



Effective Health Care Program

Strategies To Prevent Weight Gain Among Adults

Executive Summary

Background

Condition

One of the Healthy People 2020 national objectives is to increase the prevalence of a healthy weight among adults to 34 percent and to reduce the prevalence of obesity among adults to less than 30 percent.¹ From 2005 to 2008, only 31 percent of adults were a healthy weight.² Obesity was estimated to cost \$79 billion in the United States during 1995. By 2008, health care costs associated with obesity were thought to have risen to \$147 billion. The Federal Government pays about one half of these costs through Medicaid and Medicare spending.³

Body mass index (BMI)—expressed as weight in kilograms divided by height in meters squared (kg/m^2)—is commonly used to classify underweight (BMI $<18.5 \text{ kg}/\text{m}^2$), healthy or normal weight (BMI $18.5\text{--}24.9 \text{ kg}/\text{m}^2$), overweight (BMI $25.0\text{--}29.9 \text{ kg}/\text{m}^2$), obesity (BMI $\geq 30.0 \text{ kg}/\text{m}^2$), and extreme obesity (BMI $\geq 40.0 \text{ kg}/\text{m}^2$).

Adults tend to gain weight progressively through middle age. Although the average weight gained per year is 0.5 to 1 kg, the modest accumulation of weight over time can lead to obesity.⁴ The estimated age-adjusted prevalence of overweight and

Effective Health Care Program

The Effective Health Care Program was initiated in 2005 to provide valid evidence about the comparative effectiveness of different medical interventions. The object is to help consumers, health care providers, and others in making informed choices among treatment alternatives. Through its Comparative Effectiveness Reviews, the program supports systematic appraisals of existing scientific evidence regarding treatments for high-priority health conditions. It also promotes and generates new scientific evidence by identifying gaps in existing scientific evidence and supporting new research. The program puts special emphasis on translating findings into a variety of useful formats for different stakeholders, including consumers.

The full report and this summary are available at www.effectivehealthcare.ahrq.gov/reports/final.cfm.

obesity (BMI $\geq 25.0 \text{ kg}/\text{m}^2$) was 68 percent in the United States during 2007 and 2008. Despite the doubling in the prevalence of obesity between 1976 and 1980 and 2007 to 2008 (13 to 34 percent), the



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prevalence of overweight has remained stable between the same time periods (32 to 34 percent).

Obesity is a risk factor for chronic conditions including cardiovascular disease, type 2 diabetes, arthritis, certain types of cancer, and cancer recurrence.⁵⁻¹² Weight is associated with an increased risk of some forms of cancer and cancer recurrence. There is growing evidence that breast cancer survivors or women with breast cancer have better outcomes if they lose or maintain their weight. Obesity can also be caused by medications used to treat chronic disease, as is the case for antipsychotic treatments,¹³ some treatments for type 2 diabetes,^{14,15} and tamoxifen and aromatase inhibitors for treatment or prevention of breast cancer or cancer recurrence.¹⁶ Higher grades of obesity are associated with excess mortality, primarily from cardiovascular disease, type 2 diabetes, and certain types of cancer.^{16,17}

We aimed to review studies of strategies to prevent weight gain among adults. The strategies of interest were self-management techniques, diet, physical activity, use of the dietary fat absorption inhibitor orlistat, or combinations of these strategies applied at the individual, community, or environment level. These strategies could have been implemented in any setting, including clinical care sites, community settings, higher education institutions, and workplaces. Strategies could have targeted individuals at high risk of gaining weight because of a family history of obesity or diabetes mellitus, personal risk factors for diabetes mellitus and cardiovascular disease (such as borderline values of laboratory measures), use of medication associated with weight gain,¹⁸ or have had more inclusive enrollment criteria.^{19,20}

Scope and Key Questions

We aimed to compare the effectiveness, safety, and impact on quality of life of independent and combined strategies to prevent weight gain among adults. Studies targeting a combination of weight loss with weight maintenance or weight loss exclusively were outside of the scope of this review.

The specific Key Questions (KQ) are:

KQ1: What is the comparative effectiveness of self-management strategies for the prevention of weight gain among adults?

KQ2: What is the comparative effectiveness of dietary strategies for the prevention of weight gain among adults?

KQ3: What is the comparative effectiveness of physical activity strategies for the prevention of weight gain among adults?

KQ4: What is the comparative effectiveness of orlistat for the prevention of weight gain among adults?

KQ5: What is the comparative effectiveness of a combination of self-management, dietary, physical activity, and orlistat strategies for the prevention of weight gain among adults?

KQ6: What is the comparative effectiveness of environment-level strategies for the prevention of weight gain among adults?

We aimed to answer these questions by reviewing studies of adults that intervened with self-management, diet, physical activity, use of orlistat, or a combination of these interventions, over at least 1 year, on individuals or their environment. Dietary and physical activity strategies inherently include some aspects of self management. Only when self-management did not include traditional diet or physical activity components (i.e., daily weighing or regulating television viewing) was the study reported in KQ1. Observational studies that followed weight change by these strategies over at least one year were also included. The outcomes of interest were BMI, weight, waist circumference, obesity-related clinical outcomes (mortality, cancer recurrence if applicable and health related quality of life), and adverse effects (Figure A).

Adverse effects included burden of the intervention (which may impact adherence), nutritional deficiencies (for dietary interventions), eating disorders (from an increased focus on weight among non obese individuals), activity related injury (for physical activity interventions), and adverse effects of orlistat.

