The Effectiveness of Worksite Nutrition and Physical Activity Interventions for Controlling Employee Overweight and Obesity

A Systematic Review

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Abstract: This report presents the results of a systematic review of the effectiveness of worksite nutrition and physical activity programs to promote healthy weight among employees. These results form the basis for the recommendation by the Task Force on Community Preventive Services on the use of these interventions. Weight-related outcomes, including weight in pounds or kilograms, BMI, and percentage body fat were used to assess effectiveness of these programs.

This review found that worksite nutrition and physical activity programs achieve modest improvements in employee weight status at the 6–12-month follow-up. A pooled effect estimate of −2.8 pounds (95% CI=−4.6, −1.0) was found based on nine RCTs, and a decrease in BMI of −0.5 (95% CI=−0.8, −0.2) was found based on six RCTs. The findings appear to be applicable to both male and female employees, across a range of worksite settings.

Most of the studies combined informational and behavioral strategies to influence diet and physical activity; fewer studies modified the work environment (e.g., cafeteria, exercise facilities) to promote healthy choices. Information about other effects, barriers to implementation, cost and cost effectiveness of interventions, and research gaps are also presented in this article. The findings of this systematic review can help inform decisions of employers, planners, researchers, and other public health decision makers.

(Am J Prev Med 2009;37(4):340–357) Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine

Introduction

Obesity is a major health problem in both developed and developing countries. Many factors—genetic, behavioral, social, and economic—interact to influence the development of obesity in populations. People in societies with ample access to energy-rich foods and low physical activity levels are at increased risk of becoming overweight or obese. In occupational settings, economic and industrial innovation has resulted in far fewer workers in primary industries (e.g., agriculture, fishing, mining, or forestry); more automation and labor-saving devices in production industries; and large increases in the proportion of people engaged in sedentary industries. Workplaces are a sedentary setting for many workers and also a place where access to energy-dense food and beverages is common. Epidemiologic studies of characteristics of working conditions and worker overweight or obesity have shown associations between greater BMI and long work hours, shift work, and job stress.[1] Schulte et al. recently described the association between excess body weight and risk for a range of occupational conditions, including injury, asthma, musculoskeletal disorders, immune response, neurotoxicity, stress, cardiovascular disease, and cancer.[1]

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0749-3797/09/$–see front matter
doi:10.1016/j.amepre.2009.07.003

Table 1. Selected *Healthy People 2010*[45] objectives related to adult overweight and obesity

Objective	Population	Baseline	2010 objective
Increase the proportion of adults with high blood pressure who are taking action (e.g., losing weight, increasing physical activity, and reducing sodium intake) to help control their blood pressure (Objective 12-11)	People aged ≥18 years	82% of adult population (1998[a])	95%
Increase the proportion of adults who are at a healthy weight (Objective 19-1)	People aged ≥20 years	42% of adult population (1998[a])	60%
Reduce the proportion of adults who are obese (BMI ≥30) (Objective 19-2)	People aged ≥20 years	23% of adult population (1994[a])	15%
Reduce the proportion of adults who engage in no leisure-time physical activity (Objective 22-1)	People aged ≥18 years	40% of adult population (1997[a])	20%
Increase the proportion of adults who engage regularly, preferably daily, in moderate physical activity for at least 30 minutes per day (Objective 22-2)	People aged ≥18 years	15% of adult population (1997[a])	30%

[a]Age adjusted for the year 2000 standard population

Considering that more than 30% of the U.S. adult population is obese and that a link between obesity and cardiovascular disease, hypertension, dyslipidemia, type 2 diabetes, stroke, osteoarthritis, and some cancers has been established, concern about the economic burden associated with obesity is growing.[2,3] In the workplace, obesity is an important driver of costs associated with absenteeism, sick leave, disability, injuries, and healthcare claims.[4] Employers are keenly interested in programs and policies that improve worker health and ultimately reduce healthcare costs.[5] Extant reviews, both qualitative[6–9] and quantitative,[10–12] have yielded equivocal results on the effectiveness of worksite programs for controlling workers' weight. These reviews investigated multiple health risk outcomes besides weight status and did not attempt to quantify program impact on weight as a summary measure of effect across the bodies of evidence reviewed. The criteria developed by the Task Force on Community Preventive Services[13] were used to evaluate the effectiveness of worksite interventions targeting nutrition and physical activity behaviors among employees to promote healthy weight.

The Guide to Community Preventive Services

The systematic review in this report represents the work of the independent, nonfederal Task Force on Community Preventive Services (the Task Force). The Task Force oversees work on the *Guide to Community Preventive Services* (*Community Guide*)[14] with the support of the USDHHS in collaboration with public and private partners. The CDC provides staff support to the Task Force for development of the *Community Guide*.

Task Force recommendations are based primarily on the effectiveness of an intervention in improving important outcomes as determined by the systematic literature review process. In making its recommendations, the Task Force balances information about effectiveness with information about other potential benefits and harms of the intervention itself. The Task Force also considers the applicability of the intervention to various settings and populations in determining the scope of the recommendation. Finally, the Task Force reviews economic analyses of effective interventions, where available. Economic information is provided to assist with decision making but generally does not affect Task Force recommendations.

Healthy People 2010 Goals and Objectives for Control of Overweight and Obesity Among Adults

The interventions reviewed here may be useful in reaching objectives specified in *Healthy People 2010*,[15] the disease prevention and health promotion agenda for the U.S. (Table 1). The interventions included in this review focus on these objectives and the goal of increasing the proportion of adults who are at a healthy weight and reducing the proportion of adults who are obese.

Recommendations from Other Advisory Groups

Existing guidelines on the effects of counseling and behavioral strategies in improving diet and physical activity among overweight and obese adults were developed for physicians, dieticians, and auxiliary personnel in primary care settings.[16–19] Counseling to increase physical activity and improve diet, and behavioral strategies to support and maintain these changes, are also relevant to worksite wellness programs. Recommendations of the U.S. Preventive Services Task Force (USPSTF) on such strategies are presented in Table 2. There is mixed evidence on the effectiveness of behavioral counseling in the primary care setting in increasing physical activity and limited evidence of the effectiveness of counseling in promoting a healthy diet among those not classified as having specific risk factors. However, among adults with hyperlipidemia and other known risk factors for cardiovascular and diet-related chronic disease, there is good evidence that

Table 2. U.S. Preventive Services Task Force recommendations on behavioral counseling for physical activity and diet, and screening for obesity among adults

Behavioral counseling to increase physical activity (www.ahrq.gov/clinic/uspstf/uspsphys.htm)
The USPSTF concludes that the evidence is insufficient to recommend for or against behavioral counseling in primary care settings to promote physical activity. [I recommendation]
Behavioral counseling to promote a healthy diet (www.ahrq.gov/clinic/uspstf/uspsdiet.htm)
The USPSTF concludes that the evidence is insufficient to recommend for or against routine behavioral counseling to promote a healthy diet in unselected patients in primary care settings. [I recommendation]
The USPSTF recommends intensive behavioral dietary counseling for adult patients with hyperlipidemia and other known risk factors for cardiovascular and diet-related chronic disease. Intensive counseling can be delivered by primary care clinicians or by referral to other specialists, such as nutritionists or dieticians. [B recommendation]
Screening for obesity among adults (www.ahrq.gov/clinic/uspstf/uspsobes.htm)
The USPSTF recommends that clinicians screen all adult patients for obesity and offer intensive counseling and behavioral interventions to promote sustained weight loss for obese adults. [B recommendation]
The USPSTF concludes that the evidence is insufficient to recommend for or against the use of moderate- or low-intensity counseling together with behavioral interventions to promote sustained weight loss in obese adults. [I recommendation]
The USPSTF concludes that the evidence is insufficient to recommend for or against the use of counseling of any intensity and behavioral interventions to promote sustained weight loss in overweight adults. [I recommendation]

USPSTF, U.S. Preventive Services Task Force

intensive counseling (combined nutrition education with behavioral dietary counseling provided by a nutritionist, dietician, or specially trained primary care clinician) can produce meaningful change in daily intake of appropriate amounts of the core components of a healthy diet, including saturated fat, fiber, fruit, and vegetables. Further, the USPSTF found fair to good evidence that, in primary care settings, high-intensity counseling—about diet, exercise, or both—together with behavioral interventions aimed at skill development, motivation, and support strategies produces modest, sustained weight loss (typically 3–5 kg for 1 year or more) in adults who are obese (BMI ≥30). The effectiveness of moderate- or low-intensity counseling among obese adults could not be determined, nor could the USPSTF determine the effectiveness of counseling to promote sustained weight loss in overweight adults (BMI 25.0–29.9).

