensity was defined as less frequent contact.

As shown in Figure 1 (a summary of trials for which the difference in mean weight change between intervention and control groups could be calculated, as close as possible to 1-year follow-up), high-intensity trials were most likely to be successful, generally achieving 3 kg to 5 kg of weight loss. Two intensive trials reported success frequency. In 1 trial,[67] mean weight loss due to intervention was 3.4 kg (CI, 2.6–4.2); 30% more persons in the treatment group than in the control group lost at least 5% of their body weight, in the other, a net 5.5 kg loss ($P < 0.001$) corresponded with 38% in the intervention group losing 7% total body weight.[81]

Table 1. Summary of Findings from Prior Systematic Reviews and Our Updated Searches of Obesity Treatment Efficacy[11]*

Intervention Type	Evidence Source	Months of Follow-up		RCTs
		Range	Median	Number
Counseling and behavioral therapy	U.S. NIH[11]	12 to 60	12	29
	U.K. NHS[29]	12 to 60	12	24
	CTFPHC[28]	24 to 60	24	6
	Updated searches (1)	12 to 54	12	12
	Updated searches (2)	12 to 54	12	13
Pharmacotherapy (orlistat or sibutramine)	*BMJ Clin Evid*[31]	0.5 to 24	NA	17†
	Updated searches	6 to12	6	10
Surgery	U.S. NIH[11]	12 to 48	24	5
	U.K. NHS[29]	12 to 48	30	6
	CTFPHC[28]	24 to 60	36	4
	Updated searches	18 to 18	18	2

* Data reflect weight loss RCTs that have at least 1 year of follow-up; the longest follow-up reported is shown. Only counseling and pharmacotherapy trials that provided data on treatment effect with and without adjustment for control are included. Weight maintenance studies are not shown. Surgery data reflect only current procedures (gastric bypass, adjustable gastric banding, vertical banded gastroplasty); because trials compare 2 techniques (ie, no comparison to non-surgical control), results are unadjusted for control. Results of updated searches for counseling results are shown with (1) and without (2) inclusion of a trial combining alternative counseling strategies with pharmacotherapy.[65]

† Data presented are for 7 studies of sibutramine and 10 studies of orlistat only.

BMJ Clin Evid, *British Medical Journal's Clinical Evidence*; CTFPHC, Canadian Task Force on Preventive Health Care; NA, data not available to do appropriate calculation; NHS, U.K. National Health Service; NIH, National Institutes of Health; NR, not reported; RCT, randomized controlled trial.

Because not all trials used a null control (many compared one counseling intervention with another), our treatment efficacy estimates (intervention effect minus control) may be conservative. Of 11 high-intensity interventions to promote weight loss, 6 used a true control; 4 were successful (2.5–5.5 kg loss beyond controls in 12–54 mos),[66,67,70,81] and 2 showed borderline[76] or transient[69] weight reduction (Table 2). In 5 trials, 1 high-intensity intervention led to more weight loss than another.[65,72,74,78,82] Moderate-intensity interventions showed mixed results.[71,79] Two of the 3 low-intensity weight loss interventions were ineffective.[77,83]

Successful interventions typically included 2 to 3 components (diet, exercise, and behavioral therapy). Only 1 trial[65] examined a combination of counseling and pharmacotherapy. In this trial, adding lifestyle counseling to sibutramine therapy led to a mean weight reduction of 7.3 kg (CI, 1.6–13.0), and adding a low-calorie diet to counseling and sibutramine therapy led to a mean weight reduction of 12.8 kg (CI, 8.2–17.4).[65]

Twelve- to 18-month prolonged follow-up was reported in 3 high-intensity weight loss studies,[67,70,76] 2 of which included long-term maintenance strategies.[66,76] Although participants regained weight, modest net loss (≥ 2 kg) was maintained for 24 to 36 months in 3 of 4 interventions.[67,70,76]

Trials designed to maintain weight loss showed some success.[68,73] One promoted an additional 5 kg

Table 1. Summary of Findings from Prior Systematic Reviews and Our Updated Searches of Obesity Treatment Efficacy[11]* (cont)

Treatments Compared with Control	Weight Change: Intervention Group (kg)		Weight Change: Control Group (kg)	
Number	Range	Mean	Range	Mean
54	8 to –21.6	–5.7	1.9 to –8.8	–3.3
51	5.4 to –12.9	–4.5	1.4 to –10.6	–3.0
12	2.7 to –9.2	–3.3	–0.2 to –4.5	–2.1
22	9.2 to –17	–3.7	0.88 to –5.8	–2.0
24	9.2 to –17.9	–4.6	0.88 to –12.3	–2.6
NR	NR	NR	–2.5 to –4.4	NR
11	–3.3 to –13.1	–6.5	–2.8 to –5.8	–4.0
7	–9.7 to –159	–76.0	NA	NA
8	–9.7 to –57.9	–45.1	NA	NA
9	–17 to –45.5	–29.9	NA	NA
4	–34 to < –46	NA	NA	NA

(1-yr) loss.[68] In another, weight-focused counseling promoted weight maintenance in 36% more participants than exercise-focused counseling.[73]

Overall, counseling promoted modest average weight loss (3–5 kg). Multi-component, intensive interventions including behavioral therapy most often led to weight loss. Maintenance strategies helped sustain loss.

Effect of Pharmacotherapy Interventions on Body Weight

Pharmacological obesity treatment has changed substantially in the past decade. Safety concerns have eliminated several options. Evidence of the efficacy of sibutramine (a dopamine, norepinephrine, and serotonin re-uptake inhibitor) and orlistat (a gastrointestinal lipase inhibitor) evidence has increased. Both are approved for people with BMIs of 30 kg/m^2 or more, or people who have BMIs greater than 27 kg/m^2 with other risk factors (eg, hypertension, diabetes, or dyslipidemia) in combination with lifestyle change. Efficacy trials have also examined several drugs developed for non-weight-related purposes.

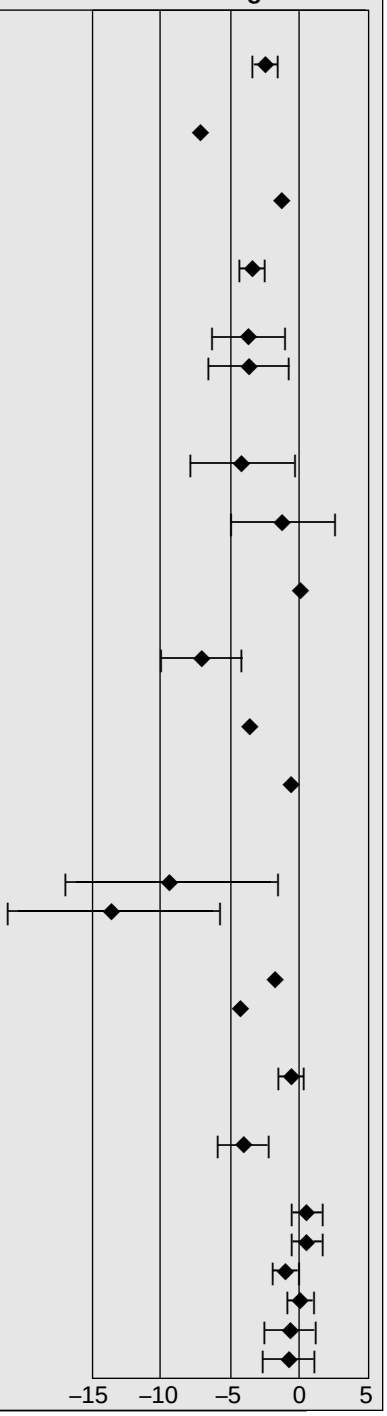
A recent obesity pharmacotherapy systematic review found that sibutramine promoted 2.8 to 4.2 kg of weight loss (7 RCTs) over 8 to 52 weeks in healthy adults and those with controlled hypertension, but weight regain followed treatment discontinuation.[31] Orlistat's efficacy was similar (mean 3.5 kg loss in 10 RCTs of 1–2 yrs duration). Phentermine (7.4 kg average loss in 1 RCT) and mazindol (3.8 kg average loss in 1 RCT, but no longer manufactured in the U.S.) caused modest weight loss in adults more than 15% overweight; other small RCTs showed limited and inconsistent efficacy of diethylpropion (2 RCTs) or fluoxetine (2 RCTs).

We identified 18 additional RCTs meeting eligibility criteria: 7 evaluated sibutramine[32,33,84–88]; 8 evaluated orlistat[89–96]; 2 evaluated metformin[81,97]; and 1 evaluated multiple drugs.[98] Three trials examined maintenance strategies.[84,92,93] Attrition (3%–50%) and poor adherence data were primary quality limitations. Generalizability issues were similar to the counseling trials.