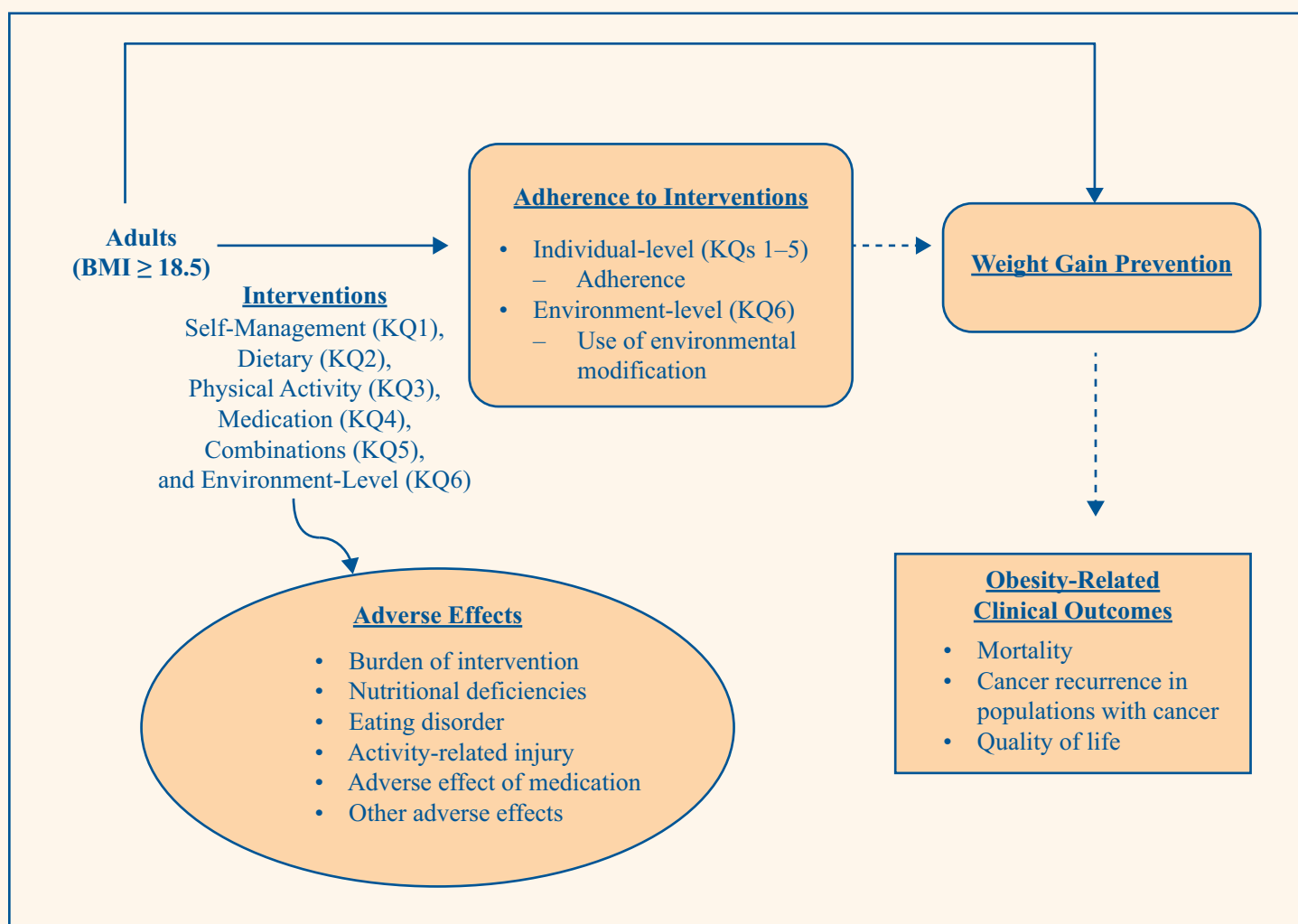
Methods

Literature Search Strategy

We searched the following databases for primary studies: MEDLINE®, Embase®, the Cochrane Central Register of Controlled Trials, CINAHL®, and PsycINFO® through June 2012. We developed a search strategy for MEDLINE, accessed via PubMed®, and developed comparable searches using the other databases. We also reviewed the reference lists of each included article, relevant review articles, and relevant studies identified in ClinicalTrials.gov.

Title, abstract, and full article reviews were performed by two independent reviewers to identify relevant publications. Only one reviewer had to identify the publication as relevant to be included at title review. At abstract review, both reviewers had to agree that the study did not include any exclusion criteria (Table A). At full article review, both reviewers had to agree that the article

Figure A. Analytic framework for comparative effectiveness of strategies to prevent weight gain among adults



BMI = body mass index; KQ = Key Question

met the inclusion criteria. Conflicts were resolved by consensus adjudication.

Relevant data were extracted from eligible trials of interventions and observational studies of approaches with a focus on items related to the population, interventions and approaches, comparisons, outcomes, timing, and setting. Each article was serially abstracted first by a first reviewer and then by a senior reviewer. Serial data abstraction involved a senior reviewer (faculty-level project investigator) abstracting data from articles while having access to the first reviewer's data. Differences in opinion were resolved through consensus adjudication and, for difficult cases, during team meetings. The timepoints of interest for data abstraction of weight outcomes were at 1 year, 2 years, 5 years, and the last reported timepoint

after 5 years of followup. For the intermediate outcomes, safety, clinical, and quality of life outcomes, we only abstracted data for the last reported timepoint on or after 1 year.

Quality Assessment of Individual Studies

Study quality was assessed using the Downs and Black methodologic quality assessment checklist (Appendix F).²¹ This checklist was developed to assess the quality of reporting, internal validity, and external validity of randomized and observational studies. We used information on study quality to assess the risk of bias (using the internal validity items) and directness (using the external validity items) of the studies. Two reviewers independently completed the checklist for each article and came to consensus for each item.

Data Synthesis

When there were three or more studies with comparable interventions and comparable outcome measures, we considered quantitative pooling of the results. We examined the studies' designs for qualitative similarities. Because we found that no groups of studies were amenable

to pooling with meta-analyses, we calculated and displayed the mean differences, risk differences or relative risks with 95% confidence intervals (CI) for the individual studies grouped by study population and comparable interventions. Observational studies did not report categories of approaches consistently, prohibiting the use of summary figures.

