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Behavioral Counseling to Promote a Healthy Diet and Physical Activity for Cardiovascular Disease Prevention in Adults Without Known Cardiovascular Disease Risk Factors: Updated Systematic Review for the U.S. Preventive Services Task Force

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The information in this report is intended to help healthcare decisionmakers—patients and clinicians, health system leaders, and policymakers, among others—make well-informed decisions and thereby improve the quality of healthcare services. This report is not intended to be a substitute for the application of clinical judgment. Anyone who makes decisions concerning the provision of clinical care should consider this report in the same way as any medical reference and in conjunction with all other pertinent information (i.e., in the context of available resources and circumstances presented by individual patients).

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Structured Abstract

Objective: We conducted this systematic review to support the U.S. Preventive Services Task Force (USPSTF) in updating its 2017 recommendation on behavioral counseling to promote a healthy diet and physical activity in adults without known CVD risk factors.

Data Sources: We performed a search of MEDLINE, PsycINFO, and the Cochrane Central Register of Controlled Trials for studies published through February 3, 2021. Studies included in the 2017 USPSTF review were re-evaluated for potential inclusion. We supplemented searches by examining reference lists from related articles and expert recommendations. We conducted active surveillance of the literature through May 21, 2021.

Study Selection: Two researchers reviewed 7,485 titles and abstracts and 411 full-text articles against prespecified inclusion criteria. We included English-language randomized clinical trials of behavioral interventions targeting improved diet, increased physical activity, decreased sedentary time, or a combination of these targets among adults without known hypertension, dyslipidemia, diabetes, impaired fasting glucose or glucose tolerance, or a combination of these factors. Studies among adults who were overweight or had obesity were included. Data were extracted from studies by one reviewer and checked by a second.

Data Analysis: Random effects meta-analysis was used to examine outcomes with sufficient evidence to warrant pooled analyses, including blood pressure, lipids, fasting blood glucose, adiposity-related outcomes, dietary measures, and physical activity. Subgroup analyses and meta-regression were used to explore effect modification. Data on health outcomes and harms were sparsely reported, and the specific outcomes measured differed across trials, precluding meta-analysis.

Results: One-hundred and thirteen randomized clinical trials were included (N=129,993). Only three trials reported long-term outcomes related to mortality or cardiovascular events, with no clear benefit of dietary or physical activity interventions after 4 or 13 years followup. Fifteen trials reported quality of life outcomes, but few demonstrated statistically significant, nor clinically significant, changes in quality of life following the interventions. Diet and physical activity behavioral interventions were associated with small, statistically significant reductions in continuous measures of blood pressure, LDL cholesterol, adiposity-related outcomes at 6 months to 1.5 years of followup versus control conditions. Blood pressure improved by an average of 0.8/0.4 mm Hg (pooled systolic blood pressure=-0.8 [95% CI, -1.3 to -0.3]; 23 RCTs [n=57,079]; I^2=11%; pooled diastolic blood pressure=-0.4 [95% CI, -0.8 to -0.0]; 24 RCTs [n=57,148]; I^2=36%). Low-density lipoprotein cholesterol was reduced by an average of 2.2 mg/dL (95% CI, -3.8 to -0.6; 15 RCTs [n=10,122]; I^2=69%). Intervention groups also showed slightly greater reductions in three adiposity-related measures: pooled body mass index=-0.3 kg/m^2 (95% CI, -0.5 to -0.1); 27 RCTs (n=59,239); I^2=95%; and pooled waist circumference=-0.8 cm (95% CI, -1.3 to -0.3); 23 RCTs (n=52,128); I^2=96%. There was evidence of a dose-response effect, with an association between increasing intervention intensity and larger improvements in intermediate outcomes. Very few studies reported the effects of the interventions beyond 12 months.

There was also consistent evidence that behavioral interventions improved participants' dietary intake and physical activity levels. Meta-analysis indicated statistically significant associations between healthy diet counseling interventions (with or without physical activity messages) and measures of saturated fat (standardized mean difference [SMD], -0.5 [95% CI, -0.8 to -0.3]; 16 RCTs [n=48,661]; I^2=97%), fiber (SMD, 0.2 [95% CI, 0.1 to 0.4]; 13 RCTs [n=47,571]; I^2=94%), and daily servings of fruits and vegetables (1.1 [95% CI, 0.4 to 1.8]; 17 RCTs [n=53,711]; I^2=99%). Physical activity interventions (with or without dietary components) resulted in an approximate 33-minute increase in physical activity per week compared with controls (33.0 minutes/week [95% CI, 21.9 to 44.2]; 37 RCTS [n=15,015]; I^2=76%) and had a 41 percent higher odds of meeting physical activity recommendations compared with those in the control group (odds ratio= 1.4 [95% CI, 1.2 to 1.7]; 24 trials [n=17,338]; I^2=55%). Adverse events were rare and there was no evidence of greater harm among intervention groups.

Limitations: Health outcomes such as cardiovascular events and quality of life were only reported in a few included trials. Measurement of behavioral outcomes was extremely heterogeneous.

Conclusions: The results of this systematic review update are consistent with the 2017 review on this topic. Healthy diet and physical activity behavioral interventions for persons without a known risk of CVD were associated with very small but statistically significant benefits across a variety of important intermediate health outcomes and small-to-moderate effects on dietary and physical activity behaviors. Very limited evidence exists regarding the health outcomes or harmful effects of these interventions.

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Chapter 1. Introduction

Purpose

In 2017, the United States Preventive Services Task Force (USPSTF) recommended that primary care professionals individualize the decision to offer or refer adults without obesity who do not have CVD risk factors to behavioral counseling to promote a healthful diet and physical activity (C Grade).[1] The current review is an update of the 2017 review[2, 3] that supported that recommendation and will be used by the USPSTF to update this recommendation. The objective of this report is to synthesize the evidence on the benefits and harms of behavioral counseling on healthy diet and physical activity among adults without CVD risk factors.

For the purposes of this review, adults not at high risk for CVD were defined as those without known hypertension or elevated blood pressure, dyslipidemia or elevated lipids, impaired fasting glucose/impaired glucose tolerance, diabetes, metabolic syndrome, or at high risk according to risk equations. This review, therefore, represents studies among adults: 1) with unknown risk (i.e., unselected adults) or 2) those explicitly without these risk factors. Studies among adults who are overweight or have obesity (without other known CVD risk factors) are included within this review.

A separate USPSTF review[4, 5] and recommendation[6] address behavioral counseling interventions in adults with known risk factors. Additionally, the USPSTF maintains several other reviews and recommendations associated with preventing CVD including interventions related to tobacco cessation,[7] weight loss,[8] aspirin use,[9] statin use,[10] and screening for and treatment of high or abnormal levels of blood pressure,[11] and glucose.[12] The recommendations related to behavioral counseling in adults with risk factors, those with abnormal blood glucose levels or diabetes, and those with obesity are particularly inter-related and are shown in **Table 1**.

Condition Definition

Healthy Diet

A healthy eating pattern accounts for all foods and beverages within an appropriate calorie level, including consuming a variety of vegetables (from all of the subgroups including dark green, red and orange, starchy, and other), fruits (especially whole fruits), grains (at least half of which are whole grains), fat-free or low-fat dairy, a variety of protein foods, and oils and limiting saturated fats and trans fats, added sugar, and sodium.[13]

Physical Activity

Physical activity is any bodily activity that enhances or maintains overall health and physical fitness. The 2018 U.S. physical activity guidelines emphasize that adults should move more and sit less throughout the day and that some physical activity is better than none.[14] For substantial health benefits, the guideline suggests that adults do at least 150 minutes to 300 minutes a week of moderate-intensity, or 75 minutes to 150 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Adults should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week and older adults are also encouraged to incorporate balance training as well as aerobic and muscle-strengthening activities.

Sedentary Behavior

Sedentary behavior refers to any waking behavior characterized by a low level of energy expenditure (less than 1.5 metabolic equivalents of task [METs]) while sitting, reclining, or lying such as watching television, using a computer, and sitting in a car.[14] The 2018 U.S. physical activity guidelines advisory committee found a strong relationship between time in sedentary behavior and the risk of all-cause mortality and CVD mortality in adults.[15] However, there is no specific target for adults for how many times during the day sedentary time should be interrupted or a healthy target for total sedentary time.

Burden and Prevalence of CVD and Risk Factors

CVD, including heart, ischemic heart disease, and stroke, is the leading cause of death in the United States for both men and women, and for most races and ethnicities including Hispanics, Blacks, and whites.[16, 17] In 2016, CVD was the underlying cause of 840,678—or 1 in 3—deaths among US adults.[18] Of these deaths, approximately 43 percent were due to coronary heart disease and 17 percent were the result of stroke.[16] This pattern is expected to continue with an estimated 23.3 million deaths from CVDs worldwide (primarily from heart disease and stroke) projected by 2030.[19] The American Heart Association estimates that by 2035, approximately 45 percent of adults in the US will have some form of CVD.[16]

Risk factors for CVD are well-established, multicomponent, and common in adults. While many of the CVD risk factors are nonmodifiable (age, sex, family history, and race and ethnicity) many are modifiable and can be changed or treated. Modifiable risk factors include: dyslipidemia or hyperlipidemia (referred to as dyslipidemia in this report), hypertension, high fasting plasma glucose level, overweight and obesity, smoking, lack of physical activity, sedentary behavior, and unhealthy diet.[18, 20Fryar, 2012 #1787] The CDC estimates that nearly half (47%) of all US adults age 20 years or older have at least one of the following CVD risk factors: uncontrolled hypertension, uncontrolled elevated low-density lipoprotein (LDL) cholesterol level, or current smoking.[21] Prevalence of risk factors as defined by the American Heart Association's (AHA) "Life's Simple 7" are presented by age group in **Table 2**.

There is a marked disparity in diet and physical activity behaviors by important subpopulations. People of lower socioeconomic status or those with lower educational attainment tend to be less active, eat fewer fruits and vegetables, and eat fewer foods rich in dietary fiber when compared with people in a higher socioeconomic position or with higher educational attainment.[22-26] Non-whites tend to exercise less than whites,[22, 23] and Blacks consume fewer servings of fruits and vegetables than whites.[24-26] Physical activity rates are lower in older vs. younger people and women vs. men.[22, 23] Structural and environmental barriers such as the nonavailability of healthy eating establishments or grocery stores, parks, sidewalks, bicycle trails, or safe and pleasant walking paths close to home or the workplace; traffic; the availability of public transportation; crime; and pollution may affect individuals' perceived or real ability to be more active and adopt healthful eating behaviors and contribute to these differences in healthful behaviors.

Behavioral Counseling Interventions for CVD Primary Prevention

Behavioral interventions to improve diet, physical activity, and sedentary behavior encompass a wide range of strategies that may be available within, feasible for, or referable from primary care.[3] These interventions can take different formats, including brief counseling by a primary care provider, with or without accompanying materials or followup counseling; mailed, print-based interventions with tailored feedback; individual or group counseling; telephone counseling with no in-person contact; or computer-based interventions, including web-based sessions, email, or mobile technology. Behavioral counseling interventions can be delivered by a primary care provider, health educator, behavioral health specialist, nutritionist or dietitian, exercise specialist, peers, or health coaches. Behavior change techniques employed in these interventions can include a broad range of activities, including goal-setting and planning, monitoring and feedback through food and activity logs or pedometers, increasing efficacy and motivation for behavioral change (including using motivational interviewing), addressing barriers to change, social support, and general education and advice regarding the benefits of healthy eating, physical activity, or reduced sedentary time. Many interventions focused on lifestyle changes also encourage weight loss among patients with excess weight.[3, 5]

Recommendations From Other Groups on Healthy Diet and Physical Activity Counseling

The 2017 USPSTF recommendation that healthcare providers should individualize the decision to offer or refer adults to behavioral counseling to promote a healthful diet and physical activity is referred to and affirmed by the American Academy of Family Physicians (AAFP).[27] Similarly, the National Institute for Health and Care Excellence (NICE) recommends that the decision to assess patients' physical activity levels and offer behavioral counseling should be based on the professional judgment of the healthcare provider.[28] However, numerous other organizations, including the American College of Sports Medicine (ACSM), American Heart Association (AHA), U.S. Department of Health and Human Services (HHS), and Department of Veterans Affairs (VA),[29] recommend that healthcare providers provide behavioral counseling on diet and physical activity to *all* of their adult patients, irrespective of chronic conditions or risk factors. The 2018 "Exercise is Medicine" initiative, developed by the ACSM and American Medical Association and endorsed by the AHA, calls for healthcare providers to review and assess every patient's physical activity level (e.g., physical activity as a vital sign), with office visits concluding with an exercise prescription or referral to a qualified health and fitness professional for further counseling.[30]

Current Clinical Practice in the United States

In the United States, 62 percent of adults report consulting a primary care provider in the past year, with an average of 3.2 visits per year,[31] and fewer than half report receiving counseling related to healthy diet, nutrition, or physical activity.[32] According to 2011–2016 data from the National Health and Nutrition Examination Survey (NHANES), lifestyle counseling provided by health care providers is generally low among all adults, but is more common for adults with higher body mass index and chronic conditions (e.g., elevated blood pressure, elevated cholesterol, type 2 diabetes mellitus).[32, 33] Among adults without chronic conditions, 20 percent report receiving counseling on exercise and 11 percent report counseling on diet.[32] In a separate analysis of data among patients with diabetes, from 2005 to 2015, Hispanic patients with diabetes had a higher likelihood of receiving diet or exercise counseling, compared with white patients with diabetes.[33] Those aged 30–49 years were more likely to receive diet or exercise counseling, compared with those aged >75 years. Compared with rural areas and other providers, visits in a metropolitan area or with an advanced practice provider had higher likelihood of any diet or exercise counseling delivery. Data on rates of counseling by sociodemographic characteristics were not available for patients without diabetes.[33]

Previous USPSTF Recommendations

In 2017, the United States Preventive Services Task Force (USPSTF) concluded that primary care professionals individualize the decision to offer or refer adults without obesity who do not have hypertension, dyslipidemia, abnormal blood glucose levels, or diabetes to behavioral counseling to promote a healthful diet and physical activity (**Grade: C recommendation**).[1] The recommendation went on to say that "Existing evidence indicates a positive but small benefit of behavioral counseling for the prevention of cardiovascular disease (CVD) in this population. Persons who are interested and ready to make behavioral changes may be most likely to benefit from behavioral counseling."

Chapter 2. Methods

Scope of Review

This is a systematic review update of a 2017 review.[2, 3] Only one substantive change was made from that review to this update. In the previous review, studies limited to adults with elevated blood pressure were included. These studies have been excluded in this update and are now considered in the USPSTF review among adults with known CVD risk factors.[4, 5]

Key Questions and Analytic Framework

We developed an Analytic Framework (**Figure 1**) and four Key Questions (KQs) to guide the literature search, data abstraction, and data synthesis.

KQs

1. Do primary care–relevant behavioral counseling interventions to improve diet, increase physical activity, and reduce sedentary behavior improve cardiovascular disease (CVD) and related health outcomes (e.g., morbidity and mortality) in adults without known CVD risk factors*?
2. Do primary care–relevant behavioral counseling interventions to improve diet, increase physical activity, and reduce sedentary behavior improve intermediate outcomes associated with CVD (g., blood pressure, lipid levels, blood glucose levels, and body mass index) in adults without known CVD risk factors*?
3. Do primary care–relevant behavioral counseling interventions to improve diet, increase physical activity, and reduce sedentary behavior improve intermediate behavioral outcomes (e.g., diet, physical activity, and sedentary behavior) in adults without known CVD risk factors*?
4. What are the harms of primary care–relevant behavioral counseling interventions to improve diet, increase physical activity, and reduce sedentary behavior in adults without known CVD risk factors*?

*CVD risk factors include hypertension or elevated blood pressure, dyslipidemia or elevated lipid levels, impaired fasting glucose or impaired glucose tolerance, and mixed or multiple risk factors (e.g., 10-year CVD risk >7.5% and metabolic syndrome)

Data Sources and Searches

We designed this review as an extension of two of our prior systematic reviews on behavioral counseling for the primary prevention of CVD. The first was our review of adults not at high risk of CVD and was published in 2017 (encompassing literature through May 2016).[2, 3] The second review focused on studies among high-risk adults and was published in 2020 (encompassing literature through September 2019).[4, 5] Our search strategies were identical for both reviews and were designed to encompass all adults regardless of risk level. During the search process for the 2020 review, we purposefully coded studies that did not include a high-risk population but that might otherwise be included for evaluation in our updated review. As such, we re-evaluated all of those records as well as the 88 studies included in the 2017 review for potential inclusion. We then searched for new primary published literature from May 2016 through February 3, 2021. We searched the following databases: MEDLINE, PsycINFO, and the Cochrane Central Register of Controlled Trials. We worked with a research librarian to develop our search strategy, which was peer reviewed by a second research librarian (**Appendix A**). All searches were limited to articles published in the English language. Collectively, the literature searches encompassed literature published from 1966 through February 3, 2021

We also examined the reference lists of previously published reviews, meta-analyses, and primary studies to identify any potential studies for inclusion. We supplemented our searches with suggestions from experts and articles identified through news and table-of-content alerts, such as those produced by the USPSTF Scientific Resource Center LitWatch activity.[34] We conducted active surveillance of the literature for relevant studies through May 21, 2021. In addition to these database searches, we searched ClinicalTrials.gov for ongoing trials through January 2021. We managed the literature search results using version X9 of EndNote® (Thomson Reuters, New York, NY), a bibliographic management software database.

Study Selection

We developed specific inclusion criteria to guide our study selection (**Appendix A Table 1**). For all KQs, we included randomized, clinical trials (RCTs), including cluster randomized trials, that evaluated the effectiveness of primary care–relevant interventions focused on improving dietary habits, increasing physical activity, and/or reducing sedentary time with the primary aim of CVD primary prevention. We excluded studies with a primary aim of weight loss or weight management as this evidence is covered by a separate systematic review conducted for the USPSTF.[35] Similarly, we excluded studies primarily aimed at falls prevention or improving cognitive function rather than CVD prevention. Studies had to report a behavioral outcome (i.e., diet, physical activity, sedentary time), intermediate outcome (e.g., blood pressure, lipid levels, weight), or health outcome (i.e., morbidity, mortality, health-related quality of life [QOL]) or report adverse events related to the intervention.

We included studies if they were among adults age 18 years or older *without* known CVD, diabetes, or CVD risk factors. The evidence on CVD prevention among adults *with* known cardiovascular risk factors is covered by a separate systematic review.[4, 5] As such, we excluded studies that 1) targeted persons with known CVD, hypertension or elevated blood pressure (high blood pressure stage 1 [systolic 130 mm Hg or diastolic 80-89 mm Hg]),[36] dyslipidemia, diabetes, impaired fasting glucose or glucose tolerance, or a combination of these factors; 2) targeted persons categorized as high risk based on a cardiovascular risk assessment tool; or 3) generically stated that participants must have one or more CVD risk factors to be included. We included studies with persons that may be at elevated risk for CVD based on factors such as age, race/ethnicity, family history of CVD, overweight or obesity, or history of gestational diabetes. We also included studies among unselected samples (e.g., a general population, recruited on the basis of age or sex only) or samples that were selected because of suboptimal behavior (e.g., did not meet national physical activity guidelines). We excluded studies of persons with other known chronic diseases, such as cancer (including studies targeting cancer survivors) or severe mental illness, as well as pregnant persons.

We included interventions that were conducted in or recruited from primary care or a health care system or that we judged could feasibly be implemented in or referred from primary care. For example, we included studies relying on virtual-, computer-, or telephone-based programs or those that exclusively used print or mailed materials, as we judged these all to be potentially feasible for a primary care office or a large health system to implement. We excluded studies that took place exclusively in or in conjunction with worksites, churches, or other settings that are not generalizable to primary care given pre-existing social ties that are not easily reproducible in primary care. Behavioral counseling was broadly defined to include interventions such as counseling or education that included but was not limited to assessment with feedback, motivational interviewing, advice, collaborative goal-setting, and exercise prescriptions.

Interventions could be delivered in various modes, including in person, with print materials, or by telephone or computer, and could be delivered by a number of potential interventionists, such as physicians, nurses, exercise specialists, dietitians, nutritionists, or behavioral health specialists. We excluded interventions focused on supervised exercise or controlled diets as well as those that focused on stress management techniques, such as meditation or yoga. We included only studies that included the following controls: no intervention (including wait list or usual care), minimal intervention (e.g., usual care limited to approximately 15 minutes or less of contact or generic brochures), or attention controls (e.g., similar format and intensity but different content). We excluded studies that evaluated the comparative effectiveness of two active interventions without the addition of a true control group. Additionally, we excluded trials in which the control group was specifically asked not to change their diet or physical activity behaviors. For the greatest applicability to U.S. primary care practice, we included only studies conducted in developed countries, as defined by “very high” development according to the 2018 United Nations Human Development Index.[37] Finally, due to resource constraints, we included only studies that published their results in English.

Two reviewers independently reviewed titles and abstracts for potential inclusion, and two reviewers reviewed the full-text articles. Discrepancies were resolved by discussion and third party consultation as needed. Title and abstract and full-text review were conducted in DistillerSR (Evidence Partners, Ottawa, Canada). We kept detailed records of all included and excluded studies (and the reason for their exclusion) during full-text review.

Quality Assessment and Data Abstraction

For the new literature, at least two reviewers applied USPSTF design-specific criteria (**Appendix A Table 2**) to assess the methodological quality of all eligible studies.[34] We assigned each study a quality rating of “good,” “fair,” or “poor.” Discordant quality ratings were reviewed and discussed; a third reviewer adjudicated as needed. Good-quality studies were those that met nearly all of the specified quality criteria (e.g., comparable groups were assembled initially and maintained throughout the study and followup was ≥80%), whereas fair-quality studies did not meet these criteria but did not have serious threats to their internal validity related to the design, execution, or reporting of the study. Studies rated as poor-quality had several important limitations, including at least one of the following risks of bias: very high attrition (generally >40%); differential attrition between intervention arms (generally >20%); lack of baseline comparability between groups without adjustment; or issues in trial conduct, analysis, or reporting of results (e.g., possible selective reporting, inappropriate exclusion of participants from analyses, and questionable validity of randomization and allocation concealment procedures). Studies rated as poor-quality were excluded from the review. As the quality assessment was an update of our own work, we did not repeat critical appraisal of the original studies through full dual-quality rating.

For all of the included studies, one reviewer extracted key elements into standardized abstraction forms in Microsoft Access® 2016 (Microsoft, Redmond, WA). A second reviewer checked the data for accuracy. For each study, we abstracted general characteristics of the study (e.g., author, year, study design), clinical and demographic characteristics of the sample and setting (e.g., age, race/ethnicity, baseline clinical characteristics, setting, country), analytic methods, and results.

For intervention characteristics, we abstracted detailed information about specific components: duration, number, and length of sessions; group or one-on-one delivery; mode of delivery (i.e., in person, telephone, electronic, or print); providers and provider training; and setting. We used methods consistent with the previous reviews on this topic to estimate and categorize the intensity (or "contact time") of each intervention.

To calculate the total intensity of an intervention, we multiplied the number of sessions by the length of the respective sessions and estimated the total number of minutes. For example, a 12-month intervention consisting of eight 1-hour group sessions would have been calculated as 8 × 60 = 480 minutes. We categorized an intervention as low intensity if the number of minutes was estimated to be 30 or fewer, medium intensity if the number of minutes was 31 to 360, and high intensity if the number of minutes was greater than 360. Interventions that consisted of only print materials were categorized as low intensity. We abstracted the number of sessions and length of sessions according to what was planned (and not necessarily implemented). When reported, we abstracted actual adherence or implementation of the intervention and documented that as well. If a study did not report the length of sessions, we estimated the following: individual counseling session as 30 minutes, group counseling session as 60 minutes, telephone sessions as 15 minutes, computer-based sessions as 15-30 minutes, e-mails as 1-2 minutes, and text messages as 1 minute or less.

We noted the theoretical basis of the intervention where reported and used the description of the intervention to judge the specific behavior change techniques that were used (e.g., goals and planning, feedback and monitoring, self-belief) according to the taxonomy of Michie et al.[38] for behavior change techniques.

Data Synthesis and Analysis

We synthesized data separately for each KQ. The data on health outcomes (KQ 1) and adverse events (KQ 4) did not allow for quantitative pooling due to the limited number of contributing studies and the variability in outcomes measured, so we summarized those data in tables and narratively. For intermediate health outcomes (KQ 2) and behavioral outcomes (KQ 3), random-effects meta-analyses were performed to account for the variability of the studies.[39] Due to either high statistical heterogeneity (commonly I^2>50) or small number of trials to be pooled, restricted maximum likelihood method with the Knapp-Hartung correction was applied in meta-analyses.[40, 41] Crude effect estimates were calculated if between-group results were not reported and, we favored adjusted over unadjusted effect estimates. Within each study, we chose followup time point closest to 12 months. If there were multiple followup assessments, we favored 6 months over 18 months. We presented the results of other time points in tabular format. If a trial had more than one active intervention arm, we plotted the most intensive arm or the arm that was the most similar with other interventions included in the analysis (all denoted as intervention group 1 [IG1]).

Because we included different measures in the pooled analyses for continuous measures of physical activity, saturated fat, fiber, and sedentary, we pooled *standardized* mean differences in change between groups. We also conducted analyses limited to only studies that reported similar measures (e.g., minutes per week of physical activity, percent of energy from saturated fat) and found that the standardized pooled effects were very similar to analyses that included trials reporting other measures, indicating that confounding by measurement is minimal or absent.

We generated funnel plots to evaluate small-study effects (a possible indication of publication bias) and performed the Egger's (for continuous data) or Peters' test (for binary data) to assess the statistical significance of imbalance in study size as well as findings that suggest a pattern by study size.[42, 43] We also performed sensitivity analyses to examine whether the overall findings for each outcome were robust to influential age groups (i.e., removing studies limited to older adults), imputed standard deviations, and adjusting for clustering within cluster randomized trials. None of the results were sensitive to these modifications and are not discussed further.

We used visual displays and tables grouped and sorted by potentially important characteristics to investigate whether variability among the results was associated with any prespecified study, population, or intervention characteristics. Specifically, we examined study quality (good vs. fair), link to primary care (conducted in or recruited from primary care vs. not), conducted in USA or not, based on population selection/unselected for a demographic factor versus suboptimal behavior (e.g., sedentary, poor diet) versus other (e.g., obesity, family history), intervention focus (healthy diet only, physical activity only, healthy diet and physical activity), intervention intensity (as continuous in minutes; high vs. medium vs. low intensity), intervention duration (as continuous in weeks), number of intervention sessions, total in person contacts, and setting (e.g., remote only or print materials only). We used meta-regression and subgroup analyses to examine whether there were study, population, or intervention characteristics that were associated with effect size for systolic and diastolic blood pressure, LDL-C, fasting glucose, BMI, weight and physical activity.

We used Stata 16.1 (StataCorp LLC, College Station, TX). All significance testing was 2-sided, and results were considered statistically significant if the p-value was 0.05 or less.

Grading the Strength of the Body of Evidence

We graded the strength of the overall body of evidence for each KQ. We adapted the Evidence-based Practice Center approach,[44] which is based on a system developed by the Grading of Recommendations Assessment, Development, and Evaluation Working Group.[45] Our method explicitly addresses four of the five Evidence-based Practice Center-required domains: consistency (similarity of effect direction and size), precision (degree of certainty around an estimate), reporting bias (potential for bias related to publication, selective outcome reporting, or selective analysis reporting), and study quality (study limitations). We did not address the fifth required domain—directness—as it is implied in the structure of the KQs (i.e., whether the evidence links the interventions directly to a health outcome). We supplemented the four domains with the additional domain of dose-response association, given our *a priori* hypothesis that larger effects may be seen with greater intensity (or exposure) of interventions. Evidence of a dose-response association either across or within studies may warrant increasing the overall strength of evidence.

Consistency was rated as reasonably consistent, inconsistent, or not applicable (e.g., single study). Precision was rated as reasonably precise, imprecise, or not applicable (e.g., no evidence). The body of evidence limitations field highlights important restrictions in answering the overall KQ (e.g., suspected reporting bias, lack of replication of interventions, nonreporting of outcomes important to patients).

We graded the overall strength of evidence as high, moderate, low, or insufficient.[44] "High" indicates high confidence that the evidence reflects the true effect and that further research is very unlikely to change our confidence in the estimate of effect. "Moderate" suggests moderate confidence that the evidence reflects the true effect and that further research may change our confidence in the estimate of effect and may change the estimate. "Low" indicates low confidence that the evidence reflects the true effect and that further research is likely to change our confidence in the estimate of effect and is likely to change the estimate. A grade of "insufficient" indicates that evidence is either unavailable or does not permit estimate of an effect. We developed our overall strength of evidence grade based on consensus discussion involving at least two reviewers.

Expert Review and Public Comment

A draft research plan was posted on the USPSTF website for public comment from February 20, 2020 to March 18, 2020. The USPSTF received comments from 14 unique respondents which included voices from two federal partners (CDC and NIH), seven unique professional societies or advocacy organizations (American Geriatrics Society, American Heart Association, American Medical Association, American Psychological Association, National Center for Health Research, Physical Activity Alliance, and WW [formerly Weight Watchers]), and individual clinicians and citizens. No substantive changes were made to the research plan. Minor changes were made and clarifying text was added as appropriate. A final research plan was posted on the USPSTF website on June 4, 2020.

USPSTF Involvement

We worked with four USPSTF members at key points throughout this review, particularly when determining the scope and methods for this review and developing the Analytic Framework and KQs. After revisions reflecting the public comment period, the USPSTF members approved the final analytic framework, KQs, and inclusion and exclusion criteria. The Agency for Healthcare Research and Quality funded this review under a contract to support the work of the USPSTF. An Agency Medical Officer provided project oversight, reviewed the draft report, and assisted in the external review of the report.

Chapter 3. Results

Description of Included Studies

Our literature search yielded 7,485 unique citations. From these, we provisionally accepted 411 articles for review based on titles and abstracts (**Appendix A Figure 1**). After reviewing the full-text articles and performing critical appraisal, we included 113 studies[46-158] that were reported in 204 publications. **Appendix B** contains a full list of the 204 included articles. We carried forward 80 studies from the prior review; 33 new studies were added.

For the 411 articles that were reviewed in full, the most common reasons for exclusion were: relevant outcome (k=224), not an included study design (i.e., not an RCT; k=67), not a relevant study aim (k=31), or not an included population (i.e., studies were among adults at high risk for CVD, who had CVD, or who had other known chronic disease; k=28). **Appendix C** contains a list of all excluded trials and reasons for their exclusion.

Of the 113 included studies, 15 trials reported health outcomes (KQ 1) (e.g., CVD events, self-reported quality of life), 43 trials reported intermediate health outcomes (KQ 2) (e.g., lipid, blood pressure, and glucose levels; weight measures), and 109 trials reported behavioral outcomes (KQ 3) (objective or self-reported measures of diet, physical activity, or sedentary time). Twenty-three trials explicitly reported on harms (or the lack thereof) of a counseling intervention (KQ 4).

A summary of the study and population characteristics across all studies can be found in **Table 3**. Details of each included study, by author, can be found in **Appendix D Table 1**.

Study Characteristics

All the included studies were RCTs—20 were cluster RCTs with randomization occurring at the physician, clinic, health care center, town, or household level.[50-52, 55, 62, 72, 78, 85, 89, 96, 97, 103, 110, 128, 133, 134, 144, 146, 148, 157] The majority of the trials (60 trials) took place in the United States. The remaining trials were conducted in Europe (31 trials), Australia (11 trials), New Zealand (4 trials), Canada (5 trials), Puerto Rico (1 trial), and Japan (1trial). Samples sizes for the included trials ranged from 32 to 48,835 participants, and the median sample size was 314. We required that included trials report followup data at a minimum of 6-months; more than half of the trials (k=63) reported outcomes at 12 months or greater. Only six trials reported longer term outcomes at 3 or more years.[106, 136, 142, 155, 159, 160] Fewer than half of the studies were conducted within or recruited participants from primary care or the broader health care system (51 trials). The remaining studies recruited community volunteers through mass media, targeted recruitment, or larger population-based cohorts (e.g., registered voters, research cohorts).

Included Populations

Trials included a wide range of populations in terms of age, sociodemographic features, and clinical characteristics. The mean age of the samples ranged from 18.5 to 79.5 years (interquartile range, 39.7 to 55.4 years). Fifteen trials specifically targeted adults age 60 years or older; the mean age in those trials ranged from 65.8 to 79.5 years.[54, 79, 80, 83, 99, 100, 103, 108, 115, 132, 139, 141, 145, 148, 150] Most of the studies (73 trials) included both men and women, but one study was limited to men only (specifically Hispanic men)[161] and 26 studies were limited to women only.[46, 48, 56-58, 61, 62, 64, 65, 69, 73, 77, 86, 91, 95, 117, 120, 121, 127, 130, 136, 137, 140, 142, 144, 149] Most of the studies limited to women were further restricted to specific racial/ethnic subgroups (e.g., American Indian,[140] Chinese,[56] Hispanic,[46, 48, 61, 121, 130] Black[77]), age groups (college age),[144, 149] to women with postpartum status[136, 142] and to women who were mothers of young children.[48, 56, 73, 91] Among the 69 studies that reported the race/ethnicity of the sample, in only 17 of these studies was more than two thirds of the sample nonwhite. This included 13 trials that were limited to racial or ethnic minority groups including: Hispanic (8 trials), Black (1 trial), South Asian (1 trial), Chinese (1 trial), American Indian (1 trial) and immigrant Hispanic, Somali, and Sudanese families (1 trial). For studies that reported the education level of participants, the proportion of participants with more than a high school education (i.e., some college, vocational or technical school, or more) ranged considerably from 12.6 to 100 percent.

Among the 113 trials, 46 studies limited inclusion to persons with suboptimal levels of physical activity (e.g., <150 minutes of moderate- to vigorous-intensity physical activity per week), inadequate dietary habits (e.g., suboptimal intake of fruits, vegetables, red and processed meats, whole-fat dairy foods, or whole grains), or both. Fourteen of the 113 trials were specifically among persons at higher risk for CVD (but without levels of traditional CVD risk factors reaching diagnostic thresholds), including those with a family history of type 2 diabetes[81, 114, 143] or CVD;[126] women who were overweight or had obesity and a history of gestational diabetes[137]; and those who were overweight or had obesity.[46, 49, 52, 56, 57, 77, 94, 108, 153]

In the remaining 53 studies, participants represented a general, unselected population (i.e., were not selected based on baseline behavior, cardiovascular risk, or specific sociodemographic group). While we excluded trials conducted exclusively among persons with elevated blood pressure, dyslipidemia, or impaired fasting glucose, a few of the studies reported and included some participants with hypertension (2.8% to 70.7% of participants), dyslipidemia (11.3% to 33.8%), impaired fasting glucose (13.0% to 21.0%), or diabetes (4.2% to 27.8%). Of the 79 studies that reported baseline mean body mass index (BMI), the range was 22.4 to 38.3 kg/m^2 (mean, 27.8 kg/m^2). The mean BMI was in the overweight range (25.0 to 29.9 kg/m^2) in nearly half of the studies (k=54) and in the obese range (≥30 kg/m^2) in 18 studies. The proportion of current smokers included in the studies ranged from 1.9 to 39.1 percent in the few studies that reported it.

Included Interventions

Within the 113 trials there were 157 distinct intervention arms included (some trials included more than one active intervention arm). A summary of the interventions can be found in **Table 4**. Detailed intervention characteristics for each trial can be found in **Appendix E Tables 1, 2 and 3.** Fifty-one intervention groups (32.5%) focused on both healthy diet and physical activity, 30 groups (19.1%) focused on healthy diet only, and 76 groups (48.1%) focused on physical activity. Most of the newly added trials (published from 2016 to the present) focused on improving diet and physical activity (14 of 33 new trials) or just physical activity (14 of 33 new trials). Only five of the new trials focused on improving diet alone.

The mode of delivery of the interventions was highly variable. Most of the interventions (83/157, 52.9%), included at least one face-to-face counseling session with an interventionist, either individually or in groups. There were typically 5 sessions or fewer (median: 2, range 1-39), with individual sessions taking approximately 30–60 minutes per session and group sessions lasting 60-120 minutes per session on average. Many of the in-person counseling interventions also included booster telephone calls, emails, or text messages.

Another substantial proportion of the interventions (67/157 groups, 42.7%) were delivered completely remotely—either through technology only (i.e., web-, computer-, or text message-based) (24 groups in 14 trials), mailed print materials only (24 intervention groups in 16 trials), telephone calls only (four intervention groups in four trials), or a combination of print materials, telephone calls, and/or web-based activities (16 groups in 15 trials). Six additional interventions (in three trials, 6/157, 3.8%) took place in-person and had participants complete computer-based sessions in a computer lab or research setting but included no face-to-face counseling with an interventionist.

We estimated the "intensity" of the included interventions based on the number of contacts and contact time with an interventionist (in person or over the phone) or during interactive technology-based sessions. Thirty-one (19.8%) of the interventions offered high-contact interventions—that is, over 6 hours of contact time over the course of the full intervention. Seventy-nine (50.3%) offered medium-contact interventions, or an estimated 31 minutes to 6 hours of contact, and 47 (29.9%) were low-contact interventions with 30 minutes of less of contact. The median (interquartile range [IQR]) number of contacts was 7 (3 to 16). The duration of the interventions ranged from 1 day to 8.5 years, with most interventions taking place for 6 months or less (median, 6 months [IQR, 3 to 12 months]).

Figure 2 shows the distribution of intervention groups by contact time and by intervention focus. Most of the interventions that included messages about both healthy diet *and* physical activity were considered to have high- or medium-contact (41 out of 51 groups), whereas the physical activity only interventions were rarely high intensity (i.e., over 6 hours of contact time). Interventions that included counseling on healthy diet only were evenly distributed in terms of the amount of total intervention time.

The interventionists varied among the studies and included health educators, health coaches, behavioral health specialists, exercise specialists, nutritionists, registered dieticians, and study staff trained in behavior change and lifestyle coaching. Very few interventions (17/157, 10.8%) involved primary care clinicians in delivering all or part of the intervention.[50, 54, 72, 76, 78, 89, 93, 94, 96-98, 103, 108, 110, 126, 128, 132, 135, 148] Two of the interventions specifically focused on training primary care physicians on how to counsel patients on healthy lifestyle topics.[110, 148] Community health workers or *promotoras* were the primary interventionist in four trials that included group sessions or home visits.[46, 48, 140, 152]

Similar messages were used across all the interventions (**Appendix E Table 2 and Table 3**). Diet messages typically focused on general heart-healthy eating patterns, including increased fruit and vegetable intake (specifically 5 to 9 servings/day), decreased fat consumption and salt intake, and increased fiber consumption; fewer mentioned specific messages about increasing intake of whole grains, reducing consumption of red and processed meats, or decreasing intake of sugar-sweetened beverages. The largest trial, the Women's Health Initiative Dietary Modification Trial (WHI-DMT) (n=48,835), delivered one of the most intense interventions consisting of 18 group sessions in the first year followed by quarterly sessions over a median of 8.5 years, and focused on a 20-percent low-fat dietary pattern with goals of 5 or more daily servings of fruits and vegetables and 6 or more daily servings of grains.[142]

Physical activity messages emphasized gradually increasing aerobic activities to recommended levels (i.e., 150 minutes of moderate-intensity physical activity per week), with many interventions emphasizing walking. Eight trials included specific messages about decreasing sedentary behavior (e.g., reducing television viewing, substituting sitting with standing).[54-56, 59, 66, 71, 87, 151] Nine trials focused on weight gain prevention or included intervention strategies designed to help those who were overweight to lose weight.[56, 57, 62, 65, 68, 77, 133, 154, 155]

Many interventions provided educational counseling related to reading food labels; planning, purchasing, and preparing foods and meals; finding local physical activity opportunities; and overcoming barriers related to desired behavior changes. Optional activities included group exercise classes, free memberships to community exercise facilities, weight loss materials or courses, grocery shopping trips with a dietitian, and cooking demonstrations. Additionally, many interventions included tangible tools to facilitate behavior change, such as pedometers and diaries or apps for self-monitoring. Almost all the interventions distributed print materials to participants; some materials were standard educational information only, while others were tailored with normative or motivational feedback.

Of those trials that reported the theoretical basis of the intervention, the majority were based on principles of the transtheoretical model (i.e., stages of change), social cognitive theory, or both (**Appendix E Table 3**). As such, most interventions included behavior change techniques focused on the broad areas of goals and planning, monitoring and feedback (e.g., using food logs, dietary analysis with feedback, pedometers, activity logs, and web-based applications), increasing efficacy and motivation for healthy eating or physical activity, improving social support, and general education and advice regarding the benefits of specific behavioral changes. Seventeen trials (20 intervention arms) specifically mentioned using principles of motivational interviewing[47, 49, 60, 62, 67, 71, 73, 75, 77, 108, 110, 111, 115, 145, 152, 156, 158] and six trials based their counseling, at least in part, on the "5 A's" model (assess, advise, agree, assist, and arrange).[72, 90, 96, 107, 108, 126]

Intervention Fidelity and Participant Adherence

Adherence to the interventions was variable and reporting of adherence was very heterogeneous (**Appendix E Table 2**). Overall, however, the rates of participation appeared generally high, particularly for those with less total contact time. In most cases, typically more than 80 percent of participants reported reading most of the print materials provided, taking part in all or most face-to-face individual counseling sessions, or participating in most or all planned counseling telephone calls or web-based activities. There did not appear to be any differences in the level of adherence between the healthy diet and physical activity versus healthy diet-only or physical activity-only interventions. Adherence to the interventions with higher contact time or longer duration, especially the group-based interventions, was slightly lower than adherence to those with less planned contact.

Control Arms

Within the 113 trials, nearly half of them (55/113, 48.7%) used a no-intervention (18 trials), waitlist (16 trials), or usual care (21 trials) control group. Usual care was typically described as "routine" or "standard" care that included standard heart healthy prevention messages, generic print materials, or was otherwise not described. One new trial acknowledged a community-wide campaign focused on heart health that was occurring during the trial which both intervention and control groups could have been exposed to.[152] The remaining studies had a minimal intervention (34 trials) or attention control (24 trials) comparator.

Minimal intervention groups were variable, including generic print materials or standard internet resources regarding the benefits of healthy diet and/or physical activity, non-personalized in-person or web-based educational sessions, and tailored or self-help programs. A few of the minimal intervention groups provided participants with pedometers or tailored walking maps and encouraged self-monitoring of activity. In all cases, minimal intervention control groups were less intensive than interventions categorized as low contact interventions. The attention control groups usually followed the same intervention schedule as the study's intervention group but focused on a different health topic (e.g., stress management, general health and wellness, women's health). By design, we excluded trials with control groups where participants were specifically asked not to change their diet or physical activity habits.

Study Quality

We rated 23 of the 113 trials as good-quality and the remaining 90 as fair-quality. Twenty trials were excluded for poor quality (**Appendix C**). Common threats to internal validity of these poor-quality studies included very high attrition (generally >40%), with differential attrition between intervention arms (>20%); lack of baseline comparability between groups without adjustment; and issues in trial conduct, analysis, or reporting of results (e.g., possible selective reporting, inappropriate exclusion of participants from analyses, questionable validity of randomization and allocation concealment procedures). In general, the 23 trials rated as good-quality were characterized by appropriate randomization procedures; comparable groups at baseline (or adequate adjustment for known baseline differences in the analysis); high followup rate (i.e., ≥85% retention at 6 months); the use of reliable and valid measurement instruments applied equally across arms and blinding of outcome assessors for nonobjective measures; well-described interventions with high implementation fidelity; no evidence of selective reporting; and appropriate analyses, including intention-to-treat principles using multiple imputation or other conservative data imputation procedures for missing data. Some common limitations of the fair-quality studies included lack of reporting details about allocation concealment, small differences in baseline characteristics between treatment arms, no or unclear blinding for outcomes assessment (particularly for interviewer-administered questionnaires), relatively higher attrition (i.e., >20%) and differential attrition between groups, and no attempt (or lack of reporting) to account for missing data.

KQ 1. Do Primary Care Behavioral Counseling Interventions to Improve Diet, Increase Physical Activity, and/or Reduce Sedentary Behavior Improve Health Outcomes in Adults?

Summary of Results

Fifteen of the 113 included trials reported health outcomes (15/113, 13.3%; n=58,286). Six of these trials were identified as part of this update. Three trials reported all-cause or CVD related mortality, as well as CVD events such as myocardial infarction (MI) or stroke. The three trials included the very large Women's Health Initiative Dietary Modification Trial (WHI-DMT) that tested the effects of a high-intensity low-fat dietary group counseling intervention among postmenopausal women (n=47,179 without a history of CVD)[142] and the PACE-UP and PACE-Lift physical activity trials by Harris and colleagues (n=1,203 participants without a previous CVD diagnosis).[50, 103] Overall, few deaths and nonfatal events were reported across the three trials, and few differences were observed between treatment and control groups over 1 to 13 years of followup. When data from both the PACE-UP and PACE-Lift trials were combined, a statistically significant intervention effect was seen for both nonfatal CVD events as well as nonfatal plus fatal CVD events.

Fifteen trials reported health-related quality of life outcomes, including eleven trials of physical activity interventions, three trials of mixed interventions that included both healthy diet and physical activity or sedentary behavior components, and the WHI dietary modification study. The included trials used a variety of measures to assess quality of life including the 12 or 36-item Short-Form Health Survey (SF-12; SF-36), the EuroQol-5 Dimensions or Visual Analogue Scales (EQ-5D; EQ-VAS), the World Health Organization Well-being Index (WHO-5), or study-developed measures. Few studies demonstrated statistically significant, nor clinically significant, changes in quality of life as a result of these interventions.

Detailed Results by Outcome

CVD and Mortality

Three good-quality trials (n=48,382) (with relevant results in 7 publications) reported CVD-related health outcomes.[50, 103, 142, 160, 162-164] Only one trial was newly identified for this update;[50] longer-term data was published for both of the other trials in 2019 and is included in this summary.[160, 162] All three trials reported health outcomes among subsamples of participants without a history of CVD at enrollment, which is reported here. Overall, these trials reported relatively low event rates that in some cases suggested potential benefit of lifestyle interventions, with followup of up of 4 or 13.4 years (**Appendix F Table 1**).

In the WHI-DMT, postmenopausal women aged 50–79 years (mean=62.3 years) were randomized to either a very intense dietary counseling intervention – consisting of up to 8.5 years of group counseling—or a minimal intervention regarding healthy dietary habits.[142] The trial included 47,179 women without a history of CVD (96.6% of the full sample). Intervention goals were to reduce fat intake from ∼35% to 20% of total energy, in conjunction with increasing vegetables and fruit to 5 servings/day and grains to 6 servings/day—goals which were achieved.

