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Lifestyle Interventions for Cardiovascular Disease Risk Reduction: A Systematic Review of the Effects of Diet Composition, Food Provision, and Treatment Modality on Weight Loss

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Abstract The purpose of this systematic review was to evaluate, synthesize, and interpret findings from recent randomized controlled trials (RCTs) of dietary and lifestyle weight loss interventions examining the effects of (1) diet composition, (2) use of food provision, and (3) modality of treatment delivery on weight loss. Trials comparing different dietary approaches indicated that reducing carbohydrate intake promoted greater initial weight loss than other approaches but did not appear to significantly improve long-term outcomes. Food provision appears to enhance adherence to reduction in energy intake and produce greater initial weight losses. The long-term benefits of food provision are less clear. Trials comparing alternative treatment modalities suggest that phone-based treatment produce short- and long-term weight reductions equivalent to face-to-face interventions. The use of Internet and mobile technologies are associated with smaller reductions in body weight than face-to-face interventions. Based on this review, clinical implications and future research directions are provided.

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Introduction

Energy reduction, physical activity promotion, and behavioral strategies are fundamental components of evidence-based lifestyle intervention for weight management. However, there are a number of specific characteristics that can vary considerably across programs. For instance, weight loss interventions can differ in the type of nutritional focus or dietary recommendations provided, the frequency and duration of contacts between participants and interventionists, the method of communication between participants and treatment staff, and among other factors. It is important to understand how these variations in treatment content and delivery may influence participants' adherence and their success in achieving weight loss so that the most effective and feasible strategies are retained and/or incorporated into evidence-based treatments.

In fact, a considerable amount of research has focused on these aspects of treatment, although there has often been variability in findings and subsequent conclusions. In addition, there have been substantial differences in research designs, populations, and overall methodological strengths and limitations of studies. Therefore, it is worthwhile to review the scientific literature to interpret and integrate the most recent findings on these issues relevant to weight loss treatment delivery. The purpose of this systematic review was to critically evaluate and synthesize recent research findings on treatment characteristics that may significantly affect

participants' treatment adherence and weight management. In this review, we summarized findings from recent randomized controlled trials (RCTs) of lifestyle interventions for weight loss. In particular, we focused on the effects of three aspects of treatment, including (1) diet composition (e.g., low-carbohydrate, low-fat recommendations), (2) structure of meal plans (e.g., provision of foods), and (3) modalities of treatment delivery (e.g., in-person, telephone). Systematic reviews were conducted for each of these topics to summarize the effects of these program characteristics on participants' initial and sustained weight loss.

Methods

A review of the literature was conducted using PubMed to identify RCTs of dietary and lifestyle interventions for weight loss. Trials that specifically examined the effects of one of the following aspects of treatment were included: (1) diet composition, (2) use of structured or prepackaged meal plans, and (3) modality of treatment. The following criteria were used to evaluate trials to determine their eligibility for inclusion in this systematic review:

- Inclusion criteria—Published within the last 10 years (January 2003 to April 2014), RCTs including weight-related outcomes, conducted with free-living adults (≥18 years), ≥15 participants per trial arm, initial treatment lasting ≥2 months, published in English in a peer-reviewed journal.
- Exclusion criteria—Non-randomized trials, interventions without an adequate comparison group, attrition >40 % at any time point, treatment not focusing mostly (if not exclusively) on overweight or obese subjects, not specifically focused on weight or cardiovascular risk.

Initial follow-up was typically defined as a weight-related assessment that occurred ≤6 months after randomization. When available, extended follow-up was generally defined as a weight-related assessment that occurred ≥12 months after randomization. For studies that included more than one assessment during the initial and/or extended follow-up periods, the longer of the available time points was generally included in the summary unless a particular time point signified a distinct transition in the type or intensity of care. Studies that included components of more than one topic area (e.g., trials comparing different modalities of delivery that also included food provision) were included in only one of the reviewed domains based on the primary focus of the original trial.

Results

Trials Comparing Different Diet Compositions

Overview of Included Trials

Twenty-two unique weight loss trials that compared different dietary approaches for reducing energy intake and/or modifying macronutrient compositions were included for review [1–22]. Dietary targets examined in one or more trials included (1) "conventional" reduced calorie, reduced fat; (2) reduced carbohydrate, (3) high-protein, (4) high or low glycemic-index foods, (5) Mediterranean diet, and (6) vegan diet, although the precise definition and recommendations within each of these general categories differed across trials. Eighteen of the 22 trials included a comparison of one diet to an alternative active dietary intervention [2–8, 11–21]. Of these, 14 included a conventional, reduced fat intervention arm in comparisons [2, 4, 7, 11–21], while four included differing versions of alternative diets (e.g., high protein vs. high carbohydrate; [3, 5, 6, 8]). The remaining four trials compared an active intervention to an education-only condition or similar minimal treatment comparator [1, 9, 10, 22]. Of the 22 trials, eight reported initial outcomes only (≤6 months; [1–8]), three reported extended outcomes only (≥12 months; [9–11]), and 11 reported both initial and extended outcomes [12–22].

Summary of Findings

Half of the trials (11 of 22) found no weight loss differences between dietary conditions at any time point [3–8, 11–15], while the other 11 trials reported significant differences in weight loss at one or more assessment ([1, 2, 9, 10, 15–22]; see Table 1). Two of the eight trials that included only initial outcomes (≤6 months) found significant differences between conditions [1, 2]. One of these short-term studies reported that a Mediterranean diet achieved greater reductions in BMI than usual care [1], while the other study found that a low-carbohydrate diet achieved greater weight loss than a low-fat diet [2]. However, four short-term trials comparing various levels of dietary fat, carbohydrates, and protein composition yielded no differences in weight loss [3–6], and two trials comparing Mediterranean diets to either a low-fat diet [7] or an educational control [8] showed no differences. Two of the three trials that included only extended outcomes found that a Mediterranean-style diet achieved greater weight loss than education-only or limited-treatment conditions [9, 10]. The other long-term study, which compared a Mediterranean diet to a more intensive comparison treatment, failed to show differences in weight loss [11].