Table A. Study inclusion and exclusion criteria

Population and condition of interest	Adult participants. If a study includes some participants under age 18 years and results are not reported separately for adults, the study will be included as long as 90 percent of the total population is 18 years and older. Studies of overweight and obese patients were included if the study did not describe the goal of the strategy to be weight loss or maintenance of weight after weight loss. <i>Excluded</i> studies if they included only women during their pregnancies. <i>Excluded</i> studies that included only patients at risk of weight loss (e.g., wasting disease, eating disorders), or with a BMI <18.5.
Interventions and approaches	Studies must have evaluated a strategy of interest as defined by the Key Questions. Included studies of orlistat. Included studies of caloric substitutes, such as olestra or artificial sweeteners. Included studies of lifestyle interventions for KQ5. Included studies implemented at a community level for KQ6. <i>Excluded</i> studies if the goal of the study was weight loss, a combination of weight loss and weight gain prevention (without separate reporting of results), or weight maintenance after weight loss. <i>Excluded</i> studies of biological determinants (such as genes) as the exposure. <i>Excluded</i> studies of herbal supplements, vitamins, and minerals. <i>Excluded</i> studies that included a smoking cessation strategy.
Comparisons of interest	Included comparisons of no intervention, usual care, or direct comparison with self management, dietary, physical activity, device, orlistat, or a combination of strategies. Included studies comparing different intensities of the same strategy (e.g., low fat versus high fat diet). <i>Excluded</i> studies if a study compared a strategy of interest with only a strategy not of interest. <i>Excluded</i> studies if there was no comparison.
Outcomes and timing	One year of observation of weight change during adulthood was required. Weight change must have been reported relative to a strategy of interest. Measures of weight change included weight, BMI or waist circumference. Obesity related adverse effects, quality of life, cancer recurrence*, mortality and study adherence were abstracted only if the study also reported a qualifying measure of weight.
Type of study	Included studies with any sample size from any calendar year that met all other criteria. Included all study designs including prospective (randomized and non randomized), retrospective, crossover, and case control studies. Serial cross sectional studies of the same population were eligible for KQ6. Observational studies had to account for confounding and losses to followup in the design or analysis to be eligible. Crossover studies must have reported at least 1 year of weight change in each phase of the crossover to be included. For KQ1-5 inclusion, the participants measured at the first time point must have been the same participants measured at the later time points. For KQ6 inclusion, the participants measured at the first time point were not required to be the same participants as those measured at the later time points although the communities sampled from had to be the same. <i>Excluded</i> studies with no original data (reviews, editorials, comments, letters, modeling only studies). <i>Excluded</i> studies published only as abstracts. <i>Excluded</i> qualitative studies that did not provide quantitative information on a strategy of interest and weight, such as focus groups or directed interviews.

KQ=Key Question; RCT = randomized controlled trial

*In populations with cancer only.

We selected a meaningful between-group-difference threshold in addition to a statistically significant threshold ($p < 0.05$) for reporting on the outcomes. A meaningful difference threshold was defined as 0.5 kg of weight,^{4,22} 0.2 units of BMI (based on a 0.5 kg change for an individual with a BMI of 27), or 1 cm of waist circumference relative to the comparison group. The meaningful threshold was annualized to account for the different durations of the studies. For example, the weight difference threshold was 1 kg for outcomes reported at 2 years and 2.5 kg at 5 years.

Rating the Body of Evidence

At the completion of our review, we graded the quantity, quality, and consistency of the evidence addressing Key Questions 1 through 6 by adapting an evidence grading scheme recommended by AHRQ's "Methods Guide for Effectiveness and Comparative Effectiveness Reviews."²³ We created evidence grades for each comparison and outcome by population or setting. We used four domains to yield a final evidence grade: Risk of Bias, Consistency, Directness, and Precision.

We classified evidence pertaining to Key Questions 1 through 6 into four categories: (1) "high" grade (indicating high confidence that the evidence reflects the true effect and further research is very unlikely to change our confidence in the estimate of the effect); (2) "moderate" grade (indicating moderate confidence that the evidence reflects the true effect and further research may change our confidence in the estimate of the effect and may change the estimate); (3) "low" grade (indicating low confidence that the evidence reflects the true effect and further research is likely to change our confidence in the estimate of the effect and is likely to change the estimate); and (4) "insufficient" grade (no evidence identified). A comparison-outcome pair with high strength of evidence was one with low risk of bias, consistency (or not applicable if only one study contributed), directness, and precision. Moderate strength of evidence indicated that *one* of the following was observed: a moderate risk of bias, inconsistency, indirectness, or imprecision. Low strength of evidence indicated a high risk of bias or *two* or more of the following: a moderate risk of bias, inconsistency, indirectness, and imprecision. Details on how the risk of bias, consistency, directness, and precision were identified are provided in the body of the report. For consistency with the reporting of the results, we graded the strength of evidence using the above process for each population or setting.

The team members discussed the process they used to grade the evidence throughout the report writing process. When a team member felt the evidence grade was questionable, this comparison-outcome evidence grade was discussed at a team meeting.

Applicability

We describe the applicability of studies in terms of the degree to which the study population, interventions or approaches, outcomes, and settings were relevant to individuals at risk of weight gain and features that may affect the effectiveness of the strategy.²⁴

The populations included in the studies affect the generalizability of the results. For this reason, we report the results ordered by the studied population. The most inclusive population (adults from the general population not selected based on underlying comorbidity or setting) is reported first, followed by strategies that were evaluated in individuals in a specific setting (workplace based and college based) and finally by groups of individuals with a disease or at risk of a disease (cardiovascular disease, cancer, and mental health).