Methods

Community Guide methods for conducting systematic reviews and linking evidence to effectiveness are described elsewhere[13] and on the *Community Guide* website (www.thecommunityguide.org/methods). In brief, for each *Community Guide* review topic, a systematic review development team representing diverse disciplines, backgrounds, and work settings conducts a review by (1) developing a conceptual approach to identify, organize, group, and select interventions for review; (2) developing an analytic framework depicting interrelationships among interventions, populations, and outcomes; (3) systematically searching for and retrieving evidence; (4) assessing and summarizing the quality and strength of the body of evidence of effectiveness; (5) translating evidence of effectiveness into recommendations; (6) summarizing data about applicability (i.e., the extent to which available effectiveness data might apply to diverse population segments and settings), economic impact, and barriers to implementation; and (7) identifying and summarizing research gaps.

This review was conducted by a systematic review development team composed of CDC staff from the *Community Guide* Branch and the Division of Nutrition, Physical Activity and Obesity, along with a multidisciplinary team representing a variety of perspectives on worksite health promotion and obesity prevention and control (Obesity Worksite Systematic Review Development Team; see Acknowledgments). The review builds on an earlier systematic review conducted at the Yale Prevention Research Center.[20]

Conceptual Model

Worksite health promotion refers to strategies that are designed to improve health-related behaviors and health outcomes of workers. Worksite nutrition and physical activity programs may occur separately or as part of a comprehensive worksite health promotion program addressing a broader range of objectives (e.g., smoking cessation, stress management, lipid reduction). These programs may or may not include weight control as a primary objective. The analytic framework (Figure 1) depicts the components of such comprehensive programs. Worksite environmental change and policy strategies are designed to make healthy choices easier. They target the whole workforce or population, rather than individuals, by modifying physical or organizational structures. Changes to the environment may include enhancing access to healthy foods (e.g., through modification of cafeteria offerings or vending machine content) or enhancing opportunities to engage in physical activity (e.g., by providing onsite facilities for exercise). Policy strategies may change rules and procedures for employees, such as health insurance benefits or costs, reimbursement for health club membership, or time allotted for breaks or meals at the worksite. Informational and educational strategies attempt to build the knowledge base necessary to inform optimal health practices. Information and learning experiences facilitate voluntary adaptations of behavior conducive to health. Examples include didactic instruction, health-related information provided on the company intranet, posters or pamphlets, nutrition education software, and information about the benefits of healthy diet and exercise. Behavioral and social strategies attempt to influence behaviors indirectly by targeting individ-

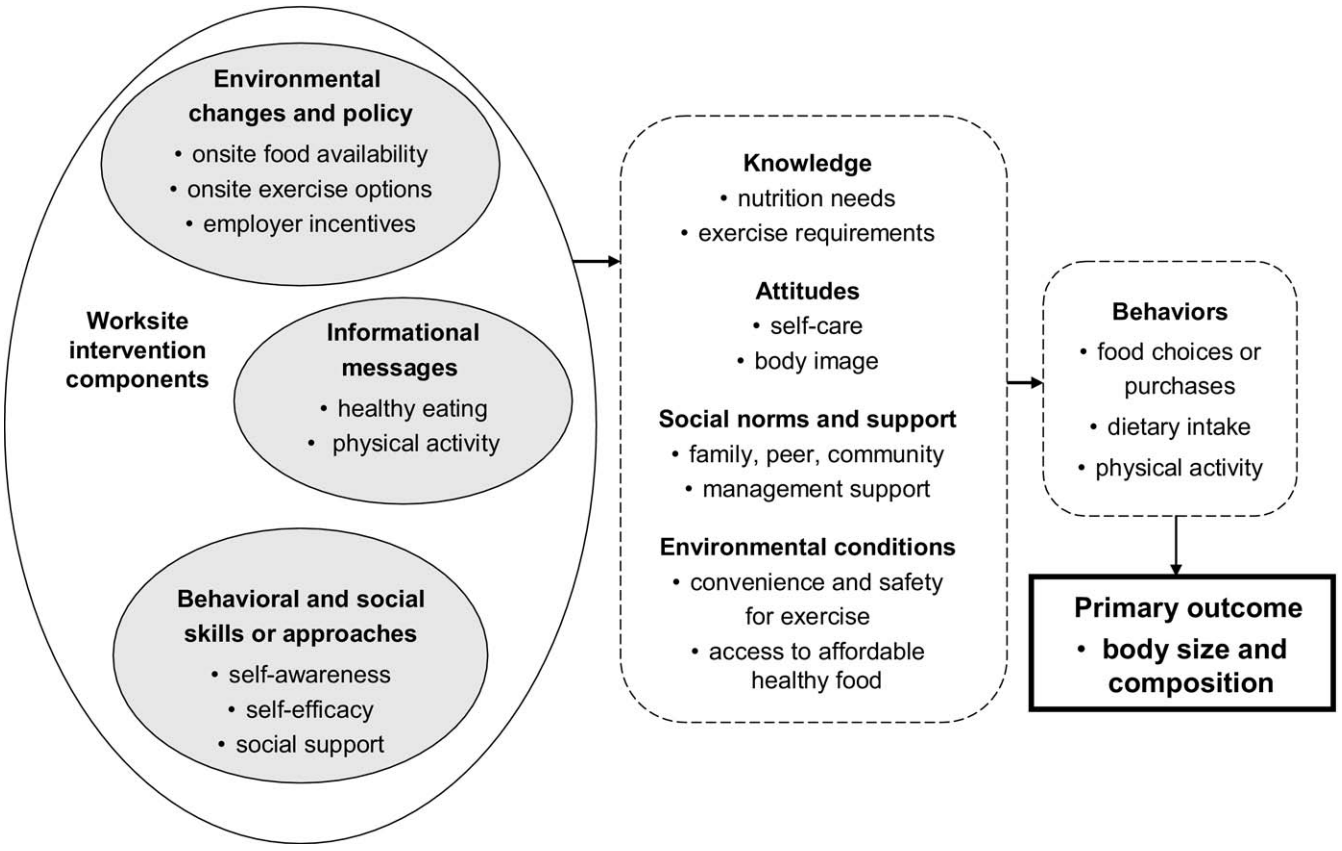

Figure 1. Analytic framework for worksite nutrition and physical activity interventions to improve weight status

ual cognition (awareness, self-efficacy, perceived support, intentions) believed to mediate behavior changes. These strategies can include structuring the social environment to provide support for people trying to initiate or maintain weight change. Such interventions may involve individual or group behavioral counseling, skill-building activities such as cue control, use of rewards or reinforcement, and inclusion of coworker or family members for support.

Search for Evidence

Using MeSH terms and text words (*workplace* or *worksite/ occupational health services* or *occupational health/ obesity* or *obese/ physical activity* or *motor activity/weight loss/physical fitness/ exercise/cardiovascular diseases/ cholesterol/ hyperlipidemia/hypertension/ nutrition/diet/body mass index/ primary prevention/ risk reduction behavior/ risk management/health promotion/health education/health behavior/ intervention studies/program evaluation*) the following databases were searched for studies between the date indicated and December 2005: MEDLINE (1966); EMBASE (1980); Cumulative Index to Nursing and Allied Health Literature (CINAHL, 1982); PsycINFO (1967); SPORTDiscus (1966); Latin American and Caribbean Health Sciences Literature (1996), Dissertation Abstracts (1980), and the Cochrane Library (2005). Search strategies are available at www.thecommunityguide.org/obesity/workprograms.html. Hand searches of the *American Journal of Preventive Medicine*, *Occupational Medicine*, and the *International Journal of Obesity* were conducted for the years 2004 through 2005. The reference lists of prior literature reviews, as well as reference lists from studies included in this review, were used to identify relevant articles. Experts in obesity or worksite interventions were consulted for additional citations. Searches were limited to literature published in English.