Of the 11 trials that included both initial and long-term outcomes, four observed no differences between diets at any time point [12–15]. These trials included 2–4 dietary arms

Table 1 Summary of trials included in systematic review

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
Trials comparing different diet compositions										
Dansinger et al. [12]	160	21 % (M2)	4 Group sessions	Diet, physical activity, limited behavioral strategies	Men and women	100.0	2	−3.6	12	−2.1
Carbohydrate restriction (Atkins)	40	38 % (M6)			BMI=27–42 kg/m^2	99.0		−3.8		−3.2
Macronutrient balance (Zone)	40	42 % (M12)			≥1 cardiac risk factor	97.0		−3.5		−3.0
Calorie restriction (weight watchers)	40				Aged 22–72 years	103.0		−3.6		−3.3
Fat restriction (Ornish)	40									
Ebbeling et al. [13]	73	10 % (M6)	23 Group workshops;	Diet, behavioral strategies	Men and women	103.5	6	NS[a]	18	NS[a]
Low-glycemic load	36	25 % (M12)	1 individual session; 5 telephone calls		BMI≥30 kg/m^2	103.3				
Low-fat	37	30 % (M18)			Aged 18–35 years					
Elhayany et al. [11]	259	17 % (M3)	24 Sessions	Diet, physical activity	Men and women with type 2 diabetes	86.7	–	–	12	−8.9
Low-carb Mediterranean	85	22 % (M6)			BMI 27–34 kg/m^2	85.5				−7.4
Traditional Mediterranean	89	25 % (M9)			Aged 30–65 years	87.9				−7.6
ADA diet	85	31 % (M12)								
Esposito et al. [9]	120	7 % (M12)	18 Group sessions (LEM only)	Diet, physical activity, behavioral strategies (LEM only)	Premenopausal women	95.0	–	–	24	−14.0*
Low-energy Mediterranean (LEM)	60				BMI≥30 kg/m^2	94.0				−3.0
Educational control	60				Aged 20–46 years					
Esposito et al. [10]	180	9 % (M24)	18 Group sessions (LEM);	Diet, physical activity, limited behavioral strategies	Men and women with metabolic syndrome	78.0	–	–	24	4.0*
Control diet (low-fat recommendations)	90		12 group sessions (control)			77.0				−1.2
Mediterranean diet	90									
Esposito et al.[b], [16, 49]	215	9 % (M48)	30 Group sessions	Diet, physical activity, limited behavioral strategies	Men and women with newly diagnosed type 2 diabetes	86.0	12	−6.2*	48	−3.8
Low-carb Mediterranean	108				Aged 30–75 years	85.7		−4.2		−3.2
Low-fat	107				BMI>25 kg/m^2					
Estruch et al. [8]	772	<1 % (M3)	1 Dietary advice session (all diets); 1 educational group session (Med diets only)	Diet	Men (aged 55–80 years) and women (aged 60–80 years) with type 2 diabetes or 3+ other CHD risk factors	Not reported	3	−0.19	–	–
Mediterranean + olive oil	257							−0.26		
Mediterranean + nuts	258							−0.24		
Education control (low-fat recommendations)	257									

Table 1 (continued)

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
Foster et al. [17]	63	22 % (M3)	4 Brief sessions (focused on diet)	Diet	Obese men and women	98.7	3	−6.8*	12	−4.4
Low carbohydrate (Atkins)	33	33 % (M6)			Mean age=44 years	98.3		−2.7 (% change)		−2.5 (% change)
Low fat	30	41 % (M12)			Mean BMI=34 kg/m^2					
Foster et al. [18]	307	7 % (M3)	38 Group sessions	Diet, physical activity, behavioral strategies	Men and women	103.3	3	−9.5*	24	−6.3
Low carbohydrate	153	14 % (M6)			BMI 30–40 kg/m^2	103.5		−8.4		−7.4
Low fat	154	26 % (M12)			Aged 18–65 years					
		37 % (M24)								
Macronutrient balance (Zone)	311	20 % (M12)	8 Group sessions	Diet, physical activity, behavioral strategies (varied based on content of diets)	Premenopausal women	86.0	2	Atkins>weight loss than other 3*[c]	12	−4.7*
Gardner et al. [20]	77				BMI 27–40 kg/m^2	84.0				−1.6
Low carbohydrate (Atkins)	79				Aged 25–50 years	85.0				−2.2
Low fat (LEARN)	79					86.0				−2.6
Very low-fat (Ornish)	76									
Iqbal et al. [14]	144	30 %/12 %[‡] (M6)	27 Group sessions	Diet, physical activity	Women and men with type 2 diabetes	118.3	6	−2.8	24	−1.5
Low carbohydrate	70	47 %/19 %[‡] (M12)			BMI ≥30 kg/m^2	115.5		−2.0		−0.2
Low fat	74	53 %/13 %[‡] (M24)			Aged ≥18 years					
Luscombe-Marsh et al. [3]	73	22 % (M4)	8 Dietary counseling visits coinciding with visits for food provision	Diet (including provision of key foods to achieve macronutrient composition)	Men and women	M/W	4	−9.7	–	–
Low fat, high protein	36				BMI 27–40 kg/m^2	100.3/90.5		−10.2		
High fat, standard protein	37				Aged 20–65 years	111.6/90.0				
McLaughlin et al. [4]	65	12 % (M4)	1 Initial nutrition education session+16 brief sessions with dietician (to review food records)	Diet (including provision of meal plans), limited behavioral strategies (self-monitoring)	Men and women with insulin resistance	94.3	4	−5.7	–	–
Low fat, high carbohydrate	34				BMI 29–36 kg/m^2	95.0		−6.9		
High fat, moderate carbohydrate	31									
McMillan-Price et al. [5]	129	10 % (M3)	12 Visits with dietician coinciding with visits for food provision	Diet (including provision of some key foods and provision of meal plans)	Men and women	86.0	3	−3.7	–	–
High carb, high GI	32				BMI ≥25 kg/m^2	87.1		−4.8		
High carb, low GI	32				Aged 18–40 years	87.7		−5.3		
High protein, high GI	32					88.4		−4.4		
High protein, low GI	33									
Noakes et al. [6]	119	16 % (M3)	3 Consultation visits with dietician+3 food preparation sessions	Diet (including provision of some key foods), physical activity,	Women	87.0	3	−7.6	–	–
High protein, low fat	58				BMI 27–40 kg/m^2	86.0		−6.9		

Table 1 (continued)

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
High carbohydrate, low fat	61			limited behavioral strategies (self-monitoring)	Aged 20–65 years					
Sacks et al. [15]	811	20 % (M24)	54 Group sessions+12 individual sessions	Diet, physical activity, behavioral strategies	Men and women	94.0	6	NS[d]	24	NS[d]
Low fat, average protein	204				BMI 25–40 kg/m^2	92.0				
Low fat, high protein	202				Aged 30–70 years	92.0				
High fat, average protein	204					94.0				
High fat, high protein	201									
Shai et al. [21]	322	2 % (M6)	18 Group sessions; 6 motivational telephone calls (as needed)	Diet, physical activity, behavioral strategies	Predominantly men (86 %)	91.3	6	Low-carb > low-fat, Med*[e]	24	−2.9*
Low fat	104	5 % (M12)			BMI ≥27 kg/m^2	91.1				−4.4
Mediterranean	109	13 % (M18)			Aged 40–65 years,	91.8				−4.7
Low carbohydrate	109	16 % (M24)			Or, presence of type 2 diabetes or CHD (regardless of BMI or age)					
Stern et al. [19]	132	40 %/11 %[‡] (M6)	15 Group sessions	Not specified	Women and men	130.0	6	Low-carb>low-fat*[f]	12	−5.1
Low carbohydrate	64	34 %/5 %[‡] (M12)			BMI ≥35 kg/m^2	132.0				−3.1
Low fat	68				Aged ≥18 years					
Toobert et al. [1]	279	12 % (M6)	Initial 3-day retreat+24 sessions (Med only)	Diet, physical activity, behavioral strategies (Med only)	Postmenopausal women with type 2 diabetes	BMI	6	BMI	–	–
Mediterranean					Aged <75 years	35.3		−0.37*		
Usual care						34.9		+0.20		
Turner-McGrievy et al. [22]	62	15 % (M12)	14 Group sessions (all participants)+26 additional support groups (34 participants)	Diet, physical activity	Postmenopausal women	87.4	12		24	
Vegan diet	31	23 % (M24)			BMI 26–44 kg/m^2	86.4		−4.9*		−3.1*
National Cholesterol Education Program (NCEP) guidelines	31				Aged 44–73 years			−1.8		−0.8
Vincent-Baudry et al. [7]	212	20 % (M3)	Not specified	Diet (nutritional recommendations and booklet)	Men and women with moderate CVD risk aged 18–70 years	BMI	3	BMI	–	–
	102					28.7		−1.5		
Mediterranean	110					28.7		−1.2		
Low fat										
Yancy et al. [2]	119	34 % (M6)	9 Group sessions	Diet, physical activity	Women and men with hyperlipidemia	97.8	6	−12.0	–	–
Low carb	59				BMI 30–60 kg/m^2	96.8		−6.5*		