Defining Effectiveness

For an intervention or approach to be considered effective, it had to meet the meaningful between-group difference and statistical thresholds. We selected a meaningful between-group-difference threshold in addition to a statistically significant threshold ($p < 0.05$) for reporting on the outcomes. A meaningful difference threshold was defined as 0.5 kg of weight,^{4,22} 0.2 units of BMI (based on a 0.5 kg change for an individual with a BMI of 27), or 1 cm of waist circumference relative to the comparison group. The meaningful threshold was annualized to account for the different durations of the studies. For example, the weight difference threshold was 1 kg for outcomes reported at 2 years and 2.5 kg at 5 years.

Results

Results of Literature Searches

From the 24,870 unique articles identified from electronic resources, 58 publications were included describing 51 studies. Thirty-eight trials included 150,081 participants at baseline. The majority (55 percent) of the trials were randomized trials that were not explicitly designed to prevent weight gain. Thirteen observational studies included 420,986 participants at baseline. Most of the observational studies were subanalyses of existing cohorts or randomized trials. Only one of the observational

studies came from a cohort that was explicitly designed to measure weight change over time.²⁵

Results by Population or Setting of the Intervention or Approach

The strength of evidence is not high for any of the tested interventions or the approaches described in observational studies to prevent weight gain as measured by changes in BMI, weight, or waist circumference. Other than workplace-based strategies, which have moderate strength of evidence of effectiveness, most evidence was low or insufficient.

When adherence was reported, it tended to be poor, with less than 80 percent adherence to interventions. The one study that assessed awareness of an environmental intervention found inconsistent awareness of all of the components implemented in the workplace.

Very few studies reported on obesity-related clinical outcomes (mortality, quality of life, or cancer recurrence) or adverse effects. All evidence for these outcomes was graded as low or insufficient. No comparative study of orlistat for weight gain prevention was identified, so Key Question 4 has no evidence.

The interventions and approaches that prevented weight gain are described by population and by setting below. In a population, if none of the strategies prevented weight gain, we describe all of the strategies that we identified. The strength of evidence for the body of evidence is provided in Table B, which also includes the evidence about secondary outcomes.

Evidence Among Adults From a General Population

Eleven randomized trials (65,562 participants) and 12 prospective cohorts (418,520 participants) were identified. The strength of evidence is low but indicates that the following may prevent weight gain: low fat diets (effective for 1 year but not longer) compared with nutrition guideline handouts; monitoring heart rate during exercise after being instructed how to perform the monitoring during a routine clinic visit compared with physician advice; group lifestyle sessions and text messages sent to mothers of young children compared with diet and physical activity guidelines handouts; and eating fewer meals prepared outside of the home compared with eating more meals prepared outside of the home.

Evidence Among Obese Adults From a General Population

One randomized trial (124 participants) was identified. The strength of evidence is low that neither behavior was

favorable to change weight or waist circumference over 18 months between women who were encouraged to walk or bicycle to work compared with those only encouraged to walk to work.

Evidence for Workplace-Based Strategies

Seven randomized trials (76,310 participants) were identified. The strength of evidence is moderate that workplace-based combination strategies prevent weight gain. A work-based intervention that combined diet, physical activity, and environmental interventions resulted in a meaningful and statistically significant prevention of BMI and waist circumference increase at 12 months and prevention of weight gain at 24 months compared with no intervention. Another work-based intervention that combined Internet-based diet and physical activity counseling also prevented weight gain at 24 months compared with no intervention.

Evidence for College-Based Strategies

Two randomized trials (155 participants) were identified. The strength of evidence is low that small group sessions with teaching about healthy lifestyle strategies, not taken for credit, prevent weight gain compared with no intervention.

Evidence Among Adults at Risk for or With Cardiovascular Disease or Diabetes Mellitus

Eleven randomized trials and one nonrandomized trial (4,206 participants) were identified. The strength of evidence is low that physical activity interventions prevent weight gain and waist circumference increases in this population compared with no intervention.

Evidence for Adults With Cancer

Three randomized trials (2,671 participants) and one prospective cohort based on a cancer registry (1,966 participants) were identified. The strength of evidence is moderate that aerobic and resistance exercise performed at home prevent weight gain among women with cancer compared with no intervention. The strength of evidence is low that decreasing television viewing prevents weight gain among people with cancer compared with increasing or no change in television viewing.

Evidence for Adults With Mental Illness

Two trials were identified (163 participants). A randomized trial provided fruits and vegetables to group homes of people with schizophrenia compared with providing fruits and vegetables with education on how to prepare meals. A nonrandomized trial combined a behavioral intervention

Table B. Summary of the strength of evidence *

Table B. Summary of the strength of evidence*								
Intervention	BMI	Weight Change [†]	Waist Circumference [†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality	Adverse Events
General Population								
Self-management	Insufficient	Low No strategy favored	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Diet	Low No diet favored	Low A healthy eating pattern was associated with less weight gain than an unhealthy eating pattern. Eating outside the home was associated with greater weight gain than consuming almost all meals at home.	Low Healthy eating scores 2 z-scores above the mean associated with 2 to 3cm smaller waistlines in Whites and Hispanics.	Low Eating food outside the home one or more times per week associated with a 20-30% increased risk of overweight or obesity compared with eating no meals outside the home. Healthy eating scores associated with a decreased odds of obesity.	Insufficient	Insufficient	Low Low-fat group had 0.1% less mortality than nutrition guidelines group.	Insufficient
Physical activity	Low Participants who were taught to monitor their heart rate by their primary care provider during exercise along with advice had a greater decrease in BMI than participants given advice by their doctor without being taught to monitor their heart rate.	Low Increasing physical activity over time is associated with less weight gain than maintaining or decreasing physical activity over time.	Low No strategy favored	Insufficient	Low Adherence with the interventions ranged from 33% to 71%.	Insufficient	Insufficient	Low No serious adverse events occurred.