Study Selection

To be considered for inclusion in this review, studies had to (1) evaluate a worksite health promotion program that included strategies involving diet, physical activity, or both; (2) target current adult employees aged ≥18 years (not including retirees); and (3) provide data on at least one weight-related outcome measured at least 6 months from the start of the intervention program. Eligible interventions could be targeted at employees of any weight status (i.e., normal weight, overweight, or obese), with or without identified risk factors (e.g., elevated blood lipids, sedentary behavior) or conditions (e.g., diabetes, hypertension).

This review included worksite interventions with weight control or weight loss as the primary focus and also worksite interventions aimed at general health promotion and risk reduction (e.g., cardiovascular disease [CVD] risks, diabetes risks) with a primary focus on healthy eating, physical activity, or both. Intervention studies that evaluated commercial weight-loss programs or products (e.g., Weight Watchers, Slim Fast) or diets <1000 calories per day were excluded. Duration of intervention was defined in terms of months and included both long-term (several sessions over several months) and short-term (e.g., one session) programs, as long as they provided a weight-related outcome measured at least 6 months from the start of the intervention. No limitation was set on worksite characteristics, including size of worksite, number of employees, nature of work (e.g., manufacturing,

service industry), or location. Studies were eligible for inclusion if their intervention arm(s) was compared to an untreated comparison group or if an intervention was compared to another intervention arm(s). Time–series studies were also eligible. Studies were included whether or not they provided adequate outcome variance statistics (e.g., SD, SE) to compute CIs for their effect estimates.

Data Extraction and Quality Assessment

Study characteristics were coded by two independent abstractors using a web-based version of the *Community Guide* abstraction form.[21] Each study was assessed for suitability of study design and quality of study execution. Disagreements among study abstractors were reconciled by consensus among the review team members. Classification of study designs is in accord with the standards of the *Community Guide* review process and sometimes differs from the classification used in the original studies. Studies with greatest design suitability are those in which data on exposed and control populations are collected prospectively; in studies with moderate design suitability, data are collected retrospectively or there are multiple pre- or post-measurements but no concurrent comparison population; and in studies with least suitable designs, there is no comparison population and only a single pre- and post-measurement in the intervention population. Quality of study execution includes six categories of threats to validity (study population and intervention descriptions, sampling, exposure and outcome measurement, data analysis, interpretation of results, and other biases). Studies with no or one limitation are categorized as having good execution; those with two to four limitations have fair execution; and those with five or more limitations have limited execution.[21] Studies with greatest or moderate design suitability and good or fair quality of execution were included in this review.

Methods for Summarizing the Body of Evidence on Effectiveness

Studies typically reported means and SDs on continuous measures (e.g., mean number of pounds or kilograms of weight change or BMI change). Net program effects were derived by calculating the difference between the changes observed in the intervention (ΔI) and comparison group (ΔC) relative to their respective baseline levels. A three-part analytic strategy was used:

1. The effects (ΔI–ΔC) on key outcomes of all studies (n=31) in which an intervention was compared to an untreated control were examined, and pooled effects were estimated using study sample size as weights;
2. Among studies (n=21) in which an intervention was compared to an untreated control, and variance data were adequately reported, meta-analysis for pooling of effects (ΔI–ΔC) on key outcomes was done using the inverse variance as the weight[22];
3. Among studies (n=16) that compared an intervention to other intervention arms, change from baseline (ΔI) for each arm was summarized narratively to see how effects vary according to intervention characteristics.

When effect estimates with variance data were pooled, the aggregation of effect sizes was based on a random-effects model.[23] Homogeneity of effects was tested using the Q statistic.[24] Statistical pooling of effects was done only when the studies and effect sizes were sufficiently similar to justify integration (i.e., the Q statistic was nonsignificant at the .10 level).

Outcome measurements were related to the same construct: weight change (in pounds or kilograms, BMI, or percentage body fat). These decision rules were used in the meta-analyses: (1) where studies reported weight change in kilograms, these were converted to pounds; (2) a single study could provide data for more than one of the outcomes above; and (3) where studies compared two or more intervention arms to a common untreated control arm, the effects were aggregated using comparisons of all applicable intervention arms.[25]

Stratified analyses using random-effects models were conducted to assess whether intervention effectiveness differed across subgroups of studies based on characteristics of the sample population, intervention features, study design, and length of follow-up assessment. Comprehensive Meta-Analysis software, version 2.2, was used for calculating pooled effects.[26]

Results

Description of Included Studies

The literature search results and identification of relevant studies is shown in Figure 2. A total of 54 candidate studies, reported in 78 papers, met inclusion criteria.[27–80] Of these, seven studies[74–80] were considered of limited quality of execution and were excluded from the review. A summary evidence table describing each study is available at the *Community Guide* website: www.thecommunityguide.org/obesity/workprograms.html. Half the studies were conducted in the U.S.; studies were also conducted in Europe, Australia, New Zealand,

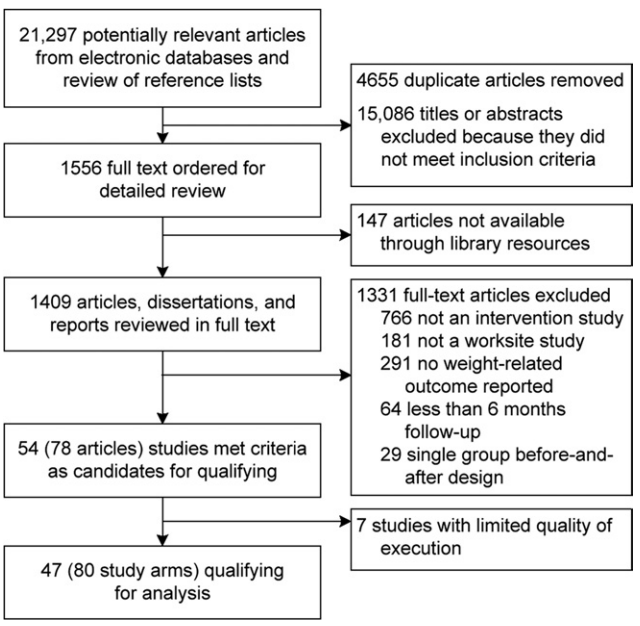

Figure 2. Flow diagram showing reasons for exclusion of studies and number of qualifying studies

Table 3. Study design and reporting characteristics of the 47 studies included in review

	RCTs	Cluster randomized trials	Nonrandomized trials	Cohort study	Time series
Untreated control group (*n*=31)					
Adequate variance data (*n*=21)	13[38,40,45,47,49,53,58–62,65,66]	4[37,42,48,52]	4[46,64,69,72]	—	—
Limited variance data (*n*=10)	4[28,32,35,55]	2[30,73]	3[31,54,56]	1 retrospective[68]	—
Multiple intervention arms (*n*=16)	7[27,34,36,39,44,57,63]	1[43]	5[29,50,51,67,71]	1 prospective[70] 1 retrospective[40]	1[33]

Japan, Canada, India, and Iceland. Study design and comparison conditions are shown in Table 3.

Studies comparing an intervention to untreated controls were analyzed separately from studies in which multiple treatment arms were compared. Study characteristics are summarized in Table 4. Among 46 of the 47 studies in the analysis, the median sample size was 141 (range 29–3728). The final study, a WHO multicountry trial, had a sample size of 63,732. Of the 39 studies reporting attrition, the median attrition rate was 17% (range: 0%–82%). The purpose of the intervention, as stated by the study author, was CVD risk reduction most often (34%); followed by weight control (26%); and physical fitness (19%). The behavioral focus of 27 studies (57%) was on diet and physical activity behaviors; 10 (21%) were diet only; and 10 (21%) were physical activity only. Of the three types of interventions coded (1, informational; 2, behavioral skills; and 3, policy or environmental), 32 studies (69%) had both informational and behavioral skills program components; among these, four included an environmental or policy component. Intensity of the program, operationally defined as the number of contacts with program participants, was reported as two to five contacts in 20 studies (43%); more than five contacts in 26 studies (55%); and was not reported in one study. Ascertaining intervention duration from the primary studies was not always possible. If the authors did not specifically state the duration of the program in weeks or months, duration was coded as the time from initiation of the intervention to the time point when the first outcome measurement occurred. Duration was <6 months in 19 studies (40%); 6–9 months in 14 studies (30%); 12–18 months in 8 studies (17%); and >18 months in 6 studies (13%). Reporting on mean age of employee population, ethnicity, and urban or rural location was limited in the primary studies.