Table 1 (continued)

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
Low fat	60				Aged 18–65 years					
Trials comparing methods of meal provision										
Hannum et al. [27]	53	[g]12% (M2)	8 Dietary education sessions	Diet	Women	85.3	2	−3.6	–	–
Self-selected diet	27				BMI 26–42 kg/m^2	86.7		−5.6*		
Portion-controlled entrees	26				Aged 24–60 years					
Hannum et al. [28]	51	15 % (M2)	8 Dietary education sessions	Diet	Men	98.0	2	−5.1	–	–
Self-selected diet	26				BMI 26–42 kg/m^2	96.8		−7.4*		
Portion-controlled entrees	25				Aged 24–60 years					
Li et al. [23]	82	21 % (M6)	9 Dietary education sessions	Diet	Men and women with type 2 diabetes	Not reported	3	−5.6*	12	−4.4*
Slimfast meal replacement plan	46	26 % (M12)			BMI 27–40 kg/m^2			−2.9		−2.4
Prescribed 500 calorie/day deficit	36				Aged ≥30 years					
Rock et al. [24]	442	8 % (M24)	104 Individual sessions	Diet, physical activity, behavioral strategies (treatment groups only)	Women	92.2	6	−9.2[i]	24	−7.4[i]
In-person treatment + prepackaged meals	167				BMI 25–40 kg/m^2	92.9		−8.3		−6.2
Phone-based treatment + prepackaged meals	164				Aged ≥18 years	91.0		−2.9*		−2.0*
Usual care	111				≥15 kg over ideal weight					
Tsai et al. [25]	50	26 % (M4)	8 Individual sessions	Diet, physical activity, behavioral strategies	Men and women	108.9	4	−5.9	–	–
Two prepackaged meals/ day	25				BMI 30–49.9 kg/m^2	106.5		−5.3		
One prepackaged meal/day	25				Aged ≥18 years					
Webber et al. [26•]	50	6 % (M3)	1 In-person session at baseline	Diet, physical activity, behavioral strategies	Men and women	BMI	3	Weight	–	–
Internet program	25				BMI 30–45 kg/m^2	35.2		−4.1		
Internet program + portion-controlled diet	25				Aged 25–65 years	35.0		−5.7		
Trials comparing different treatment modalities										
Appel et al. [31]	415	12 % (M6)	33 Telephone contacts (remote); 39 in-person or phone contacts (remote + in-person)	Diet, physical activity, behavioral strategies	Men and women	102.1	6	−6.1[h]	24	−4.6
Remote	139	4 % (M24)			One or more cardiovascular risk factor	105.0		−5.8		−5.1
Remote + in-person	138				Aged ≥21 years	104.4		−1.4		−0.8
Self-directed	138									
Befort et al. [39]	34	15 % (M4)			Women living in rural areas	95.7	4	−13.5*	6	−14.9*

Table 1 (continued)

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
Group phone	16	21 % (M6)	20 Sessions; either group or individual	Diet, physical activity, behavioral strategies	BMI 25–44.9 kg/m^2	90.5		−9.2		−9.5
Individual phone	18				Aged 22–65 years					
Carter et al. [43]	128	38 % (M6)	None, except for weight assessment visits	Self-monitoring intervention only	Men and women	96.84	6	−4.6[i]	–	–
Self-monitoring via app	43				BMI ≥27 kg/m^2	97.9		−2.9		
Self-monitoring via website	43				Aged 18–65 years	96.4		−1.3		
Self-monitoring via paper diary	41									
Chambliss et al. [44•]	120	21 % (M3)	Enhanced program only: 1 introductory seminar, 3 telephone consultations	Diet, physical activity, behavioral strategies (limited behavioral strategies only in self-monitoring and control groups)	Women and men	97.1	3	−2.7[j]	–	–
Computerized self-monitoring	45				BMI 25–35 kg/m^2	98.2		−2.5		
Computerized self-monitoring + enhanced behavioral treatment	45				Mean age=45.0 years	100.1		0.3		
Control	30									
Collins et al. [42•]	301	21 % (M6)	No clinician contact—personalized feedback was automatically generated based on participant-reported data	Diet, physical activity, behavioral strategies	Men and women	94.4	3	−2.7	6	−3.6
Basic online	143				BMI 25–40 kg/m^2	93.4		−3.3		−4.3
Basic online + personalized feedback and reminders	158				Aged 18–60 years					
Donnelly et al. [32]	74	24 % (M6.5)	26 Group sessions; either by phone or in person	Diet (including meal provision), physical activity, behavioral strategies	Men and women	102.5	4	−10.6[k]	6.5	−12.8
Phone	25				Mean BMI=33.2	95.6		−12.7		−12.5
Face-to-face	27				Aged 25–68 years	88.2		−0.25		n/a
Control	22									
Donnelly et al. [33]	395	15 % (M6)	42 Group sessions	Diet (including meal provision), physical activity, behavioral strategies	Men and women	100.0	6	−12.6	18	−6.2
Phone	201	27 % (M18)			BMI 25–44.9 kg/m^2	101.4		−13.5		−7.1
Face-to-face	194				Aged 18–65 years					
Gold et al. [38]	88	29 % (M12)	24 Weekly meetings (therapist-led program only)	Diet, physical activity, behavioral strategies	Men and women	92.0	6	−6.8*	12	−5.1*
Therapist-led online	40				BMI 25–39.9 kg/m^2	90.2		−3.3		−2.6
Basic online	48				Aged ≥18 years					
Harvey-Berino et al. [34]	481	4 % (M6)	24 Group sessions	Diet, physical activity, behavioral strategies	Men and women	97.2	6	−5.5[l]	–	–
Internet	161				BMI 25–50 kg/m^2	97.2		−8.0		
In-person	158				Mean age=46.6 years	96.5		−6.0		
Hybrid	162									