Table B. Summary of the strength of evidence* (continued)							
Intervention	BMI	Weight Change [†]	Waist Circumference [†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality
<i>General Population (continued)</i>							
Combination	Low No strategy favored	Low No strategy favored	Low No strategy favored	Low No strategy favored	Low Adherence ranged from 50% to 73%.	Insufficient	Insufficient
Built environment or community-level	Low No strategy favored	Low No strategy favored	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
<i>Obese Only</i>							
Self-management	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Diet	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Physical activity	Insufficient	Low Cycling group had 0.1 unit greater decrease in BMI than walking group.	Low Cycling group had 0.5 cm greater decrease in waist circumference than walking group.	Insufficient	Insufficient	Insufficient	Insufficient
Combination	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Built environment or community-level	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
<i>Work-Based</i>							
Self-management	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Diet	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Physical activity	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient

Table B. Summary of the strength of evidence* (continued)

Intervention	BMI	Weight Change[†]	Waist Circumference[†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality	Adverse Events
<i>Work-Based (continued)</i>								
Combination	Low Individual level diet and physical activity interventions along with an environmental component prevented BMI increases compared with no intervention.	Moderate Individual level diet and physical activity interventions along with an environmental component prevented weight gain compared with no intervention. Internet-based diet and physical activity counseling prevented weight gain compared with telephone based diet and physical activity counseling. Women in the military who received emails on diet and physical activity lost weight compared with women who received no intervention.	Low Individual level information on diet, physical activity, goal setting instructions and provision of a pedometer and measuring tape prevented waist circumference increases compared with no intervention.	Insufficient	Low Adherence ranged from 17% to 64%.	Insufficient	Insufficient	Insufficient
Built environment or community-level	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient

Table B. Summary of the strength of evidence* (continued)

Intervention	BMI	Weight Change[†]	Waist Circumference[†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality	Adverse Events
<i>College-Based</i>								
Self-management	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Diet	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Physical activity	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Combination	Low Small group, non-credit sessions with information on goal-setting, diet and physical activity prevented an increase in BMI compared with no intervention.	Low Small group, non-credit sessions with information on goal-setting, diet and physical activity prevented an increase in weight compared with no intervention.	Low No strategy favored	Insufficient	Low 53% of students attended at least 60% of the sessions during year 1 ; 26% of students attended at least 60% of the sessions during year 2.	Insufficient	Insufficient	Insufficient
Built environment or community-level	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
<i>With or at Risk For Type 2 Diabetes Mellitus or Cardiovascular Disease</i>								
Self-management	Low Goal setting results in a meaningful BMI change at one year compared with no intervention.	Insufficient	Low No strategy favored	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Diet	Low No strategy favored	Low No strategy favored	Low No strategy favored	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient

Table B. Summary of the strength of evidence* (continued)							
Intervention	BMI	Weight Change [†]	Waist Circumference [†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality
<i>With or at Risk For Type 2 Diabetes Mellitus or Cardiovascular Disease (continued)</i>							
Physical activity	Low Endurance exercise training prevented BMI gain compared with no intervention.	Low Endurance exercise training prevented weight gain compared with no intervention.	Low Endurance exercise training prevented waist circumference gain compared with no intervention.	Insufficient	Low Adherence to endurance exercise training was 57%.	Insufficient	Insufficient
Combination	Low No strategy favored	Low No strategy favored	Low Aerobic activity and strength training resulted in greater waist circumference decrease compared with no intervention.	Insufficient	Low Adherence ranged from 65% to 100%.	Low No strategy favored	Insufficient
Built environment or community-level	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
<i>Cancer</i>							
Self-management	Low Less than 3 hours per day television viewing associated with less BMI gain after colorectal cancer diagnosis compared with viewing more than 5 hours of television per day.	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient

Table B. Summary of the strength of evidence* (continued)

Table B. Summary of the strength of evidence* (continued)								
Intervention	BMI	Weight Change[†]	Waist Circumference[†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality	Adverse Events
<i>Cancer (continued)</i>								
Diet	Insufficient	Low No strategy favored	Insufficient	Insufficient	Low Adherence ranged from 60% to 90%.	Insufficient	Insufficient	Insufficient
Physical activity	Insufficient	Moderate Aerobic and resistance exercise performed at home prevented weight gain at 1 year compared with no intervention.	Insufficient	Insufficient	Low Adherence ranged from 65% to 79% in the exercise groups and was 100% among controls.	Insufficient	Insufficient	Insufficient
Combination	Low A reduced fat diet with self-management counseling among women with newly diagnosed cancer decreased BMI at 1 year compared with counseling on nutritional adequacy that did not teach self-management techniques.	Low A reduced fat diet with self-management counseling among women with newly diagnosed cancer decreased BMI at 1 year compared with counseling on nutritional adequacy that did not teach self-management techniques.	Insufficient	Insufficient	Low Intervention group reduced calories from fat through 5 years of followup.	Insufficient	Insufficient	Low No adverse events occurred.
Built environment or community-level	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient

Table B. Summary of the strength of evidence* (continued)							
Intervention	BMI	Weight Change [†]	Waist Circumference [†]	Progression to Overweight or Obese	Adherence	Quality of Life	Mortality
<i>Mental Illness</i>							
Self-management	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Diet	Low No strategy favored	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Physical activity	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Combination	Low No strategy favored	Low No strategy favored	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient
Built environment or community-level	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient

BMI = body mass index

*No studies identified orlistat as a strategy to prevent weight gain.

[†]For BMI, weight change, and waist circumference the direction of effect is provided for strategies that met the between group difference threshold.

with education on diet and exercise among patients initiating antipsychotic medications compared with no intervention. There is low strength of evidence that no intervention was favored to prevent weight gain.

Discussion

Key Findings and Strength of Evidence

We did not find strong evidence that any strategy prevents weight gain. This conclusion is similar to a previous systematic review on prevention of weight gain.²⁶

Interventions that were potentially effective included a clinic-based program to teach heart rate monitoring, a lifestyle intervention targeted at mothers of young children, workplace interventions with individual and environmental components, small group sessions to educate college women about healthy lifestyles, exercise for individuals at risk of cardiovascular disease and diabetes, and exercise performed at home among women with cancer. Potentially effective approaches, identified from observational studies, included eating meals prepared at home among college graduates and less television viewing among individuals with colorectal cancer.