Total mortality was not statistically significantly different between intervention and control groups over a median cumulative followup of 8.5 years (hazard ratio [HR], 0.96 [95% CI, 0.88 to 1.04]) or 13.4 years (HR, 0.97 [95% CI, 0.94 to 1.01]) (**Appendix F Table 1**).[162] Likewise, time-to-event analyses did not show significant differences between intervention and comparison groups for coronary heart disease (CHD, defined as nonfatal myocardial infarction plus CHD death), total stroke (ischemic plus hemorrhagic stroke), or total CVD events (CHD plus coronary artery bypass graft or percutaneous coronary intervention plus stroke), either over the intervention period (8.5 years) or over longer followup (13.4 years). The restriction to this baseline cohort of those without a history of CHD yielded results that were consistent with those for the full sample. In an analysis stratified by whether participants without prior CVD were normotensive (54%) or who had hypertension (46%) at enrollment, a significant reduction in CHD incidence occurred among baseline normotensive participants (HR, 0.70 [95% CI, 0.56 to 0.87]) whereas there was no evidence for an intervention effect among participants with hypertension at baseline, with a highly significant contrast between the two at both the end of the intervention period (p=0.003) and the full followup (p=0.003).[162] This CHD benefit in healthy normotensive women was partially offset by an increase in stroke incidence (HR, 1.29 [95% CI, 1.00 to 1.66]), and more specifically, ischemic stroke incidence.[164] There was some evidence of greater HR reductions among women who were classified as having obesity at baseline (38.2%), however these analyses were exploratory and all tests of interaction were not significant.[162]

The two other trials that reported health outcomes evaluated three different 12-week primary care pedometer-based walking interventions among adults (PACE-UP, n=1,023, age range, 45–75 years)[50] and older adults (PACE-Lift, n=298, age range, 60–75 years),[103] in the United Kingdom. The trials were similar in their recruitment of participants and intervention delivery, incorporating similar behavior change techniques and baseline characteristics (besides age and socioeconomic status [SES]) were similar within each trial. Both trials showed similar effects on changes in physical activity at up to 3 and 4 years of followup (i.e., ~30 minutes more of physical activity per week among intervention vs. control participants).[159] Primary care data related to long-term health outcomes (at 1 year [end of the initial trial followup] and 4 years) was downloaded directly from the primary care practices that were randomized. Analyses related to CVD outcomes were recorded for those with and without preexisting CVD. Overall, 85 percent of PACE-UP and 69 percent of PACE-Lift participants had 4 years of complete data.[160]

Within both studies, event rates were low (≤10 per group) for all outcomes at 1 and 4 years (**Appendix F Table 1**).[160] For nonfatal CVD events (MI, coronary artery bypass graft, angioplasty, transient ischemic attack, and stroke), in both trials, the proportion of events was lower in the intervention than in the control group at 4 years. When trial data were combined, there was a statistically significant intervention effect for nonfatal CVD events (HR, 0.27 [95% CI, 0.08 to 0.88], p=0.03). When fatal cardiovascular events were included and trial data were combined, results were similar (HR, 0.31 [95% CI, 0.11 to 0.93], p=0.04).[160] The authors reported a number needed to treat (NNT) to show benefit from the intervention at 4 years, among those with no previous cardiac diagnosis, of 62 (95% CI, 50 to 386) (absolute risk reduction

[ARR], 1.6 [95% CI, 0.3 to 2.0]) for nonfatal cardiovascular events and an NNT of 60 (95% CI, 46 to 562), ARR, 1.7 [95% CI, 0.2 to 2.2]) for total fatal and nonfatal CV events.[160]

Quality of Life

Fifteen fair- to good-quality trials (n=58,286) reported the effect of a healthy diet and/or physical activity intervention on quality of life, ten of which focused on physical activity only (**Appendix F Table 2**).[49, 50, 55, 69, 89, 97, 100, 103, 114, 115, 128, 145, 151, 157, 165] Five trials were newly identified for this updated review.[49, 50, 55, 69, 151] The SF-36 was used to measure quality of life in seven of the 14 trials;[89, 97, 100, 114, 115, 128, 165] the SF-12,[69] EQ-5D,[50, 103, 157] EQ-VAS,[151] WHO-5,[49] or study developed measures[55, 145] were used in the remaining seven trials. For studies reporting results based on the SF-12 or SF-36, only those reporting results for the mental and physical component scores are included in the table. Six additional studies reported only individual subscales of the SF-36 and are not included in the table.[89, 100, 114, 115, 128, 165]

While many studies showed trends toward improved quality of life, few studies demonstrated statistically significant differences between intervention and control groups (**Appendix F Table 2)**. In most cases, very small improvements (e.g., less than a 1-point improvement on the SF-36 score) were seen in both intervention and control groups. Of the trials not included in the table, three trials reported statistically significant differences between groups on some, but not all subscales. One study reported that SF-36 measures of self-rated “general health,” “role physical,” “vitality,” and “bodily pain” improved significantly in the intervention group compared to the usual care group ($p < .05$).[89] Likewise, another small trial reported small to moderate effect sizes ranging from 0.20 to 0.51 on several subscales of the SF-36, with intervention participants scoring better on six of the eight subscales.[114] The WHI-DMT found that at 1 year women in the dietary modification group had small improvements on all of the subscales while women in the control group declined or stayed the same. These differences were statistically significant ($p<0.001$) for all of the scales except social functioning, depression symptoms, and role-emotional health.[165] The remaining three studies reported either no differences between groups on SF-36 scores[115, 128] or significant worsening of SF-36 scores in both groups.[100]

KQ 2. Do Primary Care Behavioral Counseling Interventions to Improve Diet, Increase Physical Activity, and/or Reduce Sedentary Behavior Improve Intermediate Outcomes Associated With CVD in Adults?

Summary of Results

Forty-three of the included trials (43/113, 38.1%; n=77,965) reported the effects of a behavioral intervention on at least one intermediate outcome at 6 months or more followup (**Table 3**). Fifteen of the 43 trials were newly identified as part of this update; the remaining 29 were included in our original review. Most of these 43 studies were of medium- or high-intensity interventions and focused on healthy diet, with or without physical activity components.

When results of these trials were pooled in meta-analyses, healthy diet and/or physical activity interventions were associated with small but statistically significant improvements in blood pressure, low-density lipoprotein (LDL) cholesterol, and all measures of adiposity compared with controls at 6 months or more (**Table 5**). Average intervention effects were between-group differences in mean change (MDs) of -0.80 mm Hg (95% CI, -1.30 to -0.31) for systolic blood pressure (SBP), -0.42 mm Hg (95% CI, -0.80 to -0.04) for diastolic blood pressure (DBP), -2.20 mg/dL (95% CI, -3.80 to -0.60) for LDL cholesterol—all in favor of intervention versus control arms. For adiposity outcomes, interventions were associated with improvements in BMI (MD, -0.32 kg/m^2 [95% CI, -0.51 to -0.13]), weight (MD, -1.07 kg [95% CI, -1.62 to -0.52]), and waist circumference (MD, -0.81cm [95% CI, -1.32 to -0.30]), although there was considerable statistical heterogeneity in these analyses, so the average effect sizes should be interpreted with caution. There was no evidence of an association between healthy diet and/or physical activity counseling and total cholesterol levels, high-density lipoprotein (HDL) cholesterol, or fasting glucose, though the direction of effects generally favored the intervention.

Among the intermediate outcomes showing a statistically significant positive association, dose-response effects were evident, with increasing intervention intensity associated with larger differences between groups in intermediate outcomes. High-intensity interventions (i.e., ≥6 hours of contact) were consistently associated with statistically significant benefit on intermediate outcomes, and the effect sizes were slightly higher in analyses limited to the subset of high-intensity interventions compared with the results of combining trials of all level of intensity.

Based on the Egger's test[42] and visual inspection of funnel plots, we found no evidence of small-study effects (an indicator of publication bias) for any of the intermediate outcomes.

Detailed Results by Outcome

Blood Pressure

Twenty-four of the 113 included trials (21.2%) (n=66,249) reported the effects of interventions on a measure of blood pressure (**Appendix G Table 1**).[46, 52, 55, 65, 66, 74, 77, 86, 89, 97, 101, 104, 107, 108, 114, 117, 126, 133, 135, 136, 140-142, 151] By review design, trials that were limited to those with elevated blood pressure were excluded. The weighted mean blood pressure of participants across included studies was 124/76 mm Hg.

Individually, very few of the trials found statistically significant differences in changes in SBP or DBP between intervention and control groups. However, the pooled average difference between groups in blood pressure reductions showed statistically significant associations with mean differences of -0.80 mm Hg for SBP (95% CI, -1.30 to -0.31; 23 trials [n=57,079]; I^2=11.3%) (**Figure 3**) and -0.42 mm Hg for DBP (95% CI, -0.80 to -0.04; 24 trials [n=57,148]; I^2=35.8%) (**Figure 4**), respectively, at 6 to 18 months compared with controls (**Table 5**).

Results of meta-regressions and subgroup analyses based on various study, population, and intervention characteristics showed that there were consistent intervention effects on SBP and DBP regardless of these varying characteristics. The largest between-group differences were seen for the 11 interventions with the highest intervention contact (MD for SBP, -1.05 [95% CI, -

1.90 to -0.21] [**Figure 3**] and MD for DBP, -0.63 [95% CI, -0.76 to -0.50] [**Figure 4**]); however, the tests of subgroup differences (testing the differences between high-intensity vs. medium- or low-intensity interventions) were not statistically significant. Furthermore, meta-regression exploring the relationship between continuous measures of intervention contact (total minutes of intervention contact, minutes of in-person contact, and intervention duration) were not statistically significant. The other variables that were tested and found not be associated with effect size were: study quality (good vs. fair), country (US vs. other), primary care involvement (linked to primary care vs. not), population selection (unselected, suboptimal behavior, or other), intervention target (diet and physical activity, diet only, or physical activity only), and intervention delivery (remote only vs. not, and print only vs. not).

Exploratory sensitivity analyses removing the largest and most intense intervention—the WHI DMT among postmenopausal women (n=42,299)—resulted in mixed effects for SBP and DBP. That is, for SBP, the total variation in the effects due to heterogeneity (I^2) increased (from 11% to 22%) and slightly increased the effect estimate (MD, -0.90 [95% CI, -1.60 to -0.20]; n=14,780) whereas the heterogeneity decreased in the pooled analysis for DBP (from 36% to 26%) and resulted in a difference in mean change that was no longer statistically significant (MD, -0.38 [95% CI -0.82 to 0.06]; n=14,854).

There was no consistent pattern in the effects of the interventions on blood pressure over time. Six studies reported additional measures of SBP and DBP after 12 months of followup.[52, 77, 117, 136, 140, 142] Mean between-group reductions in blood pressure remained consistent (and not statistically significant) in four of the trials after 1 to 1.5 years,[52, 77, 117, 140] whereas they attenuated and lost significance in two other long-term trials of 1.5[136] and 6 years.[142]

Only three trials reported the prevalence or incidence of hypertension in addition to continuous measures of blood pressure.[66, 74, 142] Two of the trials found no appreciable differences between the percent of participants with elevated or high blood pressure at 6 or 12 months.[66, 74] In the WHI-DMT, women in the intervention group had a 4 percent lower overall risk of developing incident hypertension than women in the control group (HR, 0.96 [95% CI, 0.93 to 0.99]) over 8 years of followup.[142]

Lipids

Twenty-one trials (21/113, 18.6%; n=12,026) reported at least one lipid measure, including LDL, total, or HDL cholesterol levels (**Appendix G Table 2**).[46, 52, 65, 71, 74, 76, 77, 81, 89, 97, 101, 104, 107, 108, 114, 117, 126, 133, 136, 140, 141] Within the individual trials, very few found statistically significant differences in the mean change over time for any lipid outcome and the small sample sizes of each trial (most had n<350) resulted in wide confidence intervals. Baseline levels of cholesterol were generally optimal or near optimal among these samples: mean LDL and total cholesterol levels were 115 and 197 mg/dL, respectively.

All 21 trials were included in at least one meta-analysis of lipid outcomes. For LDL cholesterol, meta-analysis of 15 trials resulted in a statistically significant difference in mean change of -2.20 mg/dL (approximately 0.057 mmol/L) at 6 to 18 months of followup (95% CI, -3.80 to -0.60; n=6,350; I^2=25.7%) (**Figure 5**). When stratified by intervention intensity, this decrease was significant only among the eight high-intensity interventions, with an average effect of -3.88 mg/dL (95% CI, -6.15 to -1.61); results from meta-regression confirmed a statistically significant dose-response effect with more benefit seen as intensity increased (p=0.014). Similarly, a dose-response effect was seen with greater effect sizes associated with increasing duration of the intervention (p=0.002), the number of total intervention sessions (p=0.027), and the number of in-person sessions (p=0.003). The effect of the interventions on LDL was not associated with any other study or population characteristic that was explored.

There was no evidence of an association between healthy diet and/or physical activity interventions and levels of total cholesterol (**Figure 6)** or HDL cholesterol (**Figure 7**) in pooled analyses. Mean between-group differences in change in total cholesterol levels were inconsistent across trials, ranging from absolute differences of 14.7 mg/dL in favor of the intervention groups to 14.7 mg/dL in favor of the control group at 6 months to 2 years of followup.

Only five trials reported effect of the interventions on lipid outcomes beyond 12 months of followup.[52, 77, 104, 136, 140] In all cases, the difference between groups attenuated over time. None of the trials reported the between-group difference in the proportion of participants with high cholesterol after the intervention.

Fasting Glucose Level

Eighteen trials (18/113, 15.9%; n=60,269) reported the effect of a counseling intervention on one or more indicators of diabetes, including fasting blood glucose level, hemoglobin A1c (HbA1c) level, and incident diabetes (**Appendix G Table 3**).[46, 52, 65, 66, 71, 74, 77, 81, 86, 97, 108, 114, 117, 126, 136, 140-142] There were inconsistent results across studies that reported MDs in changes in fasting glucose, and with a few exceptions,[114, 136] none of the individual trials reported statistically significant differences in changes in fasting glucose at 6 months or more followup. Furthermore, our meta-analysis of 14 trials found no evidence of an association between interventions and changes in fasting glucose versus control groups at 6 to 12 months (MD, -0.34 mg/dL [0.02 mmol/L] [95% CI, -1.24 to 0.55]; n=7,468; I^2=42.7%) (**Table 5, Figure 8**).

The largest changes in fasting glucose level were seen in a small trial of adults with a family history of type 2 diabetes.[81] Participants randomized to a high-intensity counseling intervention focused on healthy diet plus physical activity (n=24) or to a high-intensity healthy diet-only intervention (n=25) experienced larger reductions in fasting glucose levels at 12 months than the minimal intervention group (n=19) (reductions of -7.7, -5.9, and -3.8 mg/dL, respectively). However, there were no statistically significant differences between groups.

Six of these trials also reported the effects of the interventions on HbA1c (not pooled). Results were similarly inconsistent as with the fasting blood glucose results, with only one trial among older adults who were overweight suggesting a benefit of the intervention on HbA1c level (MD, -0.25 mg/dL [95% CI, -0.37 to -0.12]) (**Appendix G Table 3**).[108]

Only three trials reported the prevalence or incidence of diabetes.[66, 74, 142] In one trial (n=348), the proportion of participants with diabetes (defined as fasting glucose ≥126 mg/dL) decreased from 12.1 to 9.8 percent in the intervention group (p<0.0001) and increased slightly (from 4.0% to

5.2%) in the control group at 6 months (odds ratio [OR], 1.99 [95% CI, 0.86 to 4.58]).[74] In another relatively small trial (n=337), the percent of self-reported diabetes increased approximately 1 percentage point among both intervention (12.4% to 13.4%) and control (11.5% to 12.7%) group participants after one year (OR, 1.06 [95% CI 0.56 to 2.00]). [66] In the very large WHI-DMT, focused on low-fat dietary patterns, 7.1 versus 7.4 percent of intervention and control participants, respectively, reported incident diabetes after 8 years of followup (HR, 0.96 [95% CI, 0.90 to 1.03]).[142]

Adiposity

Thirty-eight trials (38/113, 33.6%; n=76,501) reported an adiposity-related outcome, such as BMI, weight, or waist circumference (**Appendix G Table 4**).[46, 50, 52, 55, 56, 58, 62, 65, 68, 71, 74, 77, 81, 82, 86, 89, 97, 104, 106-109, 111, 114, 116, 117, 126, 133, 135, 136, 140-142, 144, 149, 151, 155, 157] Given the number of trials that reported each outcome, we were able to pool the results for BMI, weight, and waist circumference separately. Although we excluded trials that addressed weight loss as a direct goal of the interventions, these trials reported small improvements in BMI, weight, and waist circumference (**Table 5**). The results of each meta-analysis showed small but statistically significant associations between healthy diet and/or physical activity interventions and reductions in BMI, weight, and waist circumference at approximately 6 to 12 months (**Figures 9-11**). Considerable statistical heterogeneity (I^2>90%) was present in all analyses due to wide variation in effect estimates and precision around those estimates, which likely reflects clinical variability among the included studies. Thus, the pooled average intervention effects should be interpreted with caution.

Seventeen trials presented both BMI and weight outcomes and were included in meta-analyses for each of these outcomes.[46, 52, 65, 74, 77, 81, 86, 104, 108, 109, 111, 114, 133, 136, 142, 151, 157] Ten additional studies were unique to the BMI plot and seven studies were unique to the weight plot. Thus, these two outcomes represent slightly different sets of trials. The meta-analysis of BMI measures showed a pooled difference in mean change of -0.32 kg/m^2 (95% CI, -0.51 to -0.13; 27 trials [n=59,239]; I^2=94.6%) related to healthy diet and physical activity interventions (**Figure 9**). The range in between-group differences in change in BMI was 0.7 kg/m^2 in favor of the control group and 1.3 kg/m^2 in favor of the intervention group, although most trials suggested intervention benefit. Three trials reported large, nearly statistically significant effects in an unexpected direction (i.e., favoring the control group).[65, 82, 114] There was minimal difference in the pooled result in a sensitivity analysis removing data from the WHI DMT (pooled result of sensitivity analysis, MD, -0.30 [95% CI, -0.50 to -0.11]; 26 trials [n=17,236]; I^2=92.1%).

The subset of 12 high-intensity interventions consistently showed benefit of the interventions on BMI, with a pooled difference in mean change of -0.69 kg/m^2 supporting the intervention (95% CI, -0.99 to -0.40); no such benefit was seen among the subsets of medium- or low-intensity interventions (**Figure 9**). Furthermore, a dose-response effect was seen, with increasing intensity (that is, total minutes of intervention contact) and the total number of in-person intervention sessions being statistically significantly associated with increasing effect estimates in meta-regression ($p<0.01$). Most of the studies categorized as high-intensity also focused on both healthy diet and physical activity messages and took place outside of primary care.

A separate meta-analysis showed a statistically significant association with weight in favor of behavioral interventions over control conditions, although again the statistical heterogeneity was considerable (MD, -1.07 kg [95% CI, -1.62 to -0.52]; 24 trials (n=51,812); I^2=91.2%) (**Figure 10**). This finding translates into an MD of -2.4 lbs (95% CI, -3.6 to -1.1). The dose-response effect of intervention intensity (p=0.001) and number of in-person contacts (p=0.013) with weight was also evident. The difference in mean change was minimally reduced after removing data from the WHI DMT (MD, -1.02 [95% CI, -1.58 to -0.45]; 23 trials [n=9,809]; I^2=86.2%).

Eight trials reported adiposity outcomes over time; consistent or slightly attenuated effects were seen for BMI or weight outcomes from 6 months to 6 years of followup across trials.[46, 52, 55, 77, 104, 136, 140, 142]

There was no trend in the effect estimates for BMI or weight according to the samples' mean BMI or weight at baseline. For example, while one of the largest differences in BMI reduction was seen among the sample with the highest BMI at baseline—the Aldana study,[74] in which the mean baseline BMI was 32.3 kg/m^2 and the difference in change was -1.3 kg/m^2 at 6 months—relatively large differences were also seen among samples with a mean BMI reflecting normal or borderline overweight status (e.g., studies by Brekke,[81] Simkin-Silverman[136]). Across adiposity outcomes, five trials required participants to be overweight or have obesity upon study entry (mean BMI range, 25.0 to 38.3).[52, 56, 68, 77, 108]

Five trials could not be included in the meta-analyses for BMI[58, 68, 149] or weight[116, 140] because of limitations in data reporting (e.g., no measure of dispersion). Results of these trials were mixed, with two trials generally showing no change in adiposity within or between groups,[58, 140] two trials showing a difference in mean weight change in favor of the intervention versus control group but no estimate of the confidence in the effect,[68, 116] and one trial showing a slightly better improvement in BMI among control group participants (-1.3 kg/m^2) versus those participating in a web-based intervention (-0.6 kg/m^2).[149]

Twenty-four studies (all of which also reported BMI or weight outcomes) presented a measure of waist circumference at 6 months to 2 years of followup. Pooled analyses suggested a reduction of approximately -0.81 cm (0.3 in) in waist circumference related to a diet and/or physical activity intervention (95% CI, -1.32 to -0.30; 23 trials [n=52,128]; I^2=96.1%) (**Figure 11**). Mean baseline waist circumference ranged considerably, from 72 cm in a sample of young adults (mean age, 19.7 years)[104] to 105 cm among samples of older adults.[108, 141]

Cardiovascular Risk

Six trials used the Framingham risk equation[166] to report the effects of a diet or physical activity intervention on multivariate cardiovascular risk status (n=7,087).[47, 52, 66, 89, 97, 126] The results for this outcome were consistent with the results of other intermediate outcomes reported by each respective trial. Most trials reported reductions in 4- or 10-year risk of coronary heart disease among both intervention and control group participants at 6 to 18 months, with no statistically significant differences between groups.

Cardiorespiratory Fitness

Measures of cardiorespiratory fitness were only reported in eight trials (n=5,628).[65, 82, 97, 104, 114, 122, 140, 157] Five interventions focused on increasing physical activity only, while two focused on improving both physical activity and diet and one focused on diet only. Most of the studies reported maximal oxygen capacity (VO_2max) at baseline and followup (6 months up to 2 years) based on maximal or submaximal treadmill or cycle ergometer tests. Most studies reported that mean VO_2max improved slightly more in the intervention groups (from 0.1 to 1.8 mL/kg/min) than control groups (from 0.01 to 1.3 mL/kg/min), although these differences were not statistically significant. In one study among women,[140] there was a slight improvement in cardiorespiratory fitness in the control group but not the intervention group at 6 months, 12 months, or 1.5 years, although this difference was reported as not statistically significant.

KQ 3. Do Primary Care Behavioral Counseling Interventions to Improve Diet, Increase Physical Activity, and/or Reduce Sedentary Behavior Improve Associated Health Behaviors in Adults?

Summary of Results

All but four[47, 68, 144, 155] of the 113 included trials were included for KQ 3 (109/113, 96.5%; n=125,878). A quarter of the trials that reported behavioral outcomes 30 of 113 trials, 26.5%) were newly identified as part of this update. Most of the behavioral outcomes were based on self-report and the instruments, modes of administration, and summary measures were highly variable among the trials.

Between-group differences in mean change for dietary outcomes showed consistent benefit of the intervention versus control groups, but the precision in the magnitude of effects was quite variable across the trials that reported each respective outcome (**Table 6**). Furthermore, there was considerable statistical heterogeneity (I^2>90%) present in most meta-analyses. Nevertheless, meta-analysis indicated statistically significant associations between healthy diet counseling interventions (with or without physical activity messages) and measures of saturated fat (standardized mean difference [SMD], -0.53 [95% CI, -0.78 to -0.27]), fruit and vegetables (MD 1.11 servings/day [95% CI, 0.41 to 1.81]), and fiber (SMD, 0.24 [95% CI, 0.05 to 0.43]). The magnitude of difference ranged from -4.1 to -0.3 percentage points in the percent of calories from saturated fat, -0.2 to 5.6 servings/day of fruits and vegetables, and -0.2 to 2.5 grams per day of fiber in favor of the intervention groups compared with control groups. Among trials reporting it, interventions were associated with statistically significantly increased odds of meeting fruit and vegetable intake recommendations (i.e., 5–9 servings/day) compared with controls. Sodium intake was infrequently reported and there was no clear finding for this outcome.

Physical activity interventions (with or without dietary components) resulted in an approximate 33-minute increase in physical activity per week compared with controls (MD, 33.0 minutes/week [95% CI, 21.9 to 44.2]). Additionally, intervention group participants had a 41 percent higher odds of meeting physical activity recommendations compared with those in the control group (pooled OR, 1.41 [95% CI, 1.18 to 1.67]). Studies that limited enrollment to participants with suboptimal levels of physical activity at baseline (generally below the recommended level of 150 minutes per week) resulted in greater increases in physical activity compared with those that did not limit enrollment based on baseline physical activity levels. In contrast to findings for intermediate outcomes, there was no evidence of effect modification based on intervention intensity. Likewise, there was no evidence of a difference in effects for interventions focused only on physical activity messages versus those focused on both physical activity and healthy diet messages.

There was no evidence of small-study effects for either dietary or physical activity outcomes based on Egger's test[42] (for continuous data) or Peters' test[43] (for percent meeting physical activity recommendations).

Detailed Results by Outcomes

Diet

Forty-five of the included trials (45/113, 39.8%; n=89,140) reported one or more dietary outcome, including measures of dietary fat intake, fruits and vegetables, fiber, sodium, and overall diet quality.[46, 48, 49, 52, 54, 55, 57, 58, 60, 62, 64-66, 74-76, 78, 79, 81, 83, 84, 86, 88, 92, 93, 99, 105, 107, 109, 111, 112, 116, 119, 126, 129, 133-138, 140, 142, 151, 158] We limited our abstraction and analyses to these five specific dietary outcomes for consistency with the original review and to focus our results. Many trials, however, reported the effects of the interventions on other important dietary outcomes, such as intake of total energy, carbohydrates, protein, cholesterol, milk/dairy, potassium, and whole grains. All trials relied on self-reported dietary intake; however, the instruments to assess dietary intake were extremely heterogeneous and evidence of validity and reliability varied. Recall periods ranged from 1 to 7 days, with many studies not reporting the specific recall period. Only five of the 45 studies were rated as good quality. Fifteen of the 45 trials were newly identified as part of this update and 30 studies were carried forward from the previous review.

Dietary Fat

For this review, we abstracted outcomes related to intake of saturated fat, monounsaturated fatty acids (MUFAs), and polyunsaturated fatty acids (PUFAs). Seventeen trials (n=57,470) reported at least one of these measures of dietary fat intake, although the outcome units varied and included grams per day, percent of energy from fat, percent of calories per day from fat, and a study-defined score (**Appendix H Table 1**).[52, 60, 62, 74, 81, 84, 86, 88, 105, 112, 126, 133, 136-138, 140, 142] Regardless of measure, there was consistent evidence of an effect of the interventions on dietary fat outcomes at 6 to 12 months of followup. When all measures of saturated fat were pooled regardless of the unit, the standardized mean difference (SMD) indicated a statistically significant medium effect size in the direction of benefit (SMD, -0.53 [95% CI, -0.78 to -0.27], 16 RCTs [n=48,661]; I^2=97.4%) (**Figure 12, Table 6**). Removal of the large WHI DMT—which targeted change in fat intake—only slightly attenuated the pooled result (MD, -0.47 [95% CI, -0.71 to -0.22]), 15 trials [n=6,362]) and still resulted in substantial heterogeneity (I^2=94%).

Looking specifically at the nine trials that reported the daily percent of energy from saturated fat, the magnitude of between-group differences was from approximately -0.3 to -4.1 percentage points in the reduction of saturated fat intake, in favor of the intervention groups (MD, -2.01 [95% CI, -3.19 to -0.83]; 9 RCTs [n=46,772]; I^2=98.1%) (**Table 6**, plot not shown), with mean baseline percent of energy from saturated fat ranging from approximately 10 to 15 percent. The difference between groups in grams per day of saturated fat was more variable across studies – ranging from 0.2 to 11.6 grams per day.

Fruits and Vegetables

In general, healthy diet interventions resulted in small increases in fruit and vegetable intake compared with controls (37 RCTs, n=82,195) (**Appendix H Table 1**).[48, 49, 52, 54, 57, 58, 60, 62, 64-66, 74, 75, 79, 83, 84, 86, 88, 92, 99, 105, 107, 109, 111, 112, 116, 119, 126, 129, 133-135, 138, 140, 142, 151, 158] The pooled between-group difference in mean change was 1.11 servings of fruits and vegetables per day for intervention vs. control groups at 6 to 12 months followup (95% CI, 0.41 to 1.81; 17 RCTs [n=53,711]; I^2=99.3%) (**Figure 13, Table 6**). The direction of the effects was consistent, with the exception of two trials[111, 126] that showed essentially no change in either group. The mean change in fruit and vegetable intake ranged from a decrease of 0.1 to an increase of 6.5 servings/day among intervention groups and a decrease of 0.3 to an increase of 2.3 servings/day among control groups. Baseline servings of fruits and vegetables ranged from approximately 1.0 to 5.8 servings/day across all participants. Eighteen trials reported changes in fruit and vegetable intake separately, with most trials reporting no differences in change in either fruit intake and vegetable intake between intervention vs. control group participants. In almost all cases, the mean fruit and vegetable intake increased or decreased by less less than a half a serving, respectively, among both groups.

Six trials reported the proportion of participants meeting recommendations for fruit and/or vegetable intake at 6 to 12 months followup (**Appendix H Table 1**).[49, 54, 112, 129, 134, 151] In all but one trial,[151] interventions were associated with a statistically significant increased odds of meeting recommendations compared with control groups. For instance, in the good-quality CALM trial (n=200), a higher proportion of participants in all three telephone counseling groups reported consuming 5-9 servings of fruits and vegetables per day (54% to 81.2%) compared with the attention control group participants (32.7%) at 12 months followup.[112] Similarly, the 10 Small Steps Study (n=4,676) reported that 21.1 percent of participants receiving two computer-tailored print mailings (OR, 1.94 [95% CI, 1.52 to 2.47], p≤0.05) and 18.8 percent of participants receiving one computer-tailored mailing (OR, 1.67 [95% CI, 1.31 to 2.12], p≤0.05) compared with 12.2 percent of control group participants reported meeting fruit and vegetable recommendations (i.e., 5–9 servings/day) at 12 months followup.[129]

Fiber

Fewer trials (14 RCTs; n=58,541) reported the effects of interventions on fiber intake (**Appendix H Table 1**).[52, 62, 65, 76, 78, 79, 81, 83, 88, 93, 126, 133, 137, 142] Eight of the trials reported fiber intake in terms of grams per day, whereas the remaining five trials only reported grams per 1,000 kilocalories per day or a study-defined fiber score. All but one of the 14 trials are shown in the forest plot that presents the SMD in fiber intake (SMD, 0.24 [95% CI, 0.05 to 0.43]; 13 RCTs [n=47,571];

I^2=93.9%) (**Figure 14, Table 6**). The remaining trial did not present within-group variance but reported a statistically significantly greater increase in grams of fiber per day among intervention versus control participants (adjusted MD, 1.00 g/day [95% CI, 0.40 to 1.60]).[88] In general, all but two of the trials suggested a benefit of the intervention on fiber intake; five of these trials reported greater benefit versus the control group that was statistically significant.[76, 81, 83, 88] The largest effect size (0.84 [95% CI, 0.82 to 0.86]) was seen in the WHI DMT. A sensitivity analysis removing this data (n=42,299) considerably reduced the variation (I^2 decreased from 94% to 39%) and resulted in a smaller effect size (SMD, 0.12 [95% CI, 0.01 to 0.24]; 12 trials [n=5,272]). Among studies reporting change in fiber intake as grams per day, the magnitude of between-group difference was approximately 1 to 2.5 g/day at 6 to 12 months in favor of the intervention groups (MD, 1.05 [95% CI, 0.59 to 1.51]; 8 RCTs [n=2,414]) (**Table 6**). The baseline levels of fiber intake were quite low in these samples, ranging from 6 to 25 g/day.

Sodium

Only four trials reported sodium outcomes (n=1,444) (**Appendix H Table 1**).[57, 62, 74, 84] Two of the trials included specific messages about decreasing salt or sodium intake,[74, 84] including counseling on the Dietary Approaches to Stop Hypertension (DASH) diet, [84 141 82 82 82 82] whereas the other two trials emphasized general heart healthy diet messages.[57, 62] We did not pool these studies given the small number of trials and variability in the populations and measurement of sodium. Only one of the trials reported a statistically significantly greater reduction in sodium among intervention (-609 mg/day) versus control group (-226 mg/day) participants (MD, -383 mg/day [95% CI, -590 to -176]).[74] The remaining trials reported small changes in study-defined sodium scores and sodium intake per day in favor of the intervention groups.

Dietary Pattern

Five trials (n=1,490) reported the differences in changes in dietary pattern scores between intervention and control groups after 6 to 12 months (**Appendix H Table 1**).[46, 55, 57, 62, 151] The instruments used to measure healthful eating varied among the studies and included established indices (e.g., the Healthy Eating Index, Dietary Guideline Index) and study-developed measures. In all cases, dietary patterns improved in intervention participants and showed very little change in control group participants, and all differences were statistically significant. The clinical significance of these changes, however, are difficult to interpret.

Physical Activity

Eighty-seven trials (87/113, 77.0%; n=54,534) reported the effects of a behavioral intervention on participants' physical activity levels (**Appendix H Table 2**).[46, 49-51, 53-57, 59-63, 65-67, 69, 70, 72-74, 77, 80-83, 85, 87, 89-92, 94-98, 100-106, 108-110, 112-115, 117, 118, 120-132, 134, 136, 137, 139-141, 143, 145-154, 156-158] In most of these trials, physical activity was the primary outcome. The specific physical activity outcomes, however, were highly variable across studies and included continuous measures such as total physical activity, moderate- to vigorous-intensity physical activity (MVPA), walking, study-defined physical activity scores, and binary measures of the number of participants meeting physical activity recommendations (≥150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week). Likewise, the unit of measurement for each of these outcomes was very diverse (e.g., minutes/week, metabolic equivalent of task [MET]-minutes/week, days/week, steps/day, kcal/kg/day). Most of the studies relied on self-reported measures of physical activity (e.g., 7-day physical activity recall, International Physical Activity Questionnaire); however, 30 studies used accelerometers or pedometers to capture an objective measure of physical activity alone or in addition to self-report measures. Twenty-six trials were newly identified as part of this update and 61 were included in the original review.

Continuous Levels of Physical Activity

Overall, there was evidence that behavioral interventions increased participants' physical activity levels (**Table 6**). The meta-analysis of the SMD in change in continuous measures of physical activity (e.g., minutes/week, kcal/kg/day, steps/day) showed a small but statistically significant association between physical activity interventions (with or without healthy diet messages) and an increase in physical activity levels compared with controls at 6 to 12 months of followup (SMD, 0.19 [95% CI, 0.14 to 0.25]; 59 trials [n=20,801]; I^2=65.4%) (**Figure 15**).

Meta-regression revealed no evidence of effect modification for most pre-specified study, population, and intervention characteristics. For instance, there was no indication that larger or smaller effects were seen when comparing studies that collected physical activity measures via self-report (33 trials) versus those based on objective data collected via accelerometer or pedometer (e.g., steps/day) (26 trials). Similarly, no effect modification was evident based on study quality, setting (US vs. not or whether the intervention was conducted in primary care), intervention intensity (including total minutes of intervention contact, the duration of the intervention, and the total number of sessions) or whether the intervention was completely remotely delivered. In addition, there was no evidence that the effects differed between the subgroup of interventions focused only on increasing physical activity (SMD, 0.18 [95% CI, 0.12 to 0.24]; 39 trials [n=14,560]) versus those that focused on both physical activity and healthy diet goals (SMD, 0.22 [95% CI, 0.10 to 0.34]; 20 trials [n=6,241]).

There was evidence, however, of an interaction between intervention effectiveness and physical activity outcomes according to whether the sample was selected based on suboptimal behavior (i.e., not meeting physical activity recommendations or a specific threshold of physical activity). The pooled effect size for studies that limited enrollment to participants with suboptimal levels of physical activity (SMD, 0.29 [95% CI, 0.20 to 0.39]; 28 trials [n=10,309]; I^2=73.8%) was statistically significantly higher than for studies that did not limit enrollment based on baseline physical activity levels (SMD, 0.12 [95% CI, 0.07 to 0.17]; 31 trials [n=8,770]; I^2=35.4% (meta-regression, p=0.002). Review of the baseline levels of physical activity within each sample confirmed lower levels of baseline physical activity in general among participants selected for low levels of physical activity compared with those not selected on the basis of their baseline levels of physical activity (**Appendix H Table 2**). In most of the studies in which participants were selected on the basis of suboptimal behavior, participants were well below the recommended levels of physical activity at baseline (with mean baseline levels among most studies ranging from 2.5 to less than 75 minutes/week), whereas studies in which participants were enrolled regardless of their baseline physical activity levels had higher baseline values (with the mean baseline above 220 minutes/week in most studies). All but three of the studies that selected participants with suboptimal baseline physical activity were physical activity–only trials. Most interventions were of medium- or low-intensity (i.e., less than 6 hours of intervention contact over the duration of the intervention).

To assist with interpretation of our findings, we also conducted an analysis limited to studies that reported minutes per week of total physical activity, MVPA, or moderate-intensity physical activity (as opposed to measures such as MET minutes, accelerometer counts, or scale scores). Among the 37 trials that reported minutes per week of physical activity, this change amounted to approximately 33 additional minutes of physical activity per week for the intervention group compared with the control group (MD, 33.0 minutes/week [95% CI, 21.9 to 44.2]; n=15,015) (**Figure 16**). Statistical heterogeneity was still substantial within this meta-analysis (I^2=76.0%), which was likely due to the clinical heterogeneity of the populations and interventions and the specific measurement of physical activity. There was considerable variation in the level of baseline physical activity across the studies. Physical activity ranged from 2 minutes/week among a sample of Hispanic women to 621 minutes/week (nearly 1.5 hours/day) among older adults (mean age 64.5 years) in the Netherlands. Absolute differences between groups at 6 months to 12 months ranged from approximately 14 minutes/week (in favor of the control group) to 160 minutes/week (in favor of the intervention group).

Thirteen studies that reported a physical activity outcome were not included in any of the physical activity meta-analyses due to a lack of reporting of detailed results (e.g., no within-group data, no variance) (**Appendix H Table 2**).[54, 58, 69, 80, 83, 92, 102, 108, 118, 123, 124, 139, 143, 156] Results of these studies varied. Eight trials reported beneficial effects of the intervention on at least one physical activity outcome[54, 69, 83, 108, 118, 124, 139, 156] whereas five trials reported no statistically significant effect of the intervention on levels of MVPA or total physical activity at 6 months to 12 months.[80, 92, 102, 123, 143]

Meeting Physical Activity Recommendations

Twenty-four trials reported the proportion of participants meeting recommended levels of physical activity at 6 months to 2 years of followup (**Appendix H Table 2**).[50, 54, 61, 66, 77, 89, 91, 94, 96, 97, 112, 115, 117, 121, 122, 124, 125, 129, 131, 134, 148, 152, 156, 158] The definition of meeting physical activity recommendations was generally the same in all of the trials—at least 150 minutes of MVPA per week. The meta-analysis of all 24 trials showed that physical activity interventions were associated with a 41 percent higher odds of meeting physical activity recommendations at 6 to 12 months of followup compared with those in the control group (pooled OR, 1.41 [95% CI, 1.18 to 1.67]; 24 trials [n=17,338]; I^2=55.1%) (**Figure 17**). Across all of the trials, the proportion of participants meeting physical activity recommendations at followup ranged from 16.3 to 95.6 percent in the intervention groups and from 6 to 83.1 percent in the control groups, with an absolute difference ranging from -12.1 percentage points (in favor of the control group) to 20.5 percentage points (in favor of the intervention group). In most cases, the proportion of participants meeting the recommendation was based on self-reported measures. In a few cases that based this outcome on accelerometer-measured physical activity, more participants in the control groups were meeting recommendations than participants in the intervention groups (though differences were not statistically significant).[77, 91]

Seven trials reported this outcome at multiple time points; there was no pattern across studies in the persistence of effect over time (**Appendix H Table 2**).[61, 94, 97, 117, 121, 122, 152] In some trials, a greater number of participants were meeting physical activity recommendations at longer compared with shorter followup (i.e., 12 months vs. 6 months), whereas in other trials, fewer participants were meeting recommendations over time. Similar patterns in the differences between groups were also evident, in that some trials found greater differences immediately following the interventions (i.e., 6 months) yet others found greater differences at longer (12 or 24 months) followup.

Sedentary Behavior

Sixteen trials (16/113, 14.2%; n=5,867) reported measures of sedentary behavior, independent of physical activity (**Appendix H Table 3**).[50, 54, 55, 60-62, 67, 71, 83, 103, 110, 123, 137, 140, 151, 157] Only one of these trials, the good-quality study by Aadahl et al.[71 70] (n=166), designed its intervention specifically to reduce daily television viewing and minimize sitting time.[71] The remaining trials focused the intervention on increasing physical activity (with or without diet messages), with only a few mentioning messages about decreasing sedentary behavior. The instruments and measures used for this outcome were different among the studies including both accelerometer-measured and self-report sitting time, screen time, TV time, and total sedentary time (as minutes/week, hours/week or day, or scores). When measures were combined, the standardized effect of the interventions did not show a statistically significant difference between groups at 6 to 12 months followup, although the effect was in the direction of intervention benefit (SMD, -0.22 [95% CI, -0.47 to 0.03]; 15 trials [n=3,479]; I^2=89.9%) (**Table 6, Figure 18**). The results across the studies were highly variable, with some showing decreases in sedentary time among intervention but not control groups and some showing increases in sedentary time among both intervention and control groups (but, to a lesser extent among intervention groups). One trial found that sedentary time increased significantly more among intervention than control group participants at both 6 and 12 months. Absolute hours of sedentary time at baseline were also highly variable ranging from to approximately 12 to 72 hours/week with changes in both groups ranging from 40 minutes more to 22 hours fewer of sedentary or screen time per week at 6 or 12 months.

Concordance Between Intermediate and Behavioral Outcomes

Among trials that reported both intermediate and behavioral outcomes (38 trials), findings were generally concordant within studies (**Table 7**). That is, trials that reported a statistically significant benefit of the intervention on one or more intermediate outcomes also reported statistically significant benefit on dietary and/or physical activity behaviors at each given time point. Furthermore, the specific intermediate outcome showing benefit within each trial generally reflected the specific behavior changes targeted in that trial. For example, trials finding differences in between-group mean BMI and/or weight reductions also reported large between-group improvements in dietary intake outcomes (e.g., studies by Aldana[74], Brekke,[81] Coates,[86] Lombard,[62] Simkin-Silverman,[136] and Tinker[142]). The limited number of studies that reported a statistically significant benefit of the intervention on LDL or total cholesterol reported concordant significant between-group reductions in saturated fat intake.[133, 136]

In many instances in which trials did not find any benefit in intermediate outcomes, the trials demonstrated statistically significant improvements in dietary intake and/or physical activity.[50, 55, 58, 62, 71, 76, 82, 89, 101, 109, 116, 117, 151] Among the physical activity-only interventions that reported increased physical activity levels as a result of the interventions, statistically significant effects on intermediate outcomes were limited to waist circumference,[71] HDL cholesterol level,[97] or BMI or weight.[108] There were two trials that reported statistically significant improvements in intermediate outcomes in the absence of concurrent improvements in behaviors. Both were weight gain prevention trials in which statistically significant differences were found between groups for adiposity outcomes, despite no substantial differences between groups in dietary intake or physical activity levels.[77, 104]

KQ 4. What Adverse Events Are Associated With Primary Care Behavioral Counseling Interventions to Improve Diet, Increase Physical Activity, and/or Reduce Sedentary Behavior in Adults?

Summary of Results

We examined all 113 included trials for any reported harms, as defined by the study authors. Generally, the harms of included counseling interventions were sparsely reported and were inconsistently defined, which precluded pooling. Twenty-three of the 113 included trials (20.4%) specifically mentioned the occurrence of harms or lack of harms (n=12,452); 12 of these 23 trials were newly identified as part of this update. Across these studies, adverse events related to counseling were exceedingly rare with generally no statistically significant differences in any study for: any adverse events, serious adverse events, musculoskeletal injuries, or falls.

Detailed Results

Twenty-three trials reported on the presence or absence of adverse events (AEs) related to the interventions.[50-52, 54, 62, 63, 69, 72, 77, 80, 83, 89, 103, 113, 115, 117, 128, 135, 141, 151, 153, 155, 157] Most of the interventions focused specifically on increasing physical activity; only two trials focused only on improving dietary habits.

There was substantial variability in the level of detail in the reporting of harms across the 23 trials. Fourteen trials reported AEs or serious AEs of any kind,[50-52, 54, 62, 69, 72, 77, 83, 103, 135, 153, 157] although eight of these trials simply reported that no AEs were reported or that no AEs related to the trial were evident but no additional details were provided.[54, 62, 72, 83, 135, 153, 157] The other six trials found that rates of AEs were relatively similar across groups (ranging from 22.6% to 80% of intervention participants and 25.4% to 71% of control group participants), and none reported rates of any AEs to be statistically significantly different between groups.[50-52, 69, 77, 103, 153] The weight gain prevention SNAP trial among young adults also monitored safety alerts related to: eating disorders, a BMI less than 18.5 kg/m^2 at followup, and greater than 20 percent weight loss from baseline. No alerts among any groups were noted for eating disorders or a BMI less than 18.5 kg/m^2 at followup and few cases (2, 2, and 3 cases in the two intervention groups and control group, respectively) of >20 percent weight loss were observed.[155]

Twelve trials (n=5,771), seven of which focused exclusively on physical activity, reported the incidence of musculoskeletal injuries, fractures, or falls and found primarily no differences between treatment groups.[50, 63, 80, 89, 103, 113, 115, 117, 128, 141, 151, 155] The absolute rates of musculoskeletal injuries and falls varied considerably among the trials, likely reflective of how the study defined these outcomes. In most cases, rates of injuries and falls were greater among intervention versus control group participants over the course of the trial, but only one trial found these differences to be statistically significant. This trial among sedentary women ages 40 to 74 years reported significantly more injuries (19% vs. 14%; p=0.03) and falls (37% vs. 29%, p<0.001) among participants in the intervention group, which received counseling that included a tailored physical activity prescription, than in the usual care control group over 24 months of followup.[117]

The most robust examination of AEs was provided by Harris and colleagues for the PACE-UP and PACE-Lift trials, the same trials that reported on CVD events as discussed within the KQ 1 results.[50, 103, 160, 167] Both trials tested 12-week physical activity pedometer-based interventions: the PACE-Lift trial[103] was among older adults ages 60–75 years whereas the PACE-UP trial[50, 167] was among adults aged 45-75 years. In PACE-Lift, nearly identical rates of AEs of any kind (e.g., falls, fractures, injuries, and deterioration in health problems) were found between treatment groups at 12 months (55% vs. 56%; p=0.90). Similarly, total AEs (including any AE from primary care records or self-reported falls, fractures, sprains, and injuries) did not differ between groups immediately following the intervention (3 months) or at 12 months. There was also no between-group difference in trial-related serious adverse events reported for safety monitoring.[50, 167]

In an analysis combining long-term data (up to 4 years) from both trials, an apparent protective effect of the intervention was found for rates of fractures. In the PACE-UP trial, the proportion of patients with a fracture during follow-up was lower in the intervention group (26/668, 3.9%) compared with the control group (28/333, 8.4%); for PACE-Lift both groups had identical proportions of fractures, 5.4 percent (8/149) in the intervention group and 5.4% (8/147) in the control group. The overall Cox regression HR when data for both trials were combined was 0.56 (95% CI 0.35 to 0.90, p=0.02).[160] In terms of falls (which were medically-reported), PACE-UP trial, 94/668 (14.1%) intervention participants vs. 48/333 (14.4%) of control group participants experienced at least one fall during and after the inventions. The rates were similar in the PACE-Lift trial, where 21/149 (14.15) vs. 15/147 (10.2%) of intervention vs. control groups, respectively, experienced at least one fall. When trial data were combined the overall incident rate ratio for falls was 1.07 (95% CI, 0.78 to 1.46, p=0.67).[160]

Impact of Population Characteristics on Effects

Direct within-study comparisons of the effectiveness of the intervention by different population subgroups were sparsely reported, often not prespecified (i.e., most were post-hoc, secondary or tertiary analyses), and rarely included interaction testing. Therefore, it is hard to draw any definitive conclusions about the differential effectiveness of interventions by subgroups.

Four trials reported subgroup results for intermediate outcomes based on age and none of them found differences in the effectiveness of the interventions on measures of blood pressure or weight change by different age categories.[62, 155, 168, 169] Two trials reported the results of the interventions on intermediate outcomes by race/ethnicity: both the WHI-DMT study (n=48,835) and the Women's Health Trial Feasibility study (n=2,208) found no differences in the effects of the interventions on SBP or incident hypertension[169] and blood pressure, glucose levels, or weight outcomes[170] among women of different racial or ethnic groups. Likewise, four trials that reported the effectiveness of interventions by sex found no differences in the results for lipid levels and weight outcomes for men vs. women.[76, 111, 133, 155]

For behavioral outcomes, five trials reported results related to dietary outcomes by age, sex, and/or race/ethnicity[76, 86, 111, 116, 171] and eight trials reported results related to physical activity by these population characteristics.[50, 54, 63, 97, 100, 139, 146, 168] While there was some modest variation in the results by subgroup, none of the trials found evidence of effect modification that was statistically significant based on any of these characteristics.

Given the high potential for confounding by clinical differences in these samples and from other sources of clinical heterogeneity, such as intervention intensity, we did not perform indirect comparisons of subpopulation effects across trials (e.g., trials limited to women vs. those limited to men).

Impact of Intervention Characteristics on Effects

As described under the outcome-specific results, there was some evidence that interventions of higher intensity—in terms of total minutes of planned intervention exposure, the number of sessions involving in-person contact with an interventionist, and the duration of the interventions—were associated with larger effects on intermediate health outcomes. These results should be interpreted with caution, however, given limiting reporting on intervention details, the subjective nature of abstracting data on intervention characteristics, as well as other factors may be confounding these findings. Furthermore, this association was only found for LDL cholesterol and adiposity measures, and not for measures of blood pressure.