Table 1 (continued)

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
Hunter et al. [29]	446	17 % (M6)	Internet group: 2 phone sessions, weekly written feedback	Diet, physical activity, behavioral strategies only in internet group	Military personnel	87.4	6	−1.3*	–	–
Internet	224				Men and women	86.6		0.6		
Usual care	222				BMI ≥25 for women					
					BMI ≥27.5 for men					
					Aged 18–65 years					
Micco et al. [37]	123	37 % (M12)	52 Weekly online meetings; IPS group included 12 monthly in-person sessions	Diet, physical activity, behavioral strategies	Men and women	92.0	6	−6.8	12	−5.1
Internet-only	62				BMI 25–39.9 kg/m^2	86.1		−5.1		−3.5
Internet + in-person support (IPS)	61				Aged ≥18 years					
Patrick et al. [30]	65	66 % (M4)[m]	3–5 Text messages per day in treatment group, plus 4 monthly phone calls	Diet, physical activity, limited behavioral strategies	Men and women	88.0	4	−0.17	–	–
Standard weight advice	32				BMI 25–39.9 kg/m^2	88.8		−4.6*		
Tailored text messages	33				Aged 25–55 years					
Perri et al. [35]	234	6 % (M18)	26 Biweekly sessions (or mailings for control group)	Diet, physical activity, behavioral strategies	Women	97.8	6	−10.0[n]	18	−8.9*
Face-to-face	83				BMI >30 kg/m^2	96.4				−8.2
Phone	72				Aged 50–75 years	95.0				−6.8
Educational control	79									
Sherwood et al. [40]	63	19 % (M6)	10 or 20 Phone sessions over 6 months in intervention groups	Diet, physical activity, behavioral strategies	Men and women	95.5	6	−2.3	–	–
Self-directed	21				BMI 30–39 kg/m^2	93.6		−3.2		
10 Phone sessions	21				Aged ≥18 years	96.7		−4.9		
20 Phone sessions	21									
Tate et al. [36]	92	16 % (M12)	Enhanced: weekly emails from counselor (5/week during month 1, weekly during months 2–12)	Diet, physical activity, behavioral strategies	Men and women	89.4	3	−2.7	12	−2.0
Basic internet	46				BMI 27–40 kg/m^2	86.2		−4.1*		−4.5*
Internet behavioral counseling	46				Mean age=48.5 years					
					≥1 risk factor for type 2 diabetes					
Turner-McGrievy [45]	78	17 % (M3)	24 Podcasts, no clinician contact	Diet, physical activity, behavioral strategies	Men and women	89.0	3	−0.3	–	–
Weight loss podcast	37				BMI 25–40 kg/m^2	91.9		−2.9*		
Theory-based weight loss podcast	41				Mean age=38.6 years					
Turner-McGrievy et al. [46]	96	10 % (M6)	24 Podcasts+32 mini-podcasts, no clinician support	Diet, physical activity, behavioral strategies	Men and women	BMI[o]	6	−2.7	–	–
Podcast only	49				BMI 25–45 kg/m^2	32.2		−2.7		
Podcast + internet support	47				Aged 18–60 years	32.9				

Table 1 (continued)

Reference	*n*	Attrition	Contact with clinician	Characteristics of intervention	Inclusion criteria/ characteristics	Pretreatment	Treatment		Follow-up	
						Original weight (kg)	Duration (mo.)	Wt. change (kg)	Duration (mo.)	Wt. change (kg)
Webber et al. [41]	66	0 % (M4)	No clinician meetings in internet group; enhanced group received 16 chat group sessions	Diet, physical activity, behavioral strategies	Women BMI 25–50 kg/m^2 Aged 22–65 years	82.5	4	−5.2	–	–
Internet	33					82.1		−3.7		
Enhanced internet	33									

NS not significant

*Significant between-group difference(s)

‡ Weights retrieved from medical record

[a] Ebbeling et al. [13] did not report specific weight change values for dietary conditions. Weight changes were not significantly different at months 6 or 18

[b] Esposito et al. [49] extended observational follow-up to 6 years postrandomization from the original trial [16]. At year 6, the mean between-group weight difference was 0.4 kg and no longer significant (95 % CI −0.1 to 0.7 kg). Because the original trial reported 4-year outcomes, which includes a much longer follow-up than most other trials, we have focused on these extended outcomes in the table

[c] Gardner et al. [20] did not report specific weight change values for dietary conditions at month 2. At month 2, the Atkins diet was significantly different than the other three diets. At month 12, the Atkins diet was significantly different from the Zone diet

[d] Sacks et al. [15] did not report specific weight change values for each dietary condition. Weight changes differed by <0.5 kg between all conditions and was not significant at any time points

[e] Shai et al. [21] did not report specific values for weight change at month 6. However, at month 6, weight loss was significantly greater in the low-carb condition vs. the low-fat or Mediterranean diet conditions, which did not differ from each other. At month 24, weight loss was significantly greater in the low-carb and Mediterranean diet conditions vs. the low-fat condition. The low-carb and Mediterranean diet conditions did not differ significantly from each other at month 24

[f] Stern et al. [19] did not report specific values for weight change at month 6. At month 6, weight loss was significantly greater in the low-carb condition vs. the low-fat condition

[g] Rock et al. [24] reported that at months 6 and 12, both the in-person treatment + prepackaged meals and the phone-based treatment + prepackaged meals were significantly different than usual care. The two active interventions did not differ from each other at either time points

[h] Appel et al. [31] reported no significant differences between the remote and remote + in-person intervention groups at any time point during the study, although both groups differed from the self-directed group at each time point

[i] Carter et al. [43] reported that this pilot study was not adequately powered to detect change in anthropomorphic measures, but noted that all three groups did significantly differ in weight change

[j] Chambliss et al. [44•] reported that both groups who self-monitored lost significantly more weight than the control group

[k] Donnelly et al. [32] reported median weight changes. At 4 months, all three groups differed significantly from each other. At follow-up, weights were only reported for the two treatment conditions and were not significantly different between phone and face-to-face groups

[l] Harvey-Berino et al. [34] reported that all conditions differed significantly from each other at 6 months

[m] Patrick et al. [30] calculated adherence as the number of text messages responded to at the stated time point

[n] Perri et al. [35] randomized groups to treatment conditions following initial treatment. During the first 6 months of treatment, all groups met face to face on a weekly basis and weight change was not significantly different between randomization to different treatment arms started following the first 6 months of the study. At follow-up, weight loss in the face-to-face and phone conditions were significantly greater than control, but the two active interventions did not differ from each other

[o] Turner-McGrievy et al. [46] reported only BMI, not weight, at baseline. At months 3 and 6, the authors reported kilogram lost (and not BMI change)

typically comparing diets focused on fat and carbohydrate restriction and/or the quality of fat and carbohydrate intake. Four of the 11 trials found significant initial effects that were not maintained over time [16–19]. In all four trials, a low-carbohydrate approach produced significantly greater initial weight loss than low-fat diets, although these benefits attenuated over time and were no longer present ≥12 months after treatment initiation.