No strategy was graded as having a high strength of evidence for its effectiveness. Workplace-based interventions and physical activity for women with cancer were graded as having a moderate strength of evidence. All other comparisons had low or insufficient evidence. The strength of evidence was low for many comparisons because the studies were not designed to measure weight maintenance or prevent weight gain and the study staff that measured weight in the intervention studies may have been aware of the participants' exposure groups. For observational studies, only one study mentioned that the original cohort was designed to measure weight longitudinally and qualified as direct evidence.²⁵

Despite the attention on primary prevention of obesity,^{1,27-32} there is little evidence to recommend specific strategies. Existing recommendations are based on intermediate measures of changes in diet or physical activity or cross-sectional measures of weight. For example, the recommendations by the Centers for Disease Control and Prevention for community interventions to prevent obesity acknowledge that the evidence to support the recommendations were not based on sufficiently long studies that measured weight as an outcome, but on short-term changes in food choices or use of environmental modifications to facilitate physical activity.²⁷

Efforts by primary care providers to share information from publications on evidence-based research to prevent weight gain may be limited by the lack of reimbursement for the time to provide information and counseling. The World Health Organization European Ministerial Conference on Counteracting Obesity recommended that primary care providers play a more active role in preventing obesity.³⁰ Although the American Medical Association recommends talking with patients about how to prevent inappropriate weight gain,³³ reimbursement for the time required to provide weight maintenance counseling for the nonobese is not supported by Medicare.^{34,35} The lack of reimbursement may at least partly explain the low adherence with these recommendations by providers. An analysis of the Behavioral Risk Factor Surveillance Survey data in 2003 indicated that only 2.6 percent of individuals with a BMI between 18 and 25 kg/m² received advice to maintain their current weight by a health care provider.³⁶

Although evidence is limited to support strategies associated with weight gain prevention, the rationale to prevent weight gain is sound given the robust evidence that obesity is associated with poor health outcomes,⁵⁻¹² is costly,³ and is difficult to reverse.³⁷

Areas for future research may focus on periods when people are already making other life changes and identifying strategies that people are interested in implementing before using resources to administer an intervention. Three of the interventions targeted populations experiencing life changes such as attending college³⁸ or beginning to cohabitate with a partner.³⁹ During these periods of change, individuals may be more amenable to accept a lifestyle modification or more likely to be adherent to the changes. Although these interventions did not uniformly result in weight maintenance compared with control or result in higher levels of adherence, designing interventions to be implemented during these and other life changes (e.g., postpartum, retirement, relocating to a new region) may be considered in future research.

Identifying an individual's interest level in an intervention prior to recommending a weight maintenance strategy may also be of interest. Many studies randomized participants to an intervention followed by multiple in-person visits, phone calls, and mailings. One trial opted to provide patients with up to three phone invitations to participate in a walking program compared with an information session. Only 33 percent of those invited to walk took part in a walk.⁴⁰ Allowing the option of participating in

an intervention (rather than required visits or phone calls) demonstrates that individuals who consent to participate in a weight-related study may not have the motivation to participate in the particular intervention of interest. Combining a time when a person is already in a period of change with an intervention that an individual is motivated to participate in may be an area for future research.

Applicability

These findings apply primarily to overweight individuals. No study included healthy-weight individuals exclusively. The one study of obese individuals included abdominally obese individuals.

Adherence was poor in many trials. The results may have been more useful if they had been reported by adherence status in addition to the intent-to treat analyses. For example, if participants who adhered to an intervention were more likely to maintain weight than the nonadherent participants, this would have been valuable information.

Behavior change is difficult for individuals whose goal is to prevent weight gain, just as behavior change is difficult for those attempting to lose weight. Workplace interventions with environmental-level change may be a way to help those attempting to prevent weight gain and those who aim to lose weight modify their behavior, especially when the workers are made aware of the intervention. For individuals, eating more meals prepared at home and decreasing television viewing are simple, low-cost changes that prevent weight gain. College groups to discuss healthy diets and physical activity also prevented weight gain. The more intensive diet and physical activity interventions reported few adverse events. Although these intensive interventions did not result in strong evidence to promote their adoption, there is no evidence that *not* adopting a strategy to prevent weight gain is preferable.

Limitations

The strength of evidence is low or insufficient for almost all comparison-outcome relationships. There are several reasons for these low grades based on how we assessed each study's quality and graded the strength of evidence. First, intervention trials were frequently downgraded for lack of blinding, for not reporting the blinding of outcome assessors, or for not accounting for losses to followup. We feel that these quality elements are required to reduce the risk of bias. Although some may argue that an objective measure such as a weight measurement is not subject to bias, we suggest that the role played by a nonblinded assessor still poses a risk of bias in this measurement. Second, we included in this review only observational

studies that accounted well for confounding and for losses to followup to ensure that we included only the highest quality observational studies. The inclusion of only high-quality observational studies narrowed the body of evidence but we could not have confidence in outcomes from studies that did not account for confounding or selection bias. Third, very few interventions had a stated goal of weight maintenance or weight gain prevention, a requirement for having direct evidence. We excluded studies that explicitly mentioned that at least some of the patients had a goal of weight loss. The best-known weight gain prevention trial—the Pound of Prevention trial—was excluded for this reason.⁴¹ Only one observational study was nested within a cohort whose original design had a weight-related outcome of interest.²⁵ Fourth, very few studies reported standard errors or confidence intervals for the between-group differences in change in a weight-related outcome over time. When the majority of studies did not report a measure of variability, we graded the body of evidence as imprecise. In some instances, the studies did not report a mean difference or point estimate stating only *there was no significant difference in weight change between the groups*.