In 6 weight loss trials (Figure 2),[32,33,85–88] sibutramine-treated participants lost 2.8 kg

Figure 1. Differences in Mean Weight Loss Between Intervention and Control Groups for Counseling and Behavioral Interventions

Study, Year, Intervention	Control	Internal Validity	Timing of Measurement
Stevens et al, 2001[70] (18-mo data)			
D, E, B+++	Usual care	Good	18 mos
Knowler et al, 2002[81]			
D, E, B+++*	D, E+	Good	34 mos
Kuller et al, 2001[65]			
D, E, B+++*	Assessment only	Good	54 mos
Tuomilehto et al, 2001[66]			
D, E, B+++	D, E+	Good	12 mos
Fogelholm et al, 2000 (1-yr data)[76]			
D, EP2, B+++	D, B+	Fair	12 mos
D, EP1, B+++	D, B+		
Jakicic et al, 1999[72]			
D, short-bout EP with EQ, B+++	D, short-bout EP, B+++	Fair	18 mos
D, long-bout EP, B+++	D, short-bout EP, B+++		
Jones et al, 1999[69]			
D, B+++	Told to lose weight+	Fair	30 mos
Sbrocco et al, 1999[74]			
D, E, B1+++	D, E, B2+++	Fair	12 mos
Ashley et al, 2001[82]			
D (dietitian) with MR, E, B+++	D (dietitian), E, B+++	Fair	12 mos
D (primary care), E, B+++	D (dietitian), E, B+++		
Wadden et al, 2001[65]			
B, sibutramine+++	Sibutramine	Fair	12 mos
D, B, sibutramine+++	Sibutramine		
Wing and Anglin, 1996[78]			
Black patients: D1, E, B+++	D2, E, B+++	Fair	12 mos
White patients: D1, E, B+++	D2, E, B+++		
Lindholm et al, 1995[79]			
D, E++	Usual Care+	Good	18 mos
Swinburn et al, 1999[71]			
D, B++	D+	Fair	12 mos
Jeffery and French, 1997[77]			
Low SES women: D, E, L	No contact	Good	12 mos
Low SES women: D, E	No contact		
High SES women: D, E, L	No contact		
High SES women: D, E	No contact		
Low SES men: D, E, L	No contact		
Low SES men: D, E	No contact		

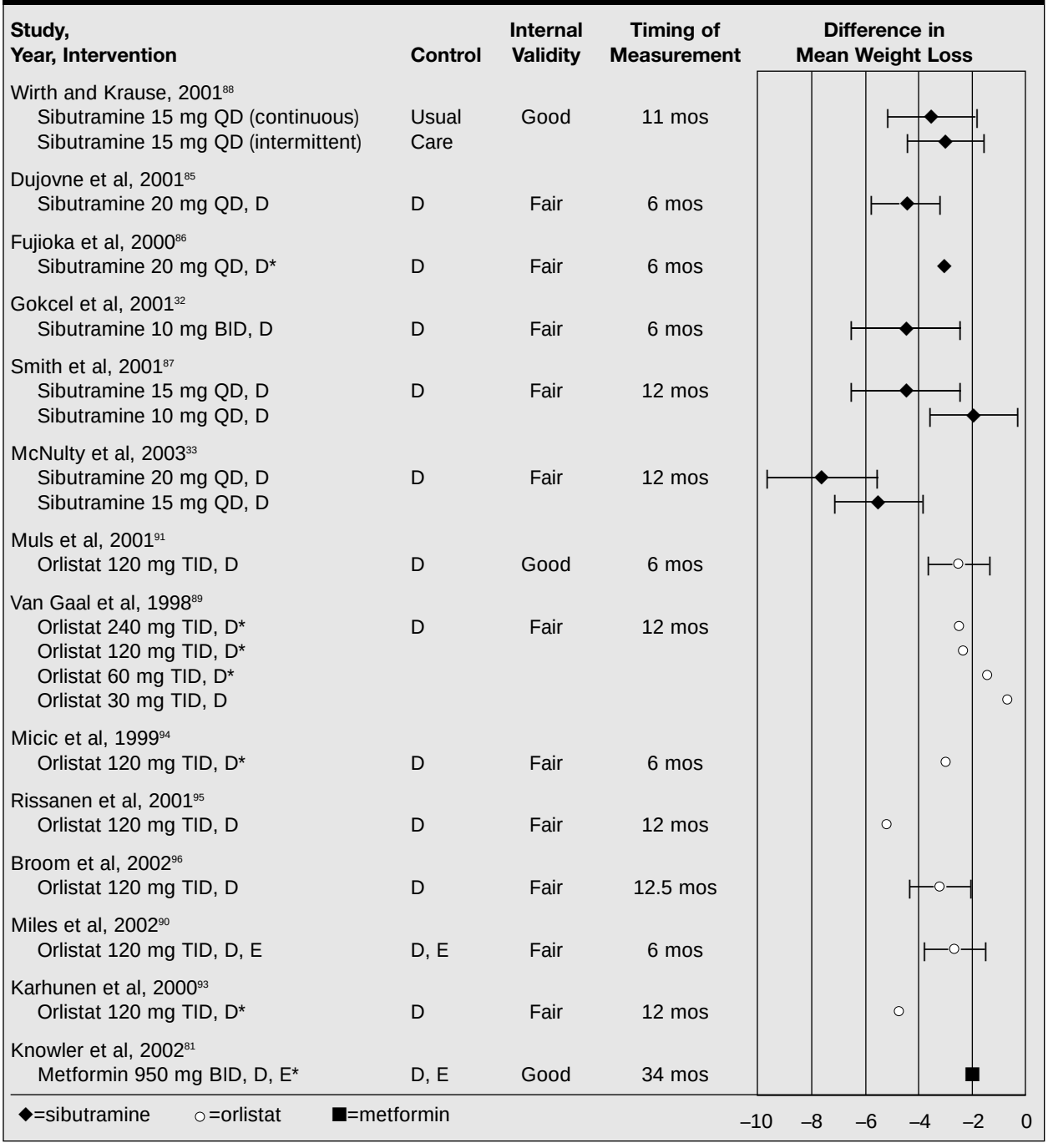


Note: Only studies for which this difference can be calculated are included. Error bars represent 95% confidence intervals and are presented for studies in which those data are available. Data presented are as close as possible to 1-year follow-up.

* Statistically significant ($P < 0.05$) but with insufficient data to calculate 95% confidence intervals.

B, behavioral therapy; D, diet; E, exercise; EP, exercise program; EQ, exercise equipment; L, lottery entry; MR, meal replacement; SES, socioeconomic status; +++, high intensity; ++, moderate intensity; +, low intensity.

Figure 2. Differences in Mean Weight Loss Between Intervention and Control Groups for Pharmacotherapy Interventions



Note: Data points (diamonds, circles, and squares) represent mean weight change in intervention group (kg) – mean weight change in placebo group (kg). Only studies for which the difference in mean weight loss could be calculated are included; each arm is represented by a data point. Error bars represent 95% confidence intervals and are presented for studies in which those data are available. Intensity of co-interventions is not assessed as most trials provided insufficient information for evaluation.

* Statistically significant ($P < 0.05$) but with insufficient data to calculate 95% confidence intervals.

B, behavioral therapy; BID, twice daily; D, diet; E, exercise; QD, daily; TID, 3 times daily.

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions

Study, Year	Goal and Components	Sample Size (N), Race, Sex, and Age†	Body Mass Index (kg/m²)‡	Study Duration	Groups§
					High Intensity
Stevens et al, 2001[70]	L + M D, E, B G + I	N: 1191 White: 79% Black: 18% F: 34% Age: 43 yrs	31	18 mos 36 mos	Weight loss Control Weight loss Control
Kuller et al, 2001[66]	L + M D, E, B G + I	N: 535 White: 92% F: 100% Age: 47 yrs	25	54 mos	Lifestyle change Assessment only
Tuomilehto et al, 2001[67]	L D, E, B G	N: 522 Race: NR F: 67% Age: 55 yrs	31	1 yr 2 yrs 1 yr	Intervention Control Intervention Control Intervention Control
Fogelholm et al, 2000[76]	L + M D, E, B G	N: 82 Race: NR F: 100% Age: 30–45 yrs	34	1 yr 2 yrs	1st PA program 2nd PA program Control 1st PA program 2nd PA program Control
Knowler et al, 2002[81]	L + M D, E, B G + I	N: 3234 White: 55% Black: 20% Hispanic: 16% American Indian: 5% Asian: 4% F: 68% Age: 51 yrs	34	2.8 yrs	Metformin Lifestyle Placebo Metformin Lifestyle Placebo
Jakicic et al, 1999[72]	L D, E, B G	N: 148 Race: NR F: 100% Age: 25–45 yrs	Weight 20%–75% higher than ideal body wt	18 mos	Long-bout PA Short-bout PA + EQ Short-bout PA
Jones et al, 1999[69]	L D, B G + I	N: 102 White: 60% Black: 40%	34	6 mos	Weight loss Control

B, behavioral therapy; D, diet; E, exercise; EQ, exercise equipment; G, group-based; I, individual-based; L, weight loss; M, maintenance of weight loss; NR, not reported; NS, not significant; OXCHECK, Oxford and Collaborators Check; PA, physical activity; SES, socioeconomic status.

† Mean values unless otherwise noted.

‡ Baseline mean or range unless otherwise noted.

§ See Appendix Table 3 for details.

|| Compared with control unless otherwise noted.

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Weight Change	Between-Group Differences‖	*P* Value	Patients Lost to Follow-up	Study Quality
–2.0 kg 0.7 kg	–2.7 kg	≤ 0.001	8% at 36 mos	Good
–0.2 kg 1.8 kg	–2.0 kg	≤ 0.001		
–0.09 kg 2.4 kg	–2.5 kg	≤ 0.001	5%	Good
–4.2 kg –0.8 kg	–3.4 kg	≤ 0.001	8%	Good
–3.5 kg –0.8 kg	–2.7 kg	≤ 0.001		
Freq 5% loss NR NR	30%	0.001		
–0.7 kg –0.6 kg 2.0 kg	–2.7 kg –2.6 kg	0.06	10%	Fair
5.9 kg 9.2 kg 9.7 kg	–3.8 kg –0.5 kg	0.07		
–2.1 kg –5.6 kg –0.1 kg	–2.0 kg –5.5 kg	≤ 0.001	7.5%	Good
Freq > 7% loss NR 38% NR				
–5.8 kg –7.4 kg –3.7 kg	–2.1 kg –3.7 kg (referent)	≤ 0.05 NS all other pairs	22% (13%–29% per group)	Fair
–3.2 kg –1.8 kg	–1.4 kg	0.05	9%	Fair

continue

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Study, Year	Goal and Components	Sample Size (N), Race, Sex, and Age†	Body Mass Index (kg/m²)‡	Study Duration	Groups§
					High Intensity
		F: 52% Intervention: 57 yrs Control: 59 yrs		12, 18 24, 30 mos	
Sbrocco et al, 1999[74]	L D, E, B G	N: 24 Race: NR F: 100% Age: 40–43 yrs (varied by group)	33	12 mos	Behavioral choice Traditional behavioral treatment
Wadden et al, 2001[65]	L D, E, B G	N: 53 Race: NR F: 100% Age Drug: 46 Drug, L: 41 Drug, D, L: 40	36–39	1 yr	Sibutramine + diet + lifestyle Sibutramine + lifestyle Sibutramine
Ashley et al, 2001[82]	L D, E, B G + I	N: 113 Race: NR F: 100% Age: 41–42 yrs (varied by group)	25–35	1 yr	Primary care visit, meal replacement Nutritionist, meal replacement Nutritionist alone
Wing and Anglin, 1996[78]	L D, E, B G	N: 93 Black: 17% White: 80% Other: 2% Female Black: 75% White: 66% Age Black: 49 yrs White: 52 yrs	Black: 37 White: 38	1 yr	Behavioral therapy, with very-low-calorie diet Behavioral therapy with low-calorie diet
Leermakers et al, 1999[73]	M D, E, B G	N: 67 White: 94% F: 80% Age: 50.8 yrs	31	18 mos	Weight-focused maintenance program PA-focused maintenance program Weight-focused program PA-focused program