Study participants were coded as white-collar or blue-collar workers based on descriptions in the studies and nature of the company. In 19 studies, this could not be determined; in 25 studies, the majority of participants (≥80%) held white-collar jobs; in the remaining four studies, the participants held blue-collar jobs. Among studies that reported gender of participants, most included both men and women (64%). Sixty-six percent of the studies indicated that some of the workers were overweight, although the proportion that was overweight was not generally reported. Half of the studies reported the presence of chronic disease risks among the employee population. Only two of the randomized trials reported intention-to-treat analysis,[35,48] and many of the studies reported insufficient variance data to allow for statistical pooling with CIs (Table 3).

Intervention Effectiveness

Analysis, Part I. To broadly assess program effects using all study designs and including studies regardless of availability of variance statistics, the review team computed a difference between groups (ΔI–ΔC) and weighted each effect by study sample size at the follow-up measurement interval. Three outcomes were examined: weight in pounds, BMI, and change in percentage body fat. The results are presented in Table 5. Among the 15 studies reporting a weight outcome in pounds (or kilograms converted to pounds), the pooled summary effect on change in weight favored the intervention population, with few exceptions, and suggests a small difference of about −3 pounds at 6–12 months (range: +3.6 to −14.77; 21 data points). At 18 and 30 months, the effect is similar, but the result is based on only one study for each time period. At 60 months, one study reported a 7-pound weight loss. Among the 15 studies reporting a change in BMI, the results were again modest and favored the intervention groups, except at 48 months. The BMI effects were less consistent: −0.4 BMI (range: +0.3 to −1.57; 12 data points) at 6 months; −0.02 BMI (range: +0.5 to −0.9; 12 data points) at 12 months; −0.34 (range: −0.1 to −0.58; 4 data points) at 18–24 months; −0.27 (range −0.2 to −0.75; 2 data points) at 36 months; and +0.08 (range: +0.4 to −1.7; 6 data points) at 48 months. Twelve studies reported change in percentage body fat, measured most often as change in skinfold thickness. The summary effect suggests a 1% decrease at 12 months. Table 6 provides information about all other outcomes reported in the studies with untreated comparison groups.

Analysis, Part II. In the second stage of analysis, study effects were examined separately by study design: RCTs, cluster RCTs, and nonrandomized designs. In 31 studies, an intervention was compared to an untreated

Table 4. Characteristics of worksite diet and physical activity interventions reporting weight outcomes

Study and country	N	Study purpose	Overwt (%) other risks (%)	Focus (diet, exercise, or both)	Components: informational behavioral env & policy	Intensity: 1: 1 contact 2: 2–5 3: >5 (duration in wk)	Pounds (mo f/u) ΔI−ΔC	BMI (mo f/u) ΔI−ΔC	Percent body fat (mo f/u) ΔI−ΔC	Attrit (%)
RCTs with untreated comparison group (n=17)										
Aldana (2005)[27] U.S.	145*	CVD risk reduction	NR NR	Both	Y Y N	3 (6)	−7.48	−1.57	−2	6
Barratt (1994)[31] Australia	683*	CVD risk reduction	NR NR	Diet	Y N N	3 (12)				62
Bruno (1983)[34] U.S.	145*	CVD risk reduction	NR NR	Diet	Y Y N	3 (8)	(only reported ideal wt)			33
Crouch (1986)[37] U.S.	109	CVD risk reduction	NR NR	Both	Y Y N	2 (14)	Arm A −3.97 Arm B +1.10 Arm C +0.88 (12 mo)			12
Drummond (1998)[39] Scotland	93	Weight loss	NR NR	Diet	Y Y N	2 (6)	Arm A −1.1 Arm B −2.65 (6 mo)	−0.1 −0.4	−0.4 −0.1	20
Fukahori (1999)[44] Japan	108	Physical fitness	NR CVD risk (NR)	Exercise	N Y Y	3 (12)		−0.5 (6 mo)		7
Gerdle (1995)[46] Sweden	97	Physical fitness	NR NR	Exercise	N Y N	3 (48)	−2.2 (12 mo)			20
Grandjean (1996)[48] U.S.	37	CVD risk reduction	Yes (%NR) No	Exercise	N Y N	2 (24)	−5.95 (6 mo)		−2	NR
Juneau (1987)[52] U.S.	120	Physical fitness	Yes (<25%) Sedentary (100%)	Exercise	Y Y N	2 (24)	Men −2.43 Women −1.1 (6 mo)		−0.8 +1.2	0
Krishnan (2004)[54] India	100*	Diabetes control	Overwt (58%) Diabetic (100%)	Both	Y N N	2 (4)		Narrative group % change in BMI		17
Muto (2001)[57] Japan	326	CVD risk reduction	Overwt (65%) CVD risk (% NR)	Both	Y Y Y	2 (4)	−3.75 (6 mo) −3.31 (18 mo)	−0.5 (6 mo) −0.5 (18 mo)		7
Nilsson (2001)[58] Sweden	128	CVD risk reduction	NR CVD risk (% NR)	Both	Y Y N	3 (72)		−0.8 (12 mo) −0.5 (18 mo)		31
Nisbeth (2000)[59] Denmark	85	CVD risk reduction	Overwt (3.6%) CVD risk (% NR)	Both	Y Y N	2 (20)	−3.53 (12 mo)	−0.48 (12 mo)		29
Oden (1989)[60] U.S.	45	Physical Fitness	NR Smoke (13%)	Exercise	N Y N	3 (24)			−2.56%	NR
Okayama (2004)[61] Japan	191	CVD risk reduction	NR ↑ chol	Both	Y N N	2 (24)	−1.1 (6 mo)			2

(continued on next page)

Table 4. *(continued)*

Study and country	N	Study purpose	Overwt (%) other risks (%)	Focus (diet, exercise, or both)	Components: informational behavioral env & policy	Intensity: 1: 1 contact 2: 2–5 3: >5 (duration in wk)	Pounds (mo f/u) ΔI−ΔC	BMI (mo f/u) ΔI−ΔC	Percent body fat (mo f/u) ΔI−ΔC	Attrit (%)
Pritchard (2002)[64] Australia	66	Weight loss	BMI>25 (100%) ↑ B/P (% NR)	Both	N Y N	3 (48)	Arm A −14.77 Arm B −6.39 (12 mo)			12
Proper (2003)[65] Netherlands	299	Increase physical activity	NR No	Both	Y Y N	3 (36)		−0.2 (9 mo)	−0.8 (9 mo)	36
Cluster RCTs with untreated comparison group (*n*=6)										
Anderson (1999)[29] U.S.	234*	CVD risk reduction	NR ↑ chol (100%)	Diet	Y Y N	2 (12)	Arm A +3.6 Arm B −5.4 (12 mo)	−0.2 −0.9		48
Cook (2001)[36] New Zealand	253	Healthy lifestyle	Overwt: (36% I gp 40% C gp) hypertens (% NR)	Both	Y N Y	3 (24)	−0.66 (6 mo) 0 (12 mo)	−0.1 (6 mo) 0 (12 mo)		6
Elliot (2004)[41] U.S.	33	Healthy lifestyle	Overwt (% NR) No	Both	Y Y N	3 (24)		Arm A +0.3 Arm B −0.3 (6 mo)	+0.3 −0.4	0
Gomel (1993)[47] Australia	431	CVD risk reduction	NR CVD risk (%NR)	Both	Y Y N	3 (24)		Arm A −0.35 Arm B −0.45 Arm C −0.25	−1.0 −3.4 −0.3	15
Jeffery (1993)[51] U.S.	32 sites (400–900 empl each site)	Weight loss	Overweight (36%) CVD risk (% NR)	Both	Y Y Y	3 (96)		−0.1 (24 mo)		NR
WHO (1989)[72] UK, Belgium, Spain, Italy, Poland	63,732*	CVD risk reduction	x̄ BMI 25.5 CVD risk (% NR)	Both	Y Y N	2 (288)	−0.7 (24 mo) −0.4 (48 mo) −0.6 (72 mo)			NR
Non-randomized studies with untreated comparison group (*n*=7)										
Baer (1993)[30] U.S.	70*	CVD risk reduction	NR ↑ chol (% NR)	Diet	Y Y N	3 (48)	−13.2 (12 mo)		−4.0 (12 mo)	9
Furuki (1998)[45] Japan	1014	Health promot	Overwt (14%) ↑ B/P & ↑ chol (% NR)	Both	Y Y N	NR 4 yr f/u of attenders & control		Men +0.4 Women 0.0 Overwt M 0.5 Overwt W −0.1		51
Karlehagen (2003)[53] Sweden	169*	CVD risk reduction	Overwt (% NR) ↑ chol (% NR)	Both	Y Y N	2 (32)		−0.58 (12 mo)		11
Linenger (1991)[55] U.S.	3728*	Increase physical activity	NR NR	Both	N Y Y	2 (48)			−1.0 (12 mo)	50
Pohjonen (2001)[63] Finland	87	Physical activity effects	NR NR	Exercise	Y Y N	3 (36)	−5.95 (12 mo) −7.06 (60 mo)		−1.3 (12 mo) −0.7 (60 mo)	20
Talvi (1999)[68] Finland	885	Healthy lifestyle	NR ↑ B/P (% NR)	Both	Y N N	3 (20)		Men −0.20 Women −0.75		10