Among the 43 trials that reported at least one intermediate outcome, there was a huge variation in the dose of each intervention, not only in the amount of time delivering the intervention but also the modes of delivery. The estimated total minutes of intervention contact ranged from 2 minutes to 38.5 hours (median: 2 hours and 40 minutes). Our estimate of intensity included time spent during in-person sessions, telephone calls, computer-based sessions, and the estimated time for reading e-mails or text message. Print-based materials and mailings did not contribute to the intensity value. Interventions that were solely print-based were always categorized as low intensity. These estimates were based on the planned (vs. actual) number and length of sessions; in several cases, we made assumptions and provided estimates regarding the number and length of sessions based on details provided in each article. Our methods for estimating intensity are described in detail in Chapter 2.

Intensity appears to be confounded by several factors. In general, interventions of higher intensity focused on healthy diet messages and may or may not have included physical activity messages. Very few interventions of higher intensity focused on physical activity only. In addition, higher intensity interventions were generally longer in duration (e.g., ≥1 year), although the bulk of the intensive phase of these interventions generally occurred in the first 6 months. Lastly, almost all the high-intensity interventions relied on volunteer or other convenience samples and did not occur in a primary care setting. Across the 43 studies that reported an intermediate outcome, only two studies in primary care[77, 110] were categorized as high intensity, with one focused on provider training.[110]

Thirty-three of the included trials had more than one active intervention arm designed to contrast specific approaches, including varying the mode of intervention delivery, different schedules of intervention delivery, different behavior change messages (e.g., diet only or diet plus physical activity) or behavior change techniques, and interventions with and without maintanence phases following the main intervention period. [50, 53, 59, 60, 63, 65, 69, 70, 72, 75, 81, 84, 87, 92, 102, 106, 111-114, 119, 122, 123, 127, 129, 138, 145-147, 150, 153-155] There was no consistent pattern within or across these trials to suggest that certain intervention characteristics were more favorable than others in improving any outcomes. Readers should interpret these findings with caution, however, since we did not include the full body of evidence related to the comparative effectiveness of different lifestyle interventions.

Chapter 4. Discussion

Summary of Evidence

In 2017, the USPSTF recommended that primary care professionals individualize the decision to offer or refer adults who do not have obesity and who do not have hypertension, dyslipidemia, abnormal blood glucose levels, or diabetes to behavioral counseling to promote a healthful diet and physical activity (C grade).[1] We conducted this systematic review to assist the USPSTF in updating this recommendation. The current review focuses specifically on the effectiveness and harms of primary care–relevant interventions in persons without known CVD or CVD risk factors. The Task Force has a separate review[5] and recommendation[6] on the effectiveness and harms of these interventions among those with CVD risk factors.

We included 113 unique trials, just over a quarter of which (33 trials) were published since the previous USPSTF review. The pooled effect estimates found in our updated systematic review are generally consistent in magnitude with the 2017 review on this topic[3] and lower in magnitude than the effects seen with the 2020 review among persons at high risk for CVD.[5] The number of studies that contributed to each meta-analysis stayed the same or increased slightly but included higher quality and more relevant literature.

Table 8 summarizes the findings for this evidence review. We found that healthy diet and physical activity behavioral interventions in persons without CVD risk factors were associated with very modest reductions in continuous measures of blood pressure, LDL cholesterol, and adiposity at approximately 6 to 12 months of followup compared with control conditions. Given the consistency in the effect estimates and precision in those estimates over time for each intermediate outcome, we are moderately confident that our pooled estimates lie close to the true effects, although the body of evidence is still fairly small (~20 trials for most outcomes) and there is considerable variation in the interventions. Most pooled analyses resulted in moderate or substantial statistical heterogeneity, reflecting the clinical heterogeneity across studies. There was evidence of a dose-response relationship, with increasing intervention intensity being associated with larger improvements in some intermediate outcomes. Most of the interventions of higher intensity—for which we saw a benefit on intermediate outcomes—included healthy diet messages, with or without physical activity messages, and recruited persons outside of the primary care setting.

There was considerably more evidence for behavioral outcomes, with almost all included trials reporting the effects of counseling interventions on dietary intake, physical activity, and/or sedentary behaviors. The direction of effects for all behavioral outcomes were reasonably consistent and suggested small to moderate benefits for dietary and physical activity outcomes. There was less evidence on the effects of interventions on sedentary behaviors, and no clear evidence of a benefit. Data on the long-term effects of interventions (i.e., more than 1-year post-intervention) on behavioral and intermediate outcomes were limited.

Eight trials that were included in the 2017 review were excluded from this update, mostly due to the included population (e.g., having elevated blood pressure or other chronic conditions). The effect of removing these trials was particularly evident for health outcomes (KQ1), where the removal of the Hypertension Prevention Trial[172] and the Trials of Hypertension Prevention I and II[173, 174] resulted in less included evidence for all-cause and CVD-related mortality and CVD events. Furthermore, the pooled results found here for blood pressure were slightly smaller in magnitude than the pooled effects found in 2017. All three of these trials focused on preventing hypertension, through intensive sodium restriction, among adults with high-normal blood pressure and are now included in the USPSTF related review among persons at high risk for CVD.[5] Given the changes in thresholds defining elevated and high blood pressure,[175] conceptually, this evidence is better synthesized with the companion review.

We have limited certainty in the evidence for the effects of lifestyle interventions on longer-term health outcomes, including all-cause and CVD-specific mortality, CVD events, and quality of life. The evidence for these outcomes was sparse and inconsistent in the effects, precluding a robust conclusion.

Finally, despite a relatively smaller body of evidence related to harms, we are moderately confident that there are no serious adverse events associated with behavioral counseling for healthy diet and physical activity.

Applicability of Findings and Intervention Approaches

By design, the current review excluded studies that specifically recruited individuals at high risk of CVD—defined only by the presence of hypertension, dyslipidemia, or impaired fasting glucose. In all other ways, the persons represented in the trials exhibited a broad range of sociodemographic and behavioral characteristics. Many included studies were limited to subpopulations for which particular CVD risk factors and dietary and activity habits may differ from their counterparts, including women (in particular, the large WHI dietary modification trial [n=48,835]), older adults (60 years or older), racial/ethnic minority groups, those with a family history of CVD or diabetes, and persons who are overweight or have obesity. Furthermore, nearly half of the studies limited enrollment to persons with suboptimal levels of physical activity, inadequate dietary habits, or both. The remaining studies were conducted among unselected adults with varying sociodemographic and clinical characteristics. Unfortunately, very few trials reported the underlying CVD risk of participants at baseline (i.e., the proportion of participants with existing hypertension or dyslipidemia). While this review was designed to represent persons *not* at risk of CVD, we cannot confidently say that all participants within the included evidence were of "average" CVD risk; we just know that they were not recruited into these trials because of an underlying risk.

Although the majority of studies recruited participants directly (via invitations through primary care, the broader health care system, or some other convenience sample rather than relying on community volunteers), the adults who took part in these studies may have been more motivated to change their behaviors than those not represented in these trials. Indeed, we saw generally high rates of retention (>80% at 12 months) over the course of the studies and good adherence to the interventions—rates that may not be seen in real-world scenarios. Given the broad representation across population characteristics and the fact that most of the studies took place in the United States, we believe the findings of this review are generalizable to a U.S. primary care population, although the magnitude of the effects may be slightly lower when applied to general practice.

There was some evidence, at least for intermediate outcomes, that increasing intervention intensity—in terms of time spent with an interventionist, the number of cumulative intervention sessions, and the total duration of the intervention—was related to greater benefit. It is difficult to disentangle differences in the various intervention, population, and broader study characteristics, however, when attempting to explain the effectiveness of the interventions on these outcomes. Most of the studies that reported intermediate outcomes implemented relatively intense interventions and most of these interventions focused messages on dietary changes and may or may not have included messages about increasing physical activity. Even within the high-intensity interventions, the estimated intervention contact (minutes of counseling) ranged considerably—from 375 minutes (6 hours and 15 minutes) to 2,310 minutes (38.5 hours) over the course of 4 weeks to 6 years. Furthermore, most of these high-intensity interventions took place outside of the primary care setting and may represent persons with higher motivation to change their behaviors. Similarly, the effects seen for dietary outcomes were mostly for medium- or high-intensity interventions, whereas the effects for physical activity outcomes included trials testing mostly low- and medium-intensity interventions. There was no evidence of a dose-response relationship with intervention intensity and physical activity outcomes, but there was evidence that trials targeting persons with baseline activity below recommended levels saw larger improvements in physical activity participation than trials in which participants were already achieving higher levels of physical activity.

Based on the included literature, we are not able to define either the minimum necessary intervention components for an effective intervention or identify a single optimal or representative intervention. No two studies had exactly the same goals, behavior change messages, modes of delivery, or delivery schedule, although some explicitly built on learnings from earlier trials (for example, the STRIDE,[122] COSTRIDE,[82] and VA-STRIDE[94] trials and the PACE-Lift[103] and PACE-UP trials[50]). Though we broadly focused on studies related to the primary prevention of CVD among healthy adults, the specific aims of each trial differed and appropriately resulted in different intervention goals and components. For most trials, the primary aim was improving behavioral outcomes. Across all interventions, most included tailored advice and materials and encouraged goal setting and self-monitoring. A substantial number of the trials, many of the newer studies, included interventions that were administered completely remotely—either via telephone, print materials, or were computer- or e-mail-based.

Although we largely saw consistency in the direction of beneficial effects among all the trials, there was variation in the magnitude of the effects and there was often wide variation within studies. This variation likely reflects that even within studies, some participants can achieve greater change while others may not. Most likely, the ideal counseling intervention for any given person will depend on consideration of their specific clinical characteristics, including existing diet and physical activity behaviors, and the larger context of other prevention or screening priorities, given the limited time for a typical primary care encounter. Furthermore, it is likely that there are many social determinants of health at play (e.g., food insecurity) that may impact the size of the effects seen. Again, unfortunately, very limited data was provided on the underlying social conditions (i.e., risks and inequities) present among the included samples.

Observational Evidence on the Association Between Differences in Intermediate and Behavioral Outcomes and Health Outcomes

Due to limited direct trial evidence on the effect of healthy diet and physical activity interventions on health outcomes included in this review, we present observational data to contextualize the results. This evidence likely represents an upper bound of potential benefit given that most of the observational evidence also includes adults at high risk of CVD. This also assumes an optimistic outlook that any behavior modifications, and hence changes in intermediate outcomes, are maintained over time. Nevertheless, overall, observational data from very large prospective studies and individual participant data (IPD) meta-analyses of prospective cohort studies show that small differences in intermediate outcomes (e.g., blood pressure, non-HDL cholesterol, and BMI) translate into small reductions in the risk of cardiovascular-related and all-cause mortality. **Table 9** summarizes the relationship between each intermediate and health outcome using both the original hazard ratio (HR) reported in the observational studies as well as a converted HR for the pooled between-group differences found in this review.

We found that behavioral counseling interventions in persons without CVD risk factors were associated with a -0.80 and -0.42-mm Hg difference in SBP and DBP, respectively, compared with control groups. According to an IPD meta-analysis of 61 prospective observational studies conducted by the Prospective Studies Collaboration, a strong and direct relationship was found between blood pressure and age-specific mortality for stroke, ischemic heart disease, and other vascular causes after controlling for lipid levels, diabetes, weight, alcohol intake, and smoking.[176] When associations from this analysis, expressed as HRs per 20-mm Hg difference in SBP and per 10-mm Hg difference in DBP, were converted into smaller increments more consistent with our results, the findings suggested that a small blood pressure difference in SBP of 0.5 mm Hg in adults ages 40 to 49 years is associated with an ischemic heart disease (IHD) mortality reduction of 2 percent and a stroke mortality reduction of 3 percent (**Table 9**). These associations were similar in magnitude for DBP when estimated for increments of 0.5 mm Hg. A recent, separate analysis extended these findings to show that important associations between blood pressure and CVD events exist regardless of threshold (e.g., 140/90 mm Hg vs. 130/90 mm Hg) and when using real-world clinical databases that do not use research-quality blood pressure measurements.[177]

Our meta-analysis of lipid outcomes suggested an association between healthy diet and physical activity counseling and LDL cholesterol, with a magnitude of approximately a 2 mg/dL difference in favor of interventions. Based on a separate IPD meta-analysis by the Prospective Studies Collaboration, there is evidence of a strong positive relationship between non-HDL cholesterol level (reported instead of LDL cholesterol in the IPD meta-analysis) and ischemic heart disease mortality, where a decrease in non-HDL cholesterol of 1 mmol/L was associated with a 43 percent reduction in IHD mortality among 40 to 59-year-olds (**Table 9**).[178] Converting this to a difference of 3 mg/dL results in a 4 percent reduction in fatal IHD risk at ages 40 to 59 years and a 3 percent reduction at ages 60 to 69 years (**Table 9**).

Our pooled analysis of interventions of all levels of intensity did not find a significant effect for diet or physical activity counseling interventions on fasting glucose. Epidemiologic evidence suggests that maintaining a normoglycemic level is associated with the best cardiovascular outcomes and incremental increases beyond normoglycemia increases cardiovascular mortality.[179, 180]

By design, we excluded trials that explicitly focused on weight loss. Nevertheless, small improvements in BMI, weight, and waist circumference were found to be associated with diet and physical activity interventions at 6 to 12 months of followup. The statistical heterogeneity for these pooled effects was considerable, however, and therefore some uncertainty in the average effects remains. The between-group differences found in our included trials suggested a reduction in BMI of approximately -0.30 kg/m^2. Several large studies and meta-analyses have found strong associations between BMI and all-cause mortality and that even modest changes in BMI may be associated with small reductions in all-cause and cardiovascular related mortality.[181-183] In an IPD meta-analysis of 189 prospective studies (n=3,951,455 never smokers without chronic diseases) all-cause mortality was minimal at BMIs of 20 to 25.0 kg/m^2 and increased significantly both for BMIs just below this range and throughout the overweight and obesity range.[182] For BMI over 25.0 kg/m^2, mortality increased approximately log-linearly with BMI; the HR per 5 kg/m^2 units higher BMI was 1.31 (95% CI, 1.29 to 1.33).[182] Similarly, a recent population-based cohort study of nearly 4 million adults in the UK reported a J-shaped association between BMI and all-cause mortality.[184] The estimated all-cause mortality HR per 5 kg/m^2 increase in BMI was 0.81 (95% CI, 0.80 to 0.82) for individuals with a BMI below 25 kg/m^2 and 1.21 (95% CI, 1.20 to 1.22) in individuals with BMI above 25 kg/m^2.[184]

Among studies investigating cardiovascular mortality, increased BMI has generally been associated with increased risk,[182, 183] but it is less clear at what BMI risk begins. In the most recent IPD meta-analysis, the HR per 5 kg/m^2 higher BMI among those with a BMI greater than 25.0 kg/m^2 was 1.42 for CHD and stroke mortality.[182] Similarly, another IPD meta-analysis of 57 prospective studies found that for those with BMIs above 25 kg/m^2, each 5 kg/m^2 higher BMI was associated with about 40 percent higher risk of IHD and stroke mortality.[183] Applying conversions to determine the impact of a BMI change comparable to that found in our review, a BMI decrease of 0.3 kg/m^2 was associated with an approximate 2 to 3 percent lower risk of all-cause mortality, IHD mortality, CHD, and fatal stroke, regardless of age, among adults with a BMI above 25 kg/m^2.

For dietary outcomes, the impact of individual diet components is difficult to evaluate, as the totality of the diet is most important.[185] One meta-analysis of 16 cohort studies found a 5 percent lower risk of all-cause mortality for an increment of one serving of fruit and vegetables per day,[186] consistent with the findings of our review. A recent meta-analysis of 95 prospective cohort studies reported associations between 200 grams per day of fruit and vegetable intake and reduced risk of CVD and CHD (risk ratio [RR]=0.92), stroke (RR=0.84), and all-cause mortality (RR=0.90).[187]

The findings on intake of different types of dietary fats are less clear, although evidence suggests that a fat-modified diet may not assist with weight loss or decrease CVD and cancer mortalities.[163, 188-190] Evidence suggests that replacing 5 percent of energy from saturated fats with other types of fats or whole-grain carbohydrates is associated with health benefits,[191, 192] but not all researchers agree with this conclusion.[193-195] Further, a 5 percent change is larger than the 2 percent difference in change that we found in this review.

There is a strong body of evidence showing substantial health benefits associated with physical activity, and current evidence suggests that there is no minimum threshold for benefits to occur.[196-198] Recent evidence confirms that higher levels of physical activity are associated with a lower risk of both all-cause and CVD-related mortality.[199, 200] The greatest risk reductions in all-cause mortality are seen when comparing those classified in the second quarter for activity level compared with those in the lowest quarter, which are separated by approximately 5 minutes/day of moderate-to-vigorous physical activity (a value which is fairly equivalent to the between group difference of approximately 35 minutes/week we found in this review). The maximal risk reduction for all-cause mortality is seen at about 24 minutes/day of moderate-to-vigorous intensity physical activity.[200]

Limitations of Our Approach

There are limitations of this review that arose from scoping and analytic decisions that should be acknowledged. First, this updated review represents only a subset of the literature focused on dietary and physical activity counseling. To avoid duplication of literature addressed in other reviews for the USPSTF, we excluded some related bodies of evidence, including studies focused on persons with known disease (e.g., coronary heart disease, diabetes, impaired fasting glucose, hypertension, dyslipidemia), trials focused on weight loss or weight loss maintenance, and trials focused on dietary or physical activity counseling to prevent or manage other health risks and conditions (e.g., falls, cognitive impairment, cancer).

Although we focused this review specifically on adults “without known CVD risk factors,” exceptionally few studies reported the underlying cardiovascular risk of the population. We excluded studies that explicitly enrolled participants based on known elevated blood pressure or hypertension, dyslipidemia, diabetes, impaired fasting glucose or glucose tolerance, or a combination of these factors. We did, however, include studies among adults who may otherwise be at increased risk for CVD due to being overweight or having obesity, family history, or suboptimal dietary or physical activity behavior at baseline. Despite these operational criteria, there was still some subjectivity in determining risk and deciding which review (or reviews) each trial best fit (i.e., the current review, which focused on adults not at high risk, and/or the separate review which focused on high-risk adults). Most of the studies included in this review represented an unselected population or persons selected based on suboptimal behaviors, but did not report baseline values of blood pressure, lipid levels, glucose levels, current smoking, or adiposity.

This review was limited to interventions that were conducted in primary care or those that we felt may be feasible to conduct in or refer from primary care. Defining what interventions are “feasible for” or “referable from” primary care, however, is an ongoing challenge as it applies to USPSTF-related behavioral counseling interventions.[201-205] Only 24 of the included trials actually took place in a primary care setting or involved primary care staff in the delivery of the intervention. An additional 26 trials recruited participants through mailings or phone calls from their primary care office or health insurance provider, but the interventions themselves were delivered in a research setting, at home, or elsewhere and did not include primary care staff. The remaining 63 trials had no connection to the primary care setting; however, we judged them to be relevant to primary care given the nature of the intervention components (e.g., print material, telephone counseling, computer based) or interventionists (e.g., health educators, trained staff). Many of these latter studies recruited participants through community venues, including mass advertising or through existing convenience lists (e.g., existing research cohorts), and therefore may represent populations with higher levels of motivation to change their behaviors or participate in research. We excluded interventions delivered through worksites, churches, and other community organizations as well as interventions that focused on environmental and policy changes that may not be easily replicated or implemented solely through primary care. For readers interested in the evidence on these interventions, we refer to The Community Guide[206] and the National Cancer Institute's Evidence-Based Cancer Control Programs.[207]

Additionally, our review focused on counseling to improve dietary and activity habits and did not review the evidence on the observational relationship between certain dietary patterns or physical activity levels and health outcomes. The Scientific Report of the 2015 Dietary Guidelines Advisory Committee[208] and the World Health Organization's Guidelines on Physical Activity and Sedentary Behaviour[198] provide thorough reviews of this evidence. Furthermore, our review excluded observational studies examining whether the introduction of physical activity as a vital sign within health systems' electronic medical records increases the documentation of exercise behaviors and referrals for lifestyle-related counseling (e.g., Grant et al.[209]).

With complex interventions such as those included here, describing and synthesizing intervention characteristics is difficult. The included interventions varied considerably in terms of the nature of the advice, mode of delivery, and delivery schedule. We diligently abstracted as much detail as possible about each intervention, used an established taxonomy for describing the behavior change techniques used in the interventions,[38, 210] and carefully summarized this detail in tabular and narrative format. We used consistent rules for estimating the total minutes of contact (i.e., intensity) across studies and used our established[3, 5] cutpoints to categorize each intervention arm as low intensity (≤30 minutes), medium intensity (31 to 360 minutes), or high intensity (>360 minutes). Despite this consistency, the rules are still somewhat arbitrary, and many medium-intensity interventions were quite intensive in terms of participant contact (e.g., nearly 5 hours of participation). Furthermore, in many cases, detailed reporting of the number and length of sessions was lacking, so we had to make several assumptions.

Finally, our meta-analyses pooled a body of literature that was heterogeneous with respect to clinical and demographic characteristics, interventions, and settings. For most outcomes, the statistical heterogeneity was unimportant (I^2<40%) or moderate (I^2=30% to 60%) and therefore still reasonable to allow for interpreting of pooled estimates. However, given the clinical heterogeneity, looking at the confidence intervals for each point estimate helps us to understand the true magnitude of effects on the individual outcomes. There was considerable heterogeneity (I^2>90%) in the meta-analyses of adiposity and dietary outcomes, which is consistent with both the clinical variability of included populations and the variability in interventions among the included studies as well as the continuous nature of the data. Nevertheless, the high statistical heterogeneity may indicate that the pooled average effect of the interventions should be interpreted with caution. Studies were also limited to the English language.

Limitations of the Studies and Future Research Needs

Several limitations related to this evidence base should be noted which point to important research needs.

First, few studies were included that reported measures of intermediate cardiometabolic outcomes, and even fewer were included that reported longer term health outcomes. As the prevalence and rate of these health outcomes are lower in lower risk groups (by definition), these studies require larger sample sizes and longer followup to observe an effect of an intervention in a low-risk group of participants.[202] Without this, enhanced methods for using observational data to understand the effect of small differences in behavioral and intermediate outcomes on long-term health outcomes are needed. Additionally, future research should consistently measure and report quality of life and other related patient-centered outcomes.

Second, very few of the included trials explored whether effectiveness of the interventions varied among important subpopulations. Such analyses could assist in identifying groups of adults who might benefit more from behavioral interventions and help reduce the disparities that exist related to cardiovascular-related health. Furthermore, given this review's focus on adults without known cardiovascular risk, it would be extremely helpful if all publications included a more robust description of the characteristics of the participants included in the trials, particularly related to underlying CVD risk factors.

Third, given that behavioral outcomes were the primary outcomes in almost all the included studies, there is a crucial need for better standardization related to the collection and reporting of these outcomes. Our call for this need is not something new or unique.[202] In this review, there was extensive variability in the instruments used to measure dietary intake and physical activity, and even more variation in the specific outcomes and unit of measurement used to present results. Dietary intake was generally measured by food frequency questionnaires, entries in food diaries, or 24-hour food recalls. Very few studies used a dietary patterns approach for measuring, analyzing, or reporting results and rather reported results related to independent dietary components (e.g., saturated fat). A dietary pattern approach reflects that a composite of foods and beverages is more likely to influence health or chronic disease than will any single food or nutrient.[185] Including index-based dietary pattern measurement (i.e., a dietary index), using scores such as the Healthy Eating Index (HEI), the alternate Healthy Eating Index, or the Dietary Approaches to Stop Hypertension (DASH) score, is strongly encouraged in future intervention research aiming to change dietary habits of participants.[211] A distinct advantage of using these structured indices is the comparability of study findings. Similarly, while we understand that physical activity researchers must fit the specific measurement instruments and summary variables to the needs of their particular study aims, research protocols, and sample characteristics, we encourage investigators and publishers to strive for more uniformity in the outcomes required to be reported to measure physical activity benefit. Setting clear thresholds for benefit, such as achieving 150 minutes/week of MVPA or a certain counts per minute for accelerometer data (e.g., ≥1952 counts per minute), and dichotomizing participants as having achieved that threshold or not would also be helpful.

Finally, given the overwhelming evidence that greater time spent in sedentary behavior is independently associated with all-cause and CVD mortality[200] and clear guidance on limiting the amount of time spent being sedentary,[198] there is an urgent need for trials evaluating interventions designed to reduce sedentary behaviors. Most of the research in this area to date has taken place in workplace settings, a setting where high levels of sitting (while at a desk or driving, for instance) takes place.[212] Given the recent increase in the number of workers now working from home,[213] it is even more imperative to evaluate interventions designed to reduce prolonged sitting, including their impact on important health outcomes. A handful of studies have tested the feasibility and acceptability of interventions to reduce sitting time using activity monitors in non-workplace settings in nonrandomized or short-term studies (for example, the I-STAND intervention[214]). Replication of these interventions in RCTs with followup of at least 6 months is encouraged.

We searched ClinicalTrials.gov to identify any ongoing trials of relevance that might contribute to this body of evidence in the future. We identified nine trials, only two of which are being conducted in United States, currently under way that address interventions to prevent CVD (**Appendix I**). It is not clear, however, what the underlying CVD risk of the included samples are and to what extent they may contribute to this evidence base.

Conclusions

The results of this systematic review update are consistent with the 2017 review on this topic. Healthy diet and physical activity behavioral interventions for persons without a known risk of CVD were associated with very small but statistically significant benefits across a variety of important intermediate health outcomes and small-to-moderate effects on dietary and physical activity behaviors. Very limited evidence exists regarding the health outcomes or harmful effects of these interventions.

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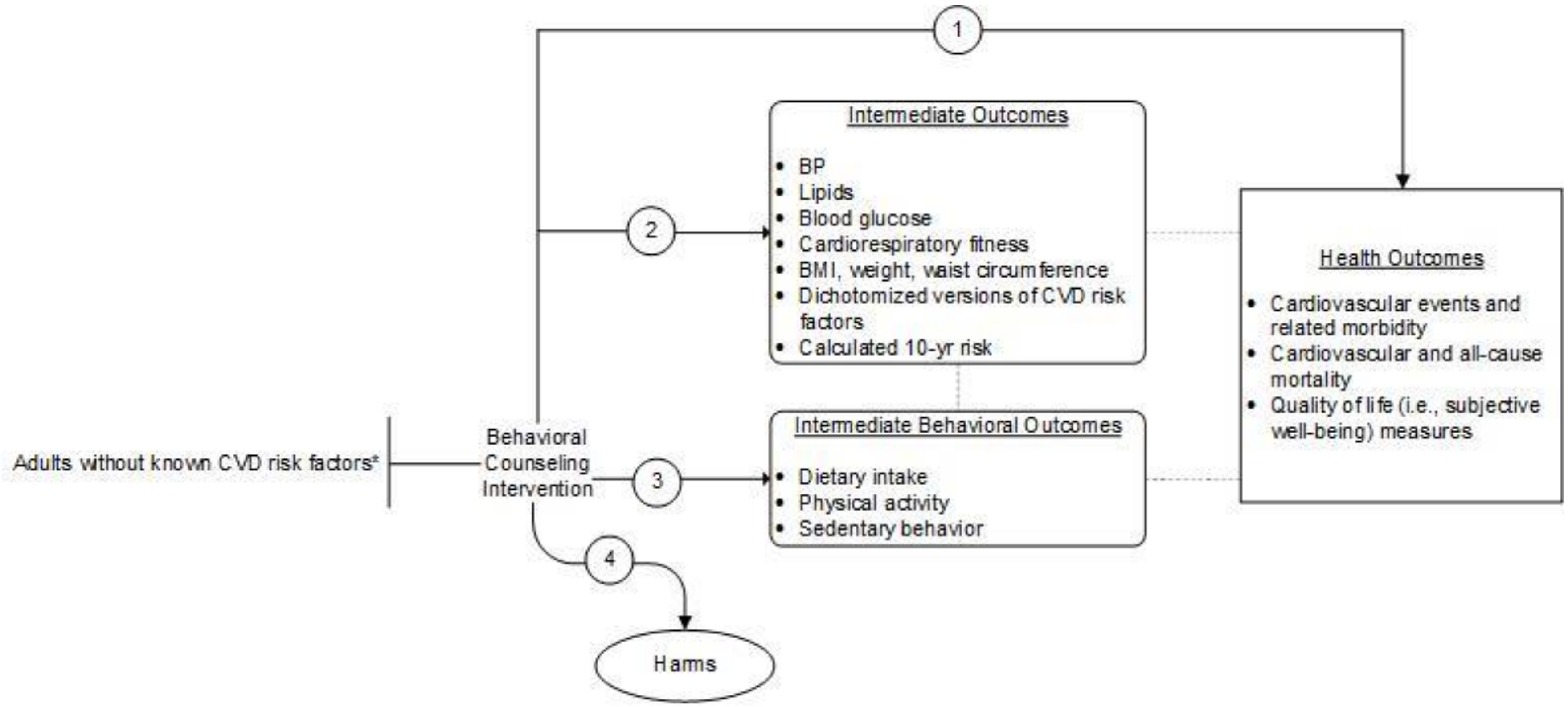
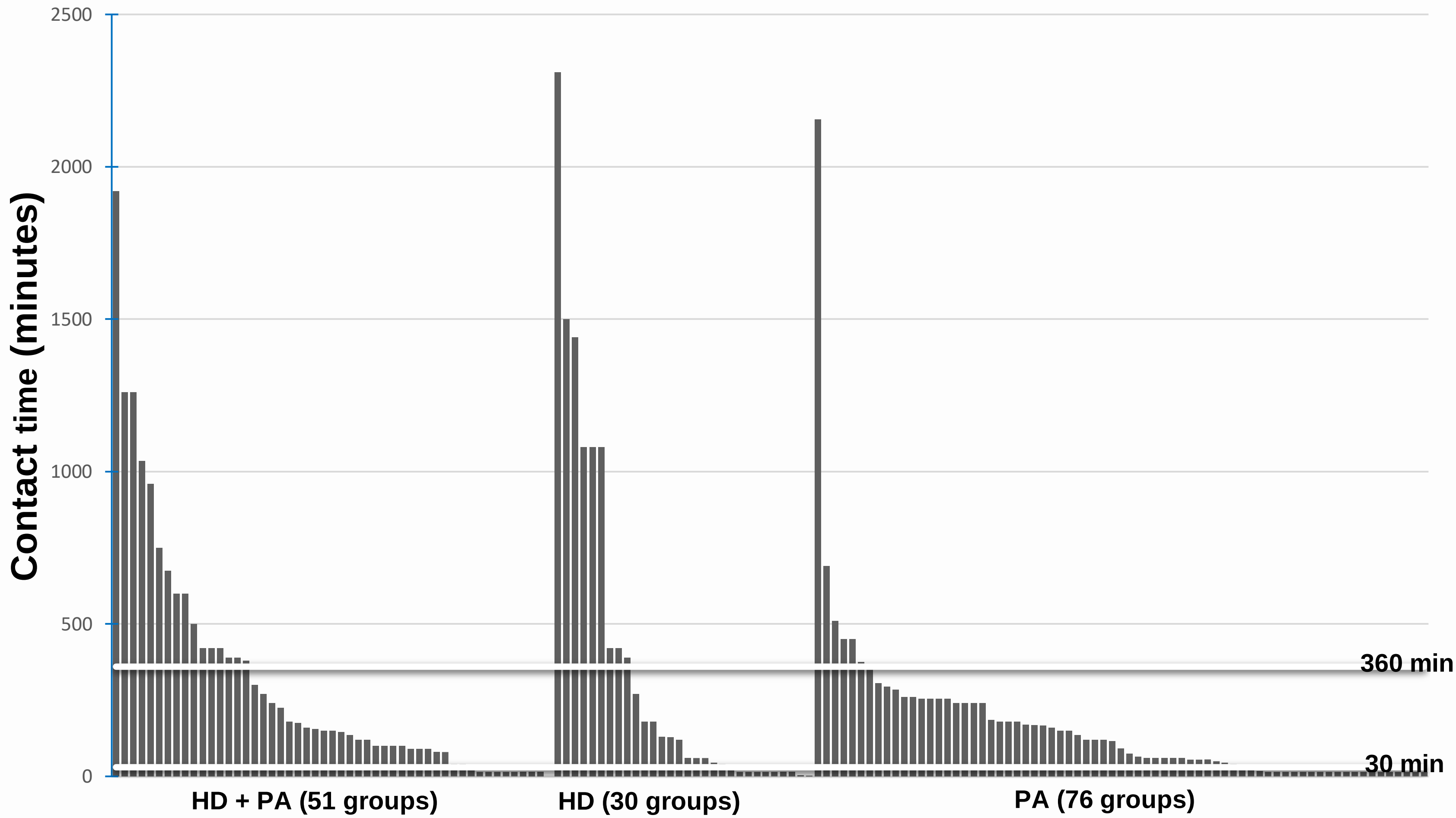
Figure 1. Analytic Framework



*CVD risk factors include: hypertension or elevated BP, dyslipidemia or elevated lipids, impaired fasting glucose or impaired glucose tolerance, and mixed or multiple risk factors (e.g., 10-year CVD risk >7.5%, metabolic syndrome)

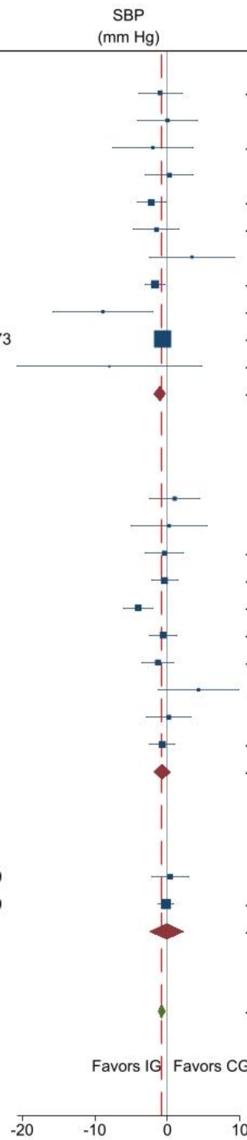
Abbreviations: BP = blood pressure, BMI = body mass index, CVD = cardiovascular disease

Figure 2. Distribution of Intervention Arms by Contact Time and Focus



Abbreviations: HD=healthy diet only; HD + PA=healthy diet and physical activity; min=minutes; PA=physical activity only
* Intervention contact time defined as: Low: 0-30 min, Medium: 31-360 min, High: >360 min

Figure 3. Pooled Analysis of Change in Systolic Blood Pressure (mm Hg) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity



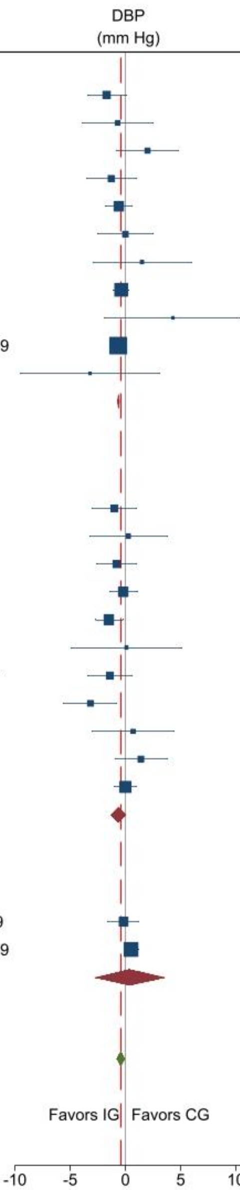
Study	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
High intensity (contact time ≥6 hrs)					
Aldana, 2006	HD+PA	6	-5.0 (15.3), 174	-4.0 (14.7), 174	-1.00 (-4.00, 2.00)
Bennett, 2013	HD+PA	12	-1.6 (14.3), 91	-1.6 (14.5), 94	0.01 (-4.15, 4.17)
Hivert, 2007	HD+PA	24	5.0 (15.2), 58	7.0 (15.1), 57	-2.00 (-7.55, 3.55)
Koniak-Griffin, 2015	HD+PA	9	-1.3 (12.3), 100	-1.6 (10.9), 94	0.28 (-2.99, 3.55)
Simkin-Silverman, 1995	HD+PA	18	-2.7 (11.5), 236	-0.5 (10.6), 253	-2.20 (-4.16, -0.24)
Thompson, 2008	HD+PA	12	-1.4 (11.8), 100	0.1 (10.9), 100	-1.50 (-4.64, 1.64)
Wieland, 2018	HD+PA	12	0.7 (11.3), 36	-2.7 (13.5), 34	3.40 (-2.42, 9.22)
Coates, 1999	HD	6	-3.1 (.), 1101	-1.4 (.), 648	-1.70 (-3.11, -0.29)
Metzgar, 2016	HD	6	-3.3 (12.0), 26	5.6 (13.1), 25	-8.90 (-15.78, -2.02)
Tinker, 2008	HD	12	-2.7 (15.3), 17126	-2.0 (14.2), 25173	-0.66 (-0.88, -0.44)
Thompson, 2014	PA	6	-5.0 (15.9), 24	3.0 (27.5), 24	-8.00 (-20.70, 4.70)
Heterogeneity: $\tau^2 = 0.22$, $I^2 = 16.67\%$, $H^2 = 1.20$					-1.05 (-1.90, -0.21)
Test of $\theta_i = \theta_j$: Q(10) = 13.90, p = 0.18					
Medium intensity (contact time 31 mins to <6 hrs)					
Anand, 2016	HD+PA	12	0.0 (15.7), 164	-1.0 (16.0), 173	1.00 (-2.39, 4.39)
Gill, 2019	HD+PA	6	-6.4 (15.5), 59	-6.6 (15.0), 59	0.23 (-5.02, 5.48)
Mosca, 2008	HD+PA	12	3.0 (15.7), 250	3.4 (14.5), 251	-0.40 (-3.05, 2.25)
Jenkins, 2017	HD	6	-1.3 (11.4), 145	-0.9 (10.1), 486	-0.40 (-2.20, 1.40)
John, 2002	HD	6	-2.0 (13.5), 344	1.4 (14.6), 346	-4.00 (-6.00, -2.00)
Roderick, 1997	HD	12	-1.1 (.), 473	-0.4 (.), 483	-0.59 (-2.43, 1.25)
Elley, 2003	PA	12	-2.6 (15.7), 451	-1.2 (14.3), 427	-1.31 (-3.51, 0.89)
Kallings, 2009	PA	6	0.2 (14.7), 41	-4.1 (12.4), 50	4.30 (-1.27, 9.87)
Kinmonth, 2008	PA	12	-3.2 (12.2), 107	-3.4 (10.7), 111	0.20 (-2.84, 3.24)
Lawton, 2008	PA	12	-2.2 (14.6), 544	-1.5 (14.8), 545	-0.70 (-2.44, 1.04)
Heterogeneity: $\tau^2 = 0.99$, $I^2 = 39.71\%$, $H^2 = 1.66$					-0.76 (-1.96, 0.45)
Test of $\theta_i = \theta_j$: Q(9) = 15.20, p = 0.09					
Low intensity (contact time ≤30 mins)					
Sacerdote, 2006	HD	12	0.2 (20.9), 1488	-0.2 (49.4), 1489	0.35 (-2.20, 2.90)
Grandes, 2009	PA	12	-3.3 (47.9), 1456	-2.9 (46.9), 1389	-0.20 (-1.24, 0.84)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$					-0.12 (-2.56, 2.32)
Test of $\theta_i = \theta_j$: Q(1) = 0.15, p = 0.70					
Overall					-0.80 (-1.30, -0.31)
Heterogeneity: $\tau^2 = 0.10$, $I^2 = 11.34\%$, $H^2 = 1.13$					
Test of $\theta_i = \theta_j$: Q(22) = 30.90, p = 0.10					
Test of $\theta = 0$: t(22) = -3.35, p = 0.003					

Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

Abbreviations: CG=control group; CI=confidence interval; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; Mins=minutes; mm Hg=millimeters of mercury; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=Standard deviation; SBP=systolic blood pressure.

Figure 4. Pooled Analysis of Change in Diastolic Blood Pressure (mm Hg) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity

Study	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
High intensity (contact time ≥6 hrs)					
Aldana, 2006	HD+PA	6	-5.5 (8.5), 174	-3.8 (8.1), 174	-1.70 (-3.44, 0.04)
Bennett, 2013	HD+PA	12	-2.3 (11.4), 91	-1.6 (10.7), 94	-0.70 (-3.89, 2.49)
Hivert, 2007	HD+PA	24	2.0 (7.6), 58	0.0 (7.5), 57	2.00 (-0.76, 4.76)
Koniak-Griffin, 2015	HD+PA	9	-1.4 (8.2), 100	-0.1 (7.7), 94	-1.29 (-3.52, 0.94)
Simkin-Silverman, 1995	HD+PA	18	1.4 (7.0), 236	2.0 (7.0), 253	-0.60 (-1.83, 0.63)
Thompson, 2008	HD+PA	12	0.4 (9.5), 100	0.4 (8.3), 100	0.00 (-2.47, 2.47)
Wieland, 2018	HD+PA	12	0.3 (9.1), 36	-1.2 (9.9), 34	1.50 (-2.95, 5.95)
Coates, 1999	HD	6	-1.1 (.), 1101	-0.6 (.), 648	-0.40 (-1.14, 0.34)
Metzgar, 2016	HD	6	-4.2 (11.0), 26	-8.5 (11.7), 25	4.30 (-1.93, 10.53)
Tinker, 2008	HD	12	-2.0 (8.2), 17125	-1.3 (7.6), 25169	-0.64 (-0.76, -0.52)
Thompson, 2014	PA	6	-1.2 (8.8), 24	2.0 (13.1), 24	-3.20 (-9.51, 3.11)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$					-0.63 (-0.76, -0.50)
Test of $\theta_i = \theta_j$: Q(10) = 9.83, p = 0.46					
Medium intensity (contact time 31 mins to <6 hrs)					
Anand, 2016	HD+PA	12	-1.0 (8.9), 164	0.0 (9.7), 173	-1.00 (-3.00, 1.00)
Gill, 2019	HD+PA	6	-1.6 (9.9), 59	-1.8 (9.6), 59	0.27 (-3.26, 3.80)
Mosca, 2008	HD+PA	12	1.1 (10.7), 250	1.9 (10.2), 251	-0.80 (-2.62, 1.02)
Jenkins, 2017	HD	6	-0.9 (7.7), 145	-1.0 (7.3), 486	-0.20 (-1.45, 1.05)
John, 2002	HD	6	-1.6 (8.7), 344	-0.3 (8.7), 346	-1.50 (-2.75, -0.25)
Roderick, 1997	HD	12	-0.2 (.), 473	-0.1 (.), 483	0.09 (-4.87, 5.05)
Elley, 2003	PA	12	-2.6 (10.9), 451	-0.8 (10.2), 427	-1.40 (-3.36, 0.56)
Hargreaves, 2016	PA	6	-6.7 (12.4), 35	-3.1 (10.1), 39	-3.17 (-5.56, -0.78)
Kallings, 2009	PA	6	-1.0 (8.3), 41	-1.7 (9.6), 50	0.70 (-3.02, 4.42)
Kinmonth, 2008	PA	12	-1.7 (9.9), 107	-3.1 (7.8), 111	1.40 (-0.95, 3.75)
Lawton, 2008	PA	12	-2.3 (8.3), 544	-2.3 (7.8), 545	0.00 (-0.96, 0.96)
Heterogeneity: $\tau^2 = 0.24$, $I^2 = 22.21\%$, $H^2 = 1.29$					-0.63 (-1.34, 0.09)
Test of $\theta_i = \theta_j$: Q(10) = 12.69, p = 0.24					
Low intensity (contact time ≤30 mins)					
Sacerdote, 2006	HD	12	0.4 (12.8), 1488	0.6 (30.3), 1489	-0.17 (-1.58, 1.24)
Grandes, 2009	PA	12	-1.4 (23.3), 1456	-1.8 (22.7), 1389	0.52 (-0.11, 1.15)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$					0.41 (-2.85, 3.66)
Test of $\theta_i = \theta_j$: Q(1) = 0.77, p = 0.38					
Overall					-0.42 (-0.80, -0.04)
Heterogeneity: $\tau^2 = 0.18$, $I^2 = 35.82\%$, $H^2 = 1.56$					
Test of $\theta_i = \theta_j$: Q(23) = 35.41, p = 0.05					
Test of $\theta = 0$: t(23) = -2.26, p = 0.03					

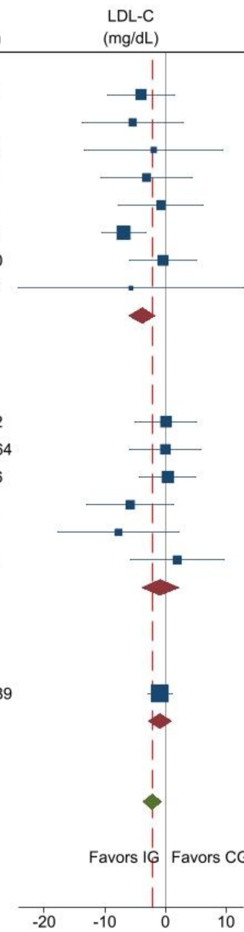


Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

Abbreviations: CI=confidence interval; DBP=diastolic blood pressure; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; mm Hg=millimeters of mercury; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

Figure 5. Pooled Analysis of Change in Low-Density Lipoprotein Cholesterol (mg/dL) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity

Study	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
High intensity (contact time ≥6 hrs)					
Aldana, 2006	HD+PA	6	5.0 (25.9), 174	9.0 (28.0), 174	-4.00 (-9.51, 1.51)
Bennett, 2013	HD+PA	12	-5.2 (29.6), 91	0.1 (27.1), 94	-5.40 (-13.69, 2.89)
Brekke, 2005	HD+PA	12	8.9 (20.1), 25	10.8 (17.6), 19	-1.93 (-13.32, 9.46)
Hivert, 2007	HD+PA	24	-5.4 (20.6), 58	-2.3 (20.4), 57	-3.09 (-10.58, 4.40)
Koniak-Griffin, 2015	HD+PA	9	-2.1 (23.8), 100	-1.4 (25.8), 94	-0.72 (-7.70, 6.26)
Simkin-Silverman, 1995	HD+PA	18	-4.2 (20.7), 236	2.7 (20.2), 253	-6.90 (-10.53, -3.27)
Thompson, 2008	HD+PA	12	-6.2 (22.1), 100	-5.8 (17.5), 100	-0.39 (-5.92, 5.14)
Metzgar, 2016	HD	6	12.5 (32.2), 26	18.2 (34.3), 23	-5.70 (-24.32, 12.92)
Heterogeneity: τ^2 = 1.97, I^2 = 14.90%, H^2 = 1.18					-3.88 (-6.15, -1.61)
Test of $\theta_i = \theta_j$: Q(7) = 5.26, p = 0.63					
Medium intensity (contact time 31 mins to <6 hrs)					
Mosca, 2008	HD+PA	12	-4.4 (31.1), 232	-4.5 (24.1), 232	0.10 (-4.96, 5.16)
Baron, 1990	HD	12	-11.6 (26.6), 164	-11.6 (27.6), 164	0.00 (-5.88, 5.88)
Jenkins, 2017	HD	6	-1.5 (22.5), 145	-1.5 (34.7), 486	0.39 (-4.24, 5.02)
Aadahl, 2014	PA	6	-8.1 (208.5), 81	-2.3 (19.3), 68	-5.79 (-12.92, 1.34)
Kallings, 2009	PA	6	-3.9 (18.9), 41	3.9 (27.8), 50	-7.72 (-17.72, 2.28)
Kinmonth, 2008	PA	12	3.9 (29.5), 107	1.9 (28.1), 111	1.93 (-5.73, 9.59)
Heterogeneity: τ^2 = 0.00, I^2 = 0.00%, H^2 = 1.00					-0.84 (-3.99, 2.31)
Test of $\theta_i = \theta_j$: Q(5) = 4.65, p = 0.46					
Low intensity (contact time ≤30 mins)					
Grandes, 2009	PA	12	-2.1 (43.2), 1456	-1.2 (41.9), 1389	-0.91 (-2.91, 1.09)
Heterogeneity: τ^2 = 0.00, I^2 = .%, H^2 = .					-0.91 (-2.91, 1.09)
Test of $\theta_i = \theta_j$: Q(0) = 0.00, p = .					
Overall					-2.20 (-3.80, -0.60)
Heterogeneity: τ^2 = 2.56, I^2 = 25.71%, H^2 = 1.35					
Test of $\theta_i = \theta_j$: Q(14) = 15.48, p = 0.35					
Test of θ = 0: t(14) = -2.95, p = 0.01					

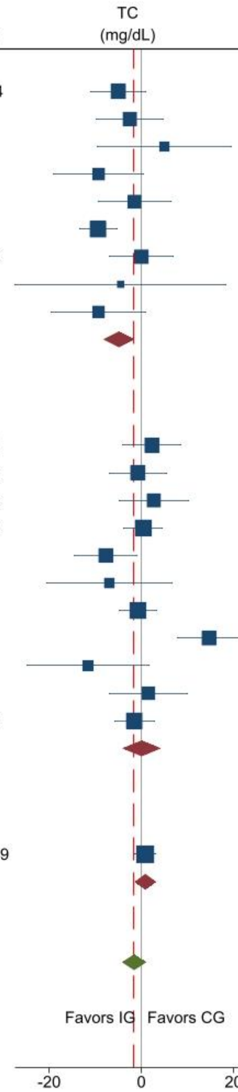


Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

Abbreviations: CI=confidence interval; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; LDL-C=low-density lipoprotein cholesterol; mg/dL=milligrams per deciliter; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

Figure 6. Pooled Analysis of Change in Total Cholesterol (mg/dL) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity

Study	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
High intensity (contact time ≥6 hrs)					
Aldana, 2006	HD+PA	6	6.0 (30.0), 174	11.0 (32.6), 174	-5.00 (-11.00, 1.00)
Bennett, 2013	HD+PA	12	-4.9 (25.8), 91	-2.4 (25.2), 94	-2.50 (-9.85, 4.85)
Brekke, 2005	HD+PA	12	14.3 (26.7), 25	9.3 (20.8), 19	5.02 (-9.50, 19.54)
Hivert, 2007	HD+PA	24	0.8 (29.4), 58	10.0 (23.3), 57	-9.27 (-18.97, 0.43)
Koniak-Griffin, 2015	HD+PA	9	-1.8 (27.8), 100	-0.3 (28.8), 94	-1.47 (-9.43, 6.49)
Simkin-Silverman, 1995	HD+PA	18	-1.6 (23.9), 236	7.8 (22.1), 253	-9.40 (-13.48, -5.32)
Thompson, 2008	HD+PA	12	-5.4 (27.6), 100	-5.4 (21.7), 100	0.00 (-6.88, 6.88)
Metzgar, 2016	HD	6	9.7 (39.9), 26	14.2 (42.8), 24	-4.50 (-27.43, 18.43)
Thompson, 2014	PA	6	-10.0 (20.5), 24	-0.8 (15.4), 24	-9.27 (-19.52, 0.98)
Heterogeneity: $\tau^2 = 6.90$, $I^2 = 31.19\%$, $H^2 = 1.45$					-4.89 (-8.29, -1.48)
Test of $\theta_i = \theta_j$: Q(8) = 10.74, p = 0.22					
Medium intensity (contact time 31 mins to <6 hrs)					
Mosca, 2008	HD+PA	12	-0.5 (36.9), 250	-2.8 (35.3), 251	2.30 (-4.03, 8.63)
Baron, 1990	HD	12	-7.7 (29.4), 167	-6.9 (28.1), 166	-0.77 (-6.94, 5.40)
Jenkins, 2017	HD	6	0.0 (38.0), 145	-1.9 (36.9), 486	2.70 (-4.83, 10.23)
John, 2002	HD	6	-0.7 (33.6), 340	-1.4 (21.6), 344	0.39 (-3.73, 4.51)
Roderick, 1997	HD	12	-8.9 (.), 473	-0.0 (.), 483	-7.72 (-14.48, -0.96)
Aadahl, 2014	PA	6	-10.0 (27.0), 81	-3.1 (23.2), 68	-6.95 (-20.45, 6.55)
Elley, 2003	PA	12	-0.7 (27.0), 451	0.4 (22.4), 427	-0.77 (-4.85, 3.31)
Hargreaves, 2016	PA	6	8.5 (28.8), 35	14.7 (27.8), 39	14.67 (7.87, 21.47)
Kallings, 2009	PA	6	-11.6 (37.8), 41	3.9 (13.9), 50	-11.58 (-24.91, 1.75)
Kinmonth, 2008	PA	12	2.3 (33.7), 107	0.8 (29.2), 111	1.54 (-6.83, 9.91)
Lawton, 2008	PA	12	-9.3 (37.2), 544	-7.7 (34.9), 545	-1.54 (-5.83, 2.75)
Heterogeneity: $\tau^2 = 23.20$, $I^2 = 70.63\%$, $H^2 = 3.40$					0.05 (-4.18, 4.28)
Test of $\theta_i = \theta_j$: Q(10) = 28.63, p = 0.00					
Low intensity (contact time ≤30 mins)					
Grandes, 2009	PA	12	0.9 (41.6), 1456	-0.1 (40.7), 1389	0.87 (-1.44, 3.18)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = .\%$, $H^2 = .$					0.87 (-1.44, 3.18)
Test of $\theta_i = \theta_j$: Q(0) = -0.00, p = .					
Overall					-1.58 (-4.21, 1.04)
Heterogeneity: $\tau^2 = 19.49$, $I^2 = 68.77\%$, $H^2 = 3.20$					
Test of $\theta_i = \theta_j$: Q(20) = 56.99, p = 0.00					
Test of $\theta = 0$: t(20) = -1.26, p = 0.22					

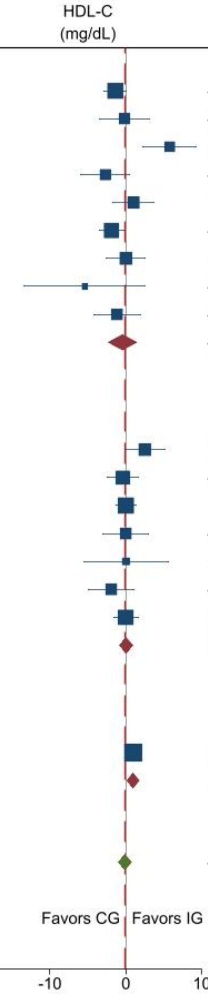


Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

Abbreviations: CI=confidence interval; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; mg/dL=milligrams per deciliter; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation; TC=total cholesterol.