Finally, three of the 11 studies found significant effects at both initial and extended follow-ups [20–22]. Gardner et al. compared four dietary interventions and found that a low-carbohydrate diet achieved significantly greater initial weight loss than the other three programs [20]. Also, the low-carbohydrate diet demonstrated continued superiority to one of the other conditions (Zone diet) at month 12 [20]. Shai et al. found that a low-carbohydrate diet produced greater weight loss than low-fat or Mediterranean diets initially, and the low-fat diet continued to achieve the least amount of weight loss and differed significantly from the low-carbohydrate and Mediterranean diets at extended follow-up [21]. The final trial indicated that a vegan diet achieved greater weight loss at 12- and 24-month follow-ups compared to an educational condition [22].

Conclusions and Limitations

While a significant amount of research has focused on the effects of different dietary approaches to weight loss, findings have been inconsistent. Across studies reviewed, there is some indication that a low-carbohydrate approach may achieve relatively greater weight loss as compared to a conventional, low-fat diet, but this is not a uniform finding. Also, these benefits may be short-lived, as most studies fail to find differences at extended follow-ups. There are also some suggestions for the benefit of a Mediterranean-style diet for weight loss, although many of these significant effects have been observed with comparisons to less-intensive, educational controls. Across trials, the magnitude of weight loss observed in intervention and control conditions varied widely, which may be attributable to the intensity and duration of treatment as well as the inconsistent inclusion of behavioral strategies in treatment.

These trials evaluated whether the interventions achieved differential weight loss assuming participants were adherent to the prescribed diets. The lack of differences between diets observed in many of these trials could be partly due to dietary non-adherence and sub-optimal differentiation between conditions in terms of what participants actually consumed. Despite this, these trials address an important question, as an efficacious treatment will have little impact if individuals are unable or unwilling to adhere to it.

There are several factors that make it challenging to generalize conclusions across studies. First, interventions included varied dietary recommendations in how and to what extent macronutrients were restricted. Some treatments encouraged energy reduction in conjunction with macronutrient rebalancing, while others did not. Second, there were varying levels of structure imposed across interventions, with some protocols providing some foods, detailed meal plans, and/or shopping/food lists, while others afforded more participant autonomy in food selections and meal preparation. Third, as mentioned previously, interventions varied tremendously in intensity (i.e., amount of contact with interventionists) and in the inclusion of behavioral strategies (e.g., self-monitoring, problem-solving) to promote adherence to dietary recommendations. In general, trials that incorporated more intensive behavioral strategies achieved greater weight loss regardless of nutritional focus.

Trials Comparing Methods of Meal Provision

Overview of Included Trials

Six trials examining the use of meal provision for weight loss were reviewed [23–25, 26•, 27, 28]. Meal provision most often included the delivery of full meal replacements (i.e., individual prepackaged meals), although commercial meal replacement shakes (i.e., Slimfast) were used in one trial [23]. Meal provision typically included at least two meal replacements per day, with some groups receiving up to two additional prepackaged snacks per day. Three of the studies compared the use of prepackaged meals to an alternative active intervention [24, 25, 26•]. Of these three, one examined the use of prepackaged meals in both phone and in-person treatment conditions (as well as a third usual care group; [24]), one examined a full meal subsidy (two meals per day) versus a partial subsidy (one meal per day, with encouragement to buy an additional meal at the participant's expense; [25]), and one compared a meal provision plan with treatment materials delivered over the internet to an internet treatment-only group [26•]. The remaining three studies compared the active intervention to dietary education sessions [23, 27, 28]. Four of the trials reported initial outcomes only [25, 26•, 27, 28], while two studies reported initial and extended outcomes [23, 24].

Summary of Findings

Four of the six trials found significant differences between conditions at one or more follow-up, while two trials found no significant weight changes between groups (see Table 1). Two of the four studies reporting only initial outcomes found significant differences in weight loss immediately following treatment, with observed benefits for the provision of portion-controlled entrees along with a variety of 'a la carte' food items [27, 28]. Two other studies described no initial differences in weight change between groups. One of these studies compared a full meal subsidy (two meals per day) versus a

partial subsidy (one meal per day; [25]), while the other study examined the use of meal provision and internet-based treatment versus internet-based treatment alone [26•].

Of the two studies that included initial and extended outcomes, both reported significant between-group differences in weight at both follow-ups [23, 24]. One trial examined the use of meal replacement shakes and found that participants in the meal provision group lost more weight than participants receiving basic dietary instructions on caloric reduction [23]. The second study compared two treatment groups to usual care [24]. Both treatment groups received commercially available prepackaged meals (i.e., Jenny Craig) during the initial intervention with the addition of weekly sessions conducted either in-person or by phone. Usual care participants lost significantly less weight than both of the meal provision groups, which did not differ from each other.

Conclusions and Limitations

The evidence for meal replacement as a method for weight loss is the most limited of the three areas reviewed. While there is a robust literature on the effects of meal replacements as part of a very-low calorie diet, there is less recent research examining food provision in the context of reduced calorie diets. Overall, the studies included in this review are fairly consistent in support for the use of meal provision for promoting weight loss in the short-term and through extended care, and the magnitude of weight loss approaches the amounts seen in conventional behavioral treatment programs without food provision. However, with a small number of studies (only two of which followed participants beyond initial treatment), it is difficult to draw firm conclusions about the overall effectiveness of meal provision for weight loss. In addition, half of the studies reviewed did not include behavioral strategies or physical activity in treatment. For the studies that included a more comprehensive behavioral approach in conjunction with meal provision, the potential benefits of meal provision was less pronounced, and there was little support for adding meal provision to existing behavioral treatment [26•]. Therefore, it is unclear what relative effectiveness meal provision provides beyond more comprehensive lifestyle interventions without meal provision. Other limitations include the relatively modest sample sizes of most of the reviewed trials.

Trials Comparing Different Treatment Modalities

Overview of Included Trials

Eighteen weight loss trials comparing alternative methods of treatment delivery were included [29–32, 33•, 34–41, 42•, 43–46]. Alternative modalities (defined as any approach other than face-to-face sessions) examined in these trials included treatment delivered by (1) phone, (2) online, (3) mobile technology, and/or (4) podcasts. Most of the studies (16 of 18) compared one type of treatment to at least one other active intervention, whereas two studies [29, 30] compared treatment to usual care or advice-only. Of the 16 involving at least two active intervention groups, only five compared an alternative treatment modality to a face-to-face approach [31, 32, 33•, 34, 35]. The other 11 studies compared different treatment intensities within the same modality (e.g., "basic" versus "enhanced" internet-based treatment; [36–41, 42•, 43–46]). Enhanced conditions typically included increased clinician feedback, social support, and/or a greater number of sessions. Twelve of the studies provided only initial outcomes (≤6 months; [29, 30, 32, 34, 39–41, 42•, 43–46]), while six reported long-term results (≥12 months; [31, 33•, 35, 36, 37, 38]).