There were also several limitations of the literature base. First, many studies did not report a weight-related goal and yet were included because they did report weight outcomes. We may have inadvertently included some trials that had a goal of weight loss but that did not say so explicitly in the published paper. Studies reported as weight maintenance among overweight and obese individuals may not have been solely targeting weight maintenance, but implicitly implied weight loss. We excluded studies that included specific aims of “weight change” associated with power calculations for an expected decrease in weight among the intervention group. However, some studies did not report power calculations or an expected direction of weight change. These studies were included. We also included observational studies that include participants with unknown weight-related goals. Second, controls had better weight maintenance than expected. In many studies, the weight maintenance in the control groups was better than is expected in a general population. Many control groups had no increase in weight over time. In the general United States population, adults gain about 0.5 kg per year.⁴ Individuals enrolled in intervention studies may be more likely to make behavior changes regardless of the group assignment. It is possible that the knowledge that one will be evaluated on weight regularly may help people to maintain weight without an intensive intervention. This may support the use of simple weight surveillance interventions in a workplace or

primary care setting. Third, very few studies reported on obesity-related clinical outcomes or adverse events. Only one study in the general population reported on mortality. The few trials that did report on adverse events stated that none were associated with the intervention. Although, none of these studies stated what adverse events they collected or how they were measured.

Strengths

The greatest strength of the evidence base was the variety of populations included. In addition to including populations with very few exclusion criteria representative of the general population, we also observed a variety of studies targeted at individuals that are known to be more likely to gain weight.

Research Gaps

We suggest that most comparisons and outcomes that have low or insufficient evidence are future research needs. In particular, we recommend future research to examine strategies to prevent weight gain among healthy weight individuals and, separately, overweight and obese individuals. Interventions for individuals initiating antipsychotic medications are also a high priority given that participants of a trial gained 10 kg in the first year of medication use. Diabetes and some cancer medications are also associated with weight gain. Interventions for patients initiating diabetes medications, tamoxifen, and aromatase inhibitors are also a high priority subpopulation, although weight loss goals may be more relevant for some of these patients.

Different degrees of intensity of the strategies should be compared. Less intensive interventions may be possible given that control groups maintained weight comparable with the intervention groups in most of the studies that we included.

There are design and reporting considerations that should be considered for future studies. Observational cohorts should make measuring weight a stated goal in their protocols if that is the intent. Intervention trials should be of sufficient duration to adequately assess the efficacy of interventions to prevent weight gain. We suggest that 1 year should be a minimum duration of followup for these interventions. Longer followup will make it easier to identify true effectiveness if individuals are expected to gain only 0.5 kg per year.

Conclusions

The evidence provides some, although limited, support for strategies to prevent weight gain. Potentially effective strategies included ones that involve minor behavior change (eating more meals prepared at home) or more major changes (endurance exercise training in a gym at least three times per week). Although there is no strong evidence to promote a particular weight gain prevention strategy, there is no evidence that *not* adopting a strategy to prevent weight gain is preferable.

References

1. HealthyPeople.gov. Normal Weight Status. www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=29.
2. Health Indicators Warehouse. Healthy Weight in Adults. www.healthindicators.gov/Indicators/Healthyweightinadults_1207/Profile/Data.
3. Finkelstein EA, Trogon JG, Cohen JW, et al. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff (Millwood)*. 2009;28(5):w822-31. PMID: 19635784.
4. Williamson DF. Descriptive epidemiology of body weight and weight change in U.S. adults. *Ann Intern Med*. 1993;119(7 Pt 2):646-9. PMID: 8363190.
5. Joshi CE, Mondul AM, Menke A et al. Weight gain is associated with an increased risk of prostate cancer recurrence after prostatectomy in the PSA era. *Cancer Prev Res (Phila)*. 2011;4(4):544-51. PMID: 21325564.
6. Stroup SP, Cullen J, Auge BK, et al. Effect of obesity on prostate-specific antigen recurrence after radiation therapy for localized prostate cancer as measured by the 2006 Radiation Therapy Oncology Group-American Society for Therapeutic Radiation and Oncology (RTOG-ASTRO) Phoenix consensus definition. *Cancer*. 2007;110(5):1003-9. PMID: 17614338.
7. Caan BJ, Emond JA, Natarajan L et al. Post-diagnosis weight gain and breast cancer recurrence in women with early stage breast cancer. *Breast Cancer Res Treat*. 2006;99(1):47-57. PMID: 16541317.
8. Rock CL, McEligot AJ, Flatt SW et al. Eating pathology and obesity in women at risk for breast cancer recurrence. *Int J Eat Disord*. 2000;27(2):172-9. PMID: 10657890.
9. McNee RK, Mason BH, Neave LM, et al. Influence of height, weight, and obesity on breast cancer incidence and recurrence in Auckland, New Zealand. *Breast Cancer Res Treat*. 1987;9(2):145-50. PMID: 3620716.
10. Tartter PI, Slater G, Papatestas AE, et al. Cholesterol, weight, height, Quetelet's index, and colon cancer recurrence. *J Surg Oncol*. 1984;27(4):232-5. PMID: 6503298.