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Weight Change	Between-Group Differences‖	*P* Value	Patients Lost to Follow-up	Study Quality
NR NR	NS			
–10.1 kg –4.3 kg	–5.76 kg	0.01	17%	Fair
–16.6 kg	–12.8 kg	≤ 0.05	32%	Fair
–11.1 kg	–7.3 kg	≤ 0.05		
–3.8 kg 59% of drug + diet + lifestyle participants had lost ≥ 15% of weight at 1 yr	(referent)			
–3.5 kg	–0.1 kg	NS	32%–38%	Fair
–7.7 kg	–3.7 kg	≤ 0.05		
–3.4 kg	(referent)			
Black: –13 kg White: –17 kg	Black: –2 kg White: –4 kg	NR	19%	Fair
Black: –11 kg White: –13 kg	(referent)			
Weight loss is approximate, from graphic data	Weight loss is approximate, from graphic data			
3.1 kg	–2.1 kg	≤ 0.05	15% at 6 mos; 28% at 18 mos	Fair
5.2 kg		≤ 0.01		
90% original weight loss maintained	–36%			
54% original weight loss maintained				

continue

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Study, Year	Goal and Components	Sample Size (N), Race, Sex, and Age†	Body Mass Index (kg/m²)‡	Study Duration	Groups§
					Moderate Intensity
Lindholm et al, 1995[79]	L D, E G	N: 681 Race: NR F: 15% Range: 30–59 yrs	Intervention Men: 27 Women: 30 Control Men: 27 Women: 29	18 mos	6 sessions of health care advice Usual care
Swinburn et al, 1999[71]	L D, B G	N: 176 Intervention European: 69% Maori: 12% Pacific Islander: 14% Other: 4% Control European: 75% Maori: 7% Pacific Islander: 4% Other: 3% F intervention: 21% F Control: 35% Intervention: 53.2% Control: 52.3%	Intervention 84 kg Control 85 kg	12 mos	Reduced fat diet Usual diet

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Weight Change	Between-Group Differences‖	*P* Value	Patients Lost to Follow-up	Study Quality
NR NR	–0.25 kg	NS	6%	Good
–3.1 kg 0.4 kg	–3.5 kg	≤ 0.001	38%	Fair

continue

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Study, Year	Goal and Components	Sample Size (N), Race, Sex, and Age†	Body Mass Index (kg/m²)‡	Study Duration	Groups§
					Low Intensity
Jeffery and French, 1997[77]	L D, E G	N: 822 Each group White: 76%–94% F: 81% Age: 31–37 yrs (varied by group)	Men: 28 Women: 26–28	12 mos	Lifestyle edu Edu + lottery Control Lifestyle edu Edu + lottery Control Lifestyle edu Edu + lottery Control
Bemelmans et al, 2000[83]	L D G	N: 266 Race: NR F Intervention: 51% F Control: 63% Female: 51% Age: 54–55 yrs (differed by group)	30	52 wks	Dietary interventions with group meetings and mailings Leaflet of Dutch nutritional guidelines
Rothacker et al, 2001[68]	M D I	N: 75 Race: NR F: 100% Range: 18–55 yrs	25	1 yr	Pre-measured low-calorie liquid supplements Low-energy, low-fat foods
OXCHECK Study Group 1995[80]	L D I	N: 2205 Race: NR F: 47% Range: 35–64 yrs	NR	NR	Health checks Standard care

Table 2. Randomized Controlled Trials of Counseling and Behavioral Interventions (cont)

Weight Change	Between-Group Differences‖	*P* Value	Patients Lost to Follow-up	Study Quality
Men 0.72 lb 0.21 lb 1.94 lb Women (High SES): 1.03 lb 0.51 lb 1.38 lb Women (High SES): 2.11 lb 3.23 lb 1.30 lb	 –1.22 lb –1.73 lb –0.35 lb –0.87 lb +0.81 lb +1.93 lb	 NS NS NS NS NS NS	14%	Good
Men: 0.5 kg/m^2 Women: 0.3 kg/m^2 Men: 0.4 kg/m^2 Women: 0.3 kg/m^2	Men: 0.1 kg/m^2 Women: 0.1 kg/m^2	NS NS	8%	Fair (but non-randomized)
–6.3 kg –1.3 kg	–5 kg	≤ 0.001	17%	Fair
NR	At follow-up, those with health checks were 0.38 kg/m^2 less than controls	≤ 0.05	25%	Fair

(CI, 1.6–4.0) to 7.8 kg (CI, 5.9–9.7) more than patients given a placebo (Table 3). Frequency of response, when recorded, was high; 27% (CI, 18–36) to 65% (CI, 60–70) of sibutramine-treated patients achieved 5% loss and 6% (CI, 1–10) to 34% (CI, 26–40) lost 10%.[33,85–88] A 5% loss occurred in 19% (CI, 9–29) to 53% (CI, 36–70) more of drug-treated participants than control participants, and a 10% loss in 5% (CI, –1 to 10) to 27% (CI, 18–36) more.

In 6 trials,[90, 91–94,96] participants treated with a typical orlistat dose (120 mg 3 times daily) lost significantly more weight (2.8 kg [CI, 1.8– 3.7] to 4.5 kg [CI not calculable]) than did controls. In a sixth, not statistically significant trial, orlistat-treated participants lost 5.8 kg more than controls.[95] In the 3 trials reporting response rates, 10% loss occurred in 14% (CI, 10–19) to 38% (CI, 29–47) of orlistat-treated participants, and such response occurred more often by 9% (CI, –2 to 20) to 19% (CI, 8–30) in orlistat-treated participants than controls.[89,91,96]

In 1 trial comparing drug and lifestyle interventions, those treated with metformin lost 2 kg more than those given a placebo but lost less than participants in the lifestyle arm.[81] Another trial showed no metformin effect.[97] A multidrug trial showed sibutramine-treated people lost significantly more weight (13.4 kg) than those treated with orlistat (8 kg) or metformin (9 kg).[98]

Maintenance studies showed moderate success. In 1,[84] sibutramine, taken 6 months for weight loss and 18 months for weight maintenance, promoted a net 4 kg (CI, 2.4–5.6) loss versus placebo. A corresponding 44% (CI, 37–50) of sibutramine versus 16% (CI, 6–25) of placebo participants maintained 80% of initial weight loss. Likewise, successful dieters treated with orlistat lost more weight and over 1 year were more likely to maintain 75% of their initial loss than those treated with placebo ($P < 0.05$).[92] In a third trial, participants treated with 1 or 2 years of orlistat lost "significantly more" weight over 2 years than placebo participants.[93] However, during the second year, orlistat was no more effective than placebo, and discontinuing therapy with the drug led to excess weight gain (eg, mean weight gain during the second year among those who discontinued orlistat was 6.3 kg vs 3.1 kg among those who took placebo throughout).[93]

Overall, pharmacotherapy with sibutramine and orlistat promoted modest mean weight loss (3–5 kg) beyond that of controls; prolonged drug courses helped sustain this loss up to 2 years. Phentermine and mazindol had similar short-term efficacy but are not approved for long-term use.[31] Metformin, diethylpropion, and fluoxetine showed mixed efficacy.

Surgical Approaches

Surgical obesity treatment is limited to patients with BMIs exceeding 40 kg/m^2 or patients with BMIs of 35 kg/m^2 or more who have associated severe health complications and have not responded to other treatment modalities.[99] Bariatric surgery is restrictive or malabsorptive, and current techniques are primarily restrictive. Gastric bypass involves complete gastric partitioning with anastomosis of the proximal gastric segment to a jejunal loop. Adjustable gastric banding involves placing an inflatable band around the stomach that can be adjusted to different diameters.[100] Vertical banded gastroplasty entails partial gastric partitioning at the proximal gastric segment with placement of a gastric outlet stoma of fixed diameter.[28] Practice patterns appear to be shifting away from this technique. These procedures can be performed open or laparoscopically. Although the duodenal switch procedure—a relatively new malabsorptive technique—is fairly common in practice, we found no RCTs evaluating its effectiveness.

Because of practical and ethical constraints to a true randomized, blinded, placebo-controlled trial of surgery for obesity, high-quality evidence is limited. The 3 prior systematic reviews of obesity therapy primarily examined randomized unblinded trials comparing surgical techniques (eg, no non-surgical controls).

The U.S. NIH reviewed 5 randomized trials, finding 10 kg to 159 kg of surgical weight loss over 12 to 48 months in patients receiving surgery (Table 1).[11] Of 7 U.K. NHS-reviewed trials, 6 showed weight loss with both gastric bypass (mean reduction, 45–65 kg) and gastroplasty

(mean reduction, 30–35 kg).[29] The CTFPHC analyzed 4 surgical randomized trials and 1 prospective cohort study[28] and found a mean weight loss of 17 kg to 46 kg after 2 to 5 years.

We identified 3 additional randomized trials, all evaluated gastric banding over 1 to 2 years (Table 4).[100–102] In addition to lack of non-surgical controls, quality concerns included lack of cointerventions and comorbidity information. None showed significantly different weight loss between arms, but all treatments promoted considerable loss (17 to > 40 kg).

In addition, we identified a large, controlled, cohort study evaluating surgery efficacy: the Swedish Obese Subjects (SOS) study,[103,104] a multi-center trial of surgical patients (equally divided among gastric banding, vertical banded gastroplasty, and gastric bypass) and nonrandomized, matched, non-surgical controls.[104] At 2 years, weight loss was 28 kg (CI, 26.9–29.1) among surgical patients versus 0.5 kg (CI, –0.2 to 1.2) among controls. Weight reduction after gastric banding, vertical banded gastroplasty, and gastric bypass was 21% (standard deviation [SD] 12), 23% (SD 10), and 33% (SD 10), respectively. After 8 years, a subset analysis showed an average 20 kg (CI, 18.0–22.0) weight loss for 251 surgical patients and a 0.7 kg (CI, –0.8 to 2.2) loss for 232 controls.[104] Overall, surgery promoted substantial, prolonged weight loss (10–159 kg over 1–5 years) in patients with extreme obesity.