Summary of Findings

Six of the trials found no weight loss differences at any follow-up [33•, 37, 40–42, 46], while 12 trials found significant differences at one or more assessment ([29–32, 34–36, 38, 39, 43–45]; see Table 1). As for specific modalities, six of the 18 trials assessed phone-based treatment [31, 32, 33•, 35, 39, 40]. Four of these trials showed significant results at one or more follow-up. Of these four trials, three found that phone treatment (or a combined phone + internet approach) was more effective than a control condition and was equally effective to in-person treatment [31, 32, 35]. One study found that group phone treatment was more effective than individual phone treatment [39]. Similar to other comparisons of phone-based and in-person treatments, Donnelly et al. found no significant differences in weight loss between these modalities [33•]. Finally, one trial found no differences in weight lost between two phone-based interventions (10 vs. 20 phone sessions) and a self-directed control group [40].

Seven of the 18 trials examined the effectiveness of internet-delivered treatment [29, 34, 36–38, 41, 42•]. Four trials compared standard internet care (e.g., basic educational information with self-monitoring capabilities) to an enhanced internet program with tailored support and feedback [36, 38, 41, 42•]. In two trials, enhanced internet programs led to significantly improved weight loss [36, 38], while the two other trials found no significant differences [41, 42•]. One trial compared internet-based treatment to a usual care condition and found that the internet condition led to greater weight loss [29]. Finally, two of the seven internet-based conditions compared internet to face-to-face interventions [34, 37]. One trial found that an internet-only condition did not differ significantly in terms of weight loss when compared to an internet condition with supplemental in-person support [37]. The remaining trial found that in-person treatment produced the

greatest weight losses, and an internet/in-person hybrid condition was more effective than an internet-only condition [34].

Two trials focused on the use of cell phones to deliver weight loss treatment. One trial examined the use of tailored text messaging to provide educational tips, feedbacks, and brief self-monitoring capabilities and found that the tailored messaging program was more effective than standard weight advice [30]. Another trial focused solely on self-monitoring strategies and compared the effectiveness of self-monitoring using a cell phone app, a website, or paper diaries. Participants using the app to self-monitor lost similar amounts of weight as participants who used the website, but both groups lost more weight than participants using paper diaries [43]. A related trial that focused on self-monitoring compared computerized self-monitoring alone to computerized self-monitoring plus enhanced behavioral strategies. Participants lost comparable amounts of weight, both of which differed from a control group [44].

Finally, two trials examined the use of podcasts to deliver treatment. One found that 24 podcast episodes based on social cognitive theory yielded greater weight loss than basic, educational weight loss podcasts [45]. The second trial compared treatment delivered by podcast to treatment including podcasts plus self-monitoring (using an online app) and a social media component. Both groups lost comparable amounts of weight [46].

Conclusions and Limitations

Due to substantial differences in treatment intensity and content across studies, it is difficult to draw conclusions about the consistency and magnitude of effects for alternative approaches to the delivery of weight loss treatment. The most consistent evidence relates to phone-based treatments, which generally demonstrate effect sizes similar to what is observed with traditional in-person interventions. Moreover, these effects are the most consistent of those found among alternative treatment modalities. Online and mobile-based treatment strategies show the most variation between trials, smaller effect sizes, and overall inconsistent findings across studies. Results of these trials are promising, yet future research is needed to refine and strengthen these treatments to create the type of individual engagement that is a central component of successful weight loss programs.

The magnitude of weight loss observed with telephone, computer, and mobile technology interventions may be largely based on the behavioral components and intensity of the programs. A recent review of technology-based weight loss programs indicated that programs need to include self-monitoring, clinician feedback/support, social support, and use of a structured and individually tailored program to be successful [47]. In the current review, some interventions included very limited behavioral components, whereas others incorporated a full array of behavioral strategies. Also, only five of the eighteen trials compared an alternative method of treatment to a face-to-face approach [31, 32, 33•, 34, 35], which limits the ability to assess whether alternative modalities can be as effective as conventional, in-person interventions. In addition, a challenge for examining technology-based interventions is the time it takes to develop and evaluate a treatment program before the technology itself becomes outdated or obsolete.

Clinical Implications and Future Directions

Based on findings from this systematic review, several clinical recommendations may be appropriate. First, there is currently limited long-term support for targeting different macronutrient compositions to improve weight loss. While low carbohydrate diets appear to enhance initial weight loss, there does not appear to be any significant advantage associated with diet composition with respect to long-term weight management. As recommended by current clinical guidelines, it may be more productive to instead find a diet that achieves moderate energy reductions that participants are willing and able to follow [48••].

Second, providing prepackaged foods to participants appears to enhance adherence to energy intake reductions and thereby produce greater initial weight losses. The provision of foods may help some individuals "jump start" their weight loss efforts and could be particularly useful for participants who have limited time, motivation, and/or knowledge to plan, measure, and prepare their own reduced calorie, healthier meals. However, the long-term benefits of food provision are less clear, particularly with respect to the transition to participants' control of food purchases.

Third, delivering weight loss treatment via telephone and/or other modalities (i.e., internet, mobile technology) offers a potential alternative to in-person treatment and may be particularly useful for populations who would otherwise have limited access to conventional, in-person programs. Phone-based interventions appear to achieve short- and long-term weight reductions comparable to in-person approaches, while the use of internet and mobile technologies are associated with smaller reductions in body weight than face-to-face interventions. Regardless of modality, it is important that alternative treatments provide a sufficient "dose" of treatment and incorporate evidence-based behavioral strategies.

Several areas for future research should be considered. Regarding interventions targeting different dietary compositions, it would be worthwhile to investigate individual characteristics (i.e., behavioral, psychological, metabolic) potentially associated with preferential responses to certain dietary recommendations. For example, some intriguing work suggests that individuals' hormonal response (i.e., insulin secretion) may influence the rate and magnitude of weight loss

achieved with a low-carbohydrate diet [13]. If future research can identify individual characteristics that allow clinicians to successfully match participants to specific dietary recommendations, this could hold great potential for improving treatment outcomes.

Future work with meal provision should examine the relative benefits of this strategy when provided with other evidence-based behavioral techniques. Additional information is also needed on the number of meals that should be provided for optimal results as well as the most effective strategies and timeline for transitioning participants from provided foods to more independent meal planning and preparation.

Future studies examining alternative modalities for treatment delivery could focus on matching individuals to treatment modality based on individual preferences or characteristics. Also, including a combination of modalities or changing modalities (e.g., from phone to in-person treatment) over time may also help promote weight loss while maintaining participant interest and engagement. This notion of utilizing or changing modalities in a stepped care fashion based on participants' initial response to treatment may also have significant merit for treatment tailoring and improving outcomes.