(continued on next page)

Table 4. Characteristics of worksite diet and physical activity interventions reporting weight outcomes *(continued)*

Study and country	N	Study purpose	Overwt (%) other risks (%)	Focus (diet, exercise, or both)	Components: informational behavioral env & policy	Intensity: 1: 1 contact 2: 2–5 3: >5 (duration in wk)	Pounds (mo f/u) ΔI−ΔC	BMI (mo f/u) ΔI−ΔC	Percent body fat (mo f/u) ΔI−ΔC	Attrit (%)
Weir (1989)[79] U.S.	258	Physical activity benefits	NR NR	Exercise	Y N N	3 (12)	W Arm A −2.6 M Arm A −7.2 W Arm B −2.6 M Arm B −1.1		−2 −5.4 −1 −0.1	36
RCTs with different treatment arms (no untreated comparison) (*n*=7)										
Abrams (1983)[26] U.S.	133*	Wt loss (A) plus maint (B)	Overwt (% NR) No	Both	Y Y Y	3 (10)	Arm A −9 Arm B −3.3 (6 mo)			82
Brownell (1985)[33] U.S.	172	Weight loss	Overwt (% NR) No	Diet	Y Y N	3 (16)	Study 3 Arm A −5.9 Arm B −5.5 (12 mo)			42
Cockcroft (1994)[35] England	297*	Healthy lifestyle	NR NR	Both	Y Y N	2 (4)		−0.55 (6mo)		72
DeLucia (1989)[38] U.S.	29	Weight loss	≥10 lbs. overwt (100%) No	Diet	Y Y N	3 (10)	Arm A −6.5 Arm B −4.21 Arm C −5.49 (6 mo)			10
Forster (1985)[43] U.S.	131	Weight loss	NR NR	Diet	Y Y N	2 (24)	Arm A (F) −11.0 Arm A (M) −12.7 Arm B (F) −11.4 Arm B (M) −19.9 (6 mo)			21
Lovibond (1985)[56] Australia	75*	CVD risk reduction	Overwt (80%) CVD risks (100%)	Both	Y Y N	2 (8)	Arm A −22.8 Arm B −17.6 Arm C −11.3 (6 mo) Arm A −21.1 Arm B −18.3 Arm C −12.1 (12 mo)			12
Peterson (1985)[62] U.S.	63*	Weight loss	Overwt (%NR) No	Both	N Y N	3 (8)	Arm A −12.8 Arm B −13.9 (6 mo)			30
Group RCTs with different treatment arms (no untreated control) (*n*=1)										
Erfurt (1991)[42] U.S.	4 sites (500–600 site)*	Health promot	Overwt (30%) CVD risk (18–45%)	Both	Y Y Y	2 (144)	<u>High risk gp</u> Site 1 +3.1 Site 2 +0.6 Site 3 −1.2 Site 4 −4.7 <u>Over-wt gp</u> Site 1 4.2 Site 2 −2.4 Site 3 −5.0 Site 4 −6.4 (8 mo)			NR
Cohort designs (*n*=3)										
Elberson (2001)[40] U.S.	374*	CVD risk reduction	NR ↑ chol (% NR)	Exercise	Y Y N	3 (48)		Arm A −0.57 Arm B +0.3		N/A
Shimizu (2004)[67] Japan	629*	CVD risk reduction	Overwt (32%) ↑ chol ↑ B/P (% NR)	Both	Y Y N	3 (192)		Older −0.07 Younger 0.30		N/A

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Table 4. *(continued)*

Study and country	N	Study purpose	Overwt (%) other risks (%)	Focus (diet, exercise, or both)	Components: informational behavioral env & policy	Intensity: 1: 1 contact 2: 2–5 3: >5 (duration in wk)	Pounds (mo f/u) ΔI−ΔC	BMI (mo f/u) ΔI−ΔC	Percent body fat (mo f/u) ΔI−ΔC	Attrit (%)
Thorsteinsson (1994)[69] Iceland	155	Reduce CVD risk	NR ↑ chol (% NR)	Diet	Y N Y	2 (96)		Arm A +0.1 Arm B +0.3 Arm C +0.1 Arm D −0.4		N/A
Time series (*n*=1)										
Briley (1992)[32] U.S.	40	Weight loss	Overwt (100%) No	Diet	Y Y N	3 (16)	−5 (12 mo)			30
Non-randomized studies with multiple treatment arms (no untreated control) (*n*=5)										
Anderson (1993)[28] U.S.	173*	Weight loss	x̄ BMI 29 NR	Both	Y Y N	2 (24)	Arm A −3.9 Arm B −12.9 (6 mo)			9
Harvey (1998)[49] U.S.	136*	Healthy lifestyle	NR CVD risk (≥15%)	Exercise	Y N N	2 (48)		Arm A −0.46 Arm B +0.41 (12 mo)		0
Hedberg (1998)[50] Sweden	102*	CVD risk reduction	NR ↑ chol (% NR)	Both	Y Y N	2 (72)		Arm A 0.3 Arm B 0.2 (18 mo)		14
Robinson (1992)[66] U.S.	137*	Physical activity benefits	NR NR	Exercise	Y Y N	3 (24)	Arm A −3.5 Arm B −3.5		Arm A −1.6 Arm B −0.3	32
Trent (1995)[70] U.S.	624*	Weight loss	Overwt (99%) No	Both	Y Y N	3 (36)			Arm A −1.7 Arm B −4 (6 mo) Arm A −2.1 Arm B −3.4 (12 mo)	41

*Study reported limited variance data

↑ elevated; attrit, attrition; BMI, body mass index; B/P, blood pressure; C, comparison; chol, cholesterol; CVD, cardiovascular disease; empl, employees; env, environmental; gp, group; hypertens, hypertension; I, intervention; M, men; maint, maintenance; mo, month; NR, not reported; overwt, overweight; promot, promotion; W, women; wk, week; wt, weight

Table 5. Mean changes attributable to the intervention, weighted by sample size

Outcome measured	No. of study arms[a]	No. of months	ΔI–ΔC,[b] range	No. of subjects	Summary effect
Pounds (n=15)	9[28,37,40,49,53,58,62]	6	−0.66, −7.48	1104	−2.82
	12[30,31,37,38,47,60,64,65]	12	−14.77, 3.6	905	−3.15
	1[58]	18	−3.31	302	−3.31
	4[72]	30	−1.10, −7.20	548	−3.14
	1[64]	60	−7.04	87	−7.04
BMI (n=16)	12[28,37,40,42,45,48,58,66]	6–9	−1.57, 0.3	1708	−0.40
	12[30,37,46,48,59,60]	12	−0.9, 0.5	2310	−0.02
	4[52,54,58,59]	18–24	−0.58, −0.1	946	−0.34
	2[69]	36	−0.2, −0.75	798	−0.27
	6[46,68]	48	−1.7, 0.4	1784	+0.08
Body fat (%) (n=12)	13[28,40,42,48,49,53,61,66]	6–9	−2.56, 1.2	1299	−1.03
	6[31,48,56,64]	12	−4, −0.1	1629	−0.93
	4[72]	30	−5.4, −0.1	548	−1.88
	1[64]	60	−0.7	87	−0.70

[a]Some studies had multiple arms. Number of citations may therefore be smaller than the number of study arms.
[b]ΔI – ΔC, difference between the changes in the intervention and comparison groups

control group, but only 21 of these reported adequate variance data to be included in this analysis (Table 3). Of these, four nonrandomized trials[46,64,69,72] were not included in these analyses because of the small number of studies for each outcome measure (i.e., two measured BMI and two weight in pounds). Nine RCTs reported weight change outcomes and six reported change in BMI. Four cluster RCTs reported BMI outcomes. Meta-analytic results using a random effects model for RCTs reporting weight change in pounds at 6–12 months are shown in Figure 3. The pooled estimate indicates a change of −2.8 pounds (95% CI=−4.63, −0.96) in favor of the intervention group. The Q test for heterogeneity was nonsignificant.