Intermediate Health Outcomes and Sustained Weight Loss

The U.S. NIH systematic review established that counseling-based weight loss (generally 5–10 kg) can improve intermediate health outcomes such as blood pressure, glycemic control, and serum lipids.[11] We assessed the effect of pharmacotherapy-associated weight loss on serum lipids and glucose. Since the prior drug review did not cover these outcomes, we abstracted these data from the primary literature it covered, in addition to the more recent articles.

We found mixed evidence for improved glucose tolerance with sibutramine-induced weight loss.[32,33,84,86,87,105] Orlistat generally,[90,96,106–109] but not always,[110] improved glucose parameters. This inconsistency may in part be due to medication alterations accompanying weight loss; in 1 trial, orlistat-treated patients with diabetes were more likely (17% vs 8%, $P < 0.05$) to decrease or discontinue diabetes medications than controls,[90] and glycosylated hemoglobin was reduced only when adjusted for these alterations.

Seven trials and 1 review linked orlistat with total cholesterol reduction.[90,92,106–111] Sibutramine showed less consistent total cholesterol findings: no significant drug versus placebo effect in 6 trials,[33,84,86,87,112,113] improvement in 3 others.[32,114,115] Orlistat was frequently (but not always)[116] associated with reduced low-density lipoprotein (LDL) cholesterol.[90,92–94,96,106–108,110,115] Sibutramine had inconsistent LDL effects.[32,84–86,90,96,113,114] Neither drug consistently affected high-density lipoprotein cholesterol[32,33,90,96,105,113,114,116,117] or triglycerides.[33,84–87,90,94,96,105,107,110,112–114]

Surgical cohort studies suggest that large amounts of weight loss may lead to dramatic improvements in glucose metabolism,[118] lipid profiles,[119,120] and blood pressure. Notably, hypertension tended to recur within 3 to 10 years in the SOS group[121]; although weight regain accompanied this recurrence, all surgical groups had maintained at least a 20 kg average loss.

Ultimate Health Outcomes and Sustained Weight Loss

We found less evidence for effects of weight loss on ultimate (generally symptomatic) health outcomes. Limited observational data suggest intentional weight loss in obese persons (particularly in those with co-morbidity) can reduce mortality.[122,123] Two large RCTs show that behaviorally mediated weight loss can prevent diabetes (58% reduction, $P < 0.05$) among those with glucose intolerance.[67,81] A smaller (31%; CI, 17–43) reduction in diabetes incidence was seen among similar metformin-treated patients.[81] Patients treated surgically (non-RCT data) may experience diabetes resolution (eg, 90% follow-up of 300 surgical patients, initially 50% glucose intolerant, initially 50% with diabetes, showed 91% to have normal fasting glucose and glycosylated

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions

Study, Year	Drug Dose (mg)	Sample Size (N), Co-Interventions	Race, Sex, Age,† Baseline BMI‡	Length, Goal	Groups
Sibutramine					
Wirth and Krause, 2001[88]	15 mg daily either continuous or intermittent	All participants: No formal diet, exercise, or behavioral program	N: 1102 White: 99.8% Female: 77%	44 wks, L	Sibutramine cont Sibutramine int Placebo
		Written dietary information	<u>Sibutramine:</u> Cont: 43 yrs Int: 43 yrs Placebo: 44 yrs		Sibutramine cont Sibutramine int Placebo
			<u>Sibutramine:</u> Cont: 34.7 kg/m^2 Int: 34.9 kg/m^2 Placebo: 35.0 kg/m^2		Sibutramine cont Sibutramine int Placebo
Dujovne et al, 2001[85]	20 mg daily	D All participants: Step I American Heart Association diet (1,500 kcal/day for females, 1,800 kcal/day for males)	N: 322 White: 82% Black: 12% Indian or Pakistani: 1% Mexican American: 2% Other: 3% Drug: 56% female Placebo: 51% female Drug: 45 yrs Placebo: 46 yrs Sibutramine: 35.1 kg/m^2 Placebo: 35.5 kg/m^2	24 wks, L	Sibutramine Placebo Sibutramine Placebo Sibutramine Placebo
Fujioka et al, 2000[86]	Titrated up to 20 mg daily	D All participants: 250–500 kcal/day caloric deficit diet with individual dietary counseling	N: 175 White: 73% Black: 17% Other: 10% Female: 47% Sibutramine: 53.5 yrs Placebo: 55.0 yrs Sibutramine: 34.1 kg/m^2 Placebo: 33.8 kg/m^2	24 wks, L	Sibutramine Placebo Sibutramine Placebo Sibutramine Placebo

B, behavioral therapy; bid, twice daily; BMI, body mass index; cont, continuous; D, diet; E, exercise; GI, gastrointestinal; int, intermittent; L, weight loss; M, maintenance of weight loss; NR, not reported; tid, three times daily.

† Values are means unless otherwise indicated.

‡ Presented as baseline mean or range unless otherwise noted.

§ Compared with control unless otherwise noted.

|| $P = 0.02$ vs placebo.

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Weight Change	Between-Group Differences§	Patients Lost to Follow-up and *P* Value‖	Adverse Events	Trial Quality
–3.8 kg –3.3 kg –0.2 kg	–3.6 kg –3.1 kg	< 0.001	Sibutramine (continuous): Dropout: 79/405 Due to adverse event: 25/405 Adverse event rate: 303/405	Good
5% loss: 65% 63% 35%	30% 28%	< 0.001	Sibutramine (intermittent): Dropout: 80/395 Due to adverse event: 13/395 Adverse event rate: 283/395	
10% loss: 32% 33% 13%	19% 20%	< 0.001	Placebo: Dropout: 55/201 Due to adverse event: 9/201 Adverse event rate: 151/201	
–4.9 kg –0.6 kg	–4.3 kg	≤ 0.05	Sibutramine: Dropout: 29.6% Due to adverse event: 9.9% Due to hypertension: 0.6%	Fair
5% loss: 42% 8%	34%	< 0.05	Placebo: Dropout: 33.8% Due to adverse event: 6.9% Due to hypertension: 1.9%	
10% loss: 12% 3%	9%	< 0.05		
–3.7 kg –0.4 kg	–3.3 kg	≤ 0.5	Sibutramine: Dropout: 29/89 Due to adverse event: 9/89	Fair
5% loss: 27% 1%	26%	< 0.001	Placebo: Dropout: 25/86 Due to adverse event: 10/86	
10% loss: 6% 1%	5%	0.12		

continue

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Study, Year	Drug Dose (mg)	Sample Size (N), Co-Interventions	Race, Sex, Age,† Baseline BMI‡	Length, Goal	Groups
Sibutramine, continued					
Gokcel et al, 2001[32]	10 mg bid	D All participants: 25 kcal/kg ideal body weight diet, with counseling at baseline	N: 60 Race: NR Female: 100% Sibutramine: 47 yrs Placebo: 49 yrs Sibutramine: 39.3 kg/m^2 Placebo: 37.4 kg/m^2	24 wks, L	Sibutramine Placebo
Smith and Goulder, 2001[87]	10 mg or 15 mg daily	D All participants: dietary advice	N: 485 White: 99% Other: 1% Female: 80% <u>Sibutramine:</u> 10 mg: 41 yrs 15 mg: 43 yrs Placebo: 42 yrs <u>Sibutramine:</u> 10 mg group: 32.9 kg/m^2 15 mg group: 32.7 kg/m^2 Placebo: 32.4 kg/m^2	52 wks, L	Sibutramine: 10 mg Sibutramine: 15 mg Placebo Sibutramine: 10 mg Sibutramine: 15 mg Placebo Sibutramine: 10 mg Sibutramine: 15 mg Placebo
McNulty et al, 2003[33]	15–20 mg daily	D Standard dietary advice by a dietitian or nurse	N: 195 Race: NR Female: 56% 15 mg group: 49 yrs 20 mg group: 48 yrs Placebo: 51 yrs <u>Sibutramine:</u> 15 mg group: 36.3 kg/m^2 20 mg group: 37.5 kg/m^2 <u>Placebo:</u> 36.2 kg/m^2	12 mos, L	Sibutramine: 15 mg Sibutramine: 20 mg Placebo Sibutramine: 15 mg Sibutramine: 20 mg Placebo Sibutramine: 15 mg Sibutramine: 20 mg Placebo
James et al, 2000[84]	10–20 mg daily	D,E,B All participants: high-intensity individualized 600 kcal deficit diet	N: 467 "Almost all" white Afro-Caribbean: 2% Asian: 1.5% Female: 84% Sibutramine: 41 yrs Placebo: 40 yrs Sibutramine: 36.5 kg/m^2 Placebo: 36.6 kg/m^2	80 wks, M (following 6 mos L phase)	Sibutramine Placebo Sibutramine Placebo