Figure 7. Pooled Analysis of Change in High-Density Lipoprotein Cholesterol (mg/dL) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity

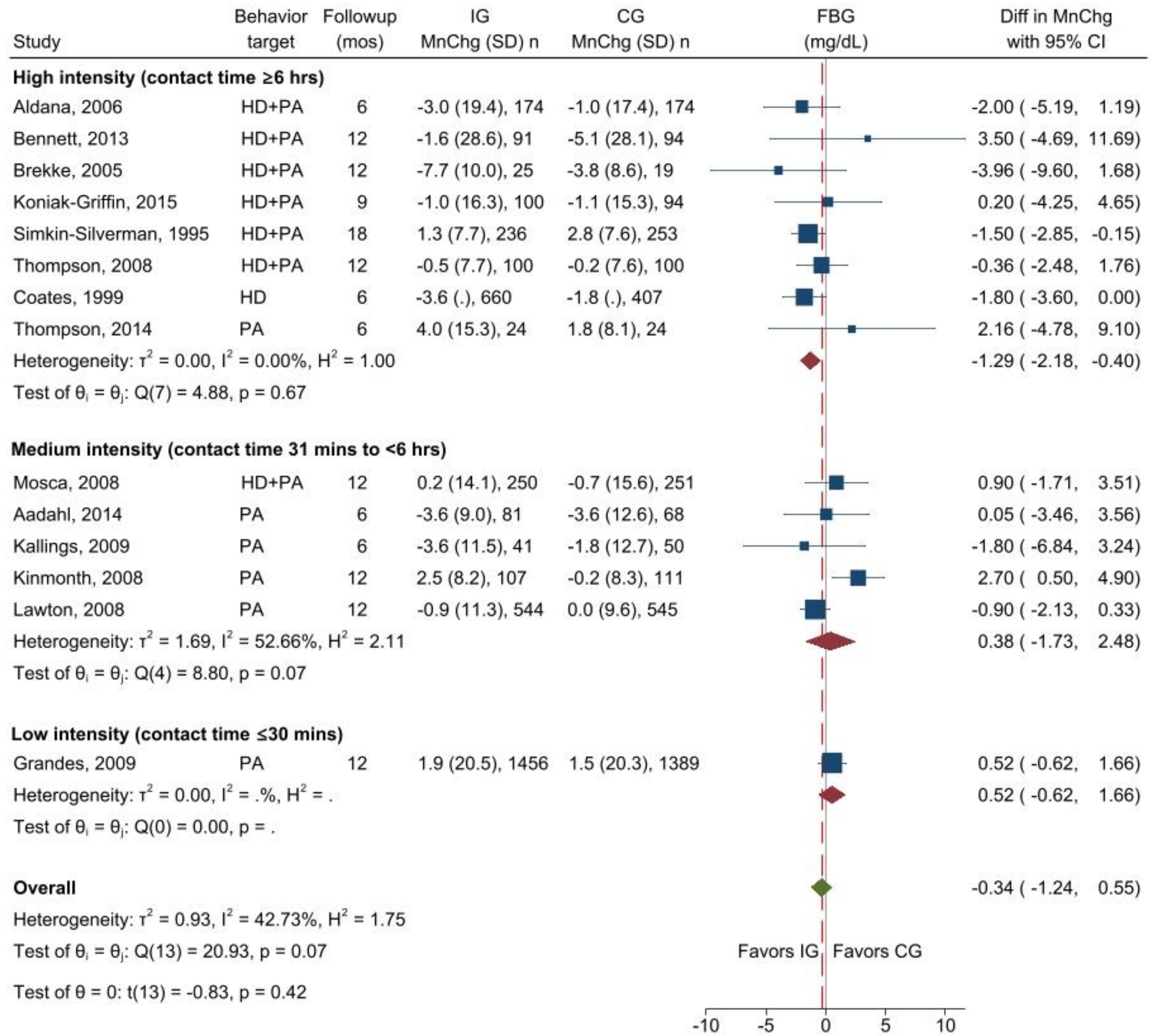
Study	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
High intensity (contact time ≥6 hrs)					
Aldana, 2006	HD+PA	6	1.4 (9.3), 174	2.8 (7.4), 174	-1.40 (-2.85, 0.05)
Bennett, 2013	HD+PA	12	-1.6 (11.4), 91	-1.4 (11.6), 94	-0.20 (-3.45, 3.05)
Brekke, 2005	HD+PA	12	4.2 (6.1), 25	-1.5 (5.6), 19	5.79 (2.28, 9.30)
Hivert, 2007	HD+PA	24	7.7 (8.8), 58	10.4 (8.7), 57	-2.70 (-5.91, 0.51)
Koniak-Griffin, 2015	HD+PA	9	1.6 (9.7), 100	0.6 (9.8), 94	1.01 (-1.73, 3.75)
Simkin-Silverman, 1995	HD+PA	18	1.0 (9.7), 236	2.9 (9.0), 253	-1.90 (-3.55, -0.25)
Thompson, 2008	HD+PA	12	1.2 (9.6), 100	1.2 (8.6), 100	0.00 (-2.53, 2.53)
Metzgar, 2016	HD	6	-3.2 (14.1), 26	2.2 (14.7), 24	-5.40 (-13.38, 2.58)
Thompson, 2014	PA	6	-1.5 (6.6), 24	-0.4 (3.9), 24	-1.16 (-4.20, 1.88)
Heterogeneity: $\tau^2 = 3.32$, $I^2 = 66.42\%$, $H^2 = 2.98$					-0.44 (-2.41, 1.52)
Test of $\theta_i = \theta_j$: Q(8) = 20.78, p = 0.01					
Medium intensity (contact time 31 mins to <6 hrs)					
Mosca, 2008	HD+PA	12	0.2 (15.4), 250	-2.3 (14.4), 251	2.50 (-0.11, 5.11)
Baron, 1990	HD	12	-1.2 (10.0), 165	-0.8 (9.2), 165	-0.39 (-2.45, 1.67)
Jenkins, 2017	HD	6	-0.8 (8.3), 145	-0.4 (8.7), 486	0.00 (-1.35, 1.35)
Aadahl, 2014	PA	6	-1.2 (7.7), 81	-0.8 (7.7), 68	-0.02 (-2.98, 2.94)
Kallings, 2009	PA	6	0.0 (12.7), 41	0.0 (13.9), 50	0.00 (-5.53, 5.53)
Kinmonth, 2008	PA	12	-1.2 (10.8), 107	0.8 (11.7), 111	-1.93 (-4.91, 1.05)
Lawton, 2008	PA	12	3.1 (14.1), 544	3.1 (12.8), 545	0.00 (-1.61, 1.61)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$					0.04 (-0.90, 0.97)
Test of $\theta_i = \theta_j$: Q(6) = 5.28, p = 0.51					
Low intensity (contact time ≤30 mins)					
Grandes, 2009	PA	12	2.7 (22.0), 1456	1.7 (21.3), 1389	0.94 (0.08, 1.80)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = .\%$, $H^2 = .$					0.94 (0.08, 1.80)
Test of $\theta_i = \theta_j$: Q(0) = 0.00, p = .					
Overall					-0.12 (-1.04, 0.80)
Heterogeneity: $\tau^2 = 1.15$, $I^2 = 51.35\%$, $H^2 = 2.06$					
Test of $\theta_i = \theta_j$: Q(16) = 34.57, p = 0.00					
Test of $\theta = 0$: t(16) = -0.28, p = 0.78					



Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

Abbreviations: CI=confidence interval; Diff=difference; HD=healthy diet; HDL-C=high-density lipoprotein cholesterol; Hrs=hours; IG=intervention group; CG=control group; mg/dL=milligrams per deciliter; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

Figure 8. Pooled Analysis of Change in Fasting Glucose (mg/dL) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity

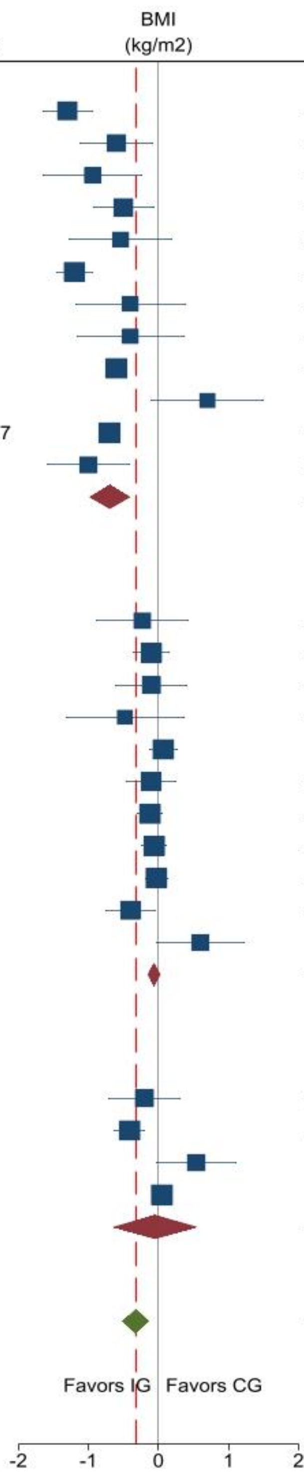


Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

Abbreviations: CI=confidence interval; Diff=difference; FBG=fasting blood glucose; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; mg/dL=milligrams per deciliter; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

Figure 9. Pooled Analysis of Change in Body Mass Index (kg/m²) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity

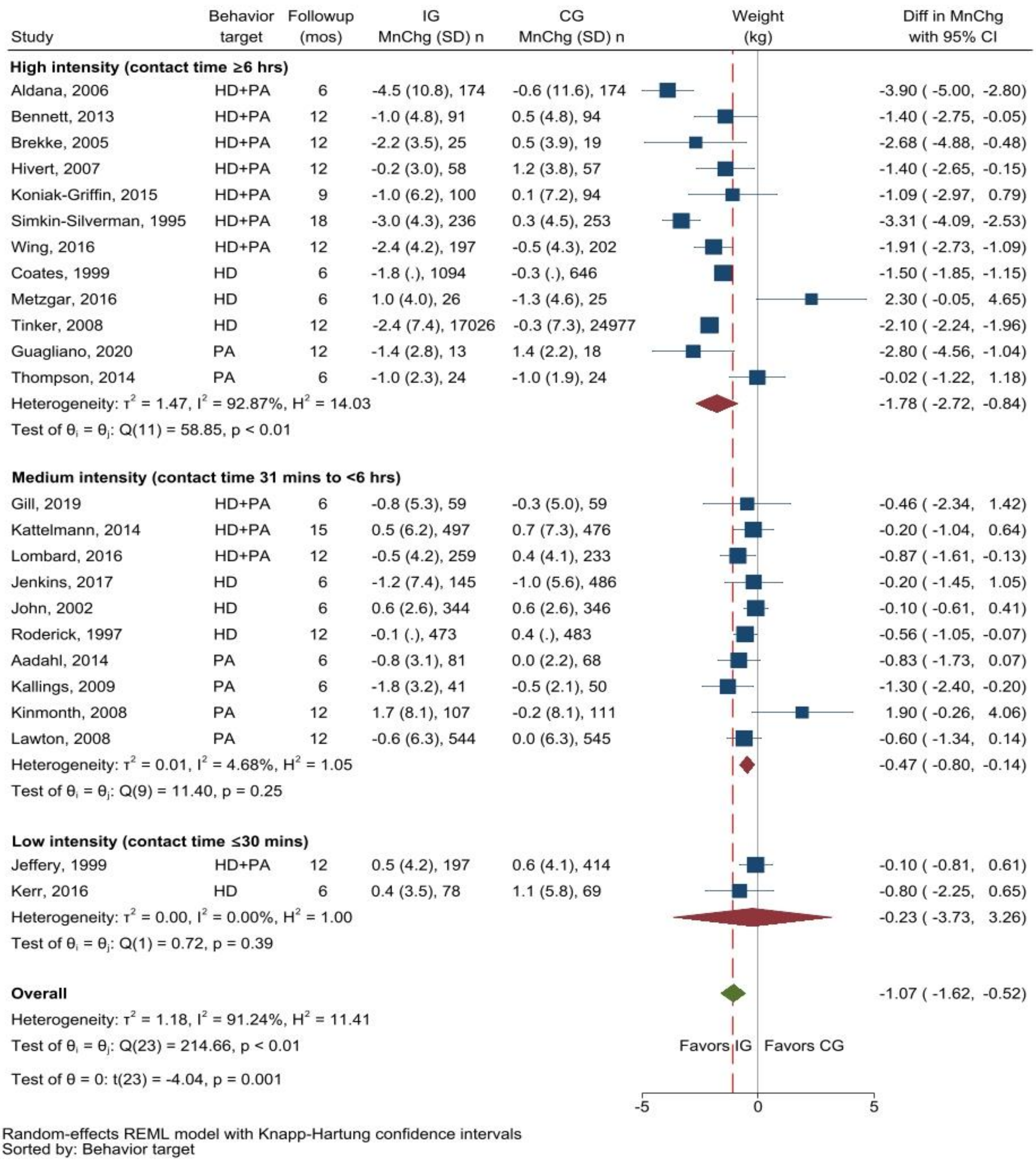
Study	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
High intensity (contact time ≥6 hrs)					
Aldana, 2006	HD+PA	6	-1.6 (3.6), 174	-0.3 (4.1), 174	-1.30 (-1.65, -0.95)
Bennett, 2013	HD+PA	12	-0.3 (1.9), 91	0.3 (1.9), 94	-0.60 (-1.11, -0.09)
Brekke, 2005	HD+PA	12	-0.7 (1.1), 25	0.2 (1.3), 19	-0.94 (-1.65, -0.23)
Hivert, 2007	HD+PA	12	-0.1 (0.8), 58	0.4 (1.5), 57	-0.50 (-0.93, -0.07)
Koniak-Griffin, 2015	HD+PA	9	-0.4 (2.3), 100	0.1 (2.9), 94	-0.54 (-1.27, 0.19)
Simkin-Silverman, 1995	HD+PA	18	-1.1 (1.4), 236	0.1 (1.5), 253	-1.20 (-1.45, -0.95)
Thompson, 2008	HD+PA	12	-0.1 (2.7), 100	0.3 (2.9), 100	-0.40 (-1.18, 0.38)
Wieland, 2018	HD+PA	12	0.2 (1.6), 36	0.6 (1.7), 34	-0.40 (-1.16, 0.36)
Coates, 1999	HD	6	-0.7 (.), 1094	-0.1 (.), 646	-0.60 (-0.74, -0.46)
Metzgar, 2016	HD	6	0.3 (1.3), 26	-0.4 (1.6), 25	0.70 (-0.10, 1.50)
Tinker, 2008	HD	12	-0.9 (2.6), 17026	-0.2 (2.6), 24977	-0.70 (-0.76, -0.64)
Guagliano, 2020	PA	12	-0.5 (1.0), 15	0.5 (0.7), 18	-1.00 (-1.59, -0.41)
Heterogeneity: $\tau^2 = 0.13$, $I^2 = 87.77\%$, $H^2 = 8.17$					-0.69 (-0.99, -0.40)
Test of $\theta_i = \theta_j$: Q(11) = 43.23, p < 0.01					
Medium intensity (contact time 31 mins to <6 hrs)					
Gill, 2019	HD+PA	6	-0.3 (1.8), 59	-0.1 (1.7), 59	-0.23 (-0.88, 0.42)
Kattelmann, 2014	HD+PA	15	0.1 (1.7), 497	0.2 (2.2), 476	-0.10 (-0.35, 0.15)
Mosca, 2008	HD+PA	12	-0.1 (2.8), 250	0.0 (3.0), 251	-0.10 (-0.61, 0.41)
Sun, 2017	HD+PA	6	-0.2 (1.3), 16	0.3 (1.2), 16	-0.48 (-1.32, 0.36)
Valve, 2013	HD+PA	24	0.6 (2.3), 1244	0.5 (2.6), 1294	0.07 (-0.13, 0.27)
Jenkins, 2017	HD	6	-0.4 (1.8), 145	-0.3 (1.7), 486	-0.10 (-0.45, 0.25)
Roderick, 1997	HD	12	0.0 (.), 473	0.1 (.), 483	-0.12 (-0.30, 0.06)
Elley, 2003	PA	12	-0.1 (1.5), 451	-0.1 (1.3), 427	-0.06 (-0.24, 0.12)
Harris, 2018	PA	12	-10.1 (2.3), 321	-0.2 (2.4), 323	-0.03 (-0.19, 0.13)
Kallings, 2009	PA	6	-0.6 (1.0), 41	-0.2 (0.7), 50	-0.40 (-0.75, -0.05)
Kinmonth, 2008	PA	12	0.6 (2.4), 107	0.0 (2.3), 111	0.60 (-0.03, 1.23)
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$					-0.06 (-0.16, 0.03)
Test of $\theta_i = \theta_j$: Q(10) = 11.48, p = 0.32					
Low intensity (contact time ≤30 mins)					
Kerr, 2016	HD	6	0.1 (0.9), 78	0.4 (1.7), 69	-0.20 (-0.71, 0.31)
Sacerdote, 2006	HD	12	-0.4 (4.7), 1488	0.0 (3.8), 1489	-0.41 (-0.63, -0.19)
Bryan, 2013	PA	12	0.6 (2.1), 113	0.0 (2.2), 105	0.54 (-0.03, 1.11)
Grandes, 2009	PA	12	0.1 (2.0), 1456	0.0 (2.0), 1389	0.05 (-0.01, 0.11)
Heterogeneity: $\tau^2 = 0.10$, $I^2 = 87.28\%$, $H^2 = 7.86$					-0.05 (-0.65, 0.56)
Test of $\theta_i = \theta_j$: Q(3) = 20.21, p = 0.00					
Overall					-0.32 (-0.51, -0.13)
Heterogeneity: $\tau^2 = 0.17$, $I^2 = 94.55\%$, $H^2 = 18.34$					
Test of $\theta_i = \theta_j$: Q(26) = 485.62, p < 0.01					
Test of $\theta = 0$: t(26) = -3.50, p = 0.002					



Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Behavior target

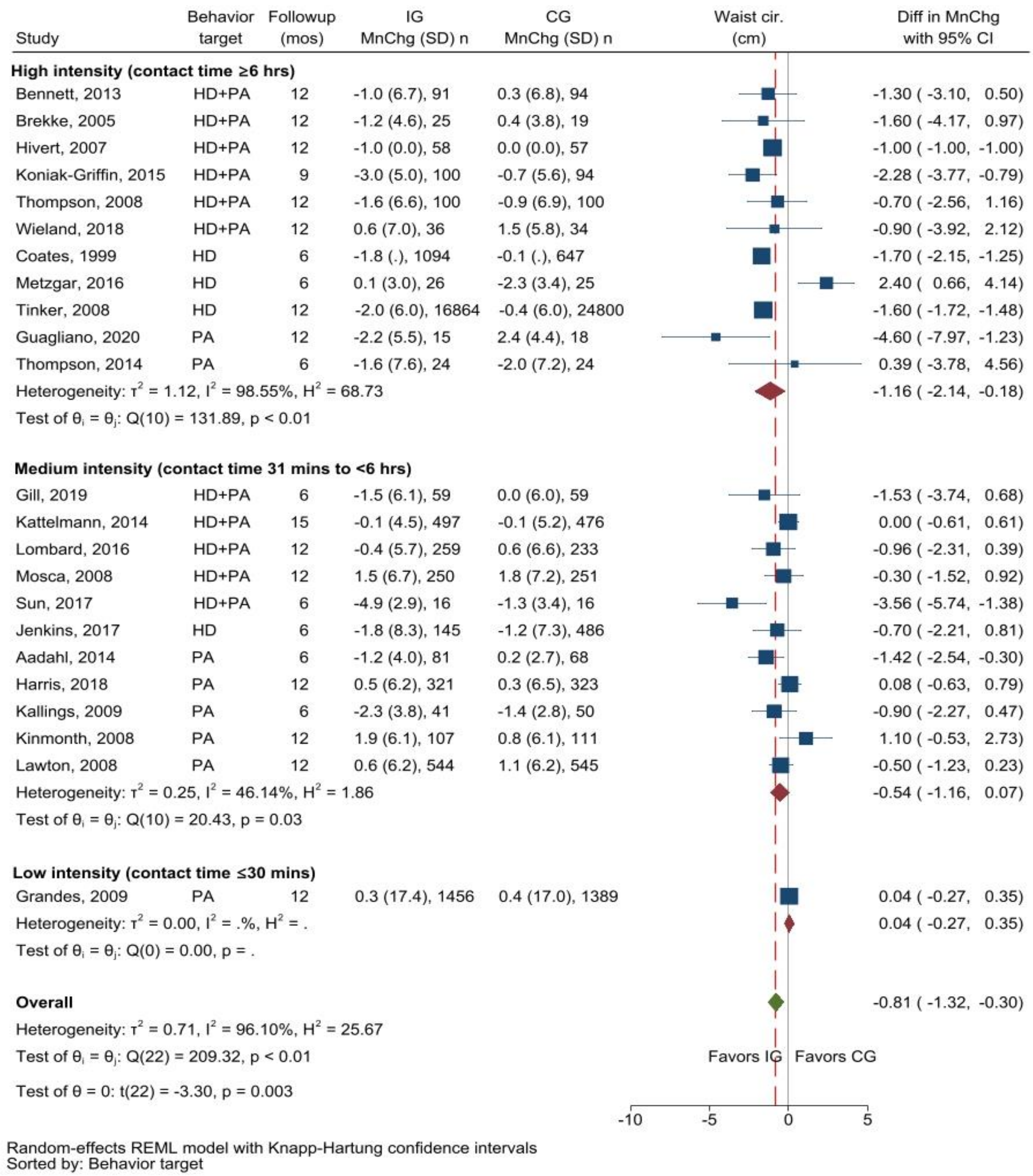
Abbreviations: BMI=body mass index; CG=control group; CI=confidence interval; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; kg/m²=kilograms per meters squared; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

Figure 10. Pooled Analysis of Change in Weight (kg) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity



Abbreviations: CI=confidence interval; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; kg=kilograms; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

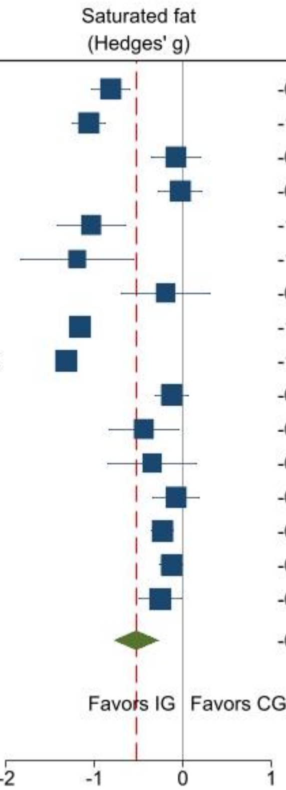
Figure 11. Pooled Analysis of Change in Waist Circumference (cm) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Intervention Intensity



Abbreviations: CI=confidence interval; Cir=circumference; Cm=centimeters; Diff=difference; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; Mins=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

Figure 12. Pooled Analysis of Change in Saturated Fat Intake (Standardized Mean Difference) in Healthy Diet and Physical Activity Interventions Compared With Controls

Study	Intensity	Behavior target	Followup (mos)	Unit of measure	IG MnChg (SD) n	CG MnChg (SD) n	SMD Hedges' g with 95% CI
Aldana, 2006	High	HD+PA	6	g/day	-13.0 (16.3), 174	-1.3 (12.1), 174	-0.82 (-1.03, -0.60)
Simkin-Silverman, 1995	High	HD+PA	18	% energy	-3.8 (3.1), 236	-0.5 (3.1), 253	-1.06 (-1.25, -0.88)
Thompson, 2008	High	HD+PA	12	g/day	-4.7 (14.0), 96	-3.6 (14.0), 95	-0.08 (-0.36, 0.20)
Jacobs, 2011	High	HD+PA	12	% change	-0.5 (34.3), 194	0.3 (27.2), 93	-0.03 (-0.27, 0.22)
Spring, 2018	High	HD+PA	9	% cal/day	-3.9 (2.8), 84	-0.9 (3.0), 44	-1.04 (-1.42, -0.65)
Brekke, 2005	High	HD	12	% energy	-4.7 (3.3), 24	-0.6 (3.4), 19	-1.20 (-1.84, -0.55)
Carpenter, 2004	High	HD	6	score	-1.2 (3.2), 28	-0.6 (3.3), 33	-0.20 (-0.69, 0.30)
Coates, 1999	High	HD	6	% energy	-4.2 (3.1), 1071	-0.7 (2.8), 649	-1.16 (-1.27, -1.06)
Tinker, 2008	High	HD	12	% energy	-4.7 (2.9), 17117	-1.0 (2.7), 25182	-1.32 (-1.34, -1.30)
Mosca, 2008	Medium	HD+PA	12	% energy	-0.7 (2.3), 232	-0.4 (2.6), 232	-0.13 (-0.31, 0.06)
King, 2013	Medium	HD+PA	12	% energy	-2.5 (2.7), 50	-1.2 (3.1), 49	-0.44 (-0.84, -0.05)
Smith, 2014	Medium	HD+PA	6	g/day	-8.6 (11.8), 29	-3.3 (17.5), 30	-0.35 (-0.86, 0.16)
Lombard, 2016	Medium	HD+PA	12	g/day	-2.8 (9.3), 114	-2.1 (9.1), 106	-0.08 (-0.34, 0.19)
Roderick, 1997	Medium	HD	12	% energy	-1.5 (3.9), 473	-0.6 (3.9), 483	-0.23 (-0.36, -0.10)
Springvloet, 2015	Medium	HD	11	score	-1.9 (6.0), 459	-1.2 (5.6), 434	-0.13 (-0.26, 0.00)
Jenkins, 2017	Medium	HD	6	% energy	-1.0 (2.6), 87	-0.4 (2.3), 317	-0.25 (-0.49, -0.02)
Overall							-0.53 (-0.78, -0.27)



Heterogeneity: $\tau^2 = 0.21$, $I^2 = 97.38\%$, $H^2 = 38.17$

Test of $\theta_i = \theta_j$: $Q(15) = 1073.42$, $p < 0.001$

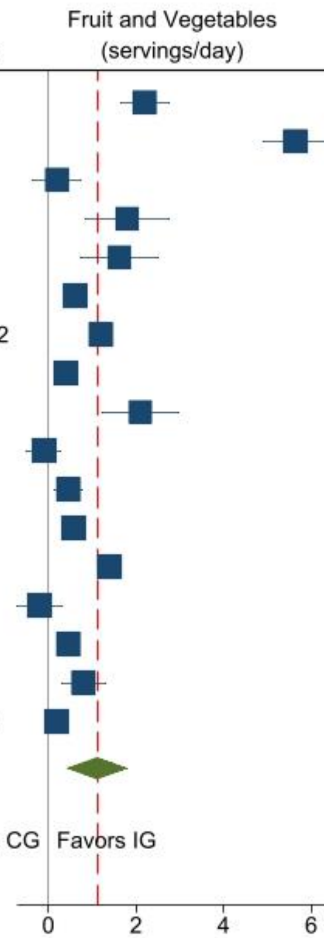
Test of $\theta = 0$: $t(15) = -4.41$, $p = 0.001$

Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Intensity and behavior target

Abbreviations: CI=confidence interval; HD=healthy diet; IG=intervention group; CG=control group; g=grams; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation; SMD=standardized mean difference.

Figure 13. Pooled Analysis of Change in Fruit and Vegetable Intake (Servings per Day) in Healthy Diet and Physical Activity Interventions Compared With Controls

Study	Intensity	Behavior target	Followup (mos)	IG MnChg (SD) n	CG MnChg (SD) n	Diff in MnChg with 95% CI
Aldana, 2006	High	HD+PA	6	2.3 (2.9), 174	0.1 (2.2), 174	2.20 (1.65, 2.75)
Spring, 2018	High	HD+PA	9	6.5 (1.7), 84	0.9 (2.4), 44	5.64 (4.91, 6.37)
Thompson, 2008	High	HD+PA	12	0.1 (2.1), 96	-0.1 (1.7), 95	0.20 (-0.35, 0.75)
Bernstein, 2002	High	HD	6	2.2 (2.2), 38	0.4 (1.9), 32	1.80 (0.84, 2.76)
Caplette, 2017	High	HD	6	1.8 (2.5), 38	0.2 (1.4), 40	1.62 (0.74, 2.50)
Coates, 1999	High	HD	6	0.7 (1.8), 1071	0.0 (1.5), 649	0.61 (0.45, 0.77)
Tinker, 2008	High	HD	12	1.5 (2.0), 17117	0.3 (1.5), 25182	1.20 (1.16, 1.24)
Kattelmann, 2014	Medium	HD+PA	15	0.1 (2.0), 497	-0.3 (1.5), 476	0.40 (0.18, 0.62)
King, 2013	Medium	HD+PA	12	2.8 (2.7), 50	0.7 (1.6), 49	2.10 (1.24, 2.96)
Mosca, 2008	Medium	HD+PA	12	-0.1 (2.3), 250	0.0 (2.2), 251	-0.10 (-0.49, 0.29)
Alexander, 2010	Medium	HD	12	2.8 (3.0), 578	2.3 (2.5), 611	0.46 (0.15, 0.77)
Greene, 2008	Medium	HD	12	0.9 (2.1), 410	0.3 (1.6), 424	0.58 (0.33, 0.83)
John, 2002	Medium	HD	6	1.4 (1.7), 329	0.1 (1.3), 326	1.40 (1.20, 1.60)
Kerr, 2016	Low	HD	6	0.0 (1.6), 78	0.2 (1.5), 69	-0.20 (-0.71, 0.31)
Kristal, 2000	Low	HD	12	0.5 (1.8), 601	0.1 (1.8), 604	0.46 (0.26, 0.66)
Lutz, 1999	Low	HD	6	0.9 (2.4), 146	0.1 (1.9), 151	0.80 (0.31, 1.29)
Sacerdote, 2006	Low	HD	12	0.4 (7.0), 1488	0.2 (5.8), 1489	0.19 (-0.06, 0.44)
Overall						1.11 (0.41, 1.81)



Heterogeneity: $\tau^2 = 1.73$, $I^2 = 99.25\%$, $H^2 = 133.86$

Test of $\theta_i = \theta_j$: $Q(16) = 480.88$, $p < 0.001$

Test of $\theta = 0$: $t(16) = 3.37$, $p = 0.004$

Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Intensity and behavior target

Abbreviations: CI=confidence interval; Diff=difference; HD=healthy diet; IG=intervention group; CG=control group; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation.

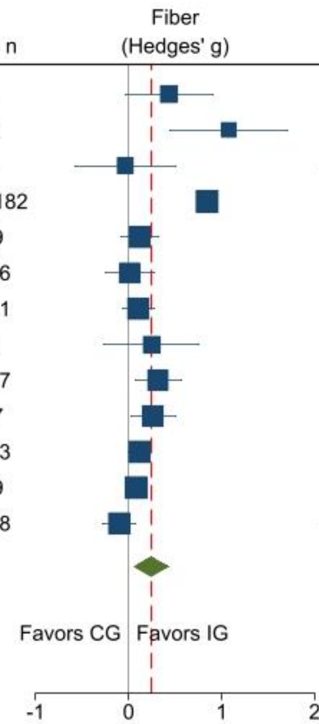
Figure 14. Pooled Analysis of Change in Fiber Intake (Standardized Mean Difference) in Healthy Diet and Physical Activity Interventions Compared With Controls

Study	Intensity	Behavior target	Followup (mos)	Unit of measure	IG MnChg (SD) n	CG MnChg (SD) n	SMD Hedges' g with 95% CI
Bernstein, 2002	High	HD	6	g/day	4.0 (5.0), 38	2.0 (4.0), 32	0.43 (-0.04, 0.90)
Brekke, 2005	High	HD	12	g/1000 kcal	3.5 (4.4), 24	-0.5 (2.4), 19	1.08 (0.44, 1.71)
Metzgar, 2016	High	HD	6	g/day	0.7 (5.6), 26	0.9 (5.1), 26	-0.04 (-0.57, 0.50)
Tinker, 2008	High	HD	12	g/1000 kcal	3.5 (3.4), 17117	0.9 (2.8), 25182	0.84 (0.82, 0.86)
Burke, 2013	Medium	HD+PA	6	score	1.3 (6.0), 176	0.6 (6.1), 199	0.12 (-0.09, 0.32)
Lombard, 2016	Medium	HD+PA	12	g/day	-0.3 (6.5), 114	-0.3 (4.5), 106	0.01 (-0.25, 0.27)
Mosca, 2008	Medium	HD+PA	12	g/day	-0.1 (10.4), 250	-1.1 (8.9), 251	0.10 (-0.07, 0.28)
Smith, 2014	Medium	HD+PA	6	g/day	0.4 (8.9), 29	-1.9 (9.5), 30	0.25 (-0.26, 0.75)
Baron, 1990	Medium	HD	12	g/day	2.4 (8.3), 121	-0.1 (7.4), 137	0.31 (0.07, 0.56)
Jenkins, 2017	Medium	HD	6	g/1000 kcal	2.7 (4.5), 87	1.6 (4.1), 317	0.26 (0.02, 0.50)
Roderick, 1997	Medium	HD	12	g/day	0.9 (8.8), 473	-0.2 (9.3), 483	0.12 (-0.01, 0.24)
Beresford, 1997	Low	HD	12	g/1000 kcal	0.6 (4.2), 859	0.2 (4.1), 959	0.08 (-0.01, 0.17)
Fries, 2005	Low	HD	12	score	-0.1 (0.4), 238	-0.1 (0.4), 278	-0.10 (-0.28, 0.07)
Overall							0.24 (0.05, 0.43)

Heterogeneity: $\tau^2 = 0.08$, $I^2 = 93.90\%$, $H^2 = 16.39$

Test of $\theta_i = \theta_j$: $Q(12) = 636.81$, $p < 0.001$

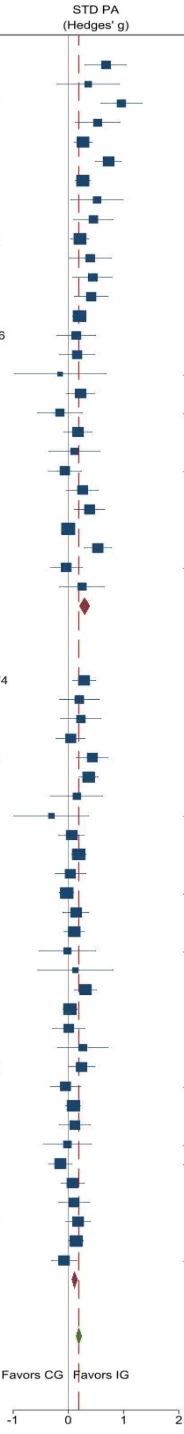
Test of $\theta = 0$: $t(12) = 2.73$, $p = 0.02$



Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Intensity and behavior target

Abbreviations: CI=confidence interval; HD=healthy diet; IG=intervention group; CG=control group; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation; SMD=standardized mean difference.

Figure 15. Pooled Analysis of Change in Physical Activity (Standardized Mean Difference) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Population Selection



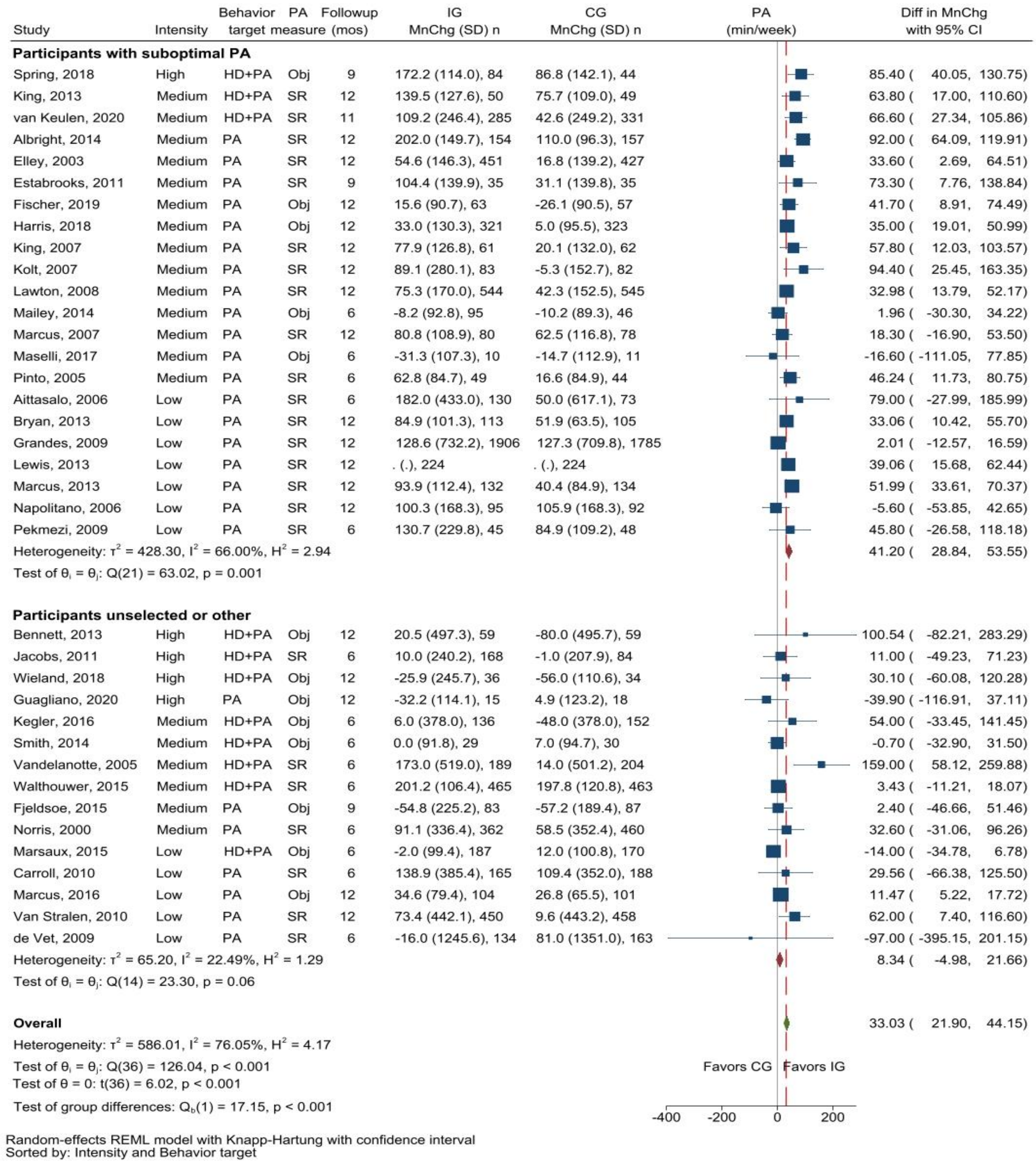
Study	Intensity	Behavior target	PA measure	Followup (mos)	Unit of measure	IG MnChg (SD) n	CG MnChg (SD) n	SMD Hedges' g with 95% CI
Participants with suboptimal PA								
Spring, 2018	High	HD+PA	Obj	9	min/week	172.2 (114.0), 84	86.8 (142.1), 44	0.68 (0.31, 1.05)
Thompson, 2014	High	PA	Obj	6	Activity units/day	-217.8 (1032.3), 24	-583.6 (940.3), 24	0.36 (-0.20, 0.93)
Gill, 2019	Medium	HD+PA	Obj	6	steps/day	1646.0 (3302.0), 59	-1485.0 (3171.5), 59	0.96 (0.58, 1.34)
King, 2013	Medium	HD+PA	SR	12	min/week	139.5 (127.6), 50	75.7 (109.0), 49	0.53 (0.13, 0.93)
van Keulen, 2020	Medium	HD+PA	SR	11	min/week	109.2 (246.4), 285	42.6 (249.2), 331	0.27 (0.11, 0.43)
Albright, 2014	Medium	PA	SR	12	min/week	202.0 (149.7), 154	110.0 (96.3), 157	0.73 (0.50, 0.96)
Elley, 2003	Medium	PA	SR	12	min/week	54.6 (146.3), 451	16.8 (139.2), 427	0.26 (0.13, 0.40)
Estabrooks, 2011	Medium	PA	SR	9	min/week	104.4 (139.9), 35	31.1 (139.8), 35	0.52 (0.05, 0.99)
Fischer, 2019	Medium	PA	Obj	12	min/week	15.6 (90.7), 63	-26.1 (90.5), 57	0.46 (0.10, 0.82)
Harris, 2018	Medium	PA	Obj	12	steps/day	478.0 (3047.0), 321	-133.0 (2683.6), 323	0.21 (0.06, 0.37)
James, 2017	Medium	PA	Obj	12	steps/day	1240.0 (2437.4), 76	321.0 (1943.4), 40	0.40 (0.02, 0.78)
King, 2007	Medium	PA	SR	12	min/week	77.9 (126.8), 61	20.1 (132.0), 62	0.44 (0.09, 0.80)
Kolt, 2007	Medium	PA	SR	12	min/week	89.1 (280.1), 83	-5.3 (152.7), 82	0.42 (0.11, 0.72)
Lawton, 2008	Medium	PA	SR	12	min/week	75.3 (170.0), 544	42.3 (152.5), 545	0.20 (0.09, 0.32)
Mailey, 2014	Medium	PA	Obj	6	counts/day	5599.0 (73171.6), 95	-4818.0 (60925.4), 46	0.15 (-0.20, 0.50)
Marcus, 2007	Medium	PA	SR	12	min/week	80.8 (108.9), 80	62.5 (116.8), 78	0.16 (-0.15, 0.47)
Maselli, 2017	Medium	PA	Obj	6	min/week	-31.3 (107.3), 10	-14.7 (112.9), 11	-0.14 (-0.97, 0.68)
Pinto, 2002	Medium	PA	SR	6	kcal/kg/day	0.6 (2.4), 112	0.1 (2.1), 126	0.22 (-0.03, 0.48)
Pinto, 2005	Medium	PA	SR	6	kcal/kg/day	-0.8 (5.0), 49	-0.1 (5.0), 44	-0.15 (-0.56, 0.25)
Van Hoecke, 2014	Medium	PA	Obj	12	steps/day	460.6 (2374.8), 124	39.8 (2282.9), 114	0.18 (-0.07, 0.43)
Wadsworth, 2010	Medium	PA	SR	6	sessions/week	0.8 (2.1), 34	0.5 (1.7), 37	0.11 (-0.35, 0.58)
Warner, 2016	Medium	PA	SR	10	MET-min/week	-10.8 (28.1), 86	-9.2 (27.9), 80	-0.06 (-0.36, 0.24)
Aittasalo, 2006	Low	PA	SR	6	min/week	182.0 (433.0), 130	50.0 (617.1), 73	0.26 (-0.03, 0.55)
Bryan, 2013	Low	PA	SR	12	min/week	84.9 (101.3), 113	51.9 (63.5), 105	0.39 (0.12, 0.65)
Grandes, 2009	Low	PA	SR	12	min/week	128.6 (732.2), 1906	127.3 (709.8), 1785	0.00 (-0.06, 0.07)
Marcus, 2013	Low	PA	SR	12	min/week	93.9 (112.4), 132	40.4 (84.9), 134	0.54 (0.29, 0.78)
Napolitano, 2006	Low	PA	SR	12	min/week	100.3 (168.3), 95	105.9 (168.3), 92	-0.03 (-0.32, 0.25)
Pekmezi, 2009	Low	PA	SR	6	min/week	130.7 (229.8), 45	84.9 (109.2), 48	0.26 (-0.15, 0.66)
Heterogeneity: τ^2 = 0.04, I^2 = 73.84%, H^2 = 3.82								0.29 (0.20, 0.39)
Test of $\theta_i = \theta_j$: Q(27) = 110.04, p < 0.001								
Participants unselected or other								
Aldana, 2006	High	HD+PA	SR	6	steps/week	12372.0 (23476.9), 174	5661.0 (23018.9), 174	0.29 (0.08, 0.50)
Bennett, 2013	High	HD+PA	Obj	12	min/week	20.5 (497.3), 59	-80.0 (495.7), 59	0.20 (-0.16, 0.56)
Hivert, 2007	High	HD+PA	SR	12	kcal/kg/year	-81.0 (700.7), 58	-260.0 (838.0), 57	0.23 (-0.13, 0.59)
Jacobs, 2011	High	HD+PA	SR	6	min/week	10.0 (240.2), 168	-1.0 (207.9), 84	0.05 (-0.21, 0.31)
Koniak-Griffin, 2015	High	HD+PA	Obj	9	steps/day	-2.0 (3089.1), 100	-1330.0 (2964.0), 94	0.44 (0.15, 0.72)
Simkin-Silverman, 1995	High	HD+PA	Obj	6	counts/hr	3.2 (8.6), 236	0.1 (8.2), 253	0.37 (0.19, 0.55)
Wieland, 2018	High	HD+PA	Obj	12	min/week	-25.9 (245.7), 36	-56.0 (110.6), 34	0.15 (-0.31, 0.62)
Guagliano, 2020	High	PA	Obj	12	min/week	-32.2 (114.1), 15	4.9 (123.2), 18	-0.30 (-0.98, 0.37)
Katz, 2008	High	PA	SR	12	score	1.9 (13.3), 185	1.0 (16.4), 117	0.06 (-0.17, 0.30)
Martinson, 2008	High	PA	SR	12	kcal/week	341.0 (2082.5), 494	-57.0 (2127.4), 487	0.19 (0.06, 0.31)
Allman-Farinelli, 2016	Medium	HD+PA	SR	9	MET-min/week	872.0 (1918.0), 96	797.0 (2115.0), 104	0.04 (-0.24, 0.31)
Kattelmann, 2014	Medium	HD+PA	SR	15	MET-min/week	56.0 (1648.6), 497	94.0 (1649.3), 476	-0.02 (-0.15, 0.10)
Kegler, 2016	Medium	HD+PA	Obj	6	min/week	6.0 (378.0), 136	-48.0 (378.0), 152	0.14 (-0.09, 0.37)
Mosca, 2008	Medium	HD+PA	SR	12	days/wk	0.6 (2.3), 232	0.3 (2.0), 232	0.11 (-0.07, 0.29)
Smith, 2014	Medium	HD+PA	Obj	6	steps/day	-153.0 (2737.3), 29	-111.0 (2154.2), 30	-0.02 (-0.52, 0.49)
Sun, 2017	Medium	HD+PA	Obj	6	steps/day	1011.1 (4824.7), 16	375.0 (4604.3), 16	0.13 (-0.54, 0.81)
Vandelanotte, 2005	Medium	HD+PA	SR	6	min/week	173.0 (519.0), 189	14.0 (501.2), 204	0.31 (0.11, 0.51)
Walthouwer, 2015	Medium	HD+PA	SR	6	min/week	201.2 (106.4), 465	197.8 (120.8), 463	0.03 (-0.10, 0.16)
Fjeldsoe, 2015	Medium	PA	Obj	9	min/week	-54.8 (225.2), 83	-57.2 (189.4), 87	0.01 (-0.29, 0.31)
Gell, 2015	Medium	PA	Obj	6	steps/day	115.6 (2467.9), 37	-548.9 (2473.9), 37	0.27 (-0.19, 0.72)
Harris, 2015	Medium	PA	Obj	12	steps/day	200.0 (2957.4), 137	-508.0 (2895.0), 136	0.24 (0.00, 0.48)
Kinmonth, 2008	Medium	PA	Obj	12	Ratio to REE	0.1 (0.7), 107	0.1 (0.6), 111	-0.05 (-0.31, 0.22)
Norris, 2000	Medium	PA	SR	6	min/week	91.1 (336.4), 362	58.5 (352.4), 460	0.09 (-0.04, 0.23)
Patel, 2017	Medium	PA	Obj	6	steps/day	1385.0 (3116.9), 94	978.0 (3518.3), 100	0.12 (-0.16, 0.40)
Samdal, 2019	Medium	PA	Obj	6	hrs/day	0.0 (0.6), 38	0.0 (0.8), 43	-0.01 (-0.45, 0.42)
Marsaux, 2015	Low	HD+PA	Obj	6	min/week	-2.0 (99.4), 187	12.0 (100.8), 170	-0.14 (-0.35, 0.07)
Carroll, 2010	Low	PA	SR	6	min/week	138.9 (385.4), 165	109.4 (352.0), 188	0.08 (-0.13, 0.29)
Marcus, 2016	Low	PA	Obj	12	min/week	34.6 (79.4), 104	26.8 (65.5), 101	0.11 (-0.17, 0.38)
Patel, 2019	Low	PA	Obj	9	steps/day	279.0 (2750.7), 150	-187.0 (2419.0), 151	0.18 (-0.05, 0.41)
Van Stralen, 2010	Low	PA	SR	12	min/week	73.4 (442.1), 450	9.6 (443.2), 458	0.14 (0.01, 0.27)
de Vet, 2009	Low	PA	SR	6	min/week	-16.0 (1245.6), 134	81.0 (1351.0), 163	-0.07 (-0.30, 0.15)
Heterogeneity: τ^2 = 0.01, I^2 = 35.44%, H^2 = 1.55								0.12 (0.07, 0.17)
Test of $\theta_i = \theta_j$: Q(30) = 42.82, p = 0.06								
Overall								0.19 (0.14, 0.25)
Heterogeneity: τ^2 = 0.02, I^2 = 65.39%, H^2 = 2.89								
Test of $\theta_i = \theta_j$: Q(58) = 159.20, p < 0.001								
Test of θ = 0: t(58) = 7.11, p < 0.001								
Test of group differences: $Q_b(1)$ = 10.92, p = 0.001								

Random-effects REML model with Knapp-Hartung confidence intervals
Sorted by: Intensity and Behavior target

Note: Suboptimal PA indicates that participants were eligible to be included in the trial if they were not meeting current physical activity guidelines.