The pooled effect from three RCTs[47,49,53] that focused on physical activity behaviors alone was −2.24 pounds (95% CI=−6.49, +2.00), compared with −3.18 pounds (95% CI=−5.88, −0.50) in five RCTs[38,58,60,62,65] in which both physical activity and dietary behaviors were the focus of the intervention. The one study[40] that focused on diet alone reported weight loss of −1.71 pounds (95% CI=−8.38, +4.95). Little difference was found between RCTs in which two to five contacts were made and those with more than five contacts, with the exception of Prichard.[65] This study, which reported larger effects than the others, was a 12-month weight-loss intervention for middle-aged men with a BMI >25. One intervention group (n=18) was advised to follow a low-fat diet (25% caloric intake as fat); the other (n=21) was advised to engage in unsupervised moderate exercise three times a week. Compared with the control group (n=19), a pooled effect of −10.33 pounds was found. The benefit to the low-fat–diet group was twice that to the exercise group.

Figure 4 shows changes in BMI among RCTs; the pooled effect at the 6–12-month follow-up was −0.47 BMI units (95% CI=−0.75, −0.19) in favor of the intervention group. Among cluster RCTs reporting changes in BMI at 6 months,[37,42,48] a pooled effect of −0.25 (95% CI=−0.64, +0.14) was found.

In subgroups analyses, no association was found between program effectiveness and focus of the program (e.g., CVD risk reduction, weight loss, physical fitness) or behavioral focus (diet or physical activity), but this analysis was limited by a small number of studies in each category that examined a similar outcome (i.e., weight, BMI, body fat).

Analysis, Part III. Sixteen studies reported comparisons between different intervention arms (Table 3).

Table 6. Impact on other outcomes reported (n=7)

Study	Outcome	Arm	Months	ΔI–ΔC
Pritchard (2002)[65]	Abdominal fat (pounds)	A	12	−2.35
		B	12	−1.25
Krishnan (2004)[55]	Group % change in BMI	BMI <25	12	−4.9
		BMI 25–29	12	16.8
		BMI ≥30	12	−11.9
Nilsson (2001)[59]	Waist-to-hip ratio		12	−0.01
			18	−0.01
Drummond (1998)[40]	Waist-to-hip ratio	A	6	−0.01
		B	6	−0.01
Fukahori (1999)[45]	Waist-to-hip ratio		6	−0.05
Cook (2001)[37]	Waist circumference		6	−0.7
			12	−0.5
Bruno (1983)[35]	% of ideal body weight		8	3.5

ΔI–ΔC, difference between the changes in the intervention and comparison group.

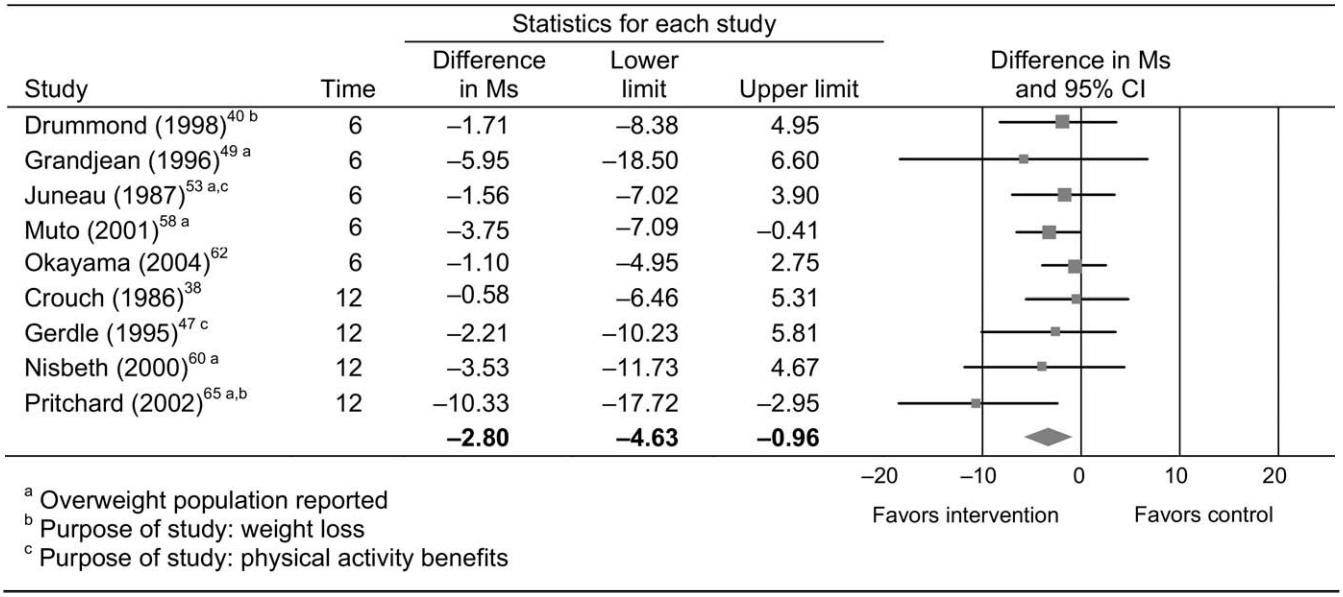

Figure 3. Impact on weight in pounds at 6–12 months in 9 RCTs

Eleven of these studies could be divided into two groups based on similarity of the research questions: (1) impact of programs with more or more intensive program components, or both and (2) impact of programs offered by professional versus lay leaders. The five remaining studies[33,39,50,70,71] could not be summarized under a common research question. The results are summarized in Table 7. Offering multiple program components typically resulted in greater weight loss, but the results are not entirely consistent. Structured programs (i.e., scheduled individual or group sessions) for behavioral skills development or physical activity conferred greater benefit than unstructured (i.e., self-directed) approaches. Informational or educational approaches alone were less effective than those that added behavioral counseling. With respect to lay versus professional group leaders, there appeared to be little difference in program effects. Few studies examined environmental approaches to improving worker weight status.[27,43,70]

Summary of Effectiveness

In conclusion, there is evidence of a modest reduction in weight as a result of worksite health promotion programs aimed at improving nutrition, physical activity, or both. Program effects are consistent, with a net loss of 2.8 pounds (95% CI=−4.63, −0.96) among workers at 6–12-month follow-up, based on the meta-analysis of nine RCTs. In terms of BMI, a net loss of 0.47 BMI (95% CI= −1.02, −0.2) at 6–12 months was observed in six RCTs. Similar results were observed for studies that could not be included in the meta-analysis. There was limited evidence to draw conclusions about differential effects by program focus (nutrition and physical activity) or program component

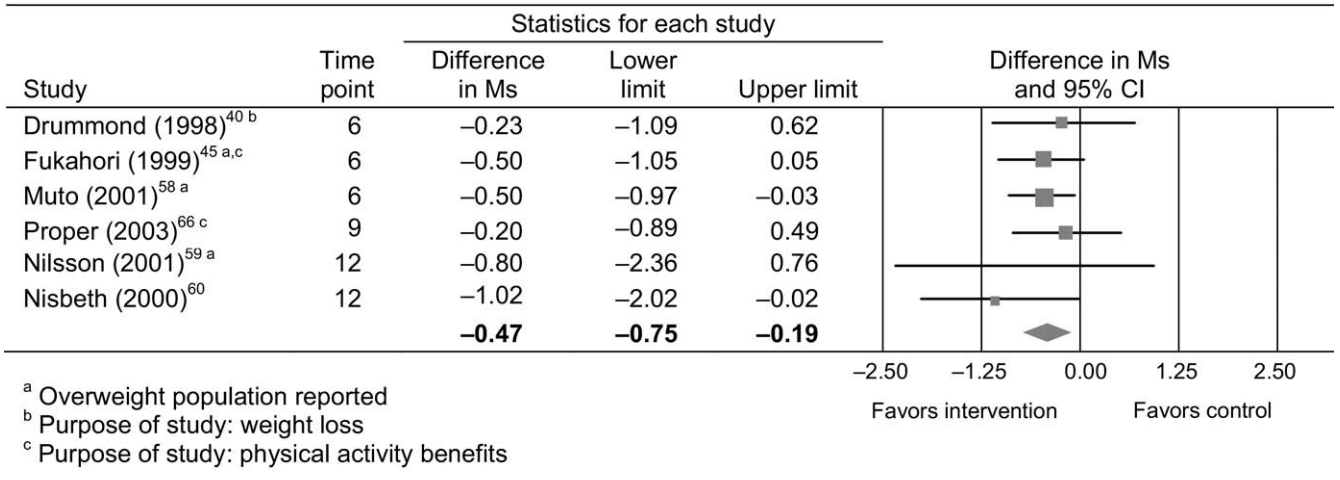

Figure 4. Impact on BMI at 6–12 months in 6 RCTs

Table 7. Studies comparing multiple component approaches with fewer program components and studies with lay versus professional leaders