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Weight Change	Between-Group Differences§	Patients Lost to Follow-up and *P* Value‖	Adverse Events	Trial Quality
–3.9 kg 0.36 kg	–4.3 kg	< 0.0001	Sibutramine: Dropout: 1/30 Due to adverse event: 1/30 Placebo: Dropout: 5/30 Due to adverse event: NR	Fair
–4.4 kg –6.4 kg –1.6 kg 5% Loss: 39% 57% 20% 10% Loss: 19% 34% 7%	–2.8 kg –4.8 kg 19% 37% 12% 27%	< 0.01 < 0.01 < 0.01	Sibutramine 10 mg: Dropout: 67/161 Due to adverse event: 2/161 Adverse event rate: 20/161 Sibutramine 15 mg: Dropout: 79/161 Due to adverse event: 2/161 Adverse event rate: 18/161 Placebo: Dropout: 83/163 Due to adverse event: 4/163 Adverse event rate: 24/163	Fair
–5.5 kg –8.0 kg –0.2 kg 5% Loss: 46% 65% 12% 10% Loss: 14% 27% 0%	–5.3 kg –7.8 kg 34% 53% 14% 27%	< 0.001 < 0.001 Sibutramine “significantly more” NR	Sibutramine 15 mg: Dropout: 19/68 Due to adverse event: NR Sibutramine 20 mg: Dropout: 13/62 Due to adverse event: NR Placebo: Dropout: 18/64 Due to adverse event: NR	Fair
–8.9 kg –4.9 kg Maintaining > 80% of original loss: 41% 14%	–4 kg 27%	< 0.001 < 0.001	Sibutramine: Dropout: 148/352 Due to adverse event: 48/352 Placebo: Dropout: 58/115 Due to adverse event: 6/115	Fair

continue

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Study, Year	Drug Dose (mg)	Co-Interventions	Sample Size (N), Race, Sex, Age,† Baseline BMI‡	Length, Goal	Groups
Orlistat					
Muls et al, 2001[91]	120 mg	D All participants: Moderate-intensity dietary advice from a dietitian (–600 kcal/day)	N: 294 Race: NR Orlistat: 82% female Placebo: 78% female Orlistat: 50 yrs Placebo: 48 yrs 33 kg/m^2	24 wks, L	Orlistat Placebo Orlistat Placebo Orlistat Placebo Orlistat Placebo
Van Gaal et al, 1998[89]	30, 60, 120, or 240 mg tid	D All participants: high-intensity dietary advice from a dietitian	N: 613 Race: NR Female: 77% Range: 40–44 yrs (varied by group) 34–35 kg/m^2 (varied by group)	52 wks, L	Orlistat: 30 mg Orlistat: 60 mg Orlistat: 120 mg Orlistat: 240 mg Placebo Orlistat: 30 mg Orlistat: 60 mg Orlistat: 120 mg Orlistat: 240 mg Placebo
Micic et al, 1999[94]	120 mg tid	D All participants: mildly hypocaloric diet with dietary advice	N: 119 Race: NR Orlistat: 70% female Placebo: 78% female Orlistat: 46 yrs Placebo: 45 yrs (median ages) Orlistat: 34.8 kg/m^2 Placebo: 35.2 kg/m^2	24 wks, L	Orlistat Placebo

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Weight Change	Between-Group Differences§	*P* Value‖	Patients Lost to Follow-up and Adverse Events	Trial Quality
–4.66 kg –1.88 kg Mean change: –5.3% –2.3% 5% loss: 64% 39% 10% loss: 23% 13%	–2.78 kg –3% 25% 10%	< 0.001 ≤ 0.001 NR NR	Orlistat: Dropout: 19/147 (13%) Adverse event rate: 80%‖ GI adverse event rate: 64% Placebo: Dropout: 16/147 (11%) Adverse event rate: 67% GI adverse event rate: 38%	Good
–8.5% –8.8% –9.8% –9.3% –6.5% 10% Loss: 28% 28% 37% 38% 19%	 –2% –2.3% –3.3% –2.8% 9% 9% 18% 19%	 < 0.001 NR	Orlistat 30 mg: Dropout: 29/122 Due to adverse event: 7/122 Adverse event rate: 79% Orlistat 60 mg: Dropout: 29/124 Due to adverse event: 6/124 Adverse event rate: 83% Orlistat 120 mg: Dropout: 23/122 Due to adverse event: 2/122 Adverse event rate: 84% Orlistat 240 mg: Dropout: 20/120 Due to adverse event: 3/120 Adverse event rate: 87% Placebo: Dropout: 27/125 Due to adverse event: 3/125 Adverse event rate: 69%	Fair
–10.8 kg –7.3 kg	–3.5 kg	0.001	Orlistat: Dropout: 10/60 Due to adverse event: 1/60 Adverse event rate: 18/60 Placebo: Dropout: 10/59 Due to adverse event: NR Adverse event rate: 7/59	Fair

continue

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Study, Year	Drug Dose (mg)	Sample Size (N), Co-Interventions	Race, Sex, Age,† Baseline BMI‡	Length, Goal	Groups
Orlistat, continued					
Rissanen et al, 2001[95]	120 mg tid	D All participants: 600 kcal deficit diet	N: 51 Race: NR Female: 100% Age: 44 yrs 36.2 kg/m^2	12 mos, L	Orlistat Placebo
Broom et al, 2002[96]	120 mg tid	D All participants: mildly hypocaloric diet (minimum of 1,200 kcal/day), with food and beverage diaries	N: 531 Race: NR Female: 78% Orlistat: 46.7 yrs Placebo: 45.3 yrs Orlistat: 37.1 kg/m^2 Placebo: 37.0 kg/m^2	54 wks, L	Orlistat Placebo Orlistat Placebo Orlistat Placebo
Miles et al, 2002[90]	120 mg tid	D, E All participants: recommended to increase physical activity and diet (–600 kcal/day) with dietary counseling throughout the study	N: 516 <u>Orlistat:</u> White: 84% Black: 10% Other: 6% <u>Placebo:</u> White: 79% Black: 14% Other: 7% Female: 48% Orlistat: 52.5 yrs Placebo: 53.7 yrs Orlistat: 35.2 kg/m^2 Placebo: 35.6 kg/m^2	52 wks, L	Orlistat Placebo Orlistat Placebo Orlistat Placebo
Karhunen et al, 2000[93]	120 mg tid	D All participants: dietary advice (–600 kcal/day) individualized advice throughout the 1 yr loss phase	N: 96 Race: NR Female: 82% Age: 43 yrs 35.9 kg/m^2	2 yrs: 1 yr of L 1 yr of M	Loss phase: Orlistat Placebo Maintenance phase: (Tx Yr 1/Tx Yr 2) Orlistat/Orlistat Orlistat/Placebo Placebo/Orlistat Placebo/Placebo

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Weight Change	Between-Group Differences§	Patients Lost to Follow-up *P* Value‖	to Follow-up and Adverse Events	Trial Quality
–13 kg –7.2 kg	–5.8 kg	NS	Dropout: 4/55	Fair
–5.8 kg –2.3 kg <u>> 5% Loss:</u> 55.6% 24.3% <u>> 10% Loss:</u> 19.7% 11.0%	–3.5 kg 31.3% 8.7%	< 0.001 < 0.001 NS	<u>Orlistat:</u> Dropout: 79/265 Due to adverse event: 20/265 Due to GI symptoms: 13/265 Serious adverse events: 13/265 <u>Placebo:</u> Dropout: 105/266 Due to adverse event: 11/266 Due to GI symptoms: 6/266 Serious adverse events: 17/266	Fair
–4.7 kg –1.8 kg <u>> 5% Loss:</u> 39.0% 15.7% <u>> 10% Loss:</u> 14.1% 3.9%	–2.9 kg 23.3% 10.2%	< 0.001 0.008 0.003	<u>Orlistat:</u> Dropout: 35% Due to adverse event: 10% Due to GI symptoms: NR GI event frequency: 83% <u>Placebo:</u> Dropout: 44% Due to adverse event: 5% Due to GI symptoms: NR GI event frequency: 62%	Fair
Yr 1: –13.1 kg –8.6 kg Yr 2 only: 3.1 kg 6.3 kg 0.5 kg 3.5 kg	–4.5 kg	0.007	No data on adverse effects Dropout: 24/96 (25%) Due to adverse event: NR	Fair

continue

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Study, Year	Drug Dose (mg)	Sample Size (N), Co-Interventions	Race, Sex, Age,† Baseline BMI‡	Length, Goal	Groups
Orlistat, continued					
Hill et al, 1999[92]	30, 60, or 120 mg 3 times daily	D, E, B All participants: 4,180 kJ/day deficit diet multi-vitamin	N: 729 White: 88 Black: 6% Hispanic: 5% Other: 1% Female: 84% Orlistat: 30 mg: 47 yrs 60 mg: 46 yrs 120 mg: 46 yrs Placebo: 46 yrs Orlistat: 30 mg: 32.6 kg/m^2 60 mg: 32.9 kg/m^2 120 mg: 32.8 kg/m^2 Placebo: 32.8 kg/m^2	52 wks M (following 6 mos of L)	Orlistat 30 mg Orlistat 60 mg Orlistat 120 mg Placebo
Metformin					
Giugliano et al, 1993[97]	850 mg bid	Counseled to maintain baseline diet and exercise patterns	N: 50 Race: NR Female: 62% Metformin: 60 yrs Placebo: 60.8 yrs Metformin: 33 kg/m^2 Placebo: 32.7 kg/m^2	6 mos, L	Metformin Placebo
Knowler et al, 2002[81]	850 mg bid (titrated up)	D,E Metformin and placebo participants: written information plus annual 20–30 min individual session emphasizing low-fat diet and physical activity	N: 3,234 White: 55% Black: 20% Hispanic: 16% Native American: 5% Asian: 4% Female: 68% Mean: 51 yrs 34 kg/m^2	2.8 yrs, L & M	Metformin Lifestyle Placebo
Multiple Drugs					
Gokcel et al, 2002[98]	Sibutramine: 10 mg bid Orlistat: 120 mg tid Metformin: 850 mg bid	D 25 kcal per kg of ideal body weight with caloric distribution: 50% carbohydrates 30% lipids 20% protein	N: 150 Race: NR Female: 100% Sibutramine: 42.3 yrs Orlistat: 42.1 yrs Metformin: 43.6 yrs Sibutramine: 38.5 kg/m^2 Orlistat: 35.3 kg/m^2 Metformin: 37.9 kg/m^2	6 mos, L	Sibutramine Orlistat Metformin

Table 3. Randomized Controlled Trials of Pharmacotherapy Interventions (cont)

Weight Change	Between-Group Differences§	Patients Lost to Follow-up — *P* Value‖	Adverse Events	Trial Quality
4.9 kg 3.8 kg 2.6 kg 4.4 kg	0.5 kg –0.6 kg –1.8 kg	< 0.001	Orlistat 30 mg: Dropout: 47/187 Due to adverse event: 17/187 Orlistat 60 mg: Dropout: 40/173 Due to adverse event: 17/173 Orlistat 120 mg: Dropout: 55/181 Due to adverse event: 27/181 Placebo: Dropout: 50/188 Due to adverse event: 5/188	Fair
Data in graph form	Data in graph form	NS	NR	Fair
–2.1 kg –5.6 kg –0.1 kg	–2.0 kg –5.5 kg	≤ 0.001	7.5%	Good
–13.4 kg –8.0 kg –9.0 kg	–4.0 kg 1.0 kg (vs metformin)	BMI loss significantly greater with sibutramine than either other group.	Sibutramine: Dropout: NR Due to adverse event: 2/50 Orlistat: Dropout: NR Due to adverse event: 2/50 Metformin: Dropout: NR Due to adverse event: NR	Fair

hemoglobin).[118,120] Likewise, lower diabetes incidence over 2 years (odds ratio 0.10; CI, 0.03–0.28) was seen in the SOS surgical patients versus non-surgical patients.[121]