Compliance with Ethics Guidelines

Conflict of Interest Gareth R. Dutton, Melissa H. Laitner, and Michael G. Perri declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:

- • Of importance
- •• Of major importance

1. Toobert DJ, Glasglow RE, Strycker LA, Barrera Jr M, Radcliffe JL, Wander RC. Biologic and quality-of-life outcomes from the Mediterranean lifestyle program. Diabetes Care. 2003;26(8):2288–93.
2. Yancy WS, Olsen MK, Guyton JR, Bakst RP, Westman EC. A low-carbohydrate, ketogenic diet versus a low-fat diet to treat obesity and hyperlipidemia. Ann Intern Med. 2004;140(10):769–77.
3. Luscombe-Marsh ND, Noakes M, Wittert GA, Keogh JB, Foster PR, Clifton PM. Carbohydrate-restricted diets high in either monounsaturated fat or protein are equally effective at promoting fat loss and improving blood lipids. Am J Clin Nutr. 2005;81:762–72.
4. McLaughlin T, Carter S, Lamendola C, Abbasi F, Yee G, Schaaf P, et al. Effects of moderate variations in macronutrient composition on weight loss and reduction in cardiovascular disease risk in obese, insulin-resistant adults. Am J Clin Nutrition. 2006;84, 1–813–8219.
5. McMillan-Price J, Petocz P, Atkinson F, O'Neill K, Samman S, Steinbeck K, et al. Comparison of 4 diets of varying glycemic load on weight loss and cardiovascular risk reduction in overweight and obese young adults. Arch Intern Med. 2006;166:1466–75.
6. Noakes M, Keogh JB, Foster PR, Clifton PM. Effect of an energy-restricted, high-protein, low-fat diet relative to a conventional high-carbohydrate, low-fat diet on weight loss, body composition, nutritional status, and markers of cardiovascular health in obese women. Am J Clin Nutr. 2005;81:1298–306.
7. Vincent-Baudry S, Defoort C, Gerber M, Bernard M, Verger P, Helal O, et al. The Medi-RIVAGE study: reduction of cardiovascular disease risk factors after a 3-month intervention with a Mediterranean-type diet or a low-fat diet. Am J Clin Nutr. 2005;82:964–71.
8. Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, Ruiz-Gutiérrez V, Covas MI, et al. Effects of a Mediterranean-style diet on cardiovascular risk factors. Ann Intern Med. 2006;145(1):1–11.
9. Esposito K, Pontillo A, Di Palo C, Giugliano G, Masella M, Marfella R, et al. Effect of weight loss and lifestyle changes on vascular inflammatory markers in obese women. J Am Med Assoc. 2003;289(14):1799–804.
10. Esposito K, Marfella R, Ciotola M, Di Palo C, Giugliano F, Giugliano G, et al. Effect of a Mediterranean-style diet on endothelial dysfunction and markers of vascular inflammation in the metabolic syndrome: a randomized trial. J Am Med Assoc. 2004;292(12):1440–6.
11. Elhayany A, Lustman A, Abel R, Attal-Singer J, Vinker S. A low carbohydrate Mediterranean diet improves cardiovascular risk factors and diabetes control among overweight patients with type 2 diabetes mellitus: a 1-year prospective randomized intervention study. Diabetes Obesity Metab. 2010;12(3):204–9. doi:10.1111/j.1463-1326.2009.01151.x.
12. Dansinger ML, Gleason JA, Griffith JL, Selker HP, Schaefer EJ. Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction. J Am Med Assoc. 2004;293(1):43–53.
13. Ebbeling CB, Leidig MM, Feldman HA, Lovesky MM, Ludwig DS. Effects of a low-glycemic load versus low-fat diet in obese young adults. J Am Med Assoc. 2007;297(19):2092–102.
14. Iqbal N, Vetter ML, Moore RH, Chittams JL, Dalton-Bakes CV, Dowd M, et al. Effects of a low-intensity intervention that prescribed a low-carbohydrate versus a low-fat diet in obese, diabetic participants. Obesity. 2010;18(9):1733–8. doi:10.1038/oby.2009.460.
15. Sacks FM, Bray GA, Carey VJ, Smith SR, Ryan DH, Anton SD, et al. Comparison of weight-loss diets with different compositions of fat, protein, and carbohydrates. N Engl J Med. 2009;360(9):859–73.
16. Esposito K, Maiorino MI, Cioltola M, Di Palo C, Scognamiglio P, Gicchino, et al. Effects of a Mediterranean-style diet on the need for antihyperglycemic drug therapy in patients with newly diagnosed type 2 diabetes. Ann Intern Med. 2009;151(5):306–14.
17. Foster GD, Wyatt HR, Hill JO, McGuckin BG, Mohammed BS, Szapary PO, et al. A randomized trial of a low-carbohydrate diet for obesity. N Engl J Med. 2003;348(21):2082–90.
18. Foster GD, Wyatt HR, Hill JO, Makris AP, Rosenbaum DL, Brill C, et al. Weight and metabolic outcomes after 2 years on a low-carbohydrate versus low-fat diet: a randomized trial. Ann Intern Med. 2010;153(3):147–57. doi:10.7326/0003-4819-153-3-201008030-00005.
19. Stern L, Iqbal N, Seshadri P, Chicano KL, Daily DA, McGrory J, et al. The effects of low-carbohydrate versus conventional weight loss diets in severely obese adults: one-year follow-up of a randomized trial. Ann Intern Med. 2004;140(10):778–85.
20. Gardner CD, Kiazand A, Alhassan S, Kim S, Stafford RS, Balise RR, et al. Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among