Comparison characteristic	Study	Study design	Arm	Elements	N	Months from baseline	ΔI (pounds or BMI)[a]
Multiple versus fewer program components	Anderson (1993)[29]	RCT	A	Behavior skill development program	78	6	−3.90
			B	Goal setting only	95		−12.90
	Lovibond (1986)[57]	RCT	A	Education, goal setting, training	25		−22.82
			B	A's program—less intensity	25		−17.64
			C	A's program—greater loss of intensity	25		−11.36
	Robinson (1992)[67]	Nonrandomized	A	Education, goal setting, incentives education	117		−3.53
			B		20		−3.53
	Abrams (1983)[27]	RCT	A	Structured program, therapist	84	10.5	−9.04
			B	Less-structured program, no therapist	49		−3.31
	Erfurt (1991)[43]	RCT	A	Education, counseling, social support	783	36	−4.7
			B	Education, counseling			−1.2
			C	Education			0.6
			D	Fitness center			3.1
			A+	A+weight-loss program			−6.4
			B+	B+weight-loss program			−5
			C+	C+weight-loss program			−2.4
			D+	D+weight-loss program			4.2
	Forster (1985)[44]	RCT	A women	Group instruction, weigh-in required	19	6	−11.3
			B women	Group instruction, weigh-in optional	21		−10.7
			C women	Self-instruction, weigh-in required	26		−10.9
			D women	Self-instruction, weigh-in optional	18		−12
			A men	Group instruction, weigh-in required	4		−19.4
			B men	Group instruction, weigh-in optional	5		−7.3
			C men	Self-instruction, weigh-in required	2		−24.5
			D men	Self-instruction, weigh-in optional	8		−18.8
	Cockcroft (1994)[36]	RCT	A	Health screening+counseling	297	6	−0.54 BMI
			B	Health screening			+0.1 BMI
	Elberson (2001)[41]	Retrospective cohort	A	Structured exercise	54	12	−0.57 BMI
			B	Unstructured exercise	320		+0.30 BMI
	Hedberg (1998)[51]	Nonrandomized	A	Health assessment+group instruction	102	18	+0.3 BMI
			B	Health assessment+self instruction			+0.2 BMI
Lay versus professional leader	Peterson (1985)[63]	RCT	A	Professional leader	30	6	−12.79
			B	Lay leader	33		−13.89
	Brownell (1985)[34]	RCT	A	Professional leader	NA	12	−5.9
			B	Lay leader			−5.5

[a]ΔI, change in intervention group
NA, not applicable

(information, behavioral skills, or environmental and policy). Among the group of studies comparing an intervention arm with other intervention arms, when more or more-intensive modes of intervention were provided to participants there appeared to be an increase in program impact. For example, offering structured programs (i.e., scheduled sessions) appears more effective than unstructured approaches, and information plus behavioral counseling confers more benefit than providing information alone. There was no apparent difference in program effectiveness based on lay versus professional group leaders.

Applicability

Identification of the effectiveness of worksite health promotion programs on weight outcomes for specific subgroups of the population was constrained by limited reporting of important study population characteristics. Ethnicity data were not reported, age was not reported in 70% of studies, and socioeconomic data and information on blue- versus white-collar jobs were not reported in 40% of the studies. Although the presence of some overweight workers was indicated in 66% of studies, prevalence rates were not provided.

Intervention programs take place in settings that may have consequences for their effectiveness. In this review, the size of the worksite was not reported in 64% of the studies. Based on the data available, the results of this review may be generalized to a white-collar workforce where both overweight and other chronic disease risk conditions exist. Some studies[27,37,43,46,52,56,58,70] examined policy and environmental changes in conjunction with instructional or behavioral approaches, but it was difficult to summarize the contribution of the environmental and policy component due to

differences in comparison conditions and outcomes reported.

Economic Efficiency

For the systematic review of economic efficiency, the definition and characteristics of the intervention, as defined by the effectiveness review team, were adopted as primary inclusion and exclusion criteria for studies. Established *Community Guide* standards to determine eligibility for economic review are discussed elsewhere.[81] Broadly speaking, these require that studies be published in English, be implemented in a country with a high-income economy as defined by the World Bank,[82] and use an economic evaluation method. The search strategy combined key economic terms such as *cost*, *cost–benefit*, *cost–utility*, and *cost-effectiveness analyses* with the terms used in the effectiveness review and, in addition to the databases for the effectiveness review, examined economic-specific databases including EconLit and the Social Science Citation Index. The data were abstracted following the procedures outlined in the economic abstraction form elsewhere.[80]

The search identified eight economic evaluation studies falling within the scope of the current effectiveness review: five cost-effectiveness studies,[84,85,87,89,91] one willingness-to-pay study,[85] and two cost-benefit studies.[83,86] One study[90] that reported cost per employee for each additional percentage point of cardiovascular risk reduced or relapse prevented, based on a combined measure of risk including weight loss, blood pressure, and smoking cessation components, was subsequently excluded from the review. Another study[90] that estimated an optimum number of fitness classes based on a participant's willingness to pay for a loss of 7.8 kg in body weight, 8.8% loss in percentage body fat, and 2.4 mmol/L loss in total cholesterol was also excluded as the economic summary measure did not consider actual expenditure per unit of weight loss or percentage loss in body fat. One study[87] looked at a weight-loss outcome after 5 weeks, a follow-up period markedly shorter than the benchmark period set for the effectiveness review. This study, however, was included in the current economic review because it provided important cost information for the program. Two studies[84,86] were identified that reported a return per dollar invested in the program based on estimated disability and medical care costs averted; one[86] was excluded from review because the outcome was reported as kilocalories expended per kilogram of body weight per week for employees participating in a fitness program, rather than the actual loss in body weight. All included studies were rated as "good" following the quality assessment criteria described in the *Community Guide* economic abstraction form. For convenience of comparability, economic summary measures were adjusted to 2005 U.S. dollars using the all-item Consumer Price Index or the Medical Care component of the CPI (retrieved from www.bls.gov), depending on whether the majority of cost items could be attributed to nonmedical or medical care goods and services.

One study[84] conducted a cost-effectiveness analysis of a worksite weight-loss program consisting of three competitions held in business/industrial settings in which participants received a behavioral treatment manual at each weigh-in. Intervention costs for the three competitions were $6149, $1377, and $762, respectively, and included material costs and personnel time for management, employees, and program staff to organize and supervise the program. The cost per pound of weight lost in these three competitions was $4.16 for a 12-week program involving employees of three banks, $2.19 for a 13-week program, and $1.60 for a 15-week program respectively, with the last two competitions involving employees of two manufacturing companies. The lower cost per pound lost in Competitions 2 and 3 was due to decreased organizational expenses compared to Competition 1. Another study[91] analyzed the cost effectiveness of team competitions at the worksite and estimated a cost of $1.45 to lose 1% of body weight. Effectiveness was measured by percentage loss in body weight rather than by amount of weight loss to permit comparison of programs with widely varying initial weights of participants. Although specific intervention costs were not detailed in the study, costs included time of the committee that planned, coordinated, and administered the program, employee time, and minimal costs of photocopying manuals and material costs for posters. A third study[89] assessed the cost effectiveness of a 3-month worksite weight-loss program that included concepts of competition and self-responsibility in an education-based campaign. The campaign cost was $25,376 and the study reported a cost of $1.77 per pound of weight lost. Another study[87] reported costs for a self-help weight-loss awareness campaign where each participant was given a kit with information on how to start a safe weight-loss program. Costs included personnel time and materials for typesetting, printing flyers, and posters. The intervention cost was $2634 excluding volunteer time and $3966 including 166 hours of volunteer time valued at $8.04 per hour. The study also reported cost-effectiveness ratios of $2.17 and $1.44, respectively, per pound of weight lost with or without the cost of volunteer time; however, the follow-up period was much shorter than that required for the effectiveness review.