Abbreviations: CI=confidence interval; HD=healthy diet; hr=hour; IG=intervention group; CG=control group; kcal=kilocalorie; MET=metabolic equivalent; min=minutes; Mos=months; Obj=objective measurement; PA=physical activity; REE=resting energy expenditure; REML=restricted maximum likelihood; SD=standard deviation; SMD=standardized mean difference; SR=self-report; STD PA=standardized physical activity.

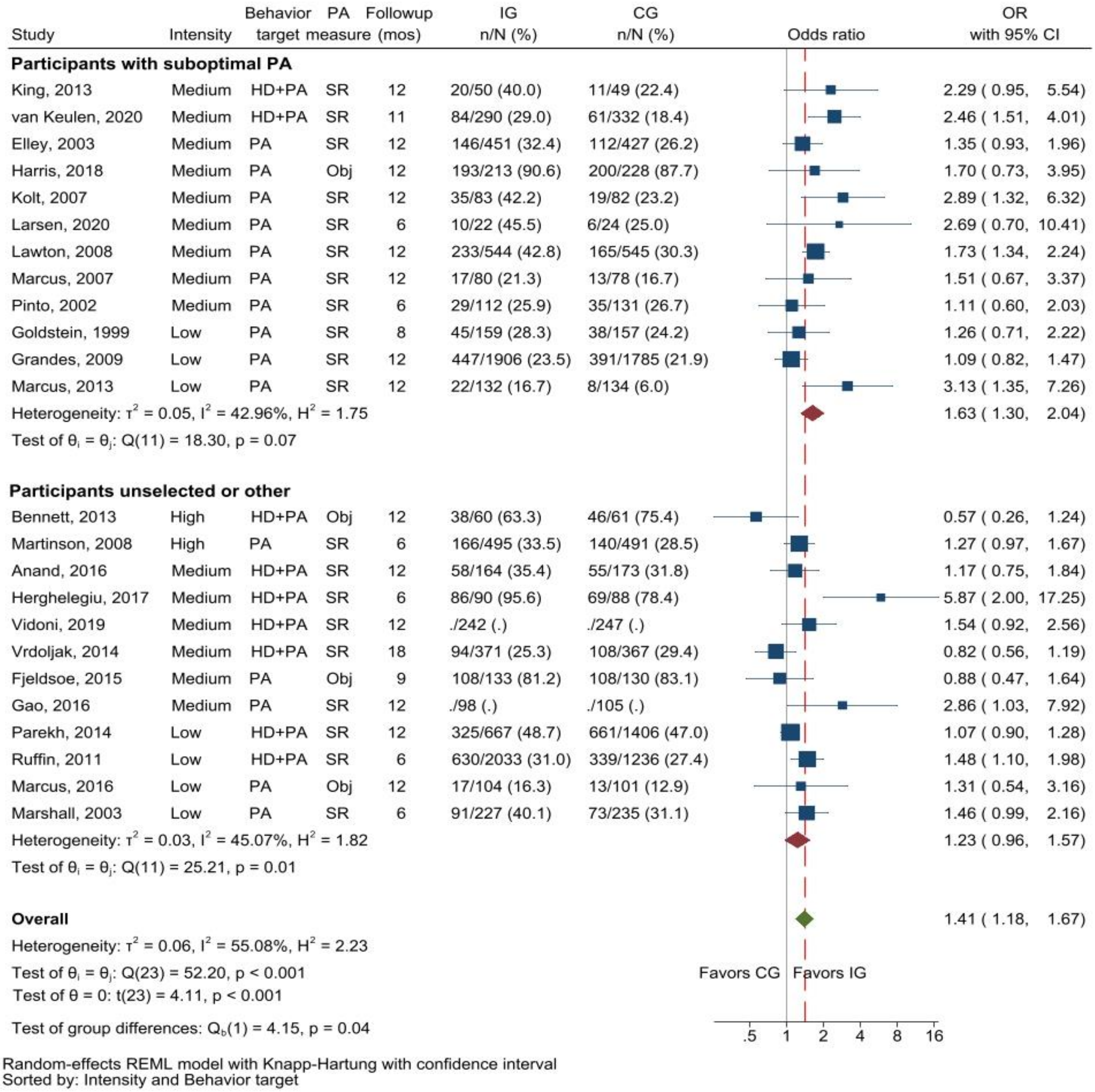
Figure 16. Pooled Analysis of Change in Physical Activity (Minutes/Week) in Healthy Diet and Physical Activity Interventions Compared With Controls, by Population Selection



Note: Suboptimal PA indicates that participants were eligible to be included in the trial if they were not meeting current physical activity guidelines.

Abbreviations: CI=confidence interval; Diff=difference; HD=healthy diet; IG=intervention group; CG=control group; Min=minutes; MnChg=mean change; Mos=months; Obj=objective measurement; PA=physical activity; REML=restricted maximum likelihood; SD=standard deviation; SR=self-report.

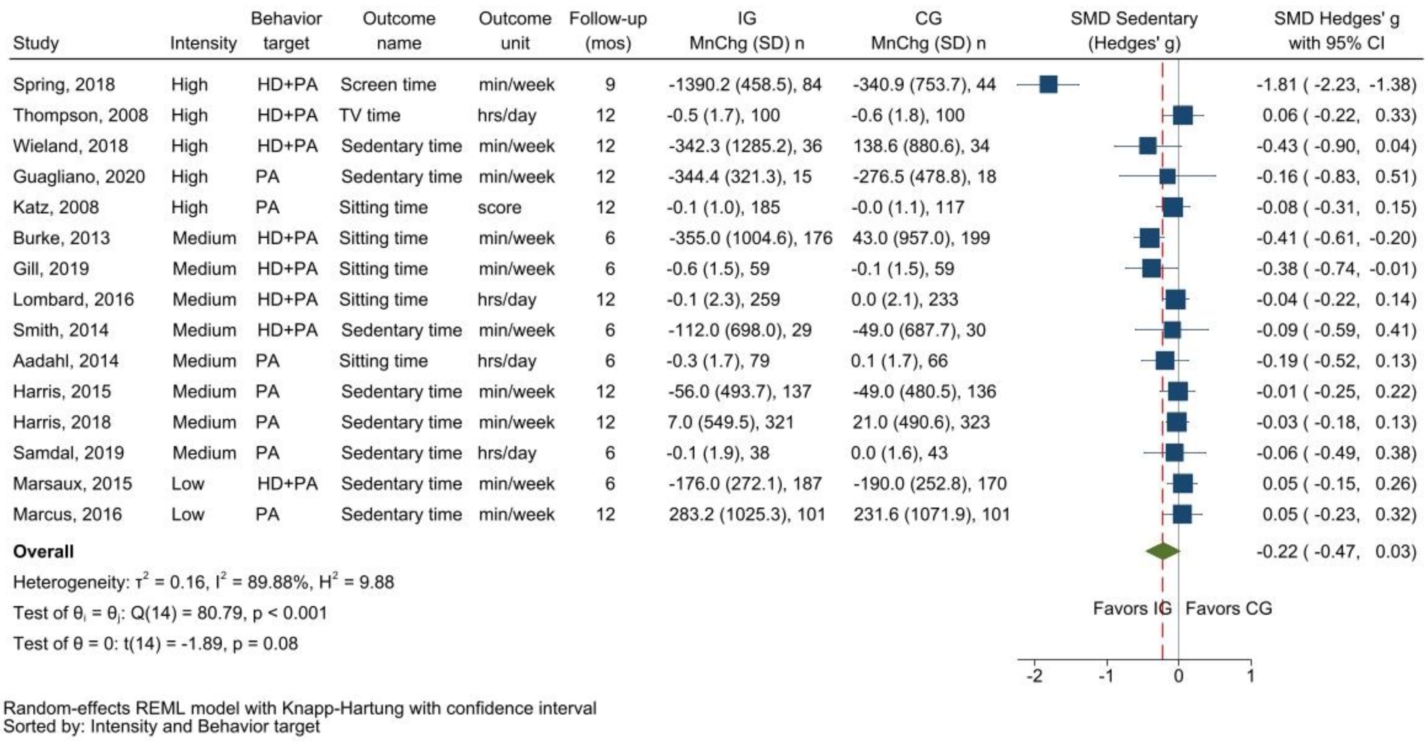
Figure 17. Pooled Analysis of Odds of Meeting Physical Activity Recommendations in Healthy Diet and Physical Activity Interventions Compared With Controls, by Population Selection



Note: Suboptimal PA indicates that participants were eligible to be included in the trial if they were not meeting current physical activity guidelines.

Abbreviations: CI=confidence interval; HD=healthy diet; IG=intervention group; CG=control group; Mos=months; Obj=objective measurement; OR=odds ratio; PA=physical activity; REML=restricted maximum likelihood; SR=self-report.

Figure 18. Pooled Analysis of Change in Sedentary Behavior (Standardized Mean Difference) in Healthy Diet and Physical Activity Interventions Compared With Controls



Abbreviations: CI=confidence interval; HD=healthy diet; Hrs=hours; IG=intervention group; CG=control group; Min=minutes; MnChg=mean change; Mos=months; PA=physical activity; REML=restricted maximum likelihood; SMD=standardized mean difference.

Table 1. Related USPSTF Behavioral Counseling Interventions

Risk Factors	Normal Weight (BMI 18.5 to <25)[*]	Overweight (BMI 25 to <30)[*‡]	Obesity (BMI ≥30)[*‡]
No hypertension, dyslipidemia, or abnormal blood glucose levels	Individualize the decision to provide or refer to behavioral counseling[215]	Individualize the decision to provide or refer to behavioral counseling[215]	Provide or refer to intensive behavioral counseling[216]
Hypertension, dyslipidemia, or both[§]	Individualize the decision to provide or refer to behavioral counseling[215†]	Provide or refer to intensive behavioral counseling[6]	Provide or refer to intensive behavioral counseling[6, 216]
Abnormal blood glucose levels or diabetes[**]	Provide or refer to intensive behavioral counseling[217]	Provide or refer to intensive behavioral counseling[6, 217]	Provide or refer to intensive behavioral counseling[6, 216, 217]

Abbreviations: BMI=body mass index; USPSTF=US Preventive Services Task Force.

[*] BMI calculated as weight in kilograms divided by the square of height in meters.
[†] From the "Other Considerations" section of the referenced recommendation statement
[‡] The 2015 USPSTF recommendation also recommends screening for abnormal blood glucose levels as part of cardiovascular risk assessment in adults aged 40 to 70 years who are overweight or have obesity. Patients with certain risk factors (family history of diabetes, personal history of gestational diabetes or polycystic ovarian syndrome, or being a member of certain racial/ethnic groups [African Americans, American Indians or Alaskan Natives, Asian Americans, Hispanics or Latinos, or Native Hawaiians or Pacific Islanders]) may also be at increased risk of diabetes at a younger age or at a lower BMI and should be considered for earlier screening[217]
[§] An updated recommendation is currently underway (https://www.uspreventiveservicestaskforce.org/uspstf/draft-update-summary/hypertension-in-adults-screening)
[**] An updated recommendation statement is currently underway (https://www.uspreventiveservicestaskforce.org/uspstf/draft-update-summary/abnormal-blood-glucose-and-type-2-diabetes-mellitus-screening)

Table 2. Prevalence Estimates of Ideal Cardiovascular Health for Each of the Seven Metrics of Cardiovascular Health in the AHA 2020 Goals Among U.S. Adults

Measure	Definition of Ideal Cardiovascular Health	Adults 20-49 Years, %	Adults ≥50 Years, %
Current Smoking	Never or quit >12 months	74.5	82.1
BMI	<25 kg/m^2	34.6	26.7
Physical Activity	≥150 min/wk MPA or ≥75 min/wk VPA	49.3	37.1
Healthy Diet Score	AHA Diet Score 4-5*	1.3	1.8
Total Cholesterol	<200 mg/dL	61.1	24.2
Blood Pressure	<120 mm Hg/<80 mm Hg	57.2	19.6
Fasting Plasma Glucose	<100 mg/dL	64.6	35.1

Abbreviations: AHA=American Heart Association; BMI=body mass index; dL=deciliter; m=meter(s); mg=milligram(s); min=minute(s); mmHg=millimeters of mercury; MPA=moderate-intensity physical activity; oz=ounce; wk=week; VPA=vigorous-intensity physical activity.

* Meeting 4 to 5 of the following dietary targets: ≥4.5 cups/day fruits and vegetables, 2 or more 3.5-oz servings/wk fish and shellfish, ≤1500 mg/d sodium, ≤36 oz/wk sugar sweetened beverages, ≥3 1-oz servings/day whole grains.

Adapted from Mozaffarian, 2016[218]

Table 3. Summary of Study and Population Characteristics of All Included Trials

Characteristics (No. RCTs reporting)	All studies	
	No. RCTs	%
All studies	113	100
Key questions		
KQ1. Health outcomes	15	13.3
KQ2. Intermediate outcomes	43	38.0
KQ3. Behavioral outcomes	109	96.5
KQ4. Harms	23	20.4
Study design		
RCT	93	82.3
Cluster RCT	20	17.7
New study	33	29.2
Good quality rating	23	20.4
Conducted in the US	60	53.1
Median sample size (IQR)	314 (200-710)	Range: 32 – 48835
Median % followup at 12 months or closest (IQR)	86 (77 – 91)	Range: 38 - 100
Population selection*		
Unselected	53	46.9
Suboptimal behavior	46	40.7
Elevated risk	14	12.4
Recruitment setting		
Primary care	37	32.7
Community volunteer	23	20.4
Direct mailing	15	13.3
Mixed	20	17.7
Other	17	15.0
Not reported	1	0.9
	Weighted mean or percent	**SD or k/K**
Age; Mean (k=105)	54.1	11.9
% of trials restricted to older adults (minimum age ≥60)	13.3	15/113
Female; % (k=113)†	79.9	20.2
Current smokers; % (k=41)	10.1	7.1
BMI; Mean kg/m^2 (k=79)	27.8	2.0
% of trials restricted to persons with excess weight	9.7	11/113
% of trials majority Hispanic or non-white‡§**	33.3	20/60
% of trials targeted low socioeconomic status population††	12.4	14/113

Abbreviations: IQR=Interquartile range; k=number of trials with the stated characteristics; K=total number of trials in the analysis; No.=Number; RCT=randomized clinical trial; SD=standard deviation; US=United States.

* According to trial eligibility criteria. "Unselected" includes a general population sample representing "all comers" or those recruited based on a sociodemographic characteristic alone. "Suboptimal behavior" includes samples selected because they were not meeting specific thresholds for dietary or physical activity behaviors. "Elevated risk" includes samples that were selected because they may have elevated risk for CVD based on family history, personal history (e.g., gestational diabetes), or being overweight or having obesity. Trials limited to those with CVD risk factors (e.g., elevated blood pressure, dyslipidemia or elevated lipid levels, impaired fasting glucose or impaired glucose tolerance, or multiple risk factors) were excluded.

† 26 trials were limited to women
‡ 13 trials were limited to Hispanic or non-white persons
§ Limited to trials in the US (60 trials)
** Where >50% of sample was non-white or Hispanic; assumed majority white, non-Hispanic if race/ethnicity not reported
†† Study described targeting a low-resource community or recruitment resulted in a sample with high unemployment, low educational attainment, or very low income

Table 4. Summary of Intervention Characteristics of All Included Trials (113 Trials, 157 Intervention Groups Studies), Overall and by Intervention Intensity

Characteristics	All interventions (157 groups)		High contact interventions (>6 hrs) (31 groups)		Medium contact interventions (31 min-6 hrs) (79 groups)		Low contact interventions (≤30 min) (47 groups)	
	No.	%	No.	%	No.	%	No.	%
Behavioral target								
Diet and physical activity	51	32.5	16	51.6	25	31.6	10	21.3
Diet only	30	19.1	9	29.0	11	13.9	10	21.3
Physical activity only	76	48.1	6	19.4	43	54.4	27	57.4
Intensity level*								
Low (0-30 min)	47	29.9						
Medium (31 min-6 hrs)	79	50.3						
High (>6 hrs)	31	19.8						
Primary care clinician involvement†								
Delivered all/most	11	7.3	1	3.2	7	8.9	3	6.4
1-time brief message	8	5.3	0	0	5	6.3	3	6.4
No involvement	131	87.3	29	93.5	64	81.0	38	80.8
Intervention format‡								
Individual sessions, in-person	71	45.2	19	61.3	46	58.2	6	12.8
Group sessions, in-person	26	16.6	16	51.6	10	2.7	0	0
Telephone calls	52	33.1	15	48.4	35	44.3	2	4.3
Technology-based§	54	34.4	7	22.6	32	40.5	15	31.9
Print materials	84	53.5	14	45.2	36	45.6	34	72.3
Print materials only	24	15.3	0	0	0	0	24	51.1
Behavior change technique‡								
Goals and planning	132	84.1	26	83.9	71	89.9	35	74.5
Feedback and monitoring	100	63.7	22	71.0	52	65.8	26	55.3
Social support	49	31.2	14	45.2	26	32.9	9	19.2
Comparison of outcomes	58	36.9	12	38.7	30	38.0	16	34.0
Self-belief	77	49.0	14	45.2	46	58.2	17	36.2
Motivational interviewing	20	12.7	4	12.9	14	17.7	2	4.3
5 A's	6	3.8	0	0	4	5.1	2	4.3
Dietary recommendation**								
General heart healthy, or not described	105	66.9	14	45.2	61	77.2	30	63.8
Low sodium	5	3.2	2	6.4	0	0	3	6.4
Fruit and vegetable intake	55	35.0	18	58.1	20	25.3	17	36.2
Fat intake	33	21.0	12	38.7	12	15.2	9	19.2

Table 4. Summary of Intervention Characteristics of All Included Trials (113 Trials, 157 Intervention Groups Studies), Overall and by Intervention Intensity

Characteristics	All interventions (157 groups)		High contact interventions (>6 hrs) (31 groups)		Medium contact interventions (31 min-6 hrs) (79 groups)		Low contact interventions (≤30 min) (47 groups)	
Focus on weight gain prevention	12	7.6	6	19.4	6	7.6	0	0
Intervention Contact	**Median (IQR)**	**Range**	**Median (IQR)**	**Range**	**Median (IQR)**	**Range**	**Median (IQR)**	**Range**
Intervention duration, months	6 (3 – 12)	0 – 72	12 (6 – 24)	1 - 72	6 (3 – 9)	0 - 24	6 (2 – 6)	0 – 36
Est. contact hours**	2.7 (1 – 5.9)	0 – 38.5	10 (7 – 18)	6.3 – 38.5	2.3 (1.3 – 3.1)	0.7 – 5.9	0.3 (0.1 – 0.4)	0 – 0.5
Number of contacts††	7 (3 – 16)	1 - 168	18 (15 – 25)	5 - 106	5 (3 – 8)	1 - 168	2 (1 – 4)	1 - 32
Number of in-person contacts	1 (0 – 2)	0 – 39	8 (1 – 16)	0 - 39	1 (0 – 2)	0 - 6	0 (0 – 0)	0 - 1
Control group (113 trials)	**No. of trials**	**% of trials**	**No. of trials**	**% of trials**	**No. of trials**	**% of trials**	**No. of trials**	**% of trials**
No intervention/waitlist	34	30.1	10	41.7	16	25.4	8	30.8
Usual care	21	18.6	4	16.7	10	15.9	7	26.9
Minimal intervention	34	30.1	7	29.2	24	38.1	3	11.5
Attention control	24	21.2	3	12.5	13	20.6	8	30.8

Abbreviations: 5A's=5A's intervention strategy (Ask, Advise, Assess, Assist, and Arrange); Est.=Estimated; Hrs=hours; IQR=Interquartile range; No.=Number; SD=Standard deviation; US=United States.

* Contacts involving in-person or telephone-based sessions with an interventionist, web- or computer-based sessions, e-mails, and text messages. Contact time was estimated when not provided (individual counseling session=30 minutes, group counseling session=60 minutes, telephone session=15 minutes, computer-based session=15-30 minutes, e-mails=1-2 minutes, text messages ≤1 minute

† Seven intervention groups did not report if primary care clinician was involved

‡ Intervention could include more than one delivery format and behavior change technique

§ Includes computer- or web-based sessions, e-mails, or text/SMS messages

** Interventions may advocate multiple diet approaches (e.g., low sodium and low fat)

†† Includes all in-person, telephone, computer, e-mail, and text message contacts. Does not include print materials

Table 5. Pooled Results of Intermediate Outcomes

Outcome	Difference in Mean Changes (95% CI)	RCTs (n)	I^2, %
SBP, mm Hg	-0.80 (-1.30 to -0.31)	23 (57,079)	11.3
DBP, mm Hg	-0.42 (-0.80 to -0.04)	24 (57,148)	35.8
Total cholesterol, mg/dL*	-1.58 (-4.21 to 1.04)	21 (10,122)	68.8
Low-density lipoprotein cholesterol, mg/dL*	-2.20 (-3.80 to -0.60)	15 (6,350)	25.7
High-density lipoprotein cholesterol, mg/dL*	-0.12 (-1.04 to 0.80)	17 (7,527)	51.4
Fasting glucose, mg/dL†	-0.34 (-1.24 to 0.55)	14 (7,468)	42.7
BMI, kg/m^2	-0.32 (-0.51 to -0.13)	27 (59,239)	94.6
Weight, kg‡	-1.07 (-1.62 to -0.52)	24 (51,812)	91.2
Waist circumference, cm§	-0.81 (-1.32 to -0.30)	23 (52,128)	96.1

Abbreviations: BMI=body mass index; BP=blood pressure; CI=confidence interval; cm=centimeter(s); DBP=diastolic blood pressure; dL=deciliter; I^2=I squared (the percentage of total variation across studies that is due to heterogeneity rather than chance); kg=kilogram(s); L=liter; lb(s)=pound(s); m=meter(s); mg=milligram(s); min=minute(s); mmHg=millimeters of mercury; mmol=millimoles; RCT=randomized clinical trial; SBP=systolic blood pressure.

* To convert mg/dL to mmol/L, multiply by 0.0259
† To convert mg/dL to mmol/L, multiply by 0.0555
‡ To convert kg to lbs, multiply by 2.205
§ To convert cm to inches, multiply by 0.394

Table 6. Pooled Results of Behavioral Outcomes for All Interventions

Outcome*	Effect size (95% CI)	No. of RCTs (n)†	I^2, %
Saturated fat			
Standardized mean difference	-0.53 (-0.78 to -0.27)	16 (48,661)	97.4
Mean difference in % of energy from fat	-2.01 (-3.19 to -0.84)	9 (46,772)	98.1
Fruits and vegetables			
Mean difference in servings per day	1.11 (0.41 to 1.81)	17 (53,711)	99.3
Fiber			
Standardized mean difference	0.24 (0.05 to 0.43)	13 (47,571)	93.9
g/day	1.05 (0.59 to 1.51)	8 (2,414)	0%
Sodium†			
mg/day	Range: -4.9 to -383.0‡	4 (n=1,444)	NA
Physical activity			
Standardized mean difference	0.19 (0.14 to 0.25)	59 (20,801)	65.4
Mean difference in minutes/week	33.0 (21.9 to 44.2)	37 (15,015)	76.0
Meeting PA recommendations	OR=1.41 (1.18 to 1.67)	24 (17,338)	55.1
Sedentary behavior			
Standardized mean difference	-0.22 (-0.47 to 0.03)	15 (3,479)	89.9

Abbreviations: CI=confidence interval; g=gram(s); I^2=I squared (the percentage of total variation across studies that is due to heterogeneity rather than chance); mg=milligram; min=minute(s); OR=odds ratio; PA=physical activity; RCT=randomized clinical trial.

* Number of trials included in meta-analyses. Not all trials reporting each outcome could be included in meta-analyses given units or data reported. Total number of trials and observations reporting outcome were: dietary fat (17 trials, n=57,470), fruits and vegetables (35 trials, n=80,366), fiber (14 trials, n=58,541), sodium (4 trials, n=1,444), physical activity (85 trials, n=52,838), and sedentary behavior (14 trials, n=5,595)

† Not meta-analyzed given few trials reporting this outcome

‡ Only 2 studies reported the mean change in sodium mg/day. One study[74] found a statistically significant mean difference in change of 383 mg/day (95% CI, -590 to -176) in intervention vs. control groups while the other[62] found no difference between groups. The other two studies reported sodium scores and found no differences between groups

Table 7. Summary of Findings Across Intermediate and Behavioral Outcomes, by Author

Author, Year	Intervention Focus	KQ 2. Intermediate outcomes										KQ 3. Behavioral outcomes	
		SBP	DBP	LDL-C	TC	HDL-C	FBG	BMI	Weight	WC	CVD Risk	Diet[*]	PA
Aadahl, 2014[71]	PA			↑	↑	↔	↔		↑	↑↑			↑↑[†]
Aldana, 2006[74]	HD+PA	↓	↑	↑	↑	↓	↑	↑↑	↑↑			↑↑	↑↑
Anand, 2016[66]	HD+PA	↑	↔				↔				↔	↔	↑[‡]
Baron, 1990[76]	HD			↔	↔	↔						↑↑	
Bennett, 2013[77]	HD+PA	↔	↑	↑	↑	↔	↓	↑↑	↑↑	↑			↑
Brekke, 2005[81]	HD+PA			↑	↓	↓↓	↑	↑↑	↑↑	↑		↑↑	↑[‡§]
Bryan, 2013[82]	PA							↓					↑↑
Caplette, 2017[58]	HD							↔				↑↑	
Coates, 1999[86]	HD	↑↑	↔				↑	↑↑	↑↑	↑↑		↑↑	
Elley, 2003[89]	PA	↑	↑		↔			↔			↔		↑↑
Gill, 2019[151]	HD+PA	↔	↔					↔	↔	↑		↑↑[**]	↑↑
Grandes, 2009[97]	PA	↔	↓	↑	↔	↑↑	↔	↔		↔	↔		↑↑
Guagliano, 2020[157]	PA							↔	↔	↔			↑↑
Hargreaves, 2016[101]	PA		↑		↑								↑↑
Harris, 2018[50]	PA							↔		↔			↑↑
Hivert, 2007[104]	HD+PA	↑	↓	↑	↑	-		↑↑	↑↑	↑		↔	↑
Jeffery, 1999[106]	HD+PA								↔			↔	↔
Jenkins, 2017[52]	HD	↔	↔	↔	↓	↔	↔	↔	↔	↔	↔	↔	
John, 2002[107]	HD	↑↑	↑↑		↔				↔			↑↑	
Kallings, 2009[108]	PA	↓	↓	↑	↑	↔	↑	↑↑	↑↑	↑			↑↑
Kattelmann, 2014[109]	HD+PA							↑	↑	↔		↑↑	↔
Kerr, 2016[111]	HD							↑	↑			↔	
Kinmonth, 2008[114]	PA	↔	↓	↓	↓	↓	↓↓	↓	↓	↓			↔
Koniak-Griffin, 2015[46]	HD+PA	↔	↑	↔	↑	↔	↔	↑	↑	↑↑		↑↑	↑↑
Kristal, 2000[116]	HD								↑[§]			↑↑	
Lawton, 2008[117]	PA	↑	↔		↑	↔	↔		↑	↑			↑↑[††]
Lombard, 2016[62]	HD+PA								↑↑	↑		↑↑	
Metzgar, 2016[65]	HD	↑↑	↓				↓	↓	↓	↓		↔	↑
Mosca, 2008[126]	HD+PA	↔	↑	↔	↓	↑	↔	↔		↔	↔	↔	↑
Roderick, 1997[133]	HD	↑	↔		↑↑			↔	↑↑			↑↑	
Sacerdote, 2006[135]	HD	↔	↔					↑↑				↑↑	
Simkin-Silverman, 1995[136]	HD+PA	↑↑	↑	↑↑	↑↑	↓↓	↑↑	↑↑	↑↑	↑↑		↑↑	↑↑
Sun, 2017[56]	HD+PA							↔	↑				↑
Thompson, 2008[140]	HD+PA	↑	↔	↔	↔	↔	↔	↑	↔[§]	↑		↔	↑
Thompson, 2014[141]	PA	↑	↑		↑	↓	↓		↔	↔			↑
Tinker, 2008[142]	HD	↑↑	↑↑					↑↑	↑↑	↑↑		↑↑	
Wadsworth, 2010[149]	PA							↓[§]					↑
Wieland, 2018[55]	HD+PA	↓	↓						↑	↑		↑↑	↑

Table 7. Summary of Findings Across Intermediate and Behavioral Outcomes, by Author

Symbol Legend:
↑↑=Statistically significant between-group difference in favor of intervention group
↑=Between-group difference in favor of intervention group, but not statistically significantly different
↔=No clear between-group difference. For blood pressure, between-group difference <0.5 mm Hg. For cholesterol and glucose, between-group difference of <1.0 mg/dL. For BMI, between-group difference of <0.25 kg/m2. For weight and waist circumference, between-group difference of <0.5 kg or cm, respectively. For CVD risk, between-group difference of 1 percentage points. For dietary outcomes, percent energy from saturated fat <1%, fiber <0.10 standardized mean difference, fruits and vegetables <0.5 serving/day. For physical activity, standardized mean difference <0.10.
↓=Between-group difference in favor of control group, not statistically significantly different
↓↓= Statistically significant between-group difference in favor of control group

Abbreviations: BMI=body mass index; CVD Risk=Multivariate risk status; CVD=cardiovascular disease; DBP=diastolic blood pressure; FBG=fasting blood glucose; HD+PA=healthy diet and physical activity; HD=healthy diet; HDL-C=high-density lipoprotein cholesterol; KQ=key question; LDL-C=low-density lipoprotein cholesterol; PA=physical activity; SBP=systolic blood pressure; TC=total cholesterol; TG=triglycerides; WC=waist circumference.

* For majority of reported dietary outcomes. See Appendix H Table 1 for detailed dietary outcome results
† Self-reported sitting time
‡ For percent meeting physical activity recommendations
§ Not included in meta-analysis
** For meeting fruit and vegetable intake recommendation (≥3 servings per day)
†† For percent meeting physical activity recommendations

Table 8. Summary of Evidence, by Key Question

KQ	No. of RCTs (No. of observations)	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
KQ1	15 RCTs (58,286) (6/15 trials identified in update)	Three good-quality trials (n=48,382) reported CVD-related health outcomes at up to 4 years and 13.4 years of followup. Largest trial (n=47,179) among post-menopausal women found no difference in all-cause or CVD-related mortality or CVD events between women in dietary counseling group vs. control group over median follow-up of 8.5 and 13.4 years. Two other trials of 12-week pedometer-based physical activity interventions found low CVD event rates for all participants, with statistically significant intervention effects on nonfatal and fatal CVD events at 4 years when the data from both trials was combined (n=1,203). Patient-reported measures of QOL were sparsely reported and showed no clear pattern of clinically important benefit at 6 to 12 months followup (15 trials [n=58,286]).	Mortality and CVD events: Inconsistent, Imprecise QOL: Inconsistent, Imprecise	Sparsely reported outcomes High variability in measures and reporting of QOL outcomes, with possible selective reporting bias	Mortality and CVD events: Low for no benefit QOL: Low for no benefit	Mortality and CVD event data limited to one large trial among post-menopausal women in the US and two primary care-based trials in the UK. Most participants were middle aged (>45 years) and older adults (>60 years) who were predominantly white females, without a history of CVD. QOL data limited to mostly physical activity trials.
KQ2	43 RCTs (77,898) (14/43 trials identified in update)	Healthy diet and physical activity behavioral interventions were associated with small, statistically significant reductions in blood pressure, LDL cholesterol, and measures of adiposity at 6 to 12 months followup. Pooled differences in mean changes were: • SBP: -0.80 (-1.30 to -0.31), k=23 RCTs (n=57,079) • DBP: -0.42 (-0.80 to -0.04), 24 RCTs (n=57,148) • LDL-C: -2.20 (-3.80 to -0.60), 15 RCTs (n=6,350) • BMI: -0.32 (-0.51 to -0.13), 27 RCTs (n=59,239) • Weight: -1.07 (-1.62 to -0.52), 24 RCTs (n=51,812) Evidence of dose-response effect with increasing intervention contact and duration associated with larger improvements in intermediate outcomes. No evidence of an association with total cholesterol, HDL cholesterol, or fasting glucose.	Reasonably consistent and reasonably precise	Evidence for each intermediate outcome drawn from subsample of full body of evidence Limited evidence beyond 12 months or for incidence of hypertension, dyslipidemia, or diabetes. Considerable statistical heterogeneity (I^2>90%) for meta-analyses of adiposity outcomes.	Moderate for benefit	Generally applicable to adults not at risk for CVD. High-intensity interventions were more likely to include both healthy diet and physical activity messages and take place outside of primary care.

Table 8. Summary of Evidence, by Key Question

KQ	No. of RCTs (No. of observations)	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
KQ3	109 RCTs (125,878) (30/109 trials identified in update)	Magnitude and precision in differences for dietary outcomes were variable across studies and resulted in considerable heterogeneity in meta-analysis. Pooled analyses indicated statistically significant associations between healthy diet interventions (with or without PA messages) and measures of saturated fat (SMD, 0.53 [95% CI, -0.78 to -0.27], 16 RCTs), fiber (SMD, 0.24 [95% CI, 0.05 to 0.43], 13 RCTs), and fruit and vegetable intake (MD, 1.11 [95% CI, 0.41 to 1.81], 17 RCTs) at 6 to 12 months followup. Sodium intake was infrequently reported. Small, statistically significant association with behavioral interventions and physical activity in favor of interventions over controls (SMD, 0.19 [95% CI, 0.14 to 0.25]; 59 trials [n=20,801]), or a mean difference of approximately 33 minutes of physical activity per week between groups (MD, 33.0 min [95% CI, 21.9 to 44.2], 37 RCTs). Additionally, intervention participants had significantly higher odds of meeting PA recommendations (150 min/week of PA) vs. control group participants (OR=1.41 [95% CI, 1.18 to 1.67], 24 RCTs). No clear evidence of an association between interventions and sedentary behaviors, though few studies included messages regarding changes in sedentary behaviors (15 RCTs).	Reasonably consistent, reasonably precise	Almost all outcomes based on self-report. Instruments, recall periods, and summary measures were extremely heterogeneous with varying evidence of validity and reliability.	Diet: Low for benefit Physical activity: Moderate for benefit Sedentary behavior: Low for no benefit	Generally applicable to adults not at risk for CVD. Larger effect sizes for physical activity outcomes were seen for persons with lower levels of physical activity at baseline. Few interventions explicitly mentioned targeting changes in sedentary behaviors.
KQ4	23 RCTs (12,452) (12/23 trials identified in update)	Adverse events related to diet and physical activity interventions were very rare, with generally no statistically significant increased risk of harm. Twelve trials (n=5,771) including physical activity counseling reported generally no differences in rates of musculoskeletal injuries or falls between intervention and control groups.	Reasonably consistent, reasonably precise	Harms were sparsely reported, and few details provided about how harms were recorded and specific events that occurred.	Moderate for no harms*	Applies to harms related to counseling interventions, and any subsequent behavior changes that occurred. Most trials reporting harms included physical activity messages.

Abbreviations: BMI=body mass index; CI=confidence interval; CV=cardiovascular; CVD=cardiovascular disease; DPB=diastolic blood pressure; FBG=fasting blood glucose; HDL-C=high-density lipoprotein cholesterol; HR=hazard ratio; k=trials; KQ=key question; LDL-C=low-density lipoprotein; MD=mean difference; min=minutes; mm=millimeter(s); No.=number; OR=odds ratio; PA=physical activity; QOL=quality of life; RCT=randomized clinical trial; SBP=systolic blood pressure; SD=standard deviation; SMD=standardized mean difference; TC=total cholesterol; US=United States.

* Despite the relatively limited number of studies that reported harms related to interventions, we are moderately confident that there are no serious harms related to behavioral counseling interventions for healthful diet and physical activity.

Table 9. Association Between Changes in Intermediate Outcomes and Mortality Outcomes, Based on Individual Patient Data Meta-Analysis of Epidemiological Studies

Intermediate Outcome	Mortality Outcome	Age, years	Original Increment Difference	HR (95% CI) for Health Outcome for Original Increment Change in Intermediate Outcome	Converted Increment Difference	HR (95% CI) for Health Outcome for Converted Increment Change in Intermediate Outcome
SBP[176]	IHD	40-49	↓20 mm Hg	0.49 (0.45 to 0.53)*	↓0.5 mm Hg	0.982 (0.980 to 0.984)
	IHD	60-69	↓20 mm Hg	0.54 (0.53 to 0.55)*	↓0.5 mm Hg	0.985 (0.984 to 0.985)
	Stroke	40-49	↓20 mm Hg	0.36 (0.32 to 0.40)*	↓0.5 mm Hg	0.975 (0.972 to 0.977)
	Stroke	60-69	↓20 mm Hg	0.43 (0.41 to 0.45)*	↓0.5 mm Hg	0.979 (0.978 to 0.980)
Non-HDL-C[178]	IHD	40-59	↓1 mmol/L	0.57 (0.52 to 0.62)†	↓3 mg/dL	0.957 (0.950 to 0.964)
	IHD	60-69	↓1 mmol/L	0.66 (0.61 to 0.71)†	↓3 mg/dL	0.968 (0.962 to 0.974)
TC[178]	IHD	40-49	↓1 mmol/L	0.44 (0.42 to 0.48)§	↓2 mg/dL	0.958 (0.956 to 0.963)
	IHD	60-69	↓1 mmol/L	0.72 (0.69 to 0.74)§	↓2 mg/dL	0.983 (0.981 to 0.985)
	Stroke	40-59	↓1 mmol/L	0.90 (0.84 to 0.97)**	↓2 mg/dL	0.995 (0.991 to 0.998)
	Stroke	60-69	↓1 mmol/L	1.02 (0.97 to 1.08)**	↓2 mg/dL	1.001 (0.998 to 1.004)
FBG††	F+NF CHD††[179]	56‡‡	↑1 mmol/L	1.12 (1.08 to 1.15)	↓2 mg/dL	1.013 (1.009 to 1.016)
	Vascular[180]	53‡‡	↑18.02 mg/dL	1.13 (1.11 to 1.15)	↓2 mg/dL	1.014 (1.012 to 1.016)
	All-cause[180]	53‡‡	↑18.02 mg/dL	1.10 (1.09 to 1.11)	↓2 mg/dL	1.011 (1.010 to 1.012)
BMI§§	IHD[183]	35-89	↑5 kg/m^2	1.39 (1.34 to 1.44)	↓0.3 kg/m^2	0.980 (0.982 to 0.978)
		35-59	↑5 kg/m^2	1.50 (1.39 to 1.62)	↓0.3 kg/m^2	0.976 (0.980 to 0.972)
		60-69	↑5 kg/m^2	1.40 (1.32 to 1.49)	↓0.3 kg/m^2	0.980 (0.984 to 0.976)
	CHD[182]	35-89	↑5 kg/m^2	1.42 (1.35 to 1.49)	↓0.3 kg/m^2	0.979 (0.982 to 0.976)
	Stroke[183]	35-89	↑5 kg/m^2	1.39 (1.31 to 1.48)	↓0.3 kg/m^2	0.980 (0.984 to 0.977)
		35-59	↑5 kg/m^2	1.76 (1.52 to 2.04)	↓0.3 kg/m^2	0.967 (0.975 to 0.958)
		60-69	↑5 kg/m^2	1.49 (1.34 to 1.67)	↓0.3 kg/m^2	0.976 (0.983 to 0.970)
	All-cause[182]	35-89	↑5 kg/m^2	1.31 (1.29 to 1.33)	↓0.3 kg/m^2	0.984 (0.985 to 0.983)
		35-49	↑5 kg/m^2	1.52 (1.47 to 1.56)	↓0.3 kg/m^2	0.975 (0.977 to 0.974)
		50-69	↑5 kg/m^2	1.37 (1.35 to 1.39)	↓0.3 kg/m^2	0.981 (0.982 to 0.980)
		70-89	↑5 kg/m^2	1.21 (1.17 to 1.25)	↓0.3 kg/m^2	0.989 (0.991 to 0.987)

Abbreviations: BMI=body mass index; CHD=coronary heart disease; CI=confidence interval; dL=deciliter; F+NF=fatal plus nonfatal; FBG=fasting blood glucose; HDL-C=high-density lipoprotein cholesterol; Hg=mercury; HR=hazard ratio; IHD=ischemic heart disease; kg=kilogram(s); m=meter(s); mg=milligram(s); mm=millimeter(s);mmol=millimole(s); NS=not significant; SBP=systolic blood pressure; TC=total cholesterol.