overweight premenopausal women. J Am Med Assoc. 2007;297(9):969–77.
21. Shai I, Schwarzfuchs D, Henkin Y, Shahar DR, Witkow S, Greenberg I, et al. Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet. N Engl J Med. 2008;359(3):229–41. doi:10.1056/NEJMoa0708681.
22. Turner-McGrievy GM, Barnard ND, Scialli AR. A two-year randomized weight loss trial comparing a vegan diet to a more moderate low-fat diet. Obesity. 2007;15(9):2276–81.
23. Li Z, Hong K, Saltsman P, DeShields S, Bellman M, Thames G, et al. Long-term efficacy of soy-based meal replacements versus an individualized diet plan in obese type II DM patients: relative effects on weight loss, metabolic parameters, and C-reactive protein. Eur J Clin Nutr. 2004;59(3):411–8. doi:10.1038/sj.ejcn.1602089.
24. Rock CL, Flatt SW, Sherwood NE, Karanja N, Pakiz B, Thomson CA. Effect of a free prepared meal and incentivized weight loss program on weight loss and weight loss maintenance in obese and overweight women. J Am Med Assoc. 2010;304(16):1803–11.
25. Tsai AG, Felton S, Hill JO, Atherly AJ. A randomized pilot trial of a full subsidy versus a partial subsidy for obesity treatment. Obesity. 2009;20(9):1838–43. doi:10.1038/oby.2011.193.
26.• Webber KH, Rose SA. A pilot internet-based behavioral weight loss intervention with or without commercially available portion-controlled foods. Obesity. 2013;21(9):E354–9. doi:10.1002/oby.20331. *Data from this trial indicate that the use of food provision in conjunction with an internet behavioral weight loss program may help to improve short term weight loss, blood glucose, and LDL cholesterol levels.*
27. Hannum SM, Carson LA, Evans EM, Canene KA, Petr EL, Bui L, et al. Use of portion-controlled entrees enhances weight loss in women. Obes Res. 2004;12(3):538–46.
28. Hannum SM, Carson LA, Evans EM, Petr EL, Wharton CM, Bui L, et al. Use of packaged entrees as part of a weight-loss diet in overweight men: an 8-week randomized clinical trial. Diabetes Obesity Metab. 2006;8(2):146–55. doi:10.1111/j.1463-1326.2005.00493.x.
29. Hunter CM, Peterson AL, Alvarez LM, Poston WC, Brundige AR, Haddock CK, et al. Weight management using the internet: a randomized controlled trial. Am J Prev Med. 2008;34(2):119–26. doi:10.1016/j.amepre.2007.09.026.
30. Patrick K, Raab F, Adams MA, Dillon L, Zabinski M, Rock CL, et al. A text message-based intervention for weight loss: randomized controlled trial. J Med Internet Res. 2009;11(1):e1. doi:10.2196/jmir.1100.
31. Appel LJ, Clark JM, Yeh H, Wang N, Couglin JW, Daumit D, et al. Comparative effectiveness of weight-loss interventions in clinical practice. N Engl J Med. 2011;365(21):1959–68.
32. Donnelly JE, Smith BK, Dunn L, Mayo MM, Jacobsen DJ, Stewart EE, et al. Comparison of a phone versus clinic approach to achieve 10 % weight loss. Int J Obes. 2007;31(8):1270–6. doi:10.1038/sj.ijo.0803568.
33.• Donnelly JE, Goetz J, Gibson C, Sullivan DK, Lee R, Smith BK, et al. Equivalent weight loss for weight management programs delivered by phone and clinic. Obesity. 2013;21(10):1951–9. doi:10.1002/oby.20334. *Results of phone-based and in-person behavioral treatment for obesity suggest that both modalities produce equivalent amounts of immediate and long-term weight loss and indicate that phone-based weight treatment significantly improves the cost-effectiveness of treatment.*
34. Harvey-Berino J, West D, Krukowski R, Prewitt E, VanBiervliet A, Ashikaga T, et al. Internet delivered behavioral obesity treatment. Prev Med. 2010;51(2):123–8. doi:10.1016/j.ypmed.2010.04.018.
35. Perri MG, Limacher MC, Durning PE, Janicke DM, Lute LD, Bobroff LB, et al. Extended-care programs for weight management in rural communities. Arch Intern Med. 2008;168(21):2347–54.
36. Tate DF, Jackvony EH, Wing RR. Effects of internet behavioral counseling on weight loss in adults at risk for type 2 diabetes. J Am Med Assoc. 2003;289(14):1833–6.
37. Micco N, Gold B, Buzzell P, Leonard H, Pintauro S, Harvey-Berino J. Minimal in-person support as an adjunct to internet obesity treatment. Ann Behav Med. 2007;33(1):49–56.
38. Gold BC, Burke S, Pintauro S, Buzzell P, Harvey-Berino J. Weight loss on the web: a pilot study comparing a structured behavioral intervention to a commercial program. Obesity. 2007;15(1):155–64.
39. Befort CA, Donnelly JE, Sullivan DK, Ellerbeck EF, Perri MG. Group versus individual phone-based obesity treatment for rural women. Eat Behav. 2010;11(1):11–7. doi:10.1016/j.eatbeh.2009.08.002.
40. Sherwood NE, Jeffery RW, Pronk NP, Boucher JL, Hanson A, Boyle R, et al. Mail and phone interventions for weight loss in a managed-care setting: weigh-to-be 2-year outcomes. Int J Obes. 2006;30(10):1565–73. doi:10.1038/sj.ijo.0803295.
41. Webber KH, Tate DF, Michael Bowling J. A randomized comparison of two motivationally enhanced internet behavioral weight loss programs. Behav Res Ther. 2008;46(9):1090–5. doi:10.1016/j.brat.2008.06.008.
42.• Collins CE, Morgan PJ, Hutchesson MJ, Callister R. Efficacy of standard versus enhanced features in a web-based commercial weight-loss program for obese adults, part 2: randomized controlled trial. J Med Internet Res. 2013;15(7):e140. doi:10.2196/jmir.2626. *Results of this randomized controlled trial suggest that the addition of personalized feedback to a basic internet weight management program provides limited additional benefits; however, personalized feedback did increase usage of the program and retention across the course of the study.*
43. Carter MC, Burley VJ, Nykjaer C, Cade JE. Adherence to a smartphone application for weight loss compared to website and paper diary: pilot randomized controlled trial. J Med Internet Res. 2013;15(4):e32. doi:10.2196/jmir.2283.
44. Chambliss HO, Huber RC, Finley CE, McDoniel SO, Kitzman-Ulrich H, Wilkinson WJ. Computerized self-monitoring and technology-assisted feedback for weight loss with and without an enhanced behavioral component. Patient Educ Couns. 2011;85(3):375–82. doi:10.1016/j.pec.2010.12.024.
45. Turner-McGrievy GM, Campbell MK, Tate DF, Truesdale KP, Bowling JM, Crosby L. Pounds Off Digitally study: a randomized podcasting weight-loss intervention. Am J Prev Med. 2009;37(4):263–9. doi:10.1016/j.amepre.2009.06.010.
46. Turner-McGrievy G, Tate D. Tweets, apps, and pods: results of the 6-month Mobile Pounds Off Digitally (Mobile POD) randomized weight-loss intervention among adults. J Med Internet Res. 2011;13(4):e120. doi:10.2196/jmir.1841.
47. Khaylis A, Yiaslas T, Bergstrom J, Gore-Felton C. A review of efficacious technology-based weight-loss interventions: five key components. Telemed e-Health. 2010;16(9):931–8. doi:10.1089/tmj.2010.0065.
48.•• Jensen MD, Ryan DH, Donato KA, Apovian CM, Ard JD, Comuzzie AG, et al. AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. Obesity. 2013;21(Suppl 3). *The most recent guidelines from the American College of Cardiology and the American Heart Association that review risk factors and consequences of obesity as well as recommendations for the assessment and treatment of overweight/obese participants by clinical providers.*
49. Esposito K, Maiorino MI, Petrizzo M, Bellastella G, Giugliano D. The effects of a Mediterranean diet on need for diabetes drugs and remission of newly diagnosed type 2 diabetes: follow-up of a randomized trial. Diabetes Care. 2014. doi:10.2337/dc13-2899.