Finally, one study[83] reported a reduction in disability and major medical costs of $1022.96 per participant at a worksite physical fitness program for a 1-year period, excluding costs of maternity or obstetrics-related claims. The intervention costs of $75,750 included the first-year budget for operating expenses, annual cost of laboratory tests and physical examinations, and annual cost of capital investment in equipment amortized

more than 20 years. Although the study did not report any change in employee weight, there was a significant decline in the percentage of body fat. The intervention returned $1.59 for every dollar invested in the program resulting in a net saving of $0.59 per $1.00.

The range of cost-effectiveness estimates from three studies varies from $1.44 to $4.16 per pound of loss in body weight. Interpretation of the economic efficiency of these interventions is difficult without further details about how a pound of weight loss translates into a final health outcome of reduced incidence of a disease and increased quantity and quality of life-years. However, at least one study[91] found that the cost effectiveness of a worksite team competition to reduce weight compared favorably with commercial weight-loss programs. Also, based on previous findings that a sustained 10% reduction in body weight would decrease expected lifetime medical care costs of hypertension, hypercholesterolemia, type 2 diabetes, CHD, and stroke by $3258 (to $7504) for men and by $3116 (to $7365) for women,[88] the intervention cost of $1.45 per 1% change in body weight from this study appears to yield a high rate of return. The return would be even higher if savings from productivity loss averted are duly accounted for.

In general, obesity prevention programs at the worksites may not only enhance employee self-confidence and improve the relationship between management and labor but also have the potential to boost the profits of companies by increasing employee productivity and reducing medical care and disability costs. More studies are needed for definitive conclusions about the economic efficiency of such programs. However, recent worksite studies rarely treat obesity prevention as a single strategy and instead focus on comprehensive health promotion programs where obesity is but one of many components in the universe of health risk factors considered.

Barriers to Implementation

No barriers to implementation were reported by authors of the studies reviewed.

Other Benefits or Harms

This review looked at weight-related outcomes only. Many other physical and mental health effects were not captured, nor were possible benefits related to productivity or absenteeism. All studies were reviewed for mention of adverse effects, and no negative effects were found related to the interventions reviewed.

Research Issues

Although evidence was found that worksite programs targeting nutrition and physical behaviors confer modest, positive, weight-related benefits, important research questions remain. One of the initial review questions was answered only partially: Which employee populations benefit the most from worksite health promotion interventions targeted at weight? Weight status varies considerably among employee populations. Reporting individual weight measures for employees from baseline to follow-up is not feasible in large occupational health studies. Instead, measurement of weight change in the studies reviewed was usually presented as group mean change in BMI, pounds, kilograms, or percentage body fat. Thus, it could not be determined if those at greatest risk (i.e., overweight or obese) benefited more or less. Nor could it be determined if a few employees lost a large amount of weight or if many employees lost small amounts.

Growing numbers of employers have adopted wellness programs as a means to lower health costs and increase productivity of workers. These employers would benefit from studies that quantify program effects at the population level. In addition to measuring mean weight change, it would be useful to learn what percentage of participants had clinically meaningful weight loss (i.e., >5% or >10% body weight loss). Also, reporting changes in the prevalence of overweight and obesity in the employee population as a result of the intervention would provide information about intervention effects at the population level. Highly effective interventions that reach only a small percentage of the population will likely not affect the prevalence.

Forty percent of the studies lacked information to determine differential effects according to blue- or white-collar job status. Those that did report occupational status included predominantly white-collar workers. Race and ethnicity data were also limited.

A variety of worksite settings were represented in this review, which adds to the generalizability of the findings. Information on the feasibility of implementing programs across small to very large worksite settings, however, was limited by missing workplace size data in 64% of the studies. No association was found between program effectiveness and focus of the program (e.g., CVD risk reduction, weight loss, physical fitness) or behavioral focus (diet or physical activity). Because the majority of programs used behavioral plus informational strategies, it was difficult to contrast program components with respect to effectiveness. Questions remain about the effect on employee weight status when implementation of environmental change (e.g., providing easy access to affordable, healthy foods, or modifying the physical environment to encourage physical activity) and employer policy strategies (health insurance incentives, contribution to gym membership fees) is included.

One third of the RCTs provided insufficient statistical information to allow meta-analytic pooling of effects. Only a few reported intention-to-treat analysis. Reporting on intervention intensity, duration, and fidelity was often ambiguous. Future studies will contribute more to the empirical knowledge base if they

follow the CONSORT guidelines for reporting RCTs and TREND guidelines for reporting nonrandomized studies.[92,93]

Discussion

This review addressed the effects of worksite nutrition and physical interventions on employee weight outcomes. According to *Community Guide* rules,[13] there is strong evidence of a consistent, albeit modest, effect. The findings are applicable to men and women in a range of worksite settings. However, some limitations should be considered when interpreting the results of this review. Although several outcome measures may be collected in worksite health promotion studies, sometimes not all are reported. The outcomes reported by authors can be influenced by the significance of results.[94] This review included only studies that reported weight outcomes and thus may have omitted studies in which weight measures were collected but not reported because of nonsignificant effects. The findings of this review must be viewed within the context of the limitations of the available evidence in the published literature. Incomplete and less-than-transparent reporting made it difficult to use the full body of evidence to assess program effectiveness. Finally, although it is important for systematic reviews to report on the effectiveness of interventions to reduce health inequalities,[95] it was not possible in this review. The joint Cochrane and Campbell Collaborations health equity group recommends assessment of Place of residence, Race or ethnicity, Occupation, Gender, Religion, Educational level, SES, and Social capital (PROGRESS) as key indicators of how program effects are distributed across populations.[96] With the exception of gender, little of this information was reported in studies included in this systematic review.

This review, along with the accompanying recommendations from the Task Force on Community Preventive Services,[97] should prove useful for employers, program planners, implementers, and researchers. It can support decisions to implement and evaluate worksite programs that promote healthy weights through changes in diet and physical activity, and provide direction for further research in this area. Although this intervention approach may be expected to have only a modest effect on weight change, viewed from the population level it can potentially prevent and control overweight and obesity when applied to a substantial proportion of the employee population and used in concert with other clinical and community approaches.

Consultants for the systematic review were David L. Katz, MD, Yale Prevention Research Center, New Haven CT; Ron Z. Goetzel, PhD, Institute for Health and Productivity Studies, Washington DC, and member of the Task Force on Community Preventive Services; and William Dietz, MD, PhD, Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC, Atlanta GA.

This review began as a collaborative effort between CDC and the Yale-Griffin Prevention Research Center, and the authors particularly want to thank David L. Katz, MD, Megan O'Connell, MPH, and Valentine Njike, MD.

The authors gratefully acknowledge the contribution of the following individuals who abstracted and coded data from the studies in this review: Carolynne Shinn, Stacie Anne Yung, Anne Lund, Claire Roach, Angela Boardman, Maya Tholandi, Nicole Campbell, Susan Vendeland, Susan Anderson, Greg Ward, Angela Thompson, Patrice Brooks, Parul Dube, Janna Servi, Theresa Monica Dancel, Davida Carr, Andrea James, Neha Desai, Jessica Marcinkevage, Michele Emory, and Sarah Gintel McGrath.

The authors thank William Thomas, MLIS, research librarian with the CDC, for valuable assistance with literature searches.

The points of view are those of the Task Force on Community Preventive Services and of the respective authors and do not necessarily reflect those of the CDC or the Department of Veterans Affairs.

The names and affiliations of the Task Force members are listed at www.thecommunityguide.org.

The work of Toby Quinn was supported with funds from the Oak Ridge Institute for Scientific Education (ORISE). The work of W. Roodly Archer was supported in part by ORISE funds.

The work of Donna Johnson was conducted under the auspices of the University of Washington Health Promotion Research Center.

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