Harms of Screening and Treatment

Difficulty sustaining weight loss has raised concern that cycles of loss followed by regain potentially carry risk. Observational studies examining weight cycling and mortality show mixed results[124–130]; conclusions are primarily limited by failure to distinguish between intentional and unintentional weight loss. Some studies examining weight cycling with intentional weight loss have found unfavorable effects on coronary heart disease and its risk factors,[131,132] but others have not.[133,134] This literature is further limited by joint consideration of participants with diverse baseline age or weight (eg, not restricted to those with excess weight, some data suggest weight-cycling risk increases inversely with BMI, so is minimized among the obese), and measurement issues (eg, self-recalled weight and problems characterizing cycling).[135–137] We did not find studies or prior reviews addressing harms of screening or counseling interventions. Some risk is likely present, particularly as obesity stigma is well established.[138–140]

Sibutramine and orlistat both entail frequent, although typically not serious, adverse effects. Sibutramine's common side effects include insomnia, nausea, hypertension, dry mouth, dizziness, and confusion.[31] In the previously reviewed studies, common adverse effects occurred in 10% to 30% of sibutramine patients versus 8% to 19% of control patients.[31] Among recent RCTs, side effects were common (11%–79%),[86–88] but incidence was similar across treatments. Sibutramine's most worrisome side effects are cardiovascular, including increased blood pressure (mean, 0.0 mm Hg–3.5 mm Hg,[31,86–88] or 5%[84,88]) and heart rate (mean, 4–6.8 beats per minute [bpm]).[31–33,85,87] In 1 study, elevated diastolic blood pressure (≥ 5 mm Hg) or pulse (≥ 10 bpm) occurred in 18% more sibutramine-treated participants than controls.[33] In people with controlled hypertension, clinically significant blood pressure increases were similar across treatment groups,[31] but some individuals experienced marked blood pressure rise.[31,86] When reported, dropout due to hypertension was up to 3.9% higher among those treated with sibutramine than among those not treated; overall, dropout for adverse events were similar in drug and placebo arms.[84,86–88]

Adverse events were reported in 7.4% to 18% more participants receiving orlistat than participants receiving placebo.[31,89,91,94] Most symptoms were gastrointestinal, including oily spotting, flatulence, and fecal urgency; these were reported by 22% to 95% of orlistat users (1%–37% more often than controls).[89–92,96] Other problems have included need for vitamin supplementation and reduced contraceptive pill absorption.[31] In recent trials, dropout from side effects was often more common (by 0%–12%) in orlistat-treated participants.[89,90,92,94,96] The metformin RCTs we reviewed did not report dropout due to drug effects; gastrointestinal symptoms were noted to be more common (77.8/100 person yrs vs 30.7/100 person yrs) in 1 trial[141] and present (in 4%) but transient in another. In the latter trial, mean lactic acid values did not rise.[97] Prior review of other weight loss medications found no evidence of serious adverse reactions for phentermine. However, case reports suggested potentially serious side effects of pulmonary hypertension with mazindol and diethylpropion therapy and psychosis with mazindol therapy.[142]

Because of limited surgical RCT data, we evaluated surgical adverse effects in case series reports. Adverse effects were both general (eg, need for prolonged follow-up, multivitamin supplementation) and procedure-specific. The gastric banding RCTs did not report mortality; 1 showed lower surgical complications with laparoscopic versus open procedures,[100] while the 2 evaluating band placement site present conflicting data regarding relative safety of esophagogastric versus gastric placement (Table 4).[101,102] Reported symptoms suggest low rates of dysphagia, hunger, vomiting, and esophagitis.[101,102] In the nonrandomized, controlled SOS study, complications were not reported by procedure; post-operative mortality was 0.2% and morbidity included bleeding (0.9%), wound complications (1.8%), abdominal infection (2.1%), thromboembolic events (0.8%),

pulmonary symptoms (6.2%), and miscellaneous events (4.8%).[104]

In 38 surgical case series, at least 3 (evaluating vertical banded gastroplasty and gastric bypass) included patients with substantial comorbidities[143–145]; multiple studies included those with modest health problems. Generally, mortality rates were low. In 12 vertical banded gastroplasty cohorts, the perioperative mortality rate ranged from 0% to 1.5% (pooled data, 6 deaths in 1,165 patients).[143,145–155] Similar rates were seen among gastric bypass patients (0%–1.5% per series)[118,144,149,156–161] and adjustable gastric banding patients (0%–1.5%).[100,102,155,162–176] Morbidity was more common. Vertical banded gastroplasty's main complications were reoperation (20%–25% over 3–5 yrs)[148,151] and wound infection (8%–32% of patients).[145,148,149] Less frequent events (< 6%) included gastric leaks, stomal stenosis, and pouch dilatations. In gastric bypass patients, wound infection was reported in 8% to 20%.[149,159,160] Single studies noted staple failure (15%),[118] vitamin B12 deficiency (40%),[118] diarrhea (13%),[160] and gastrointestinal hemorrhage (3%).[149] Adjustable gastric banding patients' morbidity was often re-operation (1%–20%),[102,162,165,168–170,175,177,178] band dislocation, leakage, or slippage (0.4%–8%).[100,163–165,167,168,170–172,177,178]

Discussion

Efficacy of Therapeutic Interventions for Obesity

Obesity is common and easy to screen for, poses a substantial health burden in the United States, and has treatment options. Although RCT evidence for long-term improved health with weight loss is limited, weight loss-associated changes in intermediate health variables suggest benefit. In the setting of escalating obesity prevalence, the importance of considering body weight in clinical practice seems clear.

Obese patients can achieve modest but clinically significant, sustained (1–2 yrs) weight loss (eg, 3–5 kg of weight loss) with counseling. As control groups frequently received some intervention, this estimate may be conservative. More intense programs generally achieved more success, as did those incorporating behavioral therapy. Treating patients on an individual (vs group) basis appeared less important.

Sibutramine and orlistat have modest potentially prolonged effects (weight loss of 3–5.5 kg). These estimates do not reflect effects of lifestyle intervention that should accompany pharmacotherapy. Weight maintenance trials suggest that prolonged therapy with these drugs confers some benefit, but that its discontinuation may lead to rapid weight regain. Other drugs show inconsistent or short-term benefit. In both counseling and pharmacotherapy trials, a relatively high frequency of participants have achieved clinically significant (5%–10%) weight loss.

Surgical options can promote substantial weight loss (10–159 kg over 1–5 yrs). Case series evidence suggests such loss can be achieved in patients with multiple comorbid conditions and may be prolonged. Although surgical options are appropriate only for the very obese, between 5% and 6% of U.S. adults have a BMI of 35 or greater,[179] so the number of potentially eligible persons may be substantial.

Limitations of the Literature

Limitations of prior systematic reviews included different eligibility criteria, treatment classifications, and approaches to data synthesis. In addition, aggregate values of their findings do not reflect variations in RCT sample size, length of follow-up, or treatment differences (eg, counseling intensity). There was partial, but incomplete, overlap in the literature covered by each review. Overall, however, findings were consistent.

Recent primary literature likewise had deficiencies. Among counseling and pharmacotherapy trials, internal validity was typically fair (with limitations including loss to follow-up and differential attrition between arms), although a few were judged to have good validity. Studies tended to report mean weight change but not frequency of response. External validity was an issue: participants were frequently volunteers with limited sex and ethnic diversity. No counseling RCT was of more than 54 months duration. Pharmacotherapy trials were accepted with shorter follow-up periods than other treatment modes. Although 6- and 12-month efficacy appeared similar among these trials, shorter duration could

Table 4. Randomized Controlled Trials of Surgical Interventions

Study, Year	Goal	Sample Size (N), Race, Sex, and Age	Co-Intervention	Baseline BMI† (mean kg/m²)	Duration
de Wit et al, 2002[100]	L	N: 50 Race: NR Female: 68%	NR	51.3 (laparoscopic) 49.7 (open)	1 yr
Weiner et al, 2001[102]	L	N: 101 Race: NR Female: 85%	"Interdisciplinary obesity surgery program"	49.5 (esophagogastric) 48.5 (retrogastric)	18 mos
Weiss et al, 2002[101]	L	N: 52 Race: NR Female: 90%	NR	42.5 (gastric) 41.8 (esophagogastric)	23–24 mos

ASGB, adjustable silicone gastric banding; L, weight loss; NR, not reported.

† Presented as baseline mean or range unless otherwise noted.

Table 4. Randomized Controlled Trials of Surgical Interventions (cont)

Groups	Weight Change	Between-Group Difference	*P* Value	Patients Lost to Follow-up and Adverse Events	Trial Quality
ASGB: Laparoscopic Open	 –35.0 kg –34.4 kg	 –1.4 kg	NS	Loss to follow-up: 2% Surgical complications Laparoscopic: 0% Open: 16.7% (incisional hernias, migrating band) Access port complications Laparoscopic: 20% Open: 21% Mean hospital stay (days) Laparoscopic: 7.8 Open: 11.8 Patients with readmission Laparoscopic: 20% Open: 29%	Fair
Placement of laparoscopic ASGB: Esophagogastric Retrogastric	Data in graph form: > 40 kg loss in both groups	NR	NS	Loss to follow-up: 4% Band slippage Esophagogastric: 0% Retrogastric: 2% Pouch dilation Esophagogastric: 0% Retrograde: 6% Esophageal dilation Esophagogastric: 4% Retrograde: 4% Hunger at 18 mos Esophagogastric: 2% Retrograde: 4% Dysphagia at 18 mos Esophagogastric: 2% Retrograde: 2% Recurrent vomiting at 18 mo Esophagogastric: 2% Retrograde: 2% Esophagitis at 18 mos Esophagogastric: 2% Retrograde: 2%	Fair
Placement of laparoscopic ASGB: Gastric Esophagogastric Gastric Esophagogastric Gastric Esophagogastric	Median BMI –17.4 kg/m^2 –18.9 kg/m^2 25% loss 100% 100% Gain 0% 0%	 1.5 kg/m^2 0% 0%	NS	Loss to follow-up: NR Mortality: NR Conversion to open surgery Gastric: 3.6% Esophagogastric: 3.8% Need for reoperation Gastric: 10.7% Esophagogastric: 19.2% Heartburn at 2 yrs Gastric: 11.1% Esophagogastric: 14.3% Dysphagia at 2 yrs Gastric: 0% Esophagogastric: 57.1%	Fair

inflate estimates of sustained weight loss. Surgical data were limited by lack of placebo-controlled RCT evidence; available studies often did not report response frequency, participant comorbidities, or co-interventions.