11. Smith SC Jr. Multiple risk factors for cardiovascular disease and diabetes mellitus. *Am J Med.* 2007;120(3 Suppl 1):S3-S11. PMID: 17320520.
12. Okoro CA, Hootman JM, Strine TW, et al. Disability, arthritis, and body weight among adults 45 years and older. *Obes Res.* 2004;12(5):854-61. PMID: 15166307.
13. Gibson M, Carek PJ, Sullivan B. Treatment of co-morbid mental illness in primary care: how to minimize weight gain, diabetes, and metabolic syndrome. *Int J Psychiatry Med.* 2011;41(2):127-42. PMID: 21675345.
14. Bennett WL, Wilson LM, Bolen S et al. Oral Diabetes Medications for Adults With Type 2 Diabetes: An Update [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (US); 2011 Mar. www.ncbi.nlm.nih.gov/books/NBK55754/. PMID: 21735563.
15. Mitri J, Hamdy O. Diabetes medications and body weight. *Expert Opin Drug Saf.* 2009;8(5):573-84. PMID: 19538102.
16. Sestak I, Harvie M, Howell A, et al. Weight change associated with anastrozole and tamoxifen treatment in postmenopausal women with or at high risk of developing breast cancer. *Breast Cancer Res Treat.* 2012;134(2):727-34. PMID: 22588672.
17. Flegal KM, Graubard BI, Williamson DF, et al. Cause-specific excess deaths associated with underweight, overweight, and obesity. *JAMA.* 2007;298(17):2028-37. PMID: 17986696.
18. Gill JM, Cooper AR. Physical activity and prevention of type 2 diabetes mellitus. *Sports Med.* 2008;38(10):807-24. PMID: 18803434.
19. Eiben G, Lissner L. Health Hunters—an intervention to prevent overweight and obesity in young high-risk women. *Int J Obes (Lond).* 2006;30(4):691-6. PMID: 16276359.
20. Norris SL, Zhang X, Avenell A, et al. Long-term non-pharmacological weight loss interventions for adults with prediabetes. *Cochrane Database Syst Rev.* 2005;(2):CD005270. PMID: 15846748.
21. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health.* 1998;52(6):377-84. PMID: 9764259.
22. Katan MB, Ludwig DS. Extra calories cause weight gain—but how much? *JAMA.* 2010;303(1):65-6. PMID: 20051571.
23. Owens DK, Lohr KN, Atkins D et al. AHRQ series paper 5: grading the strength of a body of evidence when comparing medical interventions—Agency for Healthcare Research and Quality and the Effective Health Care program. *J Clin Epidemiol.* 2010;63(5):513-23. PMID: 19595577.
24. Atkins D, Chang SM, Gartlehner G et al. Assessing applicability when comparing medical interventions: AHRQ and the Effective Health Care Program. *J Clin Epidemiol.* 2011;64(11):1198-207. PMID: 21463926.
25. Bes-Rastrollo M, Basterra-Gortari F, Sánchez-Villegas A, et al. A prospective study of eating away-from-home meals and weight gain in a Mediterranean population: the SUN (Seguimiento Universidad de Navarra) cohort. *Public Health Nutrition.* 2010;13(9):1356-63. <http://www.ncbi.nlm.nih.gov/pubmed/19954575>.
26. Lemmens VE, Oenema A, Klepp KI, et al. A systematic review of the evidence regarding efficacy of obesity prevention interventions among adults. *Obes Rev.* 2008;9(5):446-55. PMID: 18298429.
27. Khan LK, Sobush K, Keener D et al. Recommended community strategies and measurements to prevent obesity in the United States. *MMWR Recomm Rep.* 2009;58(RR-7):1-26. PMID: 19629029.
28. Yanovski SZ, Yanovski JA. Obesity prevalence in the United States—up, down, or sideways? *N Engl J Med.* 2011;364(11):987-9. PMID: 21410367.
29. Gostin LO. Law as a tool to facilitate healthier lifestyles and prevent obesity. *JAMA.* 2007;297(1):87-90. PMID: 17200479.
30. WHO European Ministerial Conference on Counteracting Obesity: Diet and Physical Activity for Health. Istanbul Turkey. www.euro.who.int/__data/assets/pdf_file/0009/87462/E89567.pdf.
31. Nutrition and Weight Status. HealthyPeople.gov. April 2012. www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=29.
31. NHLBI Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Obesity in Adults (US). Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report. Bethesda (MD): National Heart, Lung, and Blood Institute; 1998 Sep. www.ncbi.nlm.nih.gov/books/NBK2003/.
32. Hawkes N. Medical colleges and faculties unite to tackle obesity after "failure" of current strategies. *BMJ.* 2012;344:e2775. PMID: 22511215.
33. Lyznicki JM, Young DC, Riggs JA, et al. Obesity: assessment and management in primary care. *Am Fam Physician.* 2001;63(11):2185-96. PMID: 11417771.
34. Centers for Medicare and Medicaid Services. Press Release: Details for: Medicare covers screening and counseling for obesity. Tuesday, November 29, 2011. www.cms.gov/apps/media/press/release.asp?Counter=4189&intNumPerPage=10&checkDate=&checkKey=&srchType=1&numDays=3500&sr.
35. Centers for Medicare and Medicaid Services. CMS Manual System. Pub 100-04 Medicare claims Processing. March 7, 2012. www.cms.gov/Regulations-and-Guidance/Guidance/Transmittals/Downloads/R2421CP-.pdf.
36. Lutfiyya MN, Nika B, Ng L, et al. Primary prevention of overweight and obesity: an analysis of national survey data. *J Gen Intern Med.* 2008;23(6):821-3. PMID: 18350338.
37. Hall KD, Sacks G, Chandramohan D et al. Quantification of the effect of energy imbalance on bodyweight. *Lancet.* 2011;378(9793):826-37. <http://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2811%2960812-X/abstract>. PMID: 21872751.

38. Hivert MF, Langlois MF, Berard P, et al. Prevention of weight gain in young adults through a seminar-based intervention program. *Int J Obes (Lond)*. 2007;31(8):1262-9. PMID: 17356531.
39. Burke V, Giangiulio N, Gillam HF, et al. Physical activity and nutrition programs for couples: a randomized controlled trial. *J Clin Epidemiol*. 2003;56(5):421-32. PMID: 12812815.
40. Lamb SE, Bartlett HP, Ashley A, et al. Can lay-led walking programmes increase physical activity in middle aged adults? A randomised controlled trial. *J Epidemiol Community Health*. 2002;56(4):246-52. <http://www.ncbi.nlm.nih.gov/pubmed/11896130>.
41. Jeffery RW, French SA. Preventing weight gain in adults: design, methods and one year results from the Pound of Prevention study. *Int J Obes Relat Metab Disord*. 1997;21(6):457-64. PMID: 9192229.

Full Report

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