* For SBPs above 115 mm Hg. Adjusted for age (within range being considered), sex, and study. Adjustments for lipids, diabetes, weight, alcohol, and smoking did not change results

† Adjusted for age (within range being considered), sex, and study. Formal test for heterogeneity NS for sex (significant for age)

‡ Directionality inverted from negative to positive

§ Adjusted for age (within range being considered), sex, and study. Result slightly attenuated by adjustment for SBP and unaltered by adjustment for smoking. Formal test for heterogeneity NS for sex for age <69 years; formal test for heterogeneity significant for age

** Adjusted for age (within range being considered), sex, and study. Result attenuated with adjustment for SBP and minimal increase in HR with further adjustment for smoking for 40-59-year group only

†† For FBG above 100 mg/dL and assuming log-linear association. Adjusted for age, smoking, BMI, SBP

‡‡ Mean age

§§ For BMI above 25 kg/m^2

Literature Search Strategies for Primary Literature

Key:
/ = MeSH subject heading
$ = truncation
* = truncation
? = wildcard
ab = word in abstract
adj# = adjacent within x number of words
bt = book title
fs= floating subheading
hw = subject heading word
id =key phrase identifier
kf= keyword heading [word not phrase indexed]
kw = keyword
md = methodology
near/# = adjacent within x number of words
pt = publication type
ti = word in title

MEDLINE
Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) <1946 to February 24, 2020>
Search Strategy:
----
1 Diet, Reducing/ (10990)
2 Caloric Restriction/ (5895)
3 Diet, Fat-Restricted/ (3623)
4 Diet, Mediterranean/ (3238)
5 Diet, Sodium-Restricted/ (6215)
6 Diet, Carbohydrate-Restricted/ (1504)
7 Diet, Carbohydrate Loading/ (136)
8 Diet, High-Protein Low-Carbohydrate/ (33)
9 Diet, Ketogenic/ (1200)
10 Diet, Diabetic/ (4910)
11 Diet, Gluten-Free/ (2128)
12 Diet, High-Protein/ (163)
13 Diet, High-Protein Low-Carbohydrate/ (33)
14 Diet, Paleolithic/ (102)
15 Diet, Protein-Restricted/ (2821)
16 Diet, Vegetarian/ (3062)
17 Diet, Macrobiotic/ (58)
18 Diet, Vegan/ (148)
19 Fruit/ (42264)
20 Vegetables/ (23831)

21 Functional food/ (1798)
22 Feeding behavior/ (80612)
23 Diet, Healthy/ (3249)
24 Healthy lifestyle/ (1639)
25 Weight Reduction Programs/ (2011)
26 Exercise/ (105807)
27 physical conditioning, human/ (2111)
28 circuit-based exercise/ (56)
29 high-intensity interval training/ (881)
30 plyometric exercise/ (553)
31 resistance training/ (8194)
32 running/ (19291)
33 jogging/ (804)
34 swimming/ (17524)
35 walking/ (31911)
36 stair climbing/ (139)
37 Fitness trackers/ (456)
38 Accelerometry/ (4950)
39 Actigraphy/ (3458)
40 Exercise Therapy/ (39337)
41 Physical Fitness/ (26907)
42 (diet or diets or dietary).ti,bt,kf. (184220)
43 (fruit* or vegetable*).ti,bt,kf. (39548)
44 (exercise or physical activity).ti,bt,kf. (160165)
45 walking.ti,bt,kf. (17428)
46 pedometer*.ti,ab,kf. (2614)
47 fitbit*.ti,ab,kf. (546)
48 steps per.ti,ab,kf. (1233)
49 distance walked.ti,ab,kf. (1295)
50 measuring step*.ti,ab,kf. (100)
51 step count*.ti,ab,kf. (1754)
52 ((activity or fitness) adj1 track*).ti,ab,kf. (992)
53 Sedentary Behavior/ or Candy/ or Fast Foods/ (12242)
54 (sedentary adj (lifestyle* or life style* or behavio* or time)).ti,ab,kf. (11567)
55 ((sitting or lying) adj2 time).ti,ab,kf. (2053)
56 (Screen time or junk food$ or fast food$ or candy or soda or snacks or snacking).ti,ab,kf. (15747)
57 ((television or TV) adj viewing).ti,ab,kf. (2004)
58 ((watch* or view*) adj (television or TV)).ti,ab,kf. (2410)
59 ((computer or internet) adj (time or "use" or usage)).ti,ab,kf. (4928)
60 ((computer or video) adj game*).ti,ab,kf. (4482)
61 ((screen or screen based) adj (entertainment or behavio* or "use" or usage)).ti,ab,kf. (179)
62 low energy expenditure*.ti,ab,kf. (182)
63 physical* inactiv*.ti,ab,kf. (8805)
64 or/54-63 (46406)
65 (reduce* or reduction* or decrease* or change* or target*).ti,ab. (7475866)

66 64 and 65 (19456)
67 or/1-53,66 (652414)
68 Counseling/ (35173)
69 Directive Counseling/ (2308)
70 "Behavior-Therapy"/ (27528)
71 Cognitive Therapy/ (24637)
72 "Referral and Consultation"/ (65257)
73 Persuasive Communication/ (3628)
74 Social Control, Informal/ (3627)
75 Risk Reduction Behavior/ (12203)
76 Life Style/ (55556)
77 Healthy aging/ (696)
78 Motivation/ (65623)
79 Social Support/ (69095)
80 Feedback, Psychological/ (3434)
81 Self Efficacy/ (19605)
82 Health Knowledge, Attitudes, Practice/ (108320)
83 Health Behavior/ (48797)
84 Health Education/ (59902)
85 Health Promotion/ (72221)
86 Patient Education as Topic/ (84045)
87 counsel*.ti,ab,kf. (106641)
88 (advice or advise or consultation*).ti,ab,kf. (127018)
89 (behavio* adj2 (therap* or chang* or modification* or improv*)).ti,ab,kf. (84973)
90 referral*.ti,ab,kf. (108826)
91 (set* adj2 goal*).ti,ab,kf. (7044)
92 action plan*.ti,ab,kf. (7131)
93 self monitor*.ti,ab,kf. (7903)Table
94 follow-up feedback.ti,ab,kf. (18)
95 (assessment adj5 feedback).ti,ab,kf. (1566)
96 support planning.ti,ab,kf. (158)
97 risk factor management.ti,ab,kf. (793)
98 (life style or lifestyle).ti,ab,kf. (98207)
99 motivation*.ti,ab,kf. (85622)
100 health coach*.ti,ab,kf. (759)
101 health behavio*.ti,ab,kf. (23792)
102 health education.ti,ab,kf. (33432)
103 education* program*.ti,ab,kf. (41421)
104 patient education.ti,ab,kf. (18536)
105 health promotion.ti,ab,kf. (31962)
106 (promot* adj3 (exercise or physical activit* or weight loss)).ti,ab,kf. (8651)
107 nonpharmacologic intervention*.ti,ab,kf. (800)
108 non pharmacologic intervention*.ti,ab,kf. (231)
109 intervention*.ti,bt. (143644)
110 or/68-109 (1204539)
111 (cardiovascular or cardiometabolic).ti,bt. (130545)

112 67 and (110 or 111) (107297)
113 Healthy lifestyle/ or Healthy diet/ (4662)
114 ((lifestyle adj2 intervention*) or (life style adj2 intervention*) or health* lifestyle or health* life style or unhealth* lifestyle or unhealth* life style).ti,ab,kf. (15533)
115 113 or 114 (19470)
116 (cardiovascular or coronary or cardiometabolic or heart).ti,ab,kf,hw. (1858995)
117 (insulin or glucose or diabet*).ti,ab,kf,hw. (1204029)
118 (lipoprotein* or lipid* or triglyceride* or hyperlipidemia* or cholesterol).ti,ab,kf,hw. (833845)
119 (bmi or body mass index or body weight).ti,ab,kf,hw. (577495)
120 (hypertension or blood pressure).ti,ab,kf,hw. (764739)
121 or/116-120 (4132492)
122 115 and 121 (11391)
123 112 or 122 (113317)
124 123 not ((exp infant/ or child/ or adolescence/) not (exp adult/ or exp aged/ or middle aged/)) (99047)
125 124 not (animals/ not humans/) (94837)
126 (clinical trial or adaptive clinical trial or clinical trial, phase i or clinical trial, phase ii or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or randomized controlled trial or equivalence trial or pragmatic clinical trial or Meta-Analysis).pt. (961885)
127 clinical trials as topic/ or adaptive clinical trials as topic/ or clinical trials, phase i as topic/ or clinical trials, phase ii as topic/ or clinical trials, phase iii as topic/ or clinical trials, phase iv as topic/ or controlled clinical trials as topic/ or non-randomized controlled trials as topic/ or randomized controlled trials as topic/ or equivalence trials as topic/ or intention to treat analysis/ or pragmatic clinical trials as topic/ or meta-analysis as topic/ (347941)
128 control groups/ or double-blind method/ or single-blind method/ or control groups/ or random allocation/ or placebos/ (296969)
129 (randomized or randomised or placebo or randomly or phase iii or phase 3).ti,ab. (968970)
130 (RCT or placebo or sham or dummy or single blind$ or double blind$ or allocated or allocation or triple blind$ or treble blind$ or random$).ti,ab. (1323371)
131 ((control$ or clinical) adj3 (study or studies or trial$ or group$)).ti,ab. (1455009)
132 (Nonrandom$ or non random$ or non-random$ or quasi-random$ or quasirandom$).ti,ab. (42285)
133 allocated.ti,ab. (63676)
134 ((open label or open-label) adj5 (study or studies or trial$)).ti,ab. (33474)
135 ((equivalence or superiority or non-inferiority or noninferiority) adj3 (study or studies or trial$)).ti,ab. (7479)
136 (pragmatic study or pragmatic studies).ti,ab. (375)
137 ((pragmatic or practical) adj3 trial$).ti,ab. (3637)
138 ((quasiexperimental or quasi-experimental) adj3 (study or studies or trial$)).ti,ab. (7363)
139 (metaanaly$ or meta analy$).ti,ab. (165574)
140 or/126-139 (2872043)
141 125 and 140 (29883)
142 (201909* or 201910* or 201911* or 201912* or 2020*).ed. (495367)
143 141 and 142 (1259)
144 limit 143 to english language (1239)

Cochrane Central Register of Controlled Clinical Trials (CENTRAL)

#1 diet:ti
#2 diets:ti
#3 dietary:ti
#4 (fruit* or vegetable*):ti
#5 exercis*:ti
#6 walking:ti
#7 "physical activity":ti,ab,kw
#8 pedometer*:ti,ab,kw
#9 fitbit*:ti,ab,kw
#10 "steps per":ti,ab,kw
#11 distance walked:ti,ab,kw
#12 (measuring next step*):ti,ab,kw
#13 (step next count*):ti,ab,kw
#14 (activity or fitness):ti,ab,kw near/1 track*:ti,ab,kw
#15 sedentary:ti,ab,kw next (lifestyle* or (life next style*) or behavior* or behaviour* or time):ti,ab,kw
#16 (sitting or lying):ti,ab,kw near/2 time:ti,ab,kw
#17 ("screen time" or junk food* or fast food* or candy or soda or snacks or snacking):ti,ab,kw
#18 (television or tv):ti,ab,kw next viewing:ti,ab,kw
#19 (watch* or view*):ti,ab,kw next (television or tv):ti,ab,kw
#20 (computer or internet):ti,ab,kw next (time or use or usage):ti,ab,kw
#21 (computer or video):ti,ab,kw next game*:ti,ab,kw
#22 (screen or screen-based):ti,ab,kw next (entertainment or behavior* or behaviour* or use or usage):ti,ab,kw
#23 (low next energy next expenditure*):ti,ab,kw
#24 (physical* next inactiv*):ti,ab,kw
#25 or #15-#24
#26 (reduce* or reduction* or decrease* or change* or target*):ti,ab
#27 #25 and #26
#28 Conroy, #1-`#14`, `#27
#29 counsel*:ti,ab,kw
#30 (advice or advise or consultation*):ti,ab,kw
#31 Behavio*:ti,ab,kw near/2 (therap* or chang* or modification* or improv*):ti,ab,kw
#32 referral*:ti,ab,kw
#33 (set* near/2 goal*):ti,ab,kw
#34 (action next plan*):ti,ab,kw
#35 (self next monitor*):ti,ab,kw
#36 "follow up feedback":ti,ab,kw
#37 (assessment near/5 feedback):ti,ab,kw
#38 "support planning":ti,ab,kw
#39 "risk factor management":ti,ab,kw
#40 "life style":ti,ab,kw
#41 lifestyle:ti,ab,kw
#42 motivation*:ti,ab,kw

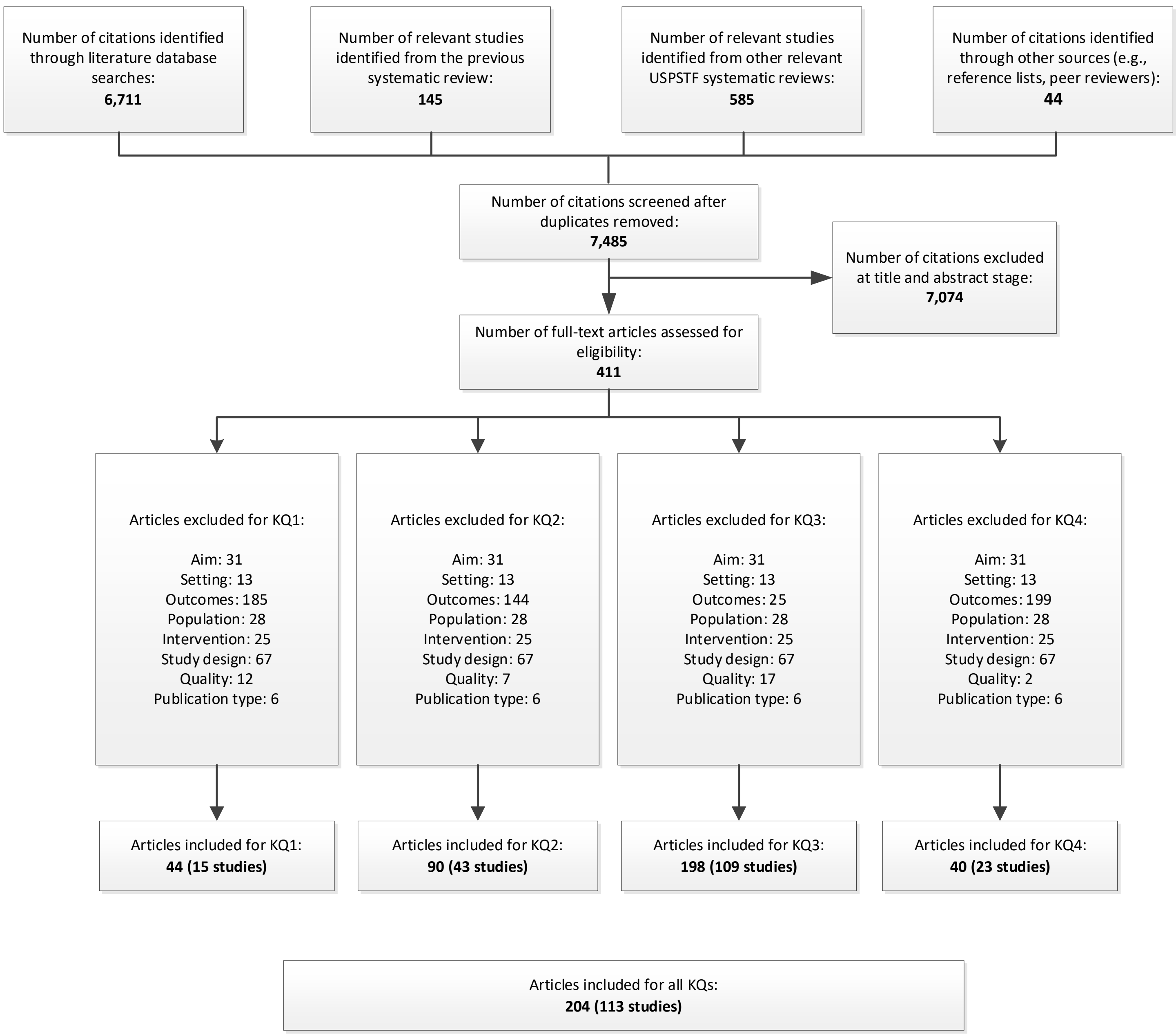
#43 health:ti,ab,kw next (coach* or behavio* or education):ti,ab,kw
#44 (education* next program*):ti,ab,kw
#45 "patient education":ti,ab,kw
#46 "health promotion":ti,ab,kw
#47 promot*:ti,ab,kw near/3 (exercise or physical activit* or weight loss):ti,ab,kw
#48 (nonpharmacologic or "non pharmacologic"):ti,ab,kw next intervention*:ti,ab,kw
#49 intervention*:ti
#50 Paxton, #29-`#49
#51 (cardiovascular or cardiometabolic):ti
#52 #28 and (#50 or #51)
#53 (lifestyle near/2 intervention*):ti,ab,kw or ("life style" near/2 intervention*):ti,ab,kw or ((health* next lifestyle) or (health* next "life style") or (unhealth* next lifestyle) or (unhealth* next "life style")):ti,ab,kw
#54 (cardiovascular or cardiometabolic or coronary or heart):ti,ab,kw
#55 (insulin or glucose or diabet*):ti,ab,kw
#56 (lipoprotein* or lipid* or triglyceride* or hyperlipidemia* or cholesterol):ti,ab,kw
#57 (bmi or body mass index or body weight):ti,ab,kw
#58 (hypertension or "blood pressure"):ti,ab,kw
#59 or #54-#58
#60 #53 and #59
#61 #52 or #60 with Publication Year from 2019 to 2020, with Cochrane Library publication date from Sep 2019 to Feb 2020, in Trials

PsycINFO
Database: PsycINFO <1806 to February Week 3 2020>
Search Strategy:
----
1 Diets/ (12591)
2 Dietary Restraint/ (1694)
3 Eating Behavior/ (12654)
4 fruit*.ti,ab,id. (17855)
5 vegetable*.ti,ab,id. (5818)
6 (diet or diets or dietary).ti,ab,id. (37318)
7 Exercise/ (22281)
8 Physical Activity/ (19157)
9 Aerobic Exercise/ (1755)
10 Walking/ (5309)
11 (exercise or physical activity).ti,ab,id. (74770)
12 walking.ti,ab,id. (15393)
13 (pedometer* or fitbit* or steps per or distance walked or measuring step* or step count*).ti,ab,id. (1440)
14 ((activity or fitness) adj1 track*).ti,ab,id. (233)
15 Activity Level/ (8689)
16 Sedentary behavior/ (1431)

17 (sedentary adj (lifestyle* or life style* or behavio* or time)).ti,ab,id. (3360)
18 ((sitting or lying) adj2 time).ti,ab,id. (672)
19 (junk food$ or fast food$ or candy or soda or snacks or snacking).ti,ab,id. (4349)
20 Screen time/ (257)
21 Television/ (5872)
22 Television Viewing/ (4176)
23 Computers/ (9864)
24 Computer Games/ (7239)
25 Role Playing Games/ (462)
26 Simulation Games/ (890)
27 screen time.ti,ab,id. (916)
28 ((television or TV) adj viewing).ti,ab,id. (2668)
29 ((watch* or view*) adj (television or TV)).ti,ab,id. (1824)
30 ((computer or internet) adj (time or "use" or usage)).ti,ab,id. (5987)
31 ((computer or video) adj game*).ti,ab,id. (7097)
32 ((screen or screen based) adj (entertainment or behavio* or "use" or usage)).ti,ab,id. (113)
33 low energy expenditure*.ti,ab,id. (23)
34 physical* inactiv*.ti,ab,id. (2272)
35 or/1-34 (187500)
36 behavior therapy/ (13798)
37 cognitive behavior therapy/ (19018)
38 cognitive therapy/ (13347)
39 Cognitive Techniques/ (1687)
40 Behavior Modification/ (10401)
41 Behavior Change/ (11912)
42 Lifestyle Changes/ (1277)
43 Lifestyle/ (10133)
44 Persuasive Communication/ (5139)
45 Motivation/ (51731)
46 Motivational Interviewing/ (2406)
47 Self Efficacy/ (22045)
48 Health Knowledge/ (7597)
49 Health Behavior/ (27506)
50 Health Education/ (12968)
51 Health Promotion/ (24207)
52 Client Education/ (3934)
53 counseling/ (22979)
54 counsel*.ti,ab,id,hw. (122480)
55 (advice or advise or consultation*).ti,ab,id,hw. (52552)
56 (behavio* adj2 (therap* or chang* or modification* or improv*)).ti,ab,id. (86122)
57 referral*.ti,ab,id. (26827)
58 (set* adj2 goal*).ti,ab,id. (8927)
59 action plan*.ti,ab,id. (3337)
60 self monitor*.ti,ab,id. (6222)
61 follow-up feedback.ti,ab,id. (22)
62 (assessment adj5 feedback).ti,ab,id. (1492)

63 support planning.ti,ab,id. (117)
64 risk factor management.ti,ab,id. (72)
65 (life style or lifestyle).ti,ab,id. (27333)
66 motivation*.ti,ab,id. (130923)
67 (health adj (coach* or behavio* or education)).ti,ab,id. (29010)
68 education* program*.ti,ab,id. (32880)
69 patient education.ti,ab,id. (3554)
70 health promotion.ti,ab,id. (19328)
71 (promot* adj3 (exercise or physical activit* or weight loss)).ti,ab,id. (3446)
72 nonpharmacologic intervention*.ti,ab,id. (214)
73 non pharmacologic intervention*.ti,ab,id. (80)
74 intervention.ti. (46389)
75 or/36-74 (604877)
76 (cardiovascular or cardiometabolic).ti. (7992)
77 35 and (75 or 76) (48057)
78 ((lifestyle adj2 intervention*) or (life style adj2 intervention*) or health* lifestyle or health* life style or unhealth* lifestyle or unhealth* life style).ti,ab,id. (4317)
79 (cardiovascular or coronary or cardiometabolic or heart).ti,ab,id. (79567)
80 (insulin or glucose or diabet*).ti,ab,id. (46849)
81 (lipoprotein* or lipid* or triglyceride* or hyperlipidemia* or cholesterol).ti,ab,id. (17476)
82 (bmi or body mass index or body weight).ti,ab,id. (40055)
83 (hypertension or blood pressure).ti,ab,id. (30956)
84 or/79-83 (171029)
85 78 and 84 (1814)
86 77 or 85 (48732)
87 (control* adj3 (study or studies or trial*)).ti,ab,id,hw. (82060)
88 clinical trial*.ti,ab,id,hw. (37730)
89 random*.ti,ab,id,hw. (196806)
90 trial.ti. (29617)
91 (treatment outcome or clinical trial).md. (44947)
92 or/87-91 (267680)
93 86 and 92 (8799)
94 limit 93 to (100 childhood <birth to age 12 yrs> or 120 neonatal <birth to age 1 mo> or 140 infancy <2 to 23 mo> or 160 preschool age <age 2 to 5 yrs> or 180 school age <age 6 to 12 yrs> or 200 adolescence <age 13 to 17 yrs>) (1691)
95 limit 93 to ("300 adulthood <age 18 yrs and older>" or 320 young adulthood <age 18 to 29 yrs> or 340 thirties <age 30 to 39 yrs> or 360 middle age <age 40 to 64 yrs> or "380 aged <age 65 yrs and older>" or "390 very old <age 85 yrs and older>") (6218)
96 94 not 95 (1069)
97 93 not 96 (7730)
98 limit 97 to animal (91)
99 limit 97 to human (7402)
100 98 not 99 (66)
101 97 not 100 (7664)
102 (201909* or 201910* or 201911* or 201912* or 2020*).up. (76419)
103 101 and 102 (330)

Appendix A Figure 1. Literature Flow Diagram



Appendix A Table 1. Inclusion and Exclusion Criteria

Category	Include	Exclude
Study aim	Primary prevention of CVD	• Secondary or tertiary prevention of CVD • Weight loss or weight loss maintenance* • Cancer prevention or treatment • Prevention or treatment of diabetes • Prevention or treatment of cognitive decline • Prevention of falls • Smoking cessation • Management of other diseases or conditions (e.g., managing symptoms associated with arthritis)
Populations	Adults age >18 years without known CVD risk factors** Includes studies among: • Adults who are unselected • Adults selected based on suboptimal behavior (e.g., poor dietary intake, not meeting recommended levels of physical activity, or high levels of sedentary time) • Adults who do not have known CVD risk factors** but whom may otherwise be at increased risk for CVD (i.e., based on age, sex, race/ethnicity, family history, or excess weight [BMI ≥25.0 kg/m^2])	Studies limited to: • Children and adolescents • Parents (if intended behavior change is directed toward children) • Persons with known CVD or diabetes mellitus • Persons with known traditional CVD risk factors (i.e., hypertension, elevated blood pressure, dyslipidemia, elevated lipid levels, impaired fasting glucose or impaired glucose tolerance, and smoking); adults at high risk for CVD based on a cardiovascular risk assessment tool; or trial inclusion criteria specifies that the population has ≥1 CVD risk factors • Current smokers • Persons with medical conditions limiting their generalizability to primary care–based populations (e.g., persons with acute illnesses, cognitive impairment, severe and persistent mental illness, cancer or cancer survivors, or chronic pain) • Pregnant women • Adults in institutions
Settings	• Studies conducted in or recruited from primary care or a health care system or could feasibly be implemented in or referred from primary care. For an intervention to be feasible for primary care or primary care referral, it would need to be conducted in a health care setting or be available for referral in the community, including electronically-delivered and community-based interventions. • Studies conducted in countries rated as "very high" on the Human Development Index (based on 2018 indicators) (as defined by the United Nations Development Programme)	Studies conducted in or recruited from settings not generalizable to primary care (e.g., inpatient hospital units, emergency departments, nursing homes and other institutionalized settings, school classroom–based programs, occupational settings)

Appendix A Table 1. Inclusion and Exclusion Criteria

Category	Include	Exclude
Interventions	Behavioral counseling intervention alone or as part of a larger multicomponent intervention on diet and nutrition, physical activity, sedentary behavior, or a combination, including but not limited to: assessment with feedback, advice, collaborative goal-setting, assistance, exercise prescriptions (referral to exercise facility or program), and arranging further contacts. Interventions may be delivered via face-to-face contact, telephone, print materials, or technology (e.g., computer-based, text messages, and remote video feed) and can be delivered by a number of potential interventionists, including but not limited to: physicians, nurses, exercise specialists, dietitians, nutritionists, and behavioral health specialists Dietary counseling may include focus on: • Increased consumption of fruits, vegetables, whole grains, fat-free or low-fat dairy, and lean proteins • Limited consumption of sodium, saturated fat, trans fat, and sugar-sweetened food and beverages Physical activity counseling may include focus on: • Aerobic activities that involve repeated use of large muscles, such as walking, cycling, and swimming • Resistance or strength training • Optional or access to guided physical activity or exercise classes allowed Sedentary behavior counseling may include focus on: • Reduced sitting time • Breaking up short periods of sedentary time Limited guided physical activity or provision of food samples allowed if intention is to teach or demonstrate healthy lifestyle principles	• Noncounseling interventions (e.g., use of incentives, supervised exercise with the goal of assessing effects of exercise, or controlled diets) • Dietary counseling solely focused on increasing specific vitamins, micronutrients, or antioxidants through dietary change or supplementation, or focused on alcohol moderation • Physical activity counseling solely focused on balance, flexibility, or gait • Stress management interventions (e.g., meditation-, yoga-, or tai chi–based interventions that have minimal aerobic or strength-building activities) • Prenatal or postnatal dietary counseling • Counseling interventions with components that are not feasible for implementation in healthcare settings (e.g., occupational/worksite, church-, or school-based interventions that are conducted within existing social networks; social marketing [e.g., media campaigns]; or policy [e.g., local or state public/health policy])
Comparisons	• No intervention (e.g., wait-list or usual care) • Minimal intervention (e.g., usual care limited to ≤15 minutes of information or pamphlets) • Attention control (e.g., similar format and intensity of intervention on a different content area)	• Active comparators without a control (as defined in inclusion criteria) • Studies in which the control group is instructed to not change their diet, physical activity, or sedentary behavior

Appendix A Table 1. Inclusion and Exclusion Criteria

Category	Include	Exclude
Outcomes	**KQ 1:** Health outcomes • Cardiovascular events and related morbidity (e.g., stroke, myocardial infarction, or heart failure) • Cardiovascular and all-cause mortality • Quality of life measures and related outcomes (e.g., functioning or well-being) **KQ 2:** Intermediate outcomes • Blood pressure • Total, low-density lipoprotein, and high-density lipoprotein cholesterol • Hemoglobin A1c, fasting glucose levels, and 1- and 2-hour glucose tolerance test results • Body mass index, weight, and waist circumference (based on objective measurement) • Cardiorespiratory fitness (e.g., vo2max, heart rate, exercise tolerance, or 6-minute walk) • Dichotomized versions of CVD risk factors (hypertension, dyslipidemia, diabetes mellitus, overweight or obesity, or incidence of metabolic syndrome) • Calculated 10-year CVD risk **KQ 3:** Intermediate Behavioral outcomes • Dietary intake or patterns • Physical activity • Sedentary behavior **KQ 4:** Harms • Harms occurring following the intervention (e.g., nutritional deficiencies, disordered eating, symptoms of anxiety, musculoskeletal injuries, or cardiovascular events)	• Knowledge, attitudes, and self-efficacy • Mental health symptom scores • Balance or flexibility
Timing of outcome assessment	≥6 months postbaseline	<6 months postbaseline
Study designs	Randomized, clinical trials and nonrandomized controlled intervention studies	Observational study designs (including prospective and retrospective cohort studies, before-after studies, interrupted time series studies, repeated measures studies, case-control studies, and case series)
Publication language	English	Languages other than English
Study quality	Fair or good	Poor (according to design-specific USPSTF criteria)

*Studies that focus on the effectiveness of primary care interventions for weight management are included in a separate review commissioned by the USPSTF on Behavioral Weight Loss Interventions to Prevent Obesity-Related Morbidity and Mortality in Adults (https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/obesity-in-adults-interventions (/uspstf/recommendation/obesity-in-adults-interventions)).
**Persons with known traditional CVD risk factors (i.e., hypertension, elevated blood pressure, dyslipidemia, elevated lipids, impaired fasting glucose or glucose tolerance); adults at high risk for CVD based on a cardiovascular risk assessment tool; or trial inclusion criteria specifies that the population has ≥1 CVD risk factors.

Abbreviations: CVD=cardiovascular disease; KQ=key question; USPSTF=U.S. Preventive Services Task Force; vo2max=maximum rate of oxygen consumption.

Appendix A Table 2. Quality Assessment Criteria of Randomized, Controlled Trials

Randomized clinical trials, adapted from U.S. Preventive Services Task Force Procedure Manual[34] and the Cochrane Assessing the Risk of Bias guidance[219]
Bias arising in the randomization process or due to confounding • Valid random assignment/random sequence generation method used • Allocation concealed • Balance in baseline characteristics **Bias due to departures from intended interventions** • Fidelity to the intervention protocol • Low risk of contamination between groups • Participants were analyzed as originally allocated **Bias from missing data** • No, or minimal, post-randomization exclusions • Outcome data are reasonably complete and comparable between groups • Reasons for missing data are similar across groups • Missing data are unlikely to bias results **Bias in measurement of outcomes** • Blinding of outcome assessors • Outcomes are measured using consistent and appropriate procedures and instruments across treatment groups • No evidence of biased use of inferential statistics **Bias in reporting results selectively** • No evidence that the measures, analyses, or subgroup analyses are selectively reported

Appendix B. Included Studies

Below is a list of included studies and their ancillary publications (indented below main results publication):

1. Aadahl M, Linneberg A, Moller TC, et al. Motivational counseling to reduce sitting time: a community-based randomized controlled trial in adults. *Am J Prev Med*. 2014;47(5):576-86. PMID: 25113139. http://dx.doi.org/10.1016/j.amepre.2014.06.020
2. Aittasalo M, Miilunpalo S, Kukkonen-Harjula K, et al. A randomized intervention of physical activity promotion and patient self-monitoring in primary health care. *Prev Med*. 2006;42(1):40-6. PMID: 16297442. https://dx.doi.org/10.1016/j.ypmed.2005.10.003
3. Albright CL, Steffen AD, Wilkens LR, et al. Effectiveness of a 12-month randomized clinical trial to increase physical activity in multiethnic postpartum women: Results from Hawaii's N Mikimiki Project. *Prev Med*. 2014;69:214-23. PMID: 25285751. http://dx.doi.org/10.1016/j.ypmed.2014.09.019
   a. Albright CL, Saiki K, Steffen AD, et al. What barriers thwart postpartum women's physical activity goals during a 12-month intervention? A process evaluation of the Na Mikimiki Project. *Women Health*. 2015;55(1):1-21. PMID: 25402618. http://dx.doi.org/10.1080/03630242.2014.972014
   b. Albright CL, Steffen AD, Novotny R, et al. Baseline results from Hawaii's Na Mikimiki Project: a physical activity intervention tailored to multiethnic postpartum women. *Women Health*. 2012;52(3):265-91. PMID: 22533900. https://dx.doi.org/10.1080/03630242.2012.662935
4. Aldana SG, Greenlaw RL, Diehl HA, et al. The behavioral and clinical effects of therapeutic lifestyle change on middle-aged adults. *Prev Chronic Dis*. 2006;3(1):A05. PMID: 16356358. http://www.cdc.gov/pcd/issues/2006/jan/05_0088.htm
   a. Aldana SG, Greenlaw RL, Diehl HA, et al. Effects of an intensive diet and physical activity modification program on the health risks of adults. *J Am Diet Assoc*. 2005;105(3):371-81. PMID: 15746824. https://dx.doi.org/10.1016/j.jada.2004.12.007
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Appendix C. Excluded Studies

Reason for Exclusion	
E1	Study aim: Not CVD prevention focused
E1a	Study aim: Weight loss or weight loss maintenance focus
E2a	Setting: not a “very high” development country
E2b	Setting: Not generalizable to primary care
E3a	Population: Adults at high-risk for CVD
E3b	Population: Adults with known CVD or diabetes mellitus
E3c	Population: Adults with other known chronic disease (e.g., cancer, chronic kidney disease, severe mental illness)
E3d	Population: Other excluded population (i.e., children and adolescents, parents, pregnant women, institutionalized adults)
E4	Outcomes: No relevant outcomes
E5	Intervention: Not an included intervention (not a, b, or c)
E5a	Intervention: Yoga or tai chi
E5b	Intervention: Supervised PA/training study
E5c	Intervention: Food provision
E6a	Study design: Not a trial
E6b	Study design: Follow-up 3 to <6 months
E6bb	Study design: Follow-up <3 months
E6c	Study design: Control group not appropriate, including CE
E6d	Study design: Control group told not to change diet or PA
E7	Study quality
E7a	Study quality: Primary article excluded for quality
E8	Publication type (e.g., not in English, conference abstract…)

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2. Agarwal P, Kithulegoda N, Bouck Z, et al. Feasibility of an Electronic Health Tool to Promote Physical Activity in Primary Care: Pilot Cluster Randomized Controlled Trial. *J Med Internet Res*. 2020;22(2):e15424. PMID: 32130122. https://dx.doi.org/10.2196/15424 **KQ1E6b, KQ2E6b, KQ3E6b, KQ4E6b.**

3. Alley S, Jennings C, Plotnikoff RC, et al. My Activity Coach - using video-coaching to assist a web-based computer-tailored physical activity intervention: a randomised controlled trial protocol. *BMC Public Health*. 2014;14:738. PMID: 25047900. https://dx.doi.org/10.1186/1471-2458-14-738 **KQ1E7a, KQ2E4, KQ3E7a, KQ4E4**.

4. Alley S, Jennings C, Plotnikoff RC, et al. Web-Based Video-Coaching to Assist an Automated Computer-Tailored Physical Activity Intervention for Inactive Adults: A Randomized Controlled Trial. *J Med Internet Res*. 2016;18(8):e223. PMID: 27520283. https://dx.doi.org/10.2196/jmir.5664 **KQ1E7, KQ2E4, KQ3E7, KQ4E4.**

5. Alley SJ, Kolt GS, Duncan MJ, et al. The effectiveness of a web 2.0 physical activity intervention in older adults - a randomised controlled trial. *International Journal of Behavioral Nutrition & Physical Activity*. 2018;15(1):4. PMID: 29329587. https://dx.doi.org/10.1186/s12966-017-0641-5 **KQ1E6c, KQ2E6c, KQ3E6c, KQ4E6c.**

6. Amaro-Gahete F, De-La-O A, Jurado-Fasoli L, et al. Exercise training as a treatment for cardiometabolic risk in sedentary adults: are physical activity guidelines the best way to improve cardiometabolic health? the fit-ageing randomized controlled trial. *Journal of Clinical Medicine*. 2019;8(12). PMID: 31805736. https://dx.doi.org/10.3390/jcm8122097 **KQ1E6b, KQ2E6b, KQ3E6b, KQ4E6b.**

7. An M, Nahm ES, Shaughnessy M, et al. A Pilot Primary Stroke Prevention Program for Elderly Korean Americans. *J Neurosci Nurs*. 2018;50(6):327-33. PMID: 30407966. https://dx.doi.org/10.1097/JNN.0000000000000397 **KQ1E6bb, KQ2E6bb, KQ3E6bb, KQ4E6bb.**

8. Arija V, Villalobos F, Pedret R, et al. Effectiveness of a physical activity program on cardiovascular disease risk in adult primary health-care users: the "Pas-a-Pas" community intervention trial. *BMC Public Health*. 2017;17(1):576. PMID: 28619115. https://dx.doi.org/10.1186/s12889-017-4485-3 **KQ1E5b, KQ2E5b, KQ3E5b, KQ4E5b.**

9. Ashton LM, Morgan PJ, Hutchesson MJ, et al. Feasibility and preliminary efficacy of the 'HEYMAN' healthy lifestyle program for young men: a pilot randomised controlled trial. *Nutrition Journal*. 2017;16(1):2. PMID: 28086890. https://dx.doi.org/10.1186/s12937-017-0227-8 **KQ1E6b, KQ2E6b, KQ3E6b, KQ4E6b.**

10. Atay E, Toraman NF, Yaman H. Exercise prescription by primary care doctors: Effect on physical activity level and functional abilities in elderly. *Turkish Journal of Geriatrics*. 2014;17(1):77-85**. KQ1E7a, KQ2E4, KQ3E4, KQ4E4.**

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14. Barrett S, Begg S, O'Halloran P, et al. Integrated motivational interviewing and cognitive behaviour therapy can increase physical activity and improve health of adult ambulatory care patients in a regional hospital: the Healthy4U randomised controlled trial. *BMC Public Health*. 2018;18(1):1166. PMID: 30305078. https://dx.doi.org/10.1186/s12889-018-6064-7 **KQ1E6c, KQ2E6c, KQ3E6c, KQ4E6c.**

15. Berendsen AAM, van de Rest O, Feskens EJM, et al. Changes in Dietary Intake and Adherence to the NU-AGE Diet Following a One-Year Dietary Intervention among European Older Adults-Results of the NU-AGE Randomized Trial. *Nutrients*. 2018;10(12):04. PMID: 30518044. https://dx.doi.org/10.3390/nu10121905 **KQ1E5c, KQ2E5c, KQ3E5c, KQ4E5c.**

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19. Brellenthin A, Lanningham-Foster L, Kohut M, et al. Comparison of the Cardiovascular Benefits of Resistance, Aerobic, and Combined Exercise (CardioRACE): rationale, design, and methods. *Am Heart J*. 2019; 217:101-111. PMID: 31520895. https://dx.doi.org/10.1016/j.ahj.2019.08.008 **KQ1E3a, KQ2E3a, KQ3E3a, KQ4E3a.**

20. Brickwood KJ, Ahuja KDK, Watson G, et al. Effects of Activity Tracker Use With Health Professional Support or Telephone Counseling on Maintenance of Physical Activity and Health Outcomes in Older Adults: Randomized Controlled Trial. *JMIR Mhealth Uhealth*. 2021;9(1):e18686. PMID: 33399541. https://dx.doi.org/10.2196/18686 **KQ1E6c, KQ2E6c, KQ3E6c, KQ4E6c.**

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24. Caso D, Carfora V, Capasso M, et al. Using Messages Targeting Psychological versus Physical Health Benefits to Promote Walking Behaviour: A Randomised Controlled Trial. *Appl Psychol Health Well Being*. 2020;17:17. PMID: 32945103. https://dx.doi.org/10.1111/aphw.12224 **KQ1E6bb, KQ2E6bb, KQ3E6bb, KQ4E6bb.**

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27. Chang M-W, Brown R, Nitzke S. Results and lessons learned from a prevention of weight gain program for low-income overweight and obese young mothers: Mothers In Motion. *BMC Public Health*. 2017;17(1):182-. PMID: 28187726. https://dx.doi.org/10.1186/s12889-017-4109-y **KQ1E7, KQ2E7, KQ3E7, KQ4E4.**

28. Chang MW, Brown R, Nitzke S. A Community-Based Intervention Program's Effects on Dietary Intake Behaviors. *Obesity (Silver Spring)*. 2017;25(12):2055-61. PMID: 29086490. https://dx.doi.org/10.1002/oby.21862 **KQ1E7a, KQ2E7a, KQ3E7a, KQ4E4.**

29. Chang MW, Nitzke S, Brown R. Mothers In Motion intervention effect on psychosocial health in young, low-income women with overweight or obesity. *BMC Public Health*. 2019;19(1):56. PMID: 30642311. https://dx.doi.org/10.1186/s12889-019-6404-2 **KQ1E7a, KQ2E7a, KQ3E7a, KQ4E4.**

30. Chang MW, Nitzke S, Brown R, et al. A community based prevention of weight gain intervention (Mothers In Motion) among young low-income overweight and obese mothers: design and rationale. *BMC Public Health*. 2014;14:280. PMID: 24666633. https://dx.doi.org/10.1186/1471-2458-14-280 **KQ1E7a, KQ2E7a, KQ3E7a, KQ4E4.**

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32. Clapperton M, Maharaj R, Motilal S, et al. The effects of structured physician delivered counselling on physical activity levels in sedentary primary care clinic attendees: a single blinded randomized controlled trial. *West Indian Medical Journal*. 2020. https://www.cochranelibrary.com/central/doi/10.1002/central/CN-02097229/full. **KQ1E8, KQ2E8, KQ3E8, KQ4E8.**

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34. Conroy DE, Hedeker D, McFadden HG, et al. Lifestyle intervention effects on the frequency and duration of daily moderate-vigorous physical activity and leisure screen time. *Health Psychology*. 2017;36(4):299-308. PMID: 27642762. https://dx.doi.org/10.1037/hea0000418 **KQ1E6c, KQ2E6c, KQ3E6c, KQ4E6c.**

35. Cook NR, Cutler JA, Obarzanek E, et al. Long term effects of dietary sodium reduction on cardiovascular disease outcomes: observational follow-up of the trials of hypertension prevention (TOHP). *BMJ*. 2007;334(7599):885-8. PMID: 17449506. https://dx.doi.org/10.1136/bmj.39147.604896.55 **KQ1E3a, KQ2E3a, KQ3E3a, KQ4E3a.**

36. Cowper PA, Peterson MJ, Pieper CF, et al. Economic Analysis of Primary Care-Based Physical Activity Counseling in Older Men: The VA-LIFE Trial. *J Am Geriatr Soc*. 2017;65(3):533-9. PMID: 28152170. https://doi.org/10.1111/jgs.14567 **KQ1E1, KQ2E1, KQ3E1, KQ4E1.**

37. Cunha PM, Ribeiro AS, Nunes JP, et al. Resistance training performed with single-set is sufficient to reduce cardiovascular risk factors in untrained older women: The randomized clinical trial. Active Aging Longitudinal Study. *Arch Gerontol Geriatr*. 2019;81:171-5. PMID: 30594892. https://dx.doi.org/10.1016/j.archger.2018.12.012 **KQ1E2a, KQ2E2a, KQ3E2a, KQ4E2a.**

38. Dahrouge S, Kaczorowski J, Dolovich L, et al. Long term outcomes of cluster randomized trial to improve cardiovascular health at population level: The Cardiovascular Health Awareness Program (CHAP). *PLoS ONE*. 2018;13(9):e0201802. PMID: 30188912. https://dx.doi.org/10.1371/journal.pone.0201802 **KQ1E2b, KQ2E2b, KQ3E2b, KQ4E2b.**

39. de Souto Barreto P, Pothier K, Soriano G, et al. A Web-Based Multidomain Lifestyle Intervention for Older Adults: the eMIND Randomized Controlled Trial. *Journal of Prevention of Alzheimer's Disease*. 2020. PMID: 33569560. https://doi.org/10.14283/jpad.2020.70 **KQ1E1, KQ2E1, KQ3E1, KQ4E1.**

40. Duthie SJ, Duthie GG, Russell WR, et al. Effect of increasing fruit and vegetable intake by dietary intervention on nutritional biomarkers and attitudes to dietary change: a randomised trial. *Eur J Nutr*. 2018;57(5):1855-72. PMID: 28560503. https://doi.org/10.1007/s00394-017-1469-0 **KQ1E6d, KQ2E6d, KQ3E6d, KQ4E6d.**

41. Eakin EG, Bull SS, Riley KM, et al. Resources for health: a primary-care-based diet and physical activity intervention targeting urban Latinos with multiple chronic conditions. *Health Psychology*. 2007;26(4):392-400. PMID: 17605558. https://doi.org/10.1037/0278-6133.26.4.392 **KQ1E3c, KQ2E3c, KQ3E3c, KQ4E3c.**

42. Edney SM, Olds TS, Ryan JC, et al. A Social Networking and Gamified App to Increase Physical Activity: Cluster RCT. *Am J Prev Med*. 2020;58(2):e51-e62. PMID: 31959326. https://dx.doi.org/10.1016/j.amepre.2019.09.009 **KQ1E5, KQ2E5, KQ3E5, KQ4E5.**

43. Eigendorf J, Melk A, Haufe S, et al. Effects of personalized endurance training on cellular age and vascular function in middle-aged sedentary women. *Eur J Prev Cardiology*. 2019; 26(17):1903-1906. PMID: 31084260. https://doi.org/10.1177/2047487319849505 **KQ1E5b, KQ2E5b, KQ3E5b, KQ4E5b.**

44. Ek A, Alexandrou C, Delisle Nyström C, et al. The Smart City Active Mobile Phone Intervention (SCAMPI) study to promote physical activity through active transportation in healthy adults: a study protocol for a randomised controlled trial. *BMC Public Health*. 2018;18(1):880. PMID: 30012116. https://doi.org/10.1186/s12889-018-5658-4 **KQ1E6d, KQ2E6d, KQ3E6d, KQ4E6d.**

45. Ek A, Alexandrou C, Soderstrom E, et al. Effectiveness of a 3-Month Mobile Phone-Based Behavior Change Program on Active Transportation and Physical Activity in Adults: Randomized Controlled Trial. *JMIR Mhealth Uhealth*. 2020;8(6):e18531. PMID: 32510462. https://dx.doi.org/10.2196/18531 **KQ1E6d, KQ2E6d, KQ3E6d, KQ4E6d.**

46. Elbert SP, Dijkstra A, Oenema A. A Mobile Phone App Intervention Targeting Fruit and Vegetable Consumption: The Efficacy of Textual and Auditory Tailored Health Information Tested in a Randomized Controlled Trial. *J Med Internet Res*. 2016;18(6):e147. PMID: 27287823. https://dx.doi.org/10.2196/jmir.5056 **KQ1E4, KQ2E4, KQ3E7, KQ4E4.**

47. Ellingson LD, Lansing JE, DeShaw KJ, et al. Evaluating Motivational Interviewing and Habit Formation to Enhance the Effect of Activity Trackers on Healthy Adults' Activity Levels: Randomized Intervention. *JMIR Mhealth Uhealth*. 2019;7(2):e10988. PMID: 30762582. https://dx.doi.org/10.2196/10988 **KQ1E6b, KQ2E6b, KQ3E6b, KQ4E6b.**

48. Emmons KM, Puleo E, Greaney ML, et al. A randomized comparative effectiveness study of Healthy Directions 2--a multiple risk behavior intervention for primary care. *Preventive Medicine*. 2014;64:96-102. PMID: 24642140. https://dx.doi.org/10.1016/j.ypmed.2014.03.011 **KQ1E4, KQ2E4, KQ3E4, KQ4E4.**

49. Estrada Del Campo Y, Cubillos L, Vu MB, et al. Feasibility and acceptability of a Mediterranean-style diet intervention to reduce cardiovascular risk for low income Hispanic American women. *Ethn Health*. 2017:1-17. PMID: 28670906. https://dx.doi.org/10.1080/13557858.2017.1346784 **KQ1E6a, KQ2E6a, KQ3E6a, KQ4E6a.**

50. Ewald B, Stacey F, Johnson N, et al. Physical activity coaching by Australian Exercise Physiologists is cost effective for patients referred from general practice. *Aust N Z J Public Health*. 2018;42(1):12-5. PMID: 29165855. https://dx.doi.org/10.1111/1753-6405.12733 **KQ1E4, KQ2E4, KQ3E4, KQ4E4.**

51. Fanning J, Porter G, Awick EA, et al. Effects of a DVD-delivered exercise program on patterns of sedentary behavior in older adults: a randomized controlled trial. *Prev Med Rep*. 2016;3:238-43. PMID: 27419021. https://dx.doi.org/10.1016/j.pmedr.2016.03.005 **KQ1E1, KQ2E1, KQ3E1, KQ4E1.**