Finally, some studies (particularly pharmacotherapy ones) used a "last observation carried forward" analytic approach—the final weight outcome available was used as the final weight for those participants who dropped out of the study. Because maximal weight loss tends to occur within 6 months of intervention, this technique may overestimate the ability to sustain weight loss. Although a common technique when a true intention-to-treat analysis is not possible, it should be combined with alternate analyses.[180,181] Although many trials showed parallel analyses of trial enrollees and completers, few authors presented parallel "worst case" analyses.

Harms of Intervention

Treatment appeared reasonably safe. We identified no evidence evaluating counseling harms. Both sibutramine and orlistat had clinically significant, often mild, adverse effects in trials lasting, at most, 2 years. Surgical options clearly entail the highest risk; they lead to mortality in less than 1% of patients in pooled samples, but up to 25% of patients may need re-operation over 5 years.

A systematic review of intervention costs was beyond the scope of this project, but, notably, obesity treatment options may entail considerable cost. Intensive counseling programs require significant time and staffing commitment. Based on average U.S. wholesale price, a 1-year supply of orlistat (120 mg 3 times daily) is $1,445.40 and sibutramine (15 mg daily) is $1464.78.[182] Surgical costs reflect both the invasive procedure and long-term follow-up. Potentially, long-term health improvements may offset these costs to some extent.

Implications for Clinical Practice and Research

Most efficacy trials reviewed here were not carried out in clinical settings; some interventions, particularly intense counseling, may be difficult to incorporate into medical practice. One option may be referral to programs that offer intense counseling with behavioral therapy. Another may be combining office-based counseling with innovative delivery of behavioral approaches, such as video tapes or Internet-delivered adjuncts.

Other topics requiring future research include longer-term efficacy and harms follow-up of weight loss strategies (including better characterization of weight-cycling risks), post marketing safety records of drugs, ability of interventions to alter body fat distribution, race- and ethnic-specific health effects of purposeful reduction of central adiposity, and efficacy of weight maintenance strategies. In the interest of obesity prevention, treatment efficacy and health effects of lifestyle modification should be clarified for patients who are overweight, but not obese. Finally, better estimates of the cost-effectiveness of obesity screening and treatment, including their impact on long-term health outcomes, are needed.

Long-term research on combined treatment modalities in more generalized populations is needed. We were unable to assess treatment effectiveness by sex or ethnicity. Intervention efficacy trials have focused on white women, and observational evidence for health outcomes comes mostly from populations of European origin. Treatment efficacy may differ with race[11,78]; as certain ethnic groups have a disproportionate obesity prevalence, this area needs further attention.

All obesity therapies carry promise and burden, which must be balanced in clinical decision-making. Counseling approaches appear the least harmful and produce modest, clinically important weight loss, but entail cost in time and resources. Pharmacotherapy promotes modest additional weight loss, but long-term drug use may be needed to sustain this benefit with unknown long-term adverse events and appreciable cost. Only surgical options consistently result in large amounts of long-term weight reduction; however, they carry a low risk for severe complications and are expensive. Body size, health status, and prior weight loss history may all influence obesity treatment.

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Appendix

Appendix Table 1. Screening for Obesity: Eligibility Criteria and Results of Searches

Key Question	Eligibility Criteria	Number of Articles Meeting Eligibility Criteria and Not in Prior Systematic Review†
Efficacy of screening	RCT Mass screening	0
Epidemiology of obesity		
a. Prevalence	Large U.S. population-based surveys	1
b. Health risks	Prospective cohort studies with absolute rates of health risk reported over ≥ 10 yrs	14
Efficacy of treatment for weight reduction or intermediate outcomes		
a. Counseling and behavioral treatment	— RCT (of fair or good quality) — Outcome: weight loss or BMI reduction; glucose tolerance, blood pressure, lipid disorders — Duration: ≥ 1 yr — BMI ≥ 25 kg/m^2 — 12-mo follow-up	21
b. Medications	— RCT (of fair or good quality) — Outcome: weight loss or BMI reduction; glucose tolerance, blood pressure, lipid disorders — Duration: ≥ 6 mos — Population: generalizable to typical U.S. primary care population	10
c. Surgery	— RCT (of fair or good quality) — Outcome: weight loss or BMI reduction; glucose tolerance, blood pressure, lipid disorders — Duration: ≥ 1 yr — Cohort — Initial BMI ≥ 25 kg/m^2 — Surgical procedure	2
Harms of screening and treatment	Same studies as efficacy of counseling/behavioral and medication interventions For surgery, same studies as efficacy plus multiple cohorts and 1 non-RCT	21 counseling 15 medication 2 surgery

RCT, randomized controlled trial; BMI, body mass index.

† References 11, 28, 29, 31.

Appendix Table 2. Criteria for Grading the Internal Validity of Individual Studies*

Study Design	Criteria
Systematic reviews	Comprehensiveness of sources and search strategy used Standard appraisal of included studies Validity of conclusions Recency and relevance
Case-control studies	Accurate ascertainment of cases Nonbiased selection of cases and controls with exclusion criteria applied equally to both Response rate Diagnostic testing procedures applied equally to each group Appropriate attention to potential confounding variables
Randomized controlled trials (RCTs) and cohort studies	Initial assembly of comparable groups: For RCTs: adequate randomization, including concealment and whether potential confounders were distributed equally among groups For cohort studies: consideration of potential confounders with either restriction or measurement for adjustment in the analysis; consideration of inception cohorts Maintenance of comparable groups (includes attrition, crossovers, adherence, contamination) Important differential loss to follow-up or overall high loss to follow-up Measurements: equal, reliable, and valid (includes masking of outcome assessment) Clear definition of interventions All important outcomes considered Analysis: adjustment for potential confounders for cohort studies, or intention-to-treat analysis for RCTs
Diagnostic accuracy studies	Screening test relevant, available for primary care, adequately described Study uses a credible reference standard, performed regardless of test results Reference standard interpreted independently of screening test Handles indeterminate results in a reasonable manner Spectrum of patients included in study Sample size Administration of reliable screening test

* Based on reference 27.

Appendix Table 3. Intensive Counseling Intervention Descriptions†

Study, Year	Intervention	Intervention Setting	Intervention Delivery
Stevens et al, 2001[70]	Control	Not noted	Not noted
	Weight loss only	Not noted	Dietitians or health educators
Knowler et al, 2002[81]	Standard lifestyle + placebo	Not noted	Not noted
	Standard lifestyle + metformin	Not noted	Not noted
	Intensive lifestyle	Not noted	Case managers
Kuller et al, 2001[66]	Assessment only	Large research clinic	Psychologists (PhD level)
	Lifestyle intervention	Large research clinic	Psychologists (PhD level), nutritionists, exercise physiologists
Tuomilehto et al, 2001[67]	Control	Not noted	Not noted
	Intervention	Not noted	Nutritionist

LCD, low calorie diet; LDL, low-density lipoprotein; VLCD, very low calorie diet; USDA, U.S. Department of Agriculture.

† Information was primarily obtained from the published sources listed. In selected cases (Tuomilehto et al,[67] Kuller et al[66]), additional information was obtained from study staff.

Appendix Table 3. Intensive Counseling Intervention Descriptions† (cont)

Counseling and Behavioral Description
Usual care (details not noted)
One individual counseling session, then 14 weekly group meetings, then 6 biweekly group meetings, then monthly group meetings. After 18 mos, alternative options were offered, including individual counseling and special group sessions focused on selected weight loss topics. Focus included self-directed behavior change, nutrition and physical activity education, and social support for making and maintaining behavior changes. Behavior change techniques included self-monitoring, setting explicit short-term goals, developing action plans to achieve those objectives, and alternative strategies for situations triggering problem eating. Dietary intervention focused on reduced calorie intake by less consumption of fat, sugar, and alcohol, with a minimum daily caloric intake of 1,500 kcal for men and 1,200 kcal for women, and moderate weight loss goals of ≤ 0.9 kg/wk. Physical activity goal was for gradually increased activity to moderate-intensity activity (40%–55% of heart rate reserve) 30–45 mins/day, 4–5 days/wk. Primary exercise was brisk walking.
Written information and an annual 20–30 minute individual session emphasizing importance of healthy lifestyles. Advice included encouragement to follow the USDA Food Guide Pyramid and equivalent of National Cholesterol Education Program Step I diet, reduce weight, and increase physical activity.
Same as for placebo, but with metformin titrated up to 875 mg twice a day.
16-session curriculum covering diet, exercise, and behavior modification taught by case managers on a 1:1 basis in the first 24 wks. Flexible, culturally sensitive, and individualized. Subsequent individual (typically monthly) and group sessions with case managers to reinforce behavioral change.
Clinical assessment, with baseline health education pamphlet on reducing cardiovascular risk factors and advice to quit smoking.
Cognitive-behavioral program aimed at preventing rises in LDL cholesterol and weight gain and increasing leisure-time activity. Intensive group program in the first 6 mos, then follow-up individual and group sessions from mos 6–54. Weight loss goal was 5–15 lbs, depending on baseline weight. Participants were asked to lower dietary fat intake and daily caloric intake. Lifestyle approach to increasing physical activity to expenditure of 1,000–1,500 kcal/wk.
General oral and written information about diet and exercise at baseline and at subsequent annual visits. 3-day food diary at baseline and at each annual visit.
Detailed advice about how to achieve weight loss, diet, and exercise goals. Participants met with nutritionist 7 times over first yr, then every 3 mos. Dietary advice was tailored to each participant based on quarterly food diaries and included behavioral modification tips. Participants received individual guidance on increasing physical activity level. Endurance exercise (walking, jogging, swimming, aerobic ball games, or skiing) was recommended as a way of increasing aerobic capacity. Supervised progressive, individualized circuit-type resistance training also offered for improving functional capacity and strength.