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53. Fernandez-Ruiz VE, Armero-Barranco D, Paniagua-Urbano JA, et al. Short-medium-long-term efficacy of interdisciplinary intervention against overweight and obesity: Randomized controlled clinical trial. *Int J Nurs Pract*. 2018;24(6):e12690. PMID: 30109735. https://dx.doi.org/10.1111/ijn.12690 **KQ1E1a, KQ2E1a, KQ3E1a, KQ4E1a.**

54. Fjeldsoe B, Miller Y, Prosser S, et al. How does MobileMums work? Mediators of a physical activity intervention. *Psychol Health*. 2019;35(8):968-983. PMID: 31744314. https:///doi.org/10.1080/08870446.2019.1687698 **KQ1E1a, KQ2E1a, KQ3E1a, KQ4E1a.**

55. Fjeldsoe BS, Goode AD, Phongsavan P, et al. Evaluating the Maintenance of Lifestyle Changes in a Randomized Controlled Trial of the 'Get Healthy, Stay Healthy' Program. *JMIR Mhealth Uhealth*. 2016;4(2):e42. PMID: 27166643. https://doi.org/10.2196/mhealth.5280 **KQ1E1a, KQ2E1a, KQ3E1a, KQ4E1a.**

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Appendix D Table 1. Study and Population Characteristics for All Studies, by Author

Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr[*]	N Rand	Population	Sub Beh[†]	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP[‡]
Aadahl, 2014 (SIT)[71] Good	X		X	X		Denmark Other	166	Adults aged 18-69 years	X	52.0 (18-69)	57.2	NR	45.8	NR	27.3	
Aittasalo, 2006[72] Fair	X			X	X	Finland Primary care	265	Adults aged 20-65 years	X	47.0 (20-65)	75.8	NR	NR	NR	NR	X
Albright, 2014 (Na Mikimiki)[73] Fair	X			X		US Mixed	311	Mothers aged 18-45 years with infants from 2 to 12 months old	X	31.8 (18-45)	100	White: 15.1 Hisp: 17.4 Asian: 65.3	64.0	77.8	27.9	X
Aldana, 2006 (CHIP)[74] Fair	X		X	X		US Other	348	Adults aged ≥18 years		50.5 (24-81)	71.8	White: 94.0 Black: 4.0	NR	72.0	32.4	
Alexander, 2010 (MENU)[75] Fair	X			X		US Other	2540	Adults aged 21-65 years		46.3 (21-65)	68.8	Black: 23.3 Hisp: 7.6	NR	91.0	NR	X
Allman-Farinelli, 2016 (TXT2BFiT)[49] Fair		X		X		Australia Mixed	250	Adults aged 18-35 years who are overweight or have obesity		27.6 (18-35)	61.3	NR	NR	80.7	26.9[§]	X
Anand, 2016 (SAHARA)[66] Good			X	X		Canada NR	343	South Asian adults aged ≥30 years		50.6 (≥30)	48.1	Asian: 100	69.7	81.9	26.9	
Ball, 2016 (Shop Smart 4Health)[64] Fair				X		Australia Community volunteer	248	Women aged 18-60 years		42.3 (18-60)	100	NR	NR	66.8	NR	
Baron, 1990[76] Fair	X		X	X		UK Primary care	368	Adults aged 25-60 years		41.7 (25-60)	48.6	NR	NR	NR	24.5	X
Bennett, 2013 (Shape Program)[77] Good	X		X	X	X	US Primary care	194	Black women aged 25-44 years who are overweight or have mild obesity		35.4 (25-44)	100	Black: 100	71.4	65.4	30.2	X

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Beresford, 1997 (Eating Patterns Study)[78] Fair	X			X		US Primary care	4778	Adults		NR (NR)	68.0	White: 91.0	NR	73.0	NR	X
Bernstein, 2002[79] Fair	X			X		US Community volunteer	70	Older adults aged ≥70 years	X	77.9 (≥70)	80.0	White: 97.1 Black: 2.9	NR	NR	28.5	
Bickmore, 2013[80] Fair	X			X	X	US Primary care	263	Adults aged ≥65 years	X	71.3 (≥65)	61.2	White: 28.5 Black: 62.7 Hisp: 7.6	NR	48.7	29.5	X
Brekke, 2005[81] Fair	X		X	X		Sweden Other	77	Adults aged 25-55 years with first-degree relatives with type 2 diabetes		42.6 (25-55)	36.8	NR	NR	NR	25.7	
Bryan, 2013 (COSTRIDE)[82] Fair	X		X	X		US Community volunteer	238	Adults aged 18-45 years	X	28.2 (18-45)	80.4	White: 67.1	NR	NR**	25.2	
Burke, 2013 (PANS)[83] Fair	X			X	X	Australia Other	478	Older adults aged 60-70 years	X	65.8 (60-70)	48.3	NR	NR	47.2	NR	
Caplette, 2017[58] Fair			X	X		Canada Mixed	80	Women aged ≥18 years	X	42.0 (22-71)	100	White: 91.3	NR	86.3	27.5	
Carpenter, 2004[84] Fair	X			X		US Other	98	Adults aged ≥18 years		49.6 (29-71)	64.3	White: 86.7 Black: 8.2 Hisp: 2.0	NR	82.7	NR	
Carroll, 2010 (CHIP)[85] Fair	X			X		US Primary care	394	Adults aged ≥18 years		46.4 (≥18)	69.0	White: 36.0 Black: 59.0	79.0	80.0	30.4	X
Coates, 1999 (WHT:FSMP)[86] Fair	X		X	X		US Mixed	2208	Postmenopausal women aged 50-79 years	X	60.0 (50-79)	100	White: 54.6 Black: 28.2 Hisp: 16.0	NR	68.0	28.8	

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
de Vet, 2009[87] Fair	X			X		Netherlands Direct mailing	709	Adults aged 18-65 years		45.9 (18-65)	67.3	NR	NR	66.0	NR	
Delichatsios, 2001[88] Fair	X			X		US Direct mailing	298	Adults aged ≥25 years	X	45.9 (≥25)	72.1	White: 44.9 Black: 44.6	85.2	71.0	28.7	X
Elley, 2003[89] Good	X	X	X	X	X	New Zealand Primary care	878	Adults aged 40-79 years	X	57.9 (40-79)	66.3	NR	NR	25.9	30.0	X
Estabrooks, 2011[90] Fair	X			X		US Primary care	115	Adults aged ≥18 years	X	48.8 (≥18)	61.0	White: 60.0 Black: 22.0 Hisp: 13.0	NR	62.0	NR	X
Fischer, 2019 (Movingcall Trial)[70] Fair				X		Switzerland Community volunteer	288	Adults aged 20-65 years	X	42.2 (30-65)	68.4	NR	84.4	76.8	26.0	
Fjeldsoe, 2015 (MobileMums)[91] Fair	X			X		Australia Mixed	263	Women with children aged <5 years		31.9 (NR)	100	NR	NR	NR	28.1	
Franko, 2008[92] Fair	X			X		US Community volunteer	476	College students aged 18-24 years		20.1 (18-24)	56.3	White: 58.2 Black: 14.1 Asian: 14.9 AI/NA: 6.1	NR	NR	NR	
Fries, 2005 (Rural Physician Cancer Prevention Project)[93] Fair	X			X		US Primary care	754	Adults aged 18-72 years		47.3 (18-72)	64.1	White: 59.5 Black: 37.7	NR	49.8	NR	X
Fukuoka, 2019 (mPED)[69] Good		X		X	X	US Mixed	210	Women aged 25-65 years	X	52.4 (25-65)	100	White: 56.7 Black: 8.1 Hisp: 6.2 Asian: 19.5	74.3	75.3	29.9	

Appendix D Table 1. Study and Population Characteristics for All Studies, by Author

Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Gao, 2016 (VA-STRIDE)[94] Fair	X			X		US Primary care	261	Veterans who are overweight or have obesity		63.2 (NR)	17.2	White: 74.6 Black: 23.3 Hisp: 3.1	30.2	63.8	31.8	X
Gell, 2015[95] Fair	X			X		US Other	87	Women		47.2 (NR)	100	NR	NR	NR	29.2	
Gill, 2019 (HealtheSteps trial)[151] Fair		X	X	X	X	Canada Primary care	118	Adults aged 18-85 years	X	57.7 (18-85)	78.8	White: 97.5	NR	70.3	31.4§	X
Goldstein, 1999 (PAL)[96] Fair	X			X		US Primary care	355	Adults aged ≥50 years	X	65.6 (≥50)	64.5	White: 95.8	36.0	NR	NR	X
Gomez Quinonez, 2016[59] Fair				X		Netherlands Other	373	Adults aged ≥18 years		38.7 (≥18)	69.2	NR	NR	NR	NR	
Grandes, 2009[97] Good	X	X	X	X		Spain Primary care	4317	Adults aged 20-80 years	X	50.0 (20-80)	65.6	NR	50.6	16.8	27.3	X
Green, 2002[98] Fair	X			X		US Direct mailing	316	Adults aged 20-64 years	X	44.0 (18-65)	52.5	White: 91.5 Black: 1.6 Hisp: 0.6 Asian: 4.4	NR	NR	NR	X
Greene, 2008 (SENIOR Study)[99] Fair	X			X		US Community volunteer	1280	Older adults aged ≥60 years		75.0 (≥60)	69.6	White: 77.1 Black: 2.1 Hisp: 14.2	NR	39.0	27.2	
Guagliano, 2020 (FRESH)[157] Fair		X	X	X	X	UK Mixed	67	Families with at least one child aged 7-11 and a consenting parent aged 18+ years		41.3 (NR)	56.7	White: 94	NR	NR	NR	
Halbert, 2000[100] Fair	X	X		X		Australia Primary care	299	Older adults aged ≥60 years	X	67.6 (≥60)	54.5	NR	37.5	NR	27.1	X

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Halperin, 2019[68] Fair			X			Puerto Rico Mixed	40	Puerto Rican young adults aged 18-19 years who are overweight		18.5 (18-19)	71.8	Hisp: 100	NR††	100	31.0	
Hargreaves, 2016 (StepWise)[101] Fair	X		X	X		New Zealand Mixed	97	Adults aged ≥25 years	X	46.2 (≥25)	84.5	NR	76.2	86.6	31.1	
Harland, 1999[102] Fair	X			X		UK Primary care	523	Adults aged 40-64 years	X	NR (40-64)	58.3	NR	51.6	NR	NR	X
Harris, 2015 (PACE-Lift)[103] Good	X	X		X	X	UK Primary care	298	Adults aged 60-75 years		NR (60-75)	53.7	White: 97.3	NR	NR	NR	X
Harris, 2018 (PACE-UP)[50] Good		X	X	X	X	UK Primary care	1023	Adults aged 45-75 years	X	NR (45-75)	63.9	White: 77.2 Black: 9.9 Asian: 6.6	56.0	NR	NR	X
Herghelegiu, 2017 (RAHEO Trial)[54] Good				X	X	Romania Primary care	200	Older adults aged ≥66 years		74.9 (≥65)	74.5	NR	NR	92.5	NR	X
Hivert, 2007[104] Fair	X		X	X		Canada Community volunteer	115	University students		19.7 (NR)	81.7	White: 93.0	NR	NR	22.4	
Horton, 2018 (Entre Familia: Reflejos de Salud Trial)[48] Fair				X		US Primary care	361	Latina mothers ≥18 years with a child aged 7-13 years		38.5 (≥18)	100	Hisp: 100	35.0	49.0	NR	X
Jacobs, 2011[105] Fair	X			X		Belgium Other	314	Adults aged 24-75 years		40.5 (25-75)	66.6	NR	NR	NR	25.2	
James, 2017 (NewCOACH Trial)[63]				X	X	Australia Primary care	203	Adults aged ≥18 years	X	57.0 (20-85)	70.0	NR	40.9	59.1	33.3	X

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Fair																
Jeffery, 1999 (Pound of Prevention)[106] Fair	X		X	X		US Mixed	1226	Adults aged 20-45 years		38.3 (20-45)	80.2	White: 89.6	NR	88.9	26.6	
Jenkins, 2017[52] Fair			X	X	X	Canada Community volunteer	631	Adults aged ≥18 years who are overweight		45.2 (44-48)	78.6	White: 59.6	NR	88.4	32.3	
John, 2002[107] Fair	X		X	X		UK Primary care	729	Adults aged 25-64 years		45.9 (25-64)	51.0	NR	NR	NR	25.8	X
Kallings, 2009[108] Good	X		X	X		Sweden Direct mailing	101	Older adults aged ≥60 years who are overweight or have obesity		NR (≥60)	57.4	NR	NR	NR	30.1	X
Kattelmann, 2014 (YEAH)[109] Fair	X		X	X		US Mixed	1639	College students aged 18-24 years		19.3 (18-24)	67.2	White: 72.1 Black: 13.1 Hisp: 5.7 Asian: 9.9 AI/NA: 0.7	NR	NR	24.1	
Katz, 2008[110] Fair	X			X		US Primary care	316	Adults aged ≥18 years		NR (≥18)	67.1	White: 35.4 Black: 29.1 Hisp: 20.6	NR	30.0	NR	X
Kegler, 2016 (Healthy Homes/Healthy Families)[57] Fair				X		US Primary care	349	Women aged 35-65 years who are overweight or have obesity		50.2 (35-65)	100	White: 14.6 Black: 84.8	44.4	43.0	38.3	X
Kerr, 2016 (CHAT)[111] Fair	X		X	X		Australia Direct mailing	247	Young adults aged 18-30 years		24.3 (18-30)	65.6	White: 77.3 Black: 0.4 Asian: 16.6	NR	NR	24.4	
King, 2007 (CHAT)[113] Fair	X			X	X	US Community volunteer	218	Adults aged ≥55 years	X	60.8 (≥55)	69.8	White: 87.3	64.0	NR‡‡	29.5	

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr[*]	N Rand	Population	Sub Beh[†]	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP[‡]
King, 2013 (CALM)[112] Good	X			X		US Community volunteer	200	Adults aged ≥45 years	X	55.2 (≥45)	51.3	White: 70.6	68.0	NR[§§]	29.2	
Kinmonth, 2008[114] Fair	X	X	X	X		UK Direct mailing	365	Adults aged 30-50 years with parental history of diabetes		40.6 (30-50)	62.0	NR	NR	NR	27.8	X
Kolt, 2007[115] Good	X	X		X	X	New Zealand Primary care	186	Older adults aged ≥65 years	X	74.2 (≥65)	66.1	NR	NR	44.1	NR	X
Koniak-Griffin, 2015 (Mujeres Sanas y Precavidas (Healthy Women Prepared for Life))[46] Fair			X	X		US Community volunteer	223	Latina women aged 35-64 years who are overweight women		44.6 (35-64)	100	Hisp: 100	25.2	12.6	32.6	
Kristal, 2000 (PEP)[116] Fair	X		X	X		US Direct mailing	1459	Adults aged 18-69 years		44.9 (18-69)	49.1	White: 85.9 Black: 4.5 Hisp: 3.0 Asian: 5.8	NR	NR	26.5	X
Larsen, 2020 (Activo)[156] Fair				X		US Community volunteer	46	Latino men aged 18-65 years	X	43.0 (18-65)	0	Hisp: 100	86.9	56.5	29.7	
Lawton, 2008[117] Good	X		X	X	X	New Zealand Primary care	1089	Women aged 40-74 years	X	58.9 (40-74)	100	White: 77.7 Asian: 13.1	NR	NR	29.2	X
Lewis, 2013[118] Good	X			X		US Mixed	448	Adults aged ≥18 years	X	42.6 (≥18)	87.1	White: 69.9 Black: 25.4	88.0	57.8	NR	
Lombard, 2016 (HeLP-her)[62] Fair			X	X	X	Australia Community volunteer	649	Women aged 18–50 years		39.6 (18-50)	100	NR	NR	81.6	28.7	

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Lutz, 1999[119] Fair	X			X		US Direct mailing	710	Adults aged ≥18 years		39.3 (≥18)	64.4	White: 77.9 Black: 19.3	NR	60.0	NR	X
Mailey, 2014[120] Fair	X			X		US Other	141	Women aged 25–52 years with at least one child under age 15 living at home	X	37.3 (25-52)	100	White: 80.1 Black: 9.2 Asian: 7.1	100	87.2	NR	
Marcus, 2007 (Project STRIDE)[122] Fair	X		X	X		US Community volunteer	239	Adults aged 18-65 years	X	44.5 (18-65)	82.0	White: 90.3	90.4	70.6	28.1	
Marcus, 2013 (Seamos Saludable Trial)[121] Good	X			X		US Community volunteer	292	Hispanic or Latina women aged 18-65 years	X	40.7 (18-65)	100	Hisp: 100	53.0	46.2	29.4	
Marcus, 2016 (Pasos Hacia La Salud trial)[61] Fair				X		US Mixed	205	Hispanic or Latina women aged 18-65 years		39.2 (18-65)	100	Hisp: 100	54.5	74.0	28.8	
Marsaux, 2015 (Food4Me Study)[123] Fair	X			X		Europe (7 countries) Mixed	1607	Adults aged ≥18 years		39.9 (18-79)	58.4	White: 96.8 Black: 0.1 Asian: 0.7	NR	NR	25.5	
Marshall, 2003[124] Fair	X			X		Australia Direct mailing	462	Adults aged 40-60 years		49.0 (40-60)	57.6	NR	NR	NR	26.4	
Martinson, 2008 (Keep Active Minnesota)[125] Good	X			X		US Mixed	1049	Adults aged 50-70 years		57.1 (50-70)	72.4	White: 94.0 Black: 3.3 Hisp: 1.8 Asian: 0.9 AI/NA: 0.2	NR	66.7	27.6	X

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Maselli, 2017[53] Fair				X		Italy Other	33	University students aged ≥18 years	X	22.0 (19-26)	NR	NR	NR	NR	NR	
Metzgar, 2016[65] Fair			X	X		US Community volunteer	87	Women aged 18-45 years		31.4 (18-45)	100	White: 60.9 Black: 11.5 Hisp: 4.6 Asian: 9.2	NR	NR	27.9	
Mosca, 2008 (FIT HEART)[126] Good	X		X	X		US Primary care	501	Adults aged 20-79 years with family history of CVD		48.0 (20-79)	66.3	White: 64.5	74.0	78.0	28.1	X
Napolitano, 2006[127] Fair	X			X		US Community volunteer	280	Women aged 18-65 years	X	47.2 (18-65)	100	White: 94.6 Hisp: 27.9	81.4	54.5	28.7	
Norris, 2000[128] Fair	X	X		X	X	US Primary care	847	Adults aged ≥30 years		54.9 (≥30)	52.1	White: 90.9	NR	82.2	NR	X
Oddone, 2018 (ACTIVATE)[47] Fair			X			US Primary care	417	Adults who have obesity current smoking and/or suboptimal PA level	X	55.8 (NR)	NR	White: 50.1 Black: 40.5 Hisp: 3.1	36.7	NR	NR	X
Parekh, 2014 (10 Small Steps Study)[129] Fair	X			X		Australia Primary care	4676	Adults aged 18-70 years		46.9 (18-70)	69.2	NR	65.2	58.7	NR	X
Patel, 2017 (BE FIT)[51] Good				X	X	US Other	206	Adults aged ≥18 years		55.4 (≥18)	56.0	White: 100	NR	94.2	24.1	
Patel, 2019 (STEP UP)[153] Good				X	X	US Other	602	Adults aged ≥18 years who are overweight or have obesity		38.7 (≥18)	NR	White: 50.7 Black: 5.3 Hisp: 4.5 Asian: 34.2	NR	99.5	29.6	
Pekmezi, 2009 (Seamos Activas (Let's Be Active))[130] Fair	X			X		US Community volunteer	93	Hispanic or Latina women aged 18-65 years	X	41.4 (18-65)	100	Hisp: 100	NR	52.0	NR	

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Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Pinto, 2002[131] Fair	X			X		US Direct mailing	298	Adults aged ≥25 years	X	45.9 (≥25)	72.1	White: 44.9 Black: 44.6	85.2	71.0	28.7	X
Pinto, 2005 (PAL2)[132] Fair	X			X		US Primary care	100	Older adults aged ≥60 years	X	68.5 (≥60)	65.0	White: 81.0 Black: 14.0	30.1	57.9	29.2	X
Roderick, 1997[133] Fair	X		X	X		UK Primary care	956	Adults aged 35-59 years		47.3 (35-59)	50.0	NR	NR	NR	26.1	X
Ruffin, 2011 (The Family Healthware Impact Trial)[134] Fair	X			X		US Primary care	4248	Adults aged 35-65 years		50.6 (35-65)	69.7	White: 91.2 Black: 3.2 Hisp: 2.3 Asian: 2.8 AI/NA: 0.1	NR	NR	27.3	X
Sacerdote, 2006[135] Fair	X		X	X	X	Italy Primary care	3179	Adults aged 18-65 years		44.4 (18-65)	50.0	NR	NR	NR	NR	X
Samdal, 2019 (Norwegian Healthy Life Study)[67] Fair				X		Norway Mixed	118	Adults aged ≥18 years		48.6 (≥18)	77.1	NR	NR	62.3	34.0	X
Simkin-Silverman, 1995 (WHLP)[136] Good	X		X	X		US Direct mailing	535	Premenopausal women aged 44-50 years		47.1 (44-50)	100	White: 97.8	86.0	85.0	25.1	
Smith, 2014[137] Fair	X			X		Australia Primary care	59	Women who are overweight or have obesity and were diagnosed with gestational diabetes over past 4 years		35.4 (NR)	100	NR	49.0	59.3	30.5	X

Appendix D Table 1. Study and Population Characteristics for All Studies, by Author

Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Spring, 2018 (Make Better Choices 2)[60] Fair				X		US Community volunteer	212	Adults aged 18-65 years	X	40.8 (18-65)	76.4	White: 41.0 Black: 46.7 Hisp: 9.8 Asian: 3.8	NR	69.3	34.3	
Springvloet, 2015[138] Fair	X			X		Netherlands Mixed	1349	Adults aged 20-65 years		49.1 (20-65)	64.6	NR	NR	45.7	25.6	
Stewart, 2001 (CHAMPS II)[139] Fair	X			X		US Direct mailing	173	Older adults aged ≥65 years	X	74.4 (65-90)	65.9	NR***	NR	56.1	NR	X
Sun, 2017[56] Fair			X	X		US Other	32	Chinese women aged ≥18 years who are overweight or have obesity		36.0 (≥18)	100	Asian: 100	NR†††	NR	25.0	
Thompson, 2008[140] Fair	X		X	X		US Community volunteer	200	American Indian women aged 18-40 years		29.2 (18-40)	100	AI/NA: 100	NR	84.6	29.4	
Thompson, 2014 (Go4Life)[141] Good	X		X	X	X	US Other	49	Older adults aged ≥65 years	X	79.5 (≥65)	81.2	NR	NR	NR	NR	
Tinker, 2008 (WHI DMT)[142] Good	X	X	X	X		US Direct mailing	48835	Postmenopausal women aged 50-79 years	X	62.2 (50-79)	100	White: 82.4 Black: 10 Hisp: 3.7 Asian: 2.2 AI/NA: 0.4	NR	NR	28.9	
Tokunaga-Nakawatase, 2014 (LISS-DP)[143] Fair	X			X		Japan Primary care	216	Adults aged 30-60 years with first-degree relative with type 2 diabetes		45.2 (30-60)	34.8	NR	49.0	39.0	22.7	X
Valve, 2013 (LINDA)[144] Fair	X		X			Finland Other	3059	Women aged 17-21 years		19.0 (17-21)	100	NR	NR	47.8	22.0	

Appendix D Table 1. Study and Population Characteristics for All Studies, by Author

Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Van Hoecke, 2014[145] Fair	X	X		X		Belgium Community volunteer	442	Older adults aged ≥60 years	X	69.5 (60-93)	66.7	NR	NR	32.6 ‡‡‡	27.1	
van Keulen, 2011 (Vitalum) [158] Fair				X		Netherlands Primary care	1629	Adults, aged 45-70	X	57.1 (44.9-70.9)	45	NR	NR	46	27.4	X
Van Stralen, 2010[146] Fair	X			X		Netherlands Primary care	8500	Adults aged ≥18 years		64.0 (≥50)	57.0	NR	45.0	52.0	25.5	X
Vandelanotte, 2005[147] Fair	X			X		Belgium Community volunteer	1023	Adults aged 20-60 years		39.1 (20-60)	64.5	NR	86.3	69.6	24.5	
Vidoni, 2019 (Tu Salud ¡Si Cuenta! (Your Health Matters!))[152] Fair				X		US Other	500	Hispanic adults aged 18-75 years		NR (18-75)	70.3	Hisp: 100	48.1	68.7 §§§	NR	
Vrdoljak, 2014[148] Fair	X			X		Croatia Primary care	738	Adults aged ≥65 years		72.3 (≥65)	61.2	NR	NR	NR	NR	X
Wadsworth, 2010[149] Fair	X		X	X		US Direct mailing	91	Women college students	X	NR (NR)	100	NR	NR	NR	27.5	
Walthouwer, 2015[154] Fair				X		Netherlands Mixed	1419	Adults aged ≥18 years		48.1 (≥18)	58.6	NR	NR	54.2	26.4	
Warner, 2016 (Active Retirement)[150] Fair	X			X		Germany Mixed	360	Older adults aged ≥65 years	X	70.3 (64-92)	75.2	NR	NR	NR	NR	

Appendix D Table 1. Study and Population Characteristics for All Studies, by Author

Author, year (Study Name) Quality	PR	KQ 1	KQ 2	KQ 3	KQ 4	Country Recr*	N Rand	Population	Sub Beh†	Age (Range)	% F	Race/ ethnicity, %	% Empl	% >HS	Mean BMI	PCP‡
Wieland, 2018 (Healthy Immigrant Families Study)[55] Fair		X	X	X		US Community volunteer	151	Immigrant and refugee families, including adults aged ≥18 years and adolescents aged 10-18 years		39.1 (≥18)	71.4	Hisp: 61.4	45.6	4.6	30.2	
Wing, 2016 (SNAP Trial)[155] Good			X		X	US Mixed	599	Adults aged 18-35 years		28.2 (18-35)	78.3	White: 73.1 Black: 11.0 Hisp: 7.7 Asian: 4.2	92.1	80.0	25.4	

Abbreviations: ACTIVATE=A Coaching by Telephone Intervention for Veterans and Care Team Engagement; AI=American Indian; BE FIT=Behavioral Economics Framingham Inventive Trial; beh=behavior; BMI=body mass index; CALM=Counseling Advice for Lifestyle Management; CHAMPS II=Community Healthy Activities Model Program for Seniors; CHAT(Kerr, 2016)=Connecting Health and Technology; CHAT(King, 2007)=Community Health Advice by Telephone; CHIP(Aldana, 2006)=Coronary Health Improvement Project; CHIP(Carroll, 2010)=Computerized Health Improvement Project; COSTRIDE=Colorado STRIDE; Empl=employed; F=female; FIT HEART=Family Intervention Trial for Heart Health; FRESH=Families Reporting Every Step to Health; HeLP=Healthy Lifestyle Program; Hisp=Hispanic; HS=high school education; KQ=key question; LISS-DP=Lifestyle Intervention Support Software for Diabetes Prevention; MENU=Making Effective Nutritional Choices; mPED=mobile phone-based physical activity education; NA=Native American; NR=not reported; PACE-Lift=Pedometer Accelerometer Consultation Evaluation; PACE-UP=Pedometer and Consultation Evaluation; PAL(Goldstein, 1999)=Physically Active for Life; PAL2(Pinto, 2005)=Physically Active for Life 2; PANS=Physical Activity and Nutrition for Seniors; PCP=primary care provider; PEP=Puget Sound Eating Patterns; PR=previous review; RAHEO=Medical Risk Assessment and Health Education in Older People; rand=randomized; recr=recruitment; SAHARA=South Asian Heart Risk Assessment; SENIOR=Study of Exercise and Nutrition in Older Rhode Islanders; SIT=Sedentary Intervention Trial; STEP UP=Social Incentives to Encourage Physical Activity and Understand Predictors; Sub=suboptimal; US=United States; UK=United Kingdom; VA-STRIDE=Veterans Affairs assiSTed eaRly mobility for hospitalizeD older vEterans; WHI DMT=Women's Health Initiative Dietary Modification Trial; WHLP=Women's Healthy Lifestyle Project; WHT:FSMP=Women's Health Trial Feasibility Study in Minority Populations; YEAH=Young Adults Eating and Active for Health.

* Participant recruitment was abstracted as taking place through primary care, direct mailing, mixed avenues, or other
† Participants were eligible if they reported dietary patterns, physical activity, or sedentary behaviors that were suboptimal or not in line with recommendations
‡ PCP=conducted in or recruited from primary care setting (X=yes)
§ Median
** 15.8 mean years education
†† 23.1% work part-time, 97.4% receive financial aid
‡‡ 16.2 mean years education
§§ 15.8 mean years education
*** 8.5% of sample was non-white
††† 13 mean years education
‡‡‡ ≥15 mean years education
§§§ >8 years education

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Aadahl, 2014[71]	IG1	SB	Counseling	Four 30-45-min individual theory-based face-to-face sessions and written materials summarizing the sessions and reiterating key messages.	M	Est. hours: 160 Total contacts: 4 In-person contacts: 4 Length, min: 40	26	Research center	Research nurse	X			X	None
Aittasalo, 2006[72]	IG1	PA	Brief counseling	One 5-10 min PCP prescription-based counseling session. Optional self-monitoring with physical activity log and referral to physical activity expert.	L	Est. hours: 10 Total contacts: 1 In-person contacts: 1 Length, min: 10	0.14	Primary care	PCP	X				UC
	IG2	PA	Self-monitoring	Pedometer and physical activity log for self-monitoring and tailored feedback via mail.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	1	Mail only	NA				X	UC
Albright, 2014[73]	IG1	PA	Tailored telephone counseling plus website	Seventeen 15 min telephone counseling calls plus a tailored website addressing key mediators of PA.	M	Est. hours: 255 Total contacts: 17 In-person contacts: 0 Length, min: 15	52	Remote only	Health educator		X	X		MI
Aldana, 2006[74]	IG1	HD, PA	Group counseling	Sixteen 2-hour group education sessions.	H	Est. hours: 1920 Total contacts: 16 In-person contacts: 16 Length, min: 120	4	NR	Dietetic and medical professionals	X			X	WL
Alexander, 2010[75]	IG1	HD	Tailored web-based + e-mail counseling	Four tailored Web sessions and four e-mail counseling sessions aimed at increasing fruit	M	Est. hours: 128 Total contacts: 8 In-person contacts: 0 Length, min: 15-30	52	Remote only	Research assistant			X		MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				and vegetable intake.										
	IG2	HD	Tailored web-based counseling	Four tailored Web sessions (no e-mail counseling sessions) aimed at increasing fruit and vegetable intake.	M	Est. hours: 120 Total contacts: 4 In-person contacts: 0 Length, min: 30	52	Remote only	NA			X		MI
Allman-Farinelli, 2016[49]	IG1	HD, PA	Counseling telephone calls and tailored feedback via text and email messages	Five 10-15-min coaching calls, 96 text messages, 12 emails, apps, and downloadable resources from the study website over 12 weeks plus a 6-month maintenance period.	M	Est. hours: 175 Total contacts: 7 In-person contacts: 0 Length, min: 15	38	Remote only	Dietician		X	X	X	MI
Anand, 2016[66]	IG1	HD, PA, SB	Email messages targeting HD and PA	Twenty-six bi-weekly motivational email messages plus 52 weekly emails or texts about healthy diet and physical activity.	M	Est. hours: 156 Total contacts: 78 In-person contacts: 0 Length, min: ~2 per message	52	Remote only	NR			X		MI
Ball, 2016[64]	IG1	HD	Skill-building newsletters and optional supermarket tour	Four bi-weekly newsletters followed by 4 monthly newsletters and a one-hour optional supermarket tour.	M	Est. hours: 60 Total contacts: 9 In-person contacts: 1 Length, min: 60	24	Remote, Other	Dietician	X			X	WL
Baron, 1990[76]	IG1	HD	Counseling	One 30-min individual or small group dietary counseling session with two follow-up visits	M	Est. hours: 60 Total contacts: 3 In-person contacts: 3 Length, min: Initial session=30 FU sessions=NR	12	Primary care	Nurse	X			X	UC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				and print materials.										
Bennett, 2013[77]	IG1	HD, PA	Counseling, tailored print materials, and self-monitoring	Behavior change goals assigned at baseline and months 2 and 4, with pedometers and logs to track daily activity, brief 5 min weekly calls with interactive phone system, twelve monthly 20 min counseling calls with RD, and 12-month membership to YMCA.	H	Est. hours: 500 Total contacts: 64 In-person contacts: 0 Length, min: 5-20	52	Primary care	Registered dietician	X	X		X	UC
Beresford, 1997[78]	IG1	HD	Brief counseling and self-help material	Self-help booklet and a 3-min motivational endorsement from primary care physician.	L	Est. hours: 3 Total contacts: 1 In-person contacts: 1 Length, min: 3	2	Primary care	PCP	X			X	UC
Bernstein, 2002[79]	IG1	HD	Home-based education	Home-based nutrition education including eight home visits, 12 phone calls, and monthly print materials.	H	Est. hours: 420 Total contacts: 20 In-person contacts: 8 Length, min: 30	26	Home	NR	X	X		X	AC
Bickmore, 2013[80]	IG1	PA	Computer-based counseling	Daily 5-min conversations with virtual coach on home computer for 2 months and continued use of electronic counseling interface at clinic kiosk when attending routine	M	Est. hours: 305 Total contacts: 61 In-person contacts: 0 Length, min: 5	52	Remote only	Computer			X		MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				appointments over remaining 10 months.										
Brekke, 2005[81]	IG1	HD	Group counseling (diet)	Two 60-120 min initial group education sessions, eight follow-up phone calls within first 4 months, and then follow-up phone calls every 10 weeks for 2 years.	H	Est. hours: 420 Total contacts: 18 In-person contacts: 2 Length, min: 15-90	104	NR	Dietician	X	X			MI
	IG2	HD, PA	Group counseling (diet and PA)	Two 60-120 min initial group education sessions, eight follow-up phone calls within first 4 months, and then follow-up phone calls every 10 weeks for 2 years.	H	Est. hours: 420 Total contacts: 18 In-person contacts: 2 Length, min: 15-90	104	NR	Dietician	X	X			MI
Bryan, 2013[82]	IG1	PA	Tailored print mailings	Fourteen individually tailored mailings with information on increasing PA delivered at varying frequencies over 12 months, along with self-help manual, and series of tip sheets.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	52	Mail only	Computer expert system				X	AC
Burke, 2013[83]	IG1	HD, PA	Self-help booklet and phone and e-mail counseling	One booklet designed to motivate and improve PA and nutrition, 6-10 telephone calls, 2-	M	Est. hours: 120 Total contacts: 8 In-person contacts: 0 Length, min: 15	26	Remote only	Senior university health science student		X	X	X	None

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				5 email contacts, bimonthly newsletters, resistance band and pedometer.										
Caplette, 2017[58]	IG1	HD	Access to a healthy eating blog (Salsa Etcetera)	Twenty-six blog posts (1/week for 6 months) related to increasing F&V intake, including participant comments.	H	Est. hours: 390 Total contacts: 26 In-person contacts: 0 Length, min: NR	24	Remote only	Registered dietician			X		MI
Carpenter, 2004[84]	IG1	HD	Group counseling	Twenty 75-min group counseling sessions.	H	Est. hours: 1500 Total contacts: 20 In-person contacts: 20 Length, min: 75	24	Research center	Research staff	X			X	MI
	IG2	HD	Mailed materials and website	Mailed curriculum and access to Website for posting questions and weekly on-line chat session.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	24	Remote only	NA			X	X	MI
Carroll, 2010[85]	IG1	PA	Tailored print mailings	Four tailored feedback reports based on preceding physical activity survey mailed to participants over 6 months.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	NA				X	AC
Coates, 1999[86]	IG1	HD	Group counseling	Up to 18 group counseling sessions.	H	Est. hours: 1080 Total contacts: 18 In-person contacts: 18 Length, min: 60	52	Research center	Nutritionist	X				MI
de Vet, 2009[87]	IG1	PA, SB	Self-directed and self-selected activity plan (with repeat planning)	Self-directed written plan for increasing self-selected physical activities by 2 hours/week	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	NA				X	MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				written at 3 different time points over 6 months.										
	IG2	PA	Self-directed and self-selected activity plan (one-time plan)	Self-directed written plan for increasing self-selected physical activities by 2 hours/week.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	NA				X	MI
	IG3	PA	Self-directed walking plan (one-time plan)	Self-directed written plan for increasing walking by 2 hours/week.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	NA				X	MI
Delichatsios, 2001[88]	IG1	HD	Automated telephone counseling	Twenty-six 5-7-minute phone calls with an automated telephone-linked communication system providing dietary counseling, advice, and feedback over 6 months, with additional written reports to supplement phone calls.	M	Est. hours: 130 Total contacts: 26 In-person contacts: 0 Length, min: 5	26	Remote only	Expert system with digitized human speech		X			AC
Elley, 2003[89]	IG1	PA	Counseling with tailored prescription	One 10 min PCP prescription-based counseling session with three 15 min followup phone calls from exercise physiologists over 3 months and four newsletters over 12 months.	M	Est. hours: 55 Total contacts: 4 In-person contacts: 1 Length, min: 10-15	52	Primary care	PCP, Exercise physiologists	X	X		X	UC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Estabrooks, 2011[90]	IG1	PA	Group counseling	Two 2-hour groups sessions, one telephone contact, and handouts for how to complete a PA plan.	M	Est. hours: 255 Total contacts: 3 In-person contacts: 2 Length, min: 15-120	12	Research center	Health educator	X	X		X	MI
Fischer, 2019 [70]	IG1	PA	Tailored telephone counseling and text messages	Twelve bi-weekly 15-40 min coaching phone calls, 48 tailored short text message prompts, and self-monitoring via website.	M	Est. hours: 240 Total contacts: 12 In-person contacts: 0 Length, min: 15-40	24	Remote only	Trained exercise science and psychology students		X	X		MI
	IG2	PA	Tailored telephone counseling	Twelve bi-weekly 15-40 min coaching phone calls, and self-monitoring via website.	M	Est. hours: 240 Total contacts: 12 In-person contacts: 0 Length, min: 15-40	24	Remote only	Trained exercise science and psychology students		X	X		MI
Fjeldsoe, 2015[91]	IG1	PA	Counseling and regular text messages	One face-to-face counseling session, 12 wks of tailored text messages, and 1 follow-up phone call.	M	Est. hours: 91 Total contacts: 2 In-person contacts: 1 Length, min: 35	12	Research center, Remote	Behavioral counselor	X	X	X	X	MI
Franko, 2008[92]	IG1	HD, PA	Web-based intervention	Two 45-min computer-based interactive sessions plus one booster session.	M	Est. hours: 135 Total contacts: 3 In-person contacts: 3 Length, min: 45	5	University	Research assistant (oversaw web sessions and answered questions)			X		AC
	IG2	HD, PA	Web-based intervention	Two 45-min computer-based interactive sessions.	M	Est. hours: 90 Total contacts: 2 In-person contacts: 2 Length, min: 45	2	University	Research assistant (oversaw web sessions and answered questions)			X		AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Fries, 2005[93]	IG1	HD	Tailored print mailing and brief counseling call	One mailing of individually tailored fat and fiber feedback with physician endorsement, minimal brief counseling call, and five low-literacy self-help booklets.	L	Est. hours: 15 Total contacts: 1 In-person contacts: 0 Length, min: NR	6	Remote only	Research staff		X		X	WL
Fukuoka, 2019[69]	IG1	PA	Brief counseling and mobile-phone application with tailored feedback for 3 months plus maintenance phase	One 30-min initial counseling session, 2 15-min brief counseling sessions and daily use of accelerometer and mobile-phone app for 9 months.	M	Est. hours: 60 Total contacts: 3 In-person contacts: 3 Length, min: 60	36	Research center, Remote	Research staff	X		X		MI
	IG2	PA	Brief counseling and mobile-phone application with tailored feedback for 3 months	One 30-min initial counseling session, 2 15-min brief counseling sessions and daily use of mobile-phone app for 3 months and of accelerometer for 9 months.	M	Est. hours: 60 Total contacts: 3 In-person contacts: 3 Length, min: 60	12	Research center, Remote	Research staff	X		X		MI
Gao, 2016[94]	IG1	PA	Individual counseling and tailored print materials	Initial 60-min counseling session followed by 14 expert computer-tailored print mailings.	M	Est. hours: 60 Total contacts: 1 In-person contacts: 1 Length, min: 60	52	Research center, Remote	PCP, computer expert system	X			X	AC
Gell, 2015[95]	IG1	PA	Targeted text messages	3 targeted text messages per week for 24 weeks plus walking maps and	M	Est. hours: 64 Total contacts: 64 In-person contacts: 0 Length, min: ~2 min per message	24	Remote only	NA		X	X		MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				informational website.										
Gill, 2019[151]	IG1	HD, PA, SB	Individual counseling with tailored PA and HD prescriptions	Four 30-40 min in-person coaching sessions; and eHealth technology tools and resources (e.g., smartphone app with virtual coach and step counter, website, online social network, and 3rd party phone coaching).	M	Est. hours: 160 Total contacts: 4 In-person contacts: 4 Length, min: 30-40	26	Primary care, Remote	Health coach	X		X	X	MI
Goldstein, 1999[96]	IG1	PA	Brief counseling with tailored prescription	One 5-min PCP prescription-based counseling session with one 5-min followup session over 4 weeks plus nine mailings over 26 weeks.	L	Est. hours: 10 Total contacts: 2 In-person contacts: 1 Length, min: 5	26	Primary care	PCP	X			X	UC
Gomez Quinonez, 2016[59]	IG1	PA	Tailored feedback via text messages (mHealth)	Tailored feedback through 9 text messages over 3 weeks.	L	Est. hours: 9 Total contacts: 9 In-person contacts: 0 Length, min: ~2 min per text	3	Remote only	Computer-tailored feedback			X		None
	IG2	PA	Tailored feedback via email (eHealth)	Tailored feedback through 9 emails over 3 weeks.	L	Est. hours: 18 Total contacts: 9 In-person contacts: 0 Length, min: ~2 min per email	5	Remote only	Computer-tailored feedback			X		None
Grandes, 2009[97]	IG1	PA	Brief counseling	One brief (assumed <15 min) counseling session with PCP using web-based	L	Est. hours: 30 Total contacts: 2 In-person contacts: 1 Length, min: 15	0.14	Primary care	PCP	X			X	UC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				software and optional 15-min followup session to develop a prescription-based action plan plus a 4-page pamphlet.										
Green, 2002[98]	IG1	PA	Telephone counseling	Mailed self-help workbook and three 20-30 min counseling phone calls.[*]	M	Est. hours: 75 Total contacts: 3 In-person contacts: 0 Length, min: 25	12	Remote only	Behavioral health specialists		X		X	MI
Greene, 2008[99]	IG1	HD	Tailored print mailings and telephone counseling	Twelve monthly tailored mailings and three 15-min coaching phone calls.	M	Est. hours: 45 Total contacts: 3 In-person contacts: 0 Length, min: 15	52	Remote only	Counselor, Computer expert system		X		X	AC
Guagliano, 2020[157]	IG1	PA	Web-based goal setting and tailored feedback	One hour in-person meeting, followed by one 15-min phone call. Minimum of 10-20 mins of family activity time per week and minimum of 5-20 mins of website time per week.	H	Est. hrs: 35.9 Total contacts: 106 In-person contacts: 1 Length, min: 15-60	52	Home, Remote	NR	X		X	X	None
	IG2	PA	Pedometer only	One printed booklet and four PA informational emails.	L	Est. hrs: 0 Total contacts: 4 In-person contacts: 0 Length, min.: NR	52	Remote only	NR			X	X	None
Halbert, 2000[100]	IG1	PA	Counseling	One 20-min counseling session and print materials on increasing PA at initial visit and two 15-min follow-up visits.	M	Est. hours: 50 Total contacts: 3 In-person contacts: 1 Length, min: 20	26	Primary care	Exercise physiologist	X			X	AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Halperin, 2019[68]	IG1	HD, PA	Peer counseling	Ten 75-min weekly peer support group sessions.	H	Est. hours: 750 Total contacts: 10 In-person contacts: 10 Length, min: 75	10	University	Health behaviorist, registered nutritionist, yoga instructor	X				UC
Hargreaves, 2016[101]	IG1	PA	Tailored walking program	Tailored pedometer- and web-based walking program.	M	Est. hours: 150 Total contacts: 1 In-person contacts: 1 Length, min: NR	12	Research center, Remote	NR	X		X		MI
Harland, 1999[102]	IG1	PA	Counseling and PA vouchers	One brief informational and advice session followed by six 40-min motivational interviews plus 30 vouchers for PA facilities.	M	Est. hours: 255 Total contacts: 7 In-person contacts: 1 Length, min: 15-40	12	Primary care	Health visitor	X			X	MI
	IG2	PA	Counseling	One brief informational and advice session followed by six 40-min motivational interviews.	M	Est. hours: 255 Total contacts: 7 In-person contacts: 1 Length, min: 15-40	12	Primary care	Health visitor	X			X	MI
	IG3	PA	Brief counseling and PA vouchers	One brief informational and advice session followed by one 40-min motivational interview plus 30 vouchers for PA facilities.	M	Est. hours: 55 Total contacts: 2 In-person contacts: 1 Length, min: 15-40	2	Primary care	Health visitor	X			X	MI
	IG4	PA	Brief counseling	One brief informational and advice session followed by one 40-min motivational interview.	M	Est. hours: 55 Total contacts: 2 In-person contacts: 1 Length, min: 15-40	2	Primary care	Health visitor	X			X	MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Harris, 2015[103]	IG1	PA	Counseling and self-monitoring	One initial 45-min PA consultation session followed by three 30-min sessions along with pedometers, accelerometers and a PA log to track activity.	M	Est. hours: 135 Total contacts: 4 In-person contacts: 4 Length, min: 30-45	12	Primary care	Nurse	X				UC
Harris, 2018[50]	IG1	PA	Pedometer-based walking intervention with nurse support	Pedometer, PACE-UP handbook with 12-week walking plan and step count diary, and 3 10-20-min individually tailored in-person nurse consultations.	M	Est. hours: 60 Total contacts: 3 In-person contacts: 3 Length, min: 10-20	12	Primary care	Nurse	X			X	WL
	IG2	PA	Pedometer-based walking intervention	Pedometer and PACE-UP handbook with 12-week walking plan and step count diary.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	12	Mail only	NA				X	WL
Herghelegiu, 2017[54]	IG1	HD, PA, SB	Individual counseling	Six 15-30 minute in-person counseling sessions.	M	Est. hours: 180 Total contacts: 6 In-person contacts: 6 Length, min: 15-30	26	Primary care	Geriatrician	X				None
Hivert, 2007[104]	IG1	HD, PA	Group counseling	Twenty-three 45-min small-group interactive seminars over 2 years.	H	Est. hours: 1035 Total contacts: 23 In-person contacts: 23 Length, min: 45	104	Other	Endocrinology resident and physical education graduate student	X				None
Horton, 2018[48]	IG1	HD	Home visits and print communication	Eleven 1.5-2 hrs home visits and 4 15-30 min telephone calls.	H	Est. hours: 1440 Total contacts: 15 In-person contacts: 11 Length, min: 90-	16	Home	Community health *promotoras*	X	X			WL

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Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
						120 (home visits), 15-30 (calls)								
Jacobs, 2011[105]	IG1	HD, PA	Counseling	Individually tailored PA and diet counseling via delivery mode of participants choice which included email, telephone, or face-to-face sessions over one year.	H	Est. hours: 380† Total contacts: 15 In-person contacts: 2 Length, min: 30	52	Research center	Health psychologist	X	X	X		UC
James, 2017[63]	IG1	PA	Individual counseling	One 60-min session and four 30-min follow-up sessions, delivered face-to-face.	M	Est. hours: 180 Total contacts: 5 In-person contacts: 5 Length, min: 30-60	13	Primary care	Exercise physiologist	X				UC
	IG2	PA	Individual and telephone counseling	One 60-min face-to-face session followed by four 30-min telephone sessions.	M	Est. hours: 180 Total contacts: 5 In-person contacts: 1 Length, min: 30-60	13	Primary care	Exercise physiologist	X	X			UC
Jeffery, 1999[106]	IG1	HD, PA	Nontailored print mailings	Thirty-six monthly newsletters plus optional intervention sessions every 6 months up to 3 years.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	156	Mail only	NA				X	None
	IG2	HD, PA	Nontailored print mailings plus incentives	Thirty-six monthly newsletters plus optional intervention sessions every 6 months up to 3 years plus an incentive lottery to encourage reading the newsletters.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	156	Mail only	NA				X	None