continue

Appendix Table 3. Intensive Counseling Intervention Descriptions† (cont)

Study, Year	Intervention	Intervention Setting	Intervention Delivery
Fogelholm et al, 2000[76]	Control (40-wk follow-up after 12-wk weight reduction program)	Not noted	Nutritionist (weight loss phase)
	Walking program (4.2 MJ/wk target expenditure) following 12-wk weight reduction program	Not noted	Nutritionist (weight loss phase), exercise instructor (maintenance phase)
	Walking program (8.4 MJ/wk target expenditure) following 12-wk weight reduction program	Not noted	Nutritionist (weight loss phase), exercise instructor (maintenance phase)
Jakicic et al, 1999[72]	Short-bout exercise	Not noted	Nutritionists, exercise physiologists, and behavioral therapists
	Long-bout exercise	Not noted	Nutritionists, exercise physiologists, and behavioral therapists
	Short-bout exercise with equipment	Not noted	Nutritionists, exercise physiologists, and behavioral therapists
Jones et al, 1999[69]	Control	Not noted	Study nurse
	Weight loss	Not noted	Registered dietitian
Sbrocco et al, 1999[74]	Behavioral choice treatment	Not noted	Clinical psychologist or clinical social worker (also a psychology graduate student) with extensive experience in the behavior treatment of obesity. Two inexperienced graduate students (psychology) were co-leaders.
	Traditional behavioral treatment	Not noted	Clinical psychologist or clinical social worker (also a psychology graduate student) with extensive experience in the behavior treatment of obesity. Two inexperienced graduate students (psychology) were co-leaders.

Appendix Table 3. Intensive Counseling Intervention Descriptions† (cont)

Counseling and Behavioral Description
12-wk weight reduction program (wk 1: low energy diet based on meal exchange; wks 2–9 VLCD; wks 10–12: low energy diets), with weekly small groups (5–12 participants) receiving instruction on diet, weight maintenance, relapse prevention. No increase in habitual exercise in the 40-wk follow-up.
12-wk weight reduction program as above. In maintenance program, each participant was prescribed a weekly walking time and walked with a heart rate monitor. One weekly walking session was supervised. All persons participated in weekly meetings in small groups throughout the maintenance program, conducted by an exercise instructor. Educational material was distributed monthly. Weekly homework included monitoring of high-risk situations for overeating. Problems in diet and prevention of relapse were discussed in the meetings.
12-wk weight reduction program, then 40-wk walking weight maintenance program as described in the 4.2 MJ program above; only difference was increased targeted energy expenditure.
Behavioral weight loss program: group treatment meetings of diminishing frequency (weekly in mos 1–6, biweekly in mos 7–12, monthly in wks 13–18). Meetings focused on behavioral strategies for modifying eating and exercise behaviors. Participants were instructed to reduce daily energy and fat intake. Caloric goal based on baseline weight, with goal of 0.45–0.9 kg loss per wk. Fat intake goal was 20% of total intake. Food diaries reviewed weekly, with feedback from interventionists. Exercise: same volume of exercise, all home based, in all 3 groups. Participants instructed to exercise 5 days/wk: initially 20 mins/day (wks 1–4), increasing to 40 mins/day by wk 9. Exercise was divided into multiple 10-min bouts performed at convenient times in the day.
Behavioral weight loss program: as in the short-bout exercise arm. Exercise: daily total exercise amounts as described in the short-bout exercise arm. Exercise was to be performed in 1 long bout.
Behavioral weight loss program as in the short-bout exercise arm. Exercise: daily total exercise amounts as described in the short-bout exercise arm. Participants were provided with motorized home treadmills.
Participants were told that they should lose weight, but received no formal diet counseling or group support.
Patients individually counseled within 10 days of randomization and 2–4 wks later. Content focused on food selection and preparation, and weight reduction goals were established. No exercise advice. They met in groups twice monthly for 3 mos, then every 3–6 mos.
13 weekly 1.5-hr group sessions with 5–7 members per group. Participants received 2-wk meal plans and recipe booklets for a low fat (25%) diet: 1,800 kcal/day. Diaries reviewed, with immediate feedback each session—including graphs of daily fat and caloric intake and a list of highest-fat foods and some alternatives. Participants encouraged to eat at a constant calorie level. Self-monitoring phased out before acute treatment ended. Participants were encouraged to complete a walking program 30 mins/day, 3 days/wk in a single bout. No formal exercise groups, but daily exercise logs. Stated purpose: to stop dieting and to view eating as a choice; to expect slower weight loss than they had experienced in the past, but more permanent change. Health behavior including food choice, avoiding exercise, eating behaviors discussed as choices designed to achieve certain outcomes. Individuals taught to identify their choices and the outcomes controlling these choices and to focus on learning to eat in a manner consistent with a reasonable eventual end-goal weight, rather than focusing on how quickly weight can be lost.
Weekly group sessions, meal plans, recipes, food diaries, and exercise as above, but with 1,200 kcal/day diet. Stated purpose: to promote substantial weight loss and to help develop habits and strategies to maintain this loss. Standard behavioral weight management techniques (eg, self-monitoring, stimulus control, and behavioral substitution) were taught. Participants were encouraged to avoid eating and purchasing high-calorie foods and to lose weight so they could then maintain these changes; they were taught to understand their reasons for eating and to engage in problem-solving to determine other methods to respond to stress.

continue

Appendix Table 3. Intensive Counseling Intervention Descriptions† (cont)

Study, Year	Intervention	Intervention Setting	Intervention Delivery
Ashley et al, 2001[82]	Dietitian-led lifestyle intervention	Not noted	Registered dietitian
	Dietitian-led lifestyle intervention with meal replacements	Not noted	Registered dietitian
	Primary care office intervention with meal replacements	Physician office	Primary care physician (2/3 of visits) or registered nurse (1/3 of visits)
Wadden et al, 2001[68]	Sibutramine alone	Not noted	Physician
	Sibutramine + lifestyle	Not noted	Physician (outcomes monitoring) doctoral-level psychologists (counseling)
	Sibutramine + lifestyle + diet	Not noted	Physician (outcomes monitoring) doctoral-level psychologists (counseling)
Wing and Anglin, 1996[78]	Behavior therapy with LCD	Not noted	Multidisciplinary team (all white)
	Behavior therapy with intermittent VLCD	Not noted	Multidisciplinary team (all white)

Appendix Table 3. Intensive Counseling Intervention Descriptions† (cont)

Counseling and Behavioral Description
26 1-hr sessions over 1 yr. Participants received instruction manuals that included lessons based on an established weight control program (LEARN). Diet included a LCD (1,200 kcal/day, with ≤ 30% of calories from fat), using standard recommendations for food groups and portion sizes. Activity instruction included walking up to 10,000 steps/day, measured by a supplied pedometer. Self-monitoring of food intake and energy expenditure in diaries. Specific to this group, participants attended small (8–10 people) classes led by a registered dietitian. Classes were weekly for 3 mos, then biweekly for 3 mos, then monthly for 4 mos. Diet was made up of conventional food items.
As in the traditional group above, instruction manuals for dieting, 1,200-kcal diet, and exercise instructions with pedometer use and self-monitoring. Sessions with registered dietitian as above. However, 2 of the 3 main meals were replaced with meal-replacement shakes or bars (reduced to 1 main meal if goal reached and maintained).
26 biweekly 10–15 min individual sessions over 1 yr, with a focus of helping patients lose weight (although other related medical problems were also discussed). Diet prescription with meal replacements as in the "dietitian-led with meal replacement" plan above. During each visit, diet, behavior modification, and physical activity habits were reviewed, and questions answered about the diet instructions.
Baseline meeting with a physician who described medication use and the importance of lifestyle modification. A balanced diet (1,200–1,500 kcal/day) was prescribed. Gradually increased exercise (typically walking) to 4–5 sessions/wk, each of 30–40 mins duration. Literature supporting these instructions was disseminated. Over the trial, patients had 10 brief (5–10 min) follow-up visits with the physician (wks 2, 4, 8, 12, 16, 20, 24, 32, 40, 52). No lifestyle counseling or instruction for self-monitoring of lifestyle change.
Physician visits on same schedule as sibutramine alone group. Additionally, in the first 20 wks, they attended weekly psychologist-led group lifestyle modification sessions. They were prescribed the same diet and exercise goals as the drug-only group but were given behavioral strategies for achieving them and were asked to self-monitor food intake and physical activity for at least 16 wks. Behavioral topics discussed at weekly sessions included stimulus control, slowed rate of eating, social support, and cognitive restructuring. During wks 24–52, sessions focused on skills for maintenance of weight loss.
Identical intervention to the sibutramine plus lifestyle group, with the addition of the first 16 wks prescription of a 1,000 kcal/day portion-controlled diet (4 servings/day of a liquid nutritional supplement with an evening balanced meal). After wk 16, gradually decreased consumption of liquid supplement, with 1,200–1,500 kcal/day diet of conventional food diet by wk 20 (similar to the patients in the other 2 arms).
1 yr of weekly sessions, including review of self-monitoring records, weighing, and a lecture/discussion on nutrition, behavioral techniques, or exercise. Topics included stimulus control, goal setting, and self-monitoring of diet and exercise. Participants encouraged to gradually increase activity until walking 2 miles/day, 5 days/wk. Participants followed a LCD (1,000–1,200 kcal/day), with < 30% calories from fat.
Counseling and behavioral therapy as above for diet and exercise. Intermittent VLCD in wks 1–12 and 24–36. During VLCD intervals, goal consumption of approximately 500 kcal/day, either as liquid formula or lean meat, fish, or fowl. After each VLCD, other foods gradually reintroduced until consumption of 1,000–1,200 kcal/day was reached.

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