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Jenkins, 2017[52]	IG1	HD	Telephone counseling	Provided Health Canada's Food Guide, with 4 weekly phone advice session followed by 5 monthly phone advice sessions, ranging from 20-30 minutes each.	M	Est. hours: 270 Total contacts: 9 In-person contacts: 0 Length, min: 30	24	Remote only	NR		X			MI
John, 2002[107]	IG1	HD	Counseling	One 25-min counseling session and one 15-min follow-up call to encourage increased consumption of fruits and vegetables and received a recipe book, a portion guide, and record book.	M	Est. hours: 40 Total contacts: 2 In-person contacts: 1 Length, min: 25	12	Research center	Research nurse	X	X		X	WL
Kallings, 2009[108]	IG1	PA	Counseling with tailored prescription	Two 30-min individualized patient-centered counseling sessions and PA prescriptions delivered at baseline and 6 months, along with one 60-minute group session at 1 month focused on PA and health and 3-5 short follow-up calls.	M	Est. hours: 120 Total contacts: 3 In-person contacts: 3 Length, min: 30-60	NR	Primary care	Health care professional, PCP	X			X	UC
Kattelmann, 2014[109]	IG1	HD, PA	Web-based intervention	Tailored e-mails and website.	M	Est. hours: 150 Total contacts: 21 In-person contacts:	64	Remote only	NA			X		WL

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
						0 Length, min: NR								
Katz, 2008[110]	IG1	PA	Provider training	Physicians participated in five interactive group sessions and were trained in how to apply the Pressure System Model (PSM) to overcome common PA barriers, identify opportunities for PA, and specify a plan for follow up during existing patient appointments.	H	Est. hours: 375 Total contacts: 5 In-person contacts: 5 Length, min: 75	26	Primary care	PA and preventive medicine specialist	X				UC
Kegler, 2016[57]	IG1	HD, PA	In-person tailored home environment coaching	Three in-person home visits and 4 coaching calls.	M	Est. hours: 150 Total contacts: 7 In-person contacts: 3 Length, min: NR	16	Home	Health coach	X	X			AC
Kerr, 2016[111]	IG1	HD	Tailored text messages	Two tailored text messages over 1 week and weekly text messages for 24 weeks.	L	Est. hours: 32 Total contacts: 32 In-person contacts: 0 Length, min: NA	24	Remote only	Automated text messages			X		None
	IG2	HD	Text messages	Two-tailored text messages.	L	Est. hours: 2 Total contacts: 2 In-person contacts: 0 Length, min: NA	1	Remote only	Automated text messages			X		None
King, 2007[113]	IG1	PA	Automated telephone counseling	Initial 30-40-min individualized session with health educator, 15 brief individualized structured phone calls with	M	Est. hours: 260 Total contacts: 16 In-person contacts: 1 Length, min: 15-30	52	Research center, Remote	Health educator	X	X		X	AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				automated telephone-linked counseling (TLC) system biweekly and then monthly over one year, pedometer and PA log to track activity and allow feedback on progress, and supplemental mailings.										
	IG2	PA	Telephone counseling	Initial 30-40-min individualized session with health educator, 15 brief individualized structured phone calls with health educator biweekly and then monthly over one year, pedometer and PA log to track activity and allow feedback on progress, and supplemental mailings.	M	Est. hours: 260 Total contacts: 16 In-person contacts: 1 Length, min: 15-35	52	Research center, Remote	Health educator	X	X		X	AC
King, 2013[112]	IG1	HD, PA	Telephone counseling with self-monitoring (PA and diet simultaneous)	One individual in-person session followed by fifteen 30-40 phone counseling sessions plus homework. PA and diet were addressed simultaneously.	M	Est. hours: 300‡ Total contacts: 16 In-person contacts: 1 Length, min: 20	52	Research center, Remote	Health educator	X	X		X	AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
	IG2	HD, PA	Telephone counseling with self-monitoring (diet discussions first)	One individual in-person session followed by 21 phone sessions plus homework; topics were introduced sequentially, beginning with diet messages.	H	Est. hours: 420[§] Total contacts: 22 In-person contacts: 1 Length, min: 20	52	Research center, Remote	Health educator	X	X		X	AC
	IG3	HD, PA	Telephone counseling with self-monitoring (PA discussions first)	One individual in-person session followed by 21 phone sessions plus homework; topics were introduced sequentially, beginning with PA messages.	H	Est. hours: 420[**] Total contacts: 22 In-person contacts: 1 Length, min: 20	52	Research center, Remote	Health educator	X	X		X	AC
Kinmonth, 2008[114]	IG1	PA	Telephone counseling	Initial in-home PA counseling session followed by four 45-min telephone support calls and two 15-min support calls over 5-month intensive phase, followed by seven monthly mailings.	M	Est. hours: 240 Total contacts: 7 In-person contacts: 1 Length, min: 15-45	52	Research center, Remote	Trained facilitators	X	X		X	MI
	IG2	PA	In-home, individual counseling	Initial in-home PA counseling session followed by four 60-min in-home visits and two 15-min support calls over 5-month intensive phase, followed	H	Est. hours: 510 Total contacts: 14 In-person contacts: 5 Length, min: 15-60	52	Home	Trained facilitators	X	X		X	MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				by seven 30-min monthly follow-up phone calls.										
Kolt, 2007[115]	IG1	PA	Telephone counseling	Eight 10-15-min telephone counseling sessions occurring weekly for 4 weeks and biweekly for 8 weeks focused on stages of behavior change in relation to increasing PA, and mailings, including an exercise log and informational pamphlets.	M	Est. hours: 120 Total contacts: 8 In-person contacts: 0 Length, min: 15	12	Remote only	Exercise counselor		X		X	None
Koniak-Griffin, 2015[46]	IG1	HD, PA	Group education plus individual home visits and telephone calls	Eight weekly 2-hour group education sessions over the first 2 months followed by individual teaching and coaching from their *promotoras* through 4 home visits plus 4 telephone calls over 4 months.	H	Est. hours: 960 Total contacts: 16 In-person contacts: 12 Length, min: 120 group sessions NR home visits and telephone calls	26	Community center, Home	Community health promotoras	X	X		X	AC
Kristal, 2000[116]	IG1	HD	Tailored print mailings and telephone counseling	Tailored self-help dietary materials and one follow-up call focused on lowering fat intake and increasing consumption of fruits and vegetables.	L	Est. hours: 15 Total contacts: 1 In-person contacts: 0 Length, min: 15	52	Remote only	Health educator		X		X	None

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Larsen, 2020[156]	IG1	PA	Counseling and individually tailored print materials and text messages	One in-person counseling session followed by weekly or monthly tailored, mailed print materials, 52 bi-weekly text messages and 4 telephone calls.	M	Est. hours: 150 Total contacts: 5 In-person contacts: 1 Length, min: NR	26	Research center, Remote	Study interventionist	X	X	X	X	AC
Lawton, 2008[117]	IG1	PA	Counseling with tailored prescription	Brief 10-min session with primary care nurse with green prescription to increase PA, followed by five 15-min follow-up calls over 9 months and one 30-min FU visit.	M	Est. hours: 115 Total contacts: 7 In-person contacts: 2 Length, min: 10-30	38	Primary care	Primary care nurse	X	X			UC
Lewis, 2013[118]	IG1	PA	Tailored print mailings	Eleven individually tailored PA print mailings plus stage-matched manuals, tip sheets, and PA logs.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	Computer expert system				X	AC
Lombard, 2016[62]	IG1	HD, PA	One group session, personalized program manual, monthly text messages, and one telephone session	One 60-min group session and personalized program manual, followed by one text message per month and one 20-min phone coaching session.	M	Est. hours: 80 Total contacts: 2 In-person contacts: 1 Length, min: 80	12	Research center, Remote	Trained facilitators	X	X	X	X	MI
Lutz, 1999[119]	IG1	HD	Tailored print mailings with tailored prescription	Tailored nutrition newsletters and tailored goal-setting information	L	Est. hours: NA Total contacts: NA In-person contacts:	16	Mail only	Computer expert system				X	None

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				for increasing fruit and vegetable intake.		0 Length, min: NA								
	IG2	HD	Tailored print mailings	Tailored newsletters with nutrition information for increasing fruit and vegetable intake (no tailored goal setting).	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	16	Mail only	Computer expert system				X	None
	IG3	HD	Nontailored print mailings	Nontailored newsletters about increasing fruit and vegetable intake (no tailored newsletters or tailored goal setting).	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	16	Mail only	NA				X	None
Mailey, 2014[120]	IG1	PA	Group counseling	Two 90-120 min group counseling sessions, one 60 min personal training session, and five 5 min followup phone calls.	M	Est. hours: 295 Total contacts: 8 In-person contacts: 3 Length, min: 105 (group sessions), 60 (personal trainer), 5 (calls)	26	NR	Study Investigator	X	X			WL
Marcus, 2007[122]	IG1	PA	Telephone counseling	Initial 45-min session followed by fourteen 13-min telephone calls at decreasing frequency over 12 months and supplemented with a monthly PA log and brief questionnaire.	M	Est. hours: 185 Total contacts: 14 In-person contacts: 1 Length, min: 10	52	Research center, Remote	Health educator	X	X			AC
	IG2	PA	Tailored print materials	Initial 45-min session followed by fourteen	M	Est. hours: 45 Total contacts: 1 In-person contacts:	52	Research center, Remote	Computer expert system	X			X	AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				individually tailored printed reports with decreasing frequency over 12 months and supplemented with a monthly PA log and brief questionnaire.		1 Length, min: 45								
Marcus, 2013[121]	IG1	PA	Tailored print mailings and self-monitoring	Fourteen culturally adapted, Spanish-language, individually tailored PA print mailings and pedometers and PA logs for self-monitoring.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	52	Mail only	Computer expert system				X	AC
Marcus, 2016[61]	IG1	PA	Tailored internet intervention	Access to study website; 4 weekly reminder emails followed by 4 biweekly emails and then 3 monthly emails.	L	Est. hours: 22 Total contacts: 11 In-person contacts: 0 Length, min: NA	26	Remote only	NA			X		AC
Marsaux, 2015[123]	IG1	HD, PA	Tailored web-based advice (diet, PA, and phenotype)	Tailored web-based advice based on diet, physical activity, and phenotype.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Remote only	NA			X		MI
	IG2	HD, PA	Tailored web-based advice (diet & PA only)	Tailored web-based advice based on diet and physical activity only.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Remote only	NA			X		MI
	IG3	HD, PA	Tailored web-based advice (diet, physical activity, phenotype, and genotype)	Tailored web-based advice based on diet, physical activity, phenotype, and genotype.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Remote only	NA			X		MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Marshall, 2003[124]	IG1	PA	Tailored print mailing	One time mailing of letter tailored to individual stage of change and Active Living booklets corresponding to stage of change, and additional booklets aimed at higher stages of change.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	0.14	Mail only	NA				X	None
Martinson, 2008[125]	IG1	PA	Counseling	One 60-min in-person group orientation session, followed by seven 20-min individualized sessions occurring twice a month with activity coach, and follow-up calls occurring monthly for 8 months and bimonthly for subsequent year with additional materials over 2 years.	H	Est. hours: 450 Total contacts: 26 In-person contacts: 1 Length, min: 20-60	104	Research center, Remote	Activity coaches		X		X	MI
Maselli, 2017[53]	IG1	PA	Individual counseling	One-hour initial in-person group meeting, individual Skype meetings every other week, and 2 emails per week over course of 12-week intervention.	M	Est. hours: 354 Total contacts: 7 In-person contacts: 1 Length, min: 30-60	12	University, Remote	Counselor (tutor with a MS in Sport Sciences)	X		X		None
	IG2	PA	PA monitor	Wearable physical monitor with online tracking.	L	Est. hours: NR Total contacts: 1 In-person contacts:	12	Remote only	NA			X		None

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Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
						0 Length, min: NR								
Metzgar, 2016[65]	IG1	HD	Weight gain prevention intervention delivered by registered dietician (RDG)	Sixteen weekly sessions of nutrition counseling, followed by 2 monthly sessions of nutrition counseling over a six-month period.	H	Est. hours: 1080 Total contacts: 18 In-person contacts: 18 Length, min: 60	26	Other	Registered dietician	X				None
	IG2	HD	Weight gain prevention intervention delivered by a counselor (CSG)	Sixteen weekly sessions of nutrition counseling, followed by 2 monthly sessions of nutrition counseling over a six-month period.	H	Est. hours: 1080 Total contacts: 18 In-person contacts: 18 Length, min: 60	26	Other	Counselor	X				None
Mosca, 2008[126]	IG1	HD, PA	Counseling	Five 30-60-min individual education and lifestyle counseling sessions to reduce LDL-C and change diet, lifestyle and other CVD risk factors.	M	Est. hours: 225 Total contacts: 5 In-person contacts: 5 Length, min: 45	38	Research center	Health educator, registered dietician, and physician specializing in prevention of CVD	X	X		X	MI
Napolitano, 2006[127]	IG1	PA	Tailored print mailings	Four individually tailored feedback letters based on PA readiness along with one stage matched booklet and letter explaining how to utilize materials.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	Computer expert system				X	AC
	IG2	PA	Nontailored print mailings	One time mailing of AHA Choose to Move booklet and	L	Est. hours: NA Total contacts: NA In-person contacts:	12	Mail only	NA				X	AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				letter explaining how to utilize materials.		0 Length, min: NA								
Norris, 2000[128]	IG1	PA	Counseling	One time individually tailored counseling session with PCP based on PACE questionnaire responses and relevant to stage of change, followed by at least one follow-up call and optional one-time educational mailings.	M	Est. hours: 60 Total contacts: 4 In-person contacts: 1 Length, min: 15-30	20	Primary care	PCP	X	X		X	UC
Oddone, 2018[47]	IG1	HD, PA	Health risk assessment and individual coaching	Online HRA and two 10-30 min tailored health coaching telephone calls.	M	Est. hours: 40 Total contacts: 2 In-person contacts: 0 Length, min: 20	4	Remote only	Health coach		X	X		UC
Parekh, 2014[129]	IG1	HD, PA	Computer-tailored print mailings (two contacts)	Mailed 2 personalized computer-tailored feedback letters and health promotion information sheets at baseline and at 3-months.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	12	Mail only	Computer expert system				X	AC
	IG2	HD, PA	Computer-tailored print mailing (one contact)	Mailed 1 personalized computer-tailored feedback letter and health promotion information sheets at baseline.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	0.14	Mail only	Computer expert system				X	AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Patel, 2017[51]	IG1	PA	Gamification (incentive-based family intervention) including daily goal-related feedback	Daily text or email feedback on whether step goal was reached (measured by accelerometer), 12 of those weeks included a goal-based gamification component, gaining or losing points as a family unit depending on whether randomly selected family member's step goal was reached.	M	Est. hours: 168 Total contacts: 168 In-person contacts: 0 Length, min: ~2 min per message	24	Remote only	Automated feedback			X		MI
Patel, 2019[153]	IG1	PA	Gamification with competition and goal feedback	24-week gamification intervention with points and levels, emails, text message, wearable activity tracking device and competition.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	24	Remote only	None			X		MI
	IG2	PA	Gamification with collaboration and goal feedback	24-week gamification intervention with points and levels, emails, text message, wearable activity tracking device, and collaboration.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	24	Remote only	None			X		MI
	IG3	PA	Gamification with support and goal feedback	24-week gamification intervention with points and levels, emails, text message,	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	24	Remote only	None			X		MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				wearable activity tracking device, and social support of family or friends.										
Pekmezi, 2009[130]	IG1	PA	Tailored print mailings and self-monitoring	Six monthly mailings of individually tailored PA manuals on increasing PA, along with activity logs and pedometers to track and monitor progress towards PA goals, plus tip sheets on related topics.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	NA				X	AC
Pinto, 2002[131]	IG1	PA	Automated telephone counseling	Weekly 10-min counseling calls with telephone linked communication system (TLC - PA) for 12 weeks and then biweekly for 3 months and seven monthly reports providing feedback and advice towards PA goals, along with activity logs and pedometers to track and monitor progress.	M	Est. hours: 180 Total contacts: 18 In-person contacts: 0 Length, min: 10	26	Remote only	Expert system with digitized human speech		X			AC
Pinto, 2005[132]	IG1	PA	Counseling with tailored prescription	Three 30-40-min face-to-face counseling sessions in first 3 months along with	M	Est. hours: 285 Total contacts: 15 In-person contacts: 3 Length, min: 15-35	26	Primary care	PCP, Health educator	X	X		X	MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				twelve 10-15-min counseling phone calls occurring weekly for 3 months and then biweekly for 3 months, and 12 tip sheets mailed at the same time phone calls occurred.										
Roderick, 1997[133]	IG1	HD	Counseling	One dietary advice session (assumed 30-min) and one follow-up session aimed at changing serum cholesterol, weight and diet plus print materials.	M	Est. hours: 60 Total contacts: 2 In-person contacts: 1 Length, min: 30	5	Primary care	Research nurse	X				MI
Ruffin, 2011[134]	IG1	HD, PA	Computer-tailored web-based intervention	Family Healthware tool and surveys completed online that provided personalized familial risk assessment and tailored prevention messages. Could be completed in one session or over multiple sessions (assumed 30 min total).	L	Est. hours: 30 Total contacts: 1 In-person contacts: 0 Length, min: NR	26	Remote only	Computer expert system			X	X	UC
Sacerdote, 2006[135]	IG1	HD	Brief counseling	One 15-min counseling session with PCP to encourage increased	L	Est. hours: 15 Total contacts: 1 In-person contacts: 1 Length, min: 15	1	Primary care	PCP	X			X	UC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				consumption of fruits and vegetables and improve dietary habits.										
Samdal, 2019[67]	IG1	PA	Individual counseling and optional group-based PA sessions	Two 30-60 min individual MI counseling sessions and optional group-based PA sessions up to 2 times per week.	M	Est. hours: 120 Total contacts: 2 In-person contacts: 2 Length, min: 30-60	12	Other	Varied, depended on availability of professionals	X				WL
Simkin-Silverman, 1995[136]	IG1	HD, PA	Group counseling	Fifteen group sessions (assumed 60 min) over 20 weeks followed by 6 booster group sessions. Thereafter, contacted via group, mail and telephone on average every 2-3 months over 4.5 years.	H	Est. hours: 1260 Total contacts: 21 In-person contacts: 21 Length, min: 60	234	Other	Behavioral and nutritional interventionists	X	X		X	None
Smith, 2014[137]	IG1	HD, PA	Counseling	Two 60-min face-to-face counseling sessions and one telephone session within the first month followed by four monthly booster calls and text messages in months 2-6.	M	Est. hours: 145 Total contacts: 7 In-person contacts: 2 Length, min: 5-60	26	Research center	NR	X	X			None
Spring, 2018[60]	IG1	HD, PA, SB	Smartphone app and remote coaching	One in-person session of diet and physical activity counseling,	H	Est. hours: 390 Total contacts: 25 In-person contacts: 1 Length, min: 10-15	40	Research center, Remote	Health coach	X		X		AC

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
			(simultaneous behaviors)	smartphone app with simultaneous feedback on multiple behaviors, and 24 coaching calls ranging from 10-15 min each.										
	IG2	HD, PA, SB	Smartphone app and remote coaching (sequential behaviors - MVPA delayed by 7 weeks)	One in-person session of diet and physical activity counseling, smartphone app with sequential feedback on multiple behaviors, and 24 coaching calls ranging from 10-15 min each.	H	Est. hours: 390 Total contacts: 25 In-person contacts: 1 Length, min: 10-15	40	Research center, Remote	Health coach	X		X		AC
Springvloet, 2015[138]	IG1	HD	Web-based tailored education-plus feedback	Four web-based, tailored nutrition modules plus environmental-level feedback on the availability and prices of healthy foods nearby.	M	Est. hours: 180 Total contacts: 12 In-person contacts: 0 Length, min: 15	6	Remote only	NA			X		MI
	IG2	HD	Web-based tailored education	Four web-based computer-tailored nutrition education modules.	M	Est. hours: 180 Total contacts: 12 In-person contacts: 0 Length, min: 15	6	Remote only	NA			X		MI
Stewart, 2001[139]	IG1	PA	Group counseling	One group informational meeting, one individual planning session, and ten monthly group workshops, along with PA	H	Est. hours: 690 Total contacts: 12 In-person contacts: 12 Length, min: 30	52	Research center	Program staff	X	X		X	WL

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				diaries, monthly newsletters, functional fitness assessments, and two booklets focused on PA and benefits of PA.										
Sun, 2017[56]	IG1	HD, PA, SB	Interactive online educational modules	Eight weekly 30-minute, interactive online educational modules.	M	Est. hours: 240 Total contacts: 8 In-person contacts: 0 Length, min: 30	8	Remote only	NA			X		AC
Thompson, 2008[140]	IG1	HD, PA	Group counseling	Five monthly 2-2.5-hour group sessions on decreasing dietary fat, increasing fruit and vegetable consumption, and increasing PA.	H	Est. hours: 675 Total contacts: 5 In-person contacts: 5 Length, min: 135	20	NR	American Indian health educators	X			X	WL
Thompson, 2014[141]	IG1	PA	Counseling and self-monitoring	Participants wore Fitbit accelerometers for 24 weeks with feedback from the device and 24 weekly telephone counseling calls, along with three face-to-face counseling sessions with a counselor every 2 months.	H	Est. hours: 450 Total contacts: 27 In-person contacts: 3 Length, min: 15-30	24	Research center, Remote	Counselor	X	X			WL
Tinker, 2008[142]	IG1	HD	Group counseling	Eighteen group sessions (assumed 60 min) and one individual session during the first year focused on decreasing fat	H	Est. hours: 2310 Total contacts: 39 In-person contacts: 39 Length, min: 60	312	Research center	Nutritionist and peers (optional)	X				MI

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				intake and increasing fruit and vegetable intake followed by up to 20 group sessions including optional peer-led sessions over 8.5 years.										
Tokunaga-Nakawatase, 2014[143]	IG1	HD, PA	Computer-tailored print mailings	Three computer-tailored print mailings with dietary and physical activity recommendations.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	26	Mail only	Computer expert system				X	UC
Valve, 2013[144]	IG1	HD, PA	Counseling	One initial 20-min counseling session with 3-5 followup sessions plus print materials.	M	Est. hours: 100 Total contacts: 6 In-person contacts: 6 Length, min: 20	104	NR	Research nurse	X			X	UC
Van Hoecke, 2014[145]	IG1	PA	Counseling	One 60-min PA coaching session and six 30-min booster contacts or phone calls.	M	Est. hours: 240 Total contacts: 7 In-person contacts: 1 Length, min: 30-60	10	NR	Health coach	X	X		X	MI
	IG2	PA	Tailored prescription	One 15-min contact with coach, a self-help booklet, and an individualized, written walking program.	L	Est. hours: 15 Total contacts: 1 In-person contacts: 1 Length, min: 15	10	NR	Health coach	X			X	MI
Van Keulen, 2011[158]	IG1	HD, PA	Tailored print mailing and telephone motivational interviewing	Two tailored letters and two 20-min motivational interviewing phone sessions.	M	Est. hours: 0.67 Total contacts: 4 In-person contacts: 0 Length, min: 20	43	Remote only	Master's level students in Psychology and Health Promotion		X		X	None
	IG2	HD, PA	Telephone sessions only	Four 20-min telephone motivational	M	Est. hours: 1.3 Total contacts: 4 In-person contacts:	43	Remote only	Master's level students in Psychology		X			None

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
				interviewing sessions.		0 Length, min: 20			and Health Promotion					
	IG3	HD, PA	Computer-tailored print mailings only	Four tailored feedback letters.	L	Est. hours: NR Total contacts: 4 In-person contacts: 0 Length, min: NR	43	Mail only	NR				X	None
Van Stralen, 2010[146]	IG1	PA	Tailored print mailings with environmental focus	Three mailed computer-tailored letters targeting psychosocial and environmental mediators of PA, plus website access to induce changes in PA.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	14	Mail only	Computer expert system				X	WL
	IG2	PA	Tailored print mailings	Three mailed computer-tailored letters targeting psychosocial mediators to induce changes in PA.	L	Est. hours: NA Total contacts: NA In-person contacts: 0 Length, min: NA	14	Mail only	Computer expert system				X	WL
Vandelanotte, 2005[147]	IG1	HD, PA	Computer-based sessions with tailored feedback (PA and diet simultaneous)	One 100-min session completing two computer-tailored interventions.	M	Est. hours: 100 Total contacts: 1 In-person contacts: 1 Length, min: 100	0.14	Research center	Computer			X		WL
	IG2	HD, PA	Computer-based sessions with tailored feedback (PA feedback first)	Two 50-min individual interactive computer-tailored intervention sessions (PA first, diet second).	M	Est. hours: 100 Total contacts: 2 In-person contacts: 2 Length, min: 50	12	Research center	Computer			X		WL
	IG3	HD, PA	Computer-based sessions with tailored	Two 50-min individual interactive computer-tailored intervention	M	Est. hours: 100 Total contacts: 2 In-person contacts: 2 Length, min: 50	12	Research center	Computer			X		WL

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
			feedback (diet feedback first)	sessions (diet first, PA second).										
Vidoni, 2019[152]	IG1	HD, PA	Home visits and newsletter discussions	Six 30-60 min home visits, 6 monthly newsletters, and TSSC website.	M	Est. hours: 270 Total contacts: 6 In-person contacts: 6 Length, min: 30-60	26	Home	Community health worker	X			X	UC
Vrdoljak, 2014[148]	IG1	HD, PA	Provider training	Provider training (assumed two 60-min sessions) on counseling patients on healthy lifestyle over the course of one year with the use of an intervention booklet, patient education flyers, and protocol monitoring.	M	Est. hours: 120 Total contacts: 2 In-person contacts: 2 Length, min: 60	52	Primary care	NR	X				None
Wadsworth, 2010[149]	IG1	PA	Web-based intervention	One orientation session, six weekly e-mails, a Web site, access to an e-counselor, and access to computer-mediated exercise materials and 4 monthly booster e-mails.	M	Est. hours: 40 Total contacts: 1 In-person contacts: 1 Length, min: 30	26	Other	Exercise physiologist	X		X	X	MI
Walthouwer, 2015[154]	IG1	HD, PA	Web-based computer-tailored videos	Six 15-min video-based advice sessions.	M	Est. hours: 90 Total contacts: 6 In-person contacts: 0 Length, min: 15	12	Remote only	NA (Professional actors read aloud)			X		WL
	IG2	HD, PA	Web-based computer-tailored text messages	Six 15-min text-based advice messages.	M	Est. hours: 90 Total contacts: 6 In-person contacts: 0 Length, min: 15	12	Remote only	NA			X		WL

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

Author, Year	Grp	Beh tar	Intervention	Brief description	Ints Cat	Contacts	Dur, wks	Setting	Provider	IPC	Tel con	Tech del	Print mat	CG
Warner, 2016[150]	IG1	PA	Group counseling with views-on-aging component	One 2hr 45min group session focused on increasing physical activity plus focus on aging.	M	Est. hours: 166 Total contacts: 1 In-person contacts: 1 Length, min: 166	0.14	NR	Psychologists	X				AC
	IG2	PA	Group counseling	One 2hr 45min group session focused on increasing physical activity.	M	Est. hours: 170 Total contacts: 1 In-person contacts: 1 Length, min: 170	0.14	NR	Psychologists	X				AC
Wieland, 2018[55]	IG1	HD, PA, SB	Home visits and telephone calls	Twelve home visits (30-90 minutes each) over 6 months, followed by phone calls every 2 weeks (up to 12 calls total) during the next 6 months.	H	Est. hours: 1260 Total contacts: 24 In-person contacts: 12 Length, min: 15-90	52	Home	Family health promotors	X	X			WL
Wing, 2016[155]	IG1	HD, PA	Group counseling and tailored feedback on large behavior changes	Ten in-person group meetings; quarterly online newsletter on study website; 32 monthly email feedback; offered 4 online refresher courses.	H	Est. hours: 600 Total contacts: 10 In-person contacts: 10 Length, min: 60	156	Research center, Remote	Study interventionist	X		X	X	MI
	IG2	HD, PA	Group counseling and tailored feedback on small behavior changes	Ten (NR-min) in-person group meetings; quarterly online newsletter on study website; 32 monthly email feedback; offered 4 (online refresher courses.	H	Est. hours: 600 Total contacts: 10 In-person contacts: 10 Length, min: 60	156	Research center, Remote	Study interventionist	X		X		MI

Abbreviations: AC=attention control; Beh tar=behavioral target; CG=control group; Dur=duration; Est=estimated; F=fruit; FU=followup; Grp=group; H=high; HD=healthy diet; Hrs=hours; IPC=in-person contact; IG=intervention group; Ints cat=intensity category; L=low; M=medium; Mat=materials; MI=minimal intervention; Min=minutes; NA=not applicable;

Appendix E Table 1. Intervention Characteristics for All Studies, by Author

NR=not reported; PA=physical activity; PCP=primary care provider; RD=registered dietician ; SB=sedentary behavior; Tech del=technology delivered; Tel con=telephone contact; UC=usual care; V=vegetable; Wks=weeks; WL=waitlist.

[*] Only 38% of intervention group received the intervention as planned
[†] Weighted mean intensity based on self-selected dose of intervention
[‡] Actual = 244
[§] Actual = 278
[**] Actual = 270

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Aadahl, 2014[71]	IG1	SB Medium	Counseling	Four individual behavioral choice theory-based face-to-face sessions, 30-45 minutes, at 6-week intervals during a 6-month period. Sessions incorporated individual behavior goal setting, self-efficacy, and motivational interviewing techniques. Participants set specific individual goals for change in sedentary behavior by identifying adequate behavior substitutes or choices and initiating small changes in availability and access to sedentary behavior in their daily lives; and behavior goals were reviewed and evaluated. Each session also focused on one of the four key messages: (1) reduce daily TV viewing; (2) substitute sitting with standing when possible—at work and at home (no time restrictions); (3) break up prolonged sitting by standing up frequently; and (4) 30 minutes maximum of sitting per episode. Written materials containing these key messages, including strategies and suggestions for reduction of sitting time, were handed out to participants at each session in purposefully developed booklets and on postcards and stickers.	97.5% participants nearly completed all 4 intervention sessions (2 out of 81 unable to attend last session; received materials via mail)	None
Aittasalo, 2006[72]	IG1	PA Low	Brief counseling	One 5-10 min prescription-based counseling session with PCP using the 5 A's. Key issues of counseling were (1) patients current PA and their readiness to increase PA and PA preferences, (2) patient-centered goal setting, (3) emphasis on lifestyle activities, which may have more long-term effects than structured exercise, and (4) agreement on control visits most preferably with a preset date. Evidence about the health benefits of PA also presented. Optional activities included PA log for self-monitoring and referral to PA experts.	NR	UC: Not described
	IG2	PA Low	Self-monitoring	Pedometer and PA log for monitoring 5 days of activity. Received feedback and personal PA recommendations based on PA log by mail.	NR	UC: Not described
Albright, 2014[73]	IG1	PA Medium	Tailored telephone counseling plus website	Seventeen telephone calls with a counselor who used motivational interviewing techniques to problem-solve barriers using culturally sensitive techniques and to set future PA goals (incrementally building up to 150 min/week of MVPA) with a pedometer to track and set goals using steps (with goal of 10,000 steps/day). Participants were referred to a condition-specific tailored website that included a tailored mom-centric PA “resource directories” such as information on parks with paved paths for a stroller, and newsletters that included personal factors of self-regulatory behavioral skills and self-efficacy to do regular PA and enlisting social support for physical activity from family and friends.	70% received ≥13 (of 17) calls; 12.7 min per call on average; 23% did not visit website, 6% visited once, 31% visited 2-10 times,18% visited 11-20 times,22% visited ≥21 times	MI: Information on PA benefits via standard website and print materials
Aldana, 2006[74]	IG1	HD, PA High	Group counseling	Sixteen 2-hour group education sessions over 4 weeks addressing various diet, exercise, lifestyle, and health topics. Participants encouraged to follow preset dietary and exercise goals. Dietary goal was a more plant-based food diet that was low in fat, animal protein, sugar and salt, very low in cholesterol and high in fiber. Exercise goal was walking at least 30 mins/day. Participants also received a workbook with assignments, a pedometer and were encouraged to keep an exercise log and had access to shopping trips with dietitians and cooking demonstrations.	89% of classes attended on average	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Alexander, 2010[75]	IG1	HD Medium	Tailored web-based + e-mail counseling	Four tailored Web "sessions" offered 1, 3, 13, and 15 weeks after enrollment. Four sets of e-mail counseling sessions based on motivational interviewing, which were initiated by a study counselor within a week following a new Web session visit. Counseling was linked to the most current session and included feedback on current levels of intake and reflection on participant's plan. Behavioral Web "sessions" were tailored to the participant's stage of change and designed to increase motivation and self-efficacy for eating fruits and vegetables; including expanded ''goal'' intake of 5 to 9 daily servings, and a goal-setting tool was available to aid in planning for change. Each session included 4 to 5 pages of core content, illustrations, optional links to more detailed explanations, and special features designed to supplement session content. Once available, all program components were accessible throughout the 12-month study period. Optional features: individually tailored menus; 60-second video clips of recipe preparation; create own menus from the recipe library. $20 offered for completing each of 3 follow-up online surveys.	Counselor-initiated e-mails ranged from 0-17 e-mails per participants (mean=6). Participation rate in e-mail support: 22% had no exchanges, 29% had 1 to 3, 17% had 4 to 8, and 33% had 9 or more	MI: 4 nontailored web sessions provided general fruit and vegetable nutrition information
	IG2	HD Medium	Tailored web-based counseling	Four tailored Web "sessions" offered 1, 3, 13, and 15 weeks after enrollment. Behavioral Web "sessions" were tailored to the participant's stage of change and designed to increase motivation and self-efficacy for eating fruits and vegetables; including expanded ''goal'' intake of 5 to 9 daily servings, and a goal-setting tool was available to aid in planning for change. Each session included 4 to 5 pages of core content, illustrations, optional links to more detailed explanations, and special features designed to supplement session content. Once available, all program components were accessible throughout the 12-month study period. Optional features: individually tailored menus; 60-second video clips of recipe preparation; create own menus from the recipe library. $20 offered for completing each of 3 follow-up online surveys.	NR	MI: 4 nontailored web sessions provided general fruit and vegetable nutrition information
Allman-Farinelli, 2016[49]	IG1	HD, PA Medium	Counseling telephone calls and tailored feedback via text and email messages	12-week mHealth program "TXT2BFiT" including 5 coaching calls (10-15 minutes each) by a dietitian skilled in motivational interviewing, 96 text messages, 12 emails, apps, and downloadable resources from the study website. Lifestyle behaviors addressed were intake of fruits, vegetables, sugar-sweetened beverages (SSBs), take-out meals, and physical activity. For each of the 4 key behaviors addressed, a staging algorithm based on the transtheoretical model was completed as part of the baseline survey by all participants. This was used to generate a personalized set of messages (8 messages a week) from a bank of text messages to be sent over the 12-weeks. Messages were stratified by sex and whether the participant was in pre-contemplation, contemplation, preparation, action, or maintenance stages for each of the 4 behaviors. More cognitive messages were included if a behavior was in the early stage for change and messages were more behavioral if participant was in the action or maintenance stages for any given behavior. Twelve emails (once a week) were sent by the dietitian who offered coaching and repeated the information in the text messages	Mean number of coaching calls: 4.6 (SD 1.1) out of 5 (82.4% overall completed all 5). 53.7% of the intervention participants replied to 8 or more of the 16 SMS text messages with a requested response, with 20.3% replying to all. 91.2%	MI: 4 text messages, 1 on each key behavior, over 12 weeks; 2-page handout on PA guidelines

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				with links to remind participants to use the other resources provided. After a coaching call, the goals set were reiterated in the emails sent by the dietitian. Other components of the program were a comprehensive18-page diet and nutrition booklet with physical activity guidelines and a website. This website gave access to 4 designer mobile phone apps for education and self-monitoring for each of the 4 key lifestyle behaviors addressed. Other resources were online weight tracker, printable charts such as "eating on a budget," "emergency meal tool kit," "meal planner," "seasonal guide to fruit and vegetables," "tips for take-outs," physical activity planner and "staying healthy over holidays;" and a blog facility for communication. After the 12-week "TXT2BFiT" program, intervention participants received a low dose maintenance intervention. This consisted of monthly text messages and emails, and participants had continued access to the website. Two booster coaching phone calls at 5 and 8 months from baseline were included.	participants replied to 2 or more of the 4 text messages, with 62.4% replying to all 4 of them. 76.4% reported that they used the email messages; 74.5% reported that they did not access the mobile phone apps; 65.5% reported using the mailed booklet; 6.4% used the blog; 59.1% did not use the resources available on the website.	
Anand, 2016[66]	IG1	HD, PA, SB Medium	Email messages targeting HD and PA	Twenty-six bi-weekly motivational email messages plus 52 weekly emails or texts about healthy diet and physical activity. Participants received 2 types of messages: stages of change-oriented motivational messages sent by email every 2 weeks, and health tips focused on diet and physical activity sent by email or text messages (participant's choice) every week for 12 months. Participants also received their myocardial infarction risk score by email within 4 weeks after randomization. Diet messages were geared to motivate subjects to make changes including advice and support regarding reduction of energy-dense, nutrient poor foods (i.e., fried, fast foods, sugary beverages, and desserts), and advocating increased consumption of fruits and vegetables. Physical activity messages were geared toward decreasing sedentary behaviors and to increase regular physical activity. Participants were also encouraged to access the website for South Asian-specific prevention advice. All messages were culturally relevant.	Median number of motivational messages sent to the DHI group was 26 (IQR, 24-28) and the median number of health tips was 54 (IQR, 53-60) compared with zero sent to the control group.	MI: Received their myocardial infarction risk score by email within 4 weeks after randomization and were encouraged to access the study website
Ball, 2016[64]	IG1	HD Medium	Skill-building newsletters and optional supermarket tour	Women in the intervention arm received a set of 8 educational and skill-building newsletter and behavior change recourse packages (sent every two weeks for the first two months and monthly for the remaining four months of the intervention). Resources were designed to specifically address disadvantaged women's needs and focused primarily on affordability and nutrition-related attitudes and skills. Efforts were made to incorporate a range of behavior change techniques, particularly related to goal setting. Newsletters also emphasized budgeting, meal planning, cutting costs, and increasing confidence and family involvement in fruit and vegetable preparation and consumption. Each also included 2 recipes with nutritional information for healthy, inexpensive meals incorporating fruit and	69% self-reported reading all newsletters; 60% self-reported using at least one recipe.	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				vegetables. Supplementary materials (goal-setting activities; menu planners; shopping lists; seasonality, food preparation, and storage guides; and self-monitoring, exercises) and links to credible websites were also included. Intervention participants were also invited to take part in an hour-long supermarket tour conducted by an accredited dietician and research assistant.		
Baron, 1990[76]	IG1	HD Medium	Counseling	Participants completed a self-administered questionnaire concerning general health, smoking habits, and present diet, and given instruction regarding optimal body weight and diet by a nurse within the practice. Counseling sessions were done individually or in small groups and lasted about 30 minutes per session, dietary advice given in sessions was focused on making modest decreases in total fat intake from an expected level of >40% of calories to 30-35% of calories, increase in ratio of polyunsaturated to saturated fats to approximately 0.4 from an expected level of <0.3, and stressed the value of increased dietary fiber, including soluble fiber. The potential benefits of physical exercise, and moderation of salt, alcohol, and tobacco intake were also mentioned but not emphasized. A booklet was given which summarized basic ideas of diet, provided recipes, and offered advice concerning local restaurants. Study nurse also provided support and encouragement regarding dietary modification at 2 brief follow up counseling sessions. Promotional materials were also on display at the practice.	NR	UC: Participants were told they were part of a nutrition survey and were followed up on the same schedule by the same nurse, but without dietary advice
Bennett, 2013[77]	IG1	HD, PA High	Counseling, tailored print materials, and self-monitoring	Goal was a slight (<200 kcal) daily energy deficit to offset weight gain. 3 behavior change goals were assigned using the interactive obesity treatment approach (iOTA) at baseline and new goals at months 2 and 4, each goal assignment included printed personalized feedback reports with previous goal results and tailored prescriptions for new goals. Pedometers and tracking logs were used daily and reported during weekly interactive voice response (IVR) calls. Individually tailored intervention materials were delivered 22 times over one year; including one initial set at baseline, followed by 5 bimonthly mailings during months 3-12, and quarterly newsletters, 12 monthly, 20-minute counseling calls with a registered dietician trained in motivational interviewing, and a 12-month membership to local YMCAs.	81.9% completed counseling calls during 12-month period, IVR call completion rate ranged between 65.2% and 89.5% per week with a mean (SD) of 72% (28%). 70.3% initiated free YMCA membership and 40.7% visited the YMCA more than once	UC: 3 newsletters covering general wellness topics, not including weight, nutrition, or PA sent every 6 months.
Beresford, 1997[78]	IG1	HD Low	Brief counseling and self-help material	Self-help booklet and brief physician endorsement of dietary change at their routine scheduled medical appointment. Physicians introduced the booklet to the participant in a standardized fashion, taking less than 3 minutes during the encounter. The booklet contained a brief self-test of current dietary behavior, suggestions for small, sequential behavior change, self-assessment questionnaires and sections for recording short- and long-term goals. Two weeks	95% of participants who attended their appointment received their booklet	UC: Not described

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				later, a reminder letter signed by the physician was mailed to participants. Booklet and script to introduce it were placed in patient chart.		
Bernstein, 2002[79]	IG1	HD High	Home-based education	In-depth, home-based, personalized education program, which stressed increasing the intake of fruits and vegetables to a minimum of 5 servings per day and calcium-rich foods to a minimum of 3 servings per day. Provided through 8 home visits, biweekly phone contacts, and monthly letters over 6 months. Subjects were given an education book. Topics included good nutrition at any age, health benefits of eating more fruits and vegetables, importance of calcium-rich foods and risk factors for osteoporosis, what constitutes a serving, grocery shopping tips, and nutrient dense recipes. Behavior-modification techniques such as goal setting, rewards, food log recording, role-playing games, and troubleshooting were included in the home visit sessions.	NR	AC: Home-based exercise program
Bickmore, 2013[80]	IG1	PA Medium	Computer-based counseling	Two phases: 2-month intensive intervention phase delivered on take-home computer tablets followed by a 10-month maintenance phase delivered on outpatient waiting room kiosk computers. The intervention used an embodied conversational agent (ECA) exercise coach. ECAs are animated computer characters that simulate face-to-face conversation using voice, hand gesture, gaze cues, and other nonverbal behavior to make the computer interface as acceptable and intuitive as possible for individuals who may have no prior experience with computers and for those with low health literacy. At baseline, participants were instructed on how to use the touch-screen tablets and to conduct daily 5-minute conversations with the ECA for 2 months. Daily conversations focused on increasing walking. The virtual coach reviewed individual progress relative to short- and long-term goals, provided positive reinforcement, problem solving to overcome barriers to PA, and goal setting. A pedometer was used to track steps and participants downloaded their step data to the virtual system to aid in feedback given during conversations. Tablets were returned at 2 months and participants were provided instruction on how to use an identical computer kiosk program in clinic waiting room whenever they were attending a routine appointment for the remaining 10 months.	Mean interactions with take-home tablet: 35.8 (SD=19.7) out of 60 days. Use decreased after first week from average of 4.7 to 4.0 sessions per week and then declining to 3.3 sessions/week at ended of 2-month period. Mean (SD): 1.0 (2.9) interaction with outpatient kiosk over 10-month period.	MI: Pedometers and monthly activity logs to track step counts
Brekke, 2005[81]	IG1	HD High	Group counseling (diet)	Two 60-120 min dietary group education sessions given 1 to 2 weeks apart at the start of the study; participants were requested to bring another member in their household, preferably the meal preparer. Sessions addressed general dietary advice; food examples; meal patterns and regular meal frequency; and side effects of increased fiber intake. Time was provided to discuss questions and food choice. Dietary advice aimed to reduce saturated fat (10% energy), increase monounsaturated fat and of n-3 fatty acids, increase intake of vegetables, fruits, and fiber; additional goals to increase intake of low glycemic index (GI) foods and reduce the intake of high GI foods. For the first 4 months, 7 to 9 unannounced telephone interviews were performed using 24-h dietary recall as basis for	NR	MI: UC for the first year; at one-year, dietary counseling MI with lower intensity FU

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				discussion about diet. After 4 months, phone interviews were conducted every 10 weeks.		
Brekke, 2005[81]	IG2	HD, PA High	Group counseling (diet and PA)	Two 60-120 min dietary group education sessions given 1 to 2 weeks apart at the start of the study; participants were requested to bring another member in their household, preferably the meal preparer. Sessions addressed general dietary advice; food examples; meal patterns and regular meal frequency; and side effects of increased fiber intake. Time was provided to discuss questions and food choice. Dietary advice aimed to reduce saturated fat (10% energy), increase monounsaturated fat and of n-3 fatty acids, increase intake of vegetables, fruits, and fiber; additional goals to increase intake of low glycemic index (GI) foods and reduce the intake of high GI foods. In addition, sessions included exercise advice and discussion on benefits of physical activity. Suggestions on how to increase physical activity were discussed. Participants were requested to decide how to personally achieve their goals for doing at least 30 minutes of a physical activity, 4 or 5 times per week. For the first-4 months, 7 to 9 unannounced telephone interviews were performed using 24-h dietary recall and 72-hr physical activity recall as basis for discussion about diet and to encourage physical activity. After 4 months, phone interviews were conducted every 10 weeks.	NR	MI: UC for the first year; at one-year, dietary counseling MI with lower intensity FU
Bryan, 2013[82]	IG1	PA Low	Tailored print mailings	Fourteen individually tailored mailings with information based on current perceived barriers and level of motivation for increasing PA over one year, with weekly mailings during month 1, biweekly during months 2 and 3, monthly during months 4-6, and bimonthly during months 7-12. Mailings included questionnaires and printed feedback reports based on questionnaire results generated by a computer expert system, a self-help manual matched to current stage of motivational readiness, and a series of tip sheets. Participants were told that their goal was to increase PA to 30 min a day, 5 days a week.	NR	AC: 14 mailings with general health and wellness information
Burke, 2013[83]	IG1	HD, PA Medium	Self-help booklet and phone and e-mail counseling	One booklet designed for seniors that provided PA and nutrition recommendations and encouraged goal setting. The booklet was supported by an exercise chart, calendar, 3 bi-monthly newsletters, resistance band and pedometer, along with 6-10 motivational phone calls and/or 2-5 email contacts with program guides.	Call and e-mail completion NR.	None
Caplette, 2017[58]	IG1	HD High	Access to a healthy eating blog (Salsa Etcetera)	Participants had access to a healthy eating blog ("Salsa Etcetera") that included a total of 26 blog posts that they could read and comment on. New posts were published once a week for 24 weeks and an email was sent every week to inform them that a new post was on the blog. Email reminders were sent to participants who did not log on the blog for two consecutive weeks. The target behavior of the healthy eating blog was to increase fruit and vegetable consumption. Therefore, blog posts aimed at discussing various positive aspects of healthy eating with a focus on fruit and vegetable intake. The intervention contained six performance objectives: (1) eating fruit and vegetables at every meal, (2) planning fruit and vegetables purchase and preparation, (3) knowing a variety of fruit and	Each weekly post was accessed by at least 73% of women. 16% viewed the first optional video and 11% viewed the second optional video. Participants posted a total of	MI: Access to the healthy eating blog posts but no interaction with the dietician-blogger

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				vegetables, (4) healthy ingredient substitutions in recipes, (5) reading nutritional labels, and (6) making better choices at the restaurant. Each post included a step-by-step recipe developed by the research team that featured fruits and vegetables. Recipes were described using text and pictures and/or video.	514 comments on the blog during the intervention. On average, each participant commented 2 times per month.	
Carpenter, 2004[84]	IG1	HD High	Group counseling	Twenty 75-min group (13 to 15 people) counseling sessions with 2 staff cofacilitators (weekly for the first 16 weeks and biweekly for the last 8 weeks). Sessions included a brief check-in, session topic and review of materials, interactive learning strategies to personalize the topic to participants' respective lives, and review of homework. Participants were encouraged to turn in weekly food logs for feedback. Curriculum focused on process of behavior change; cofacilitators stressed 4 main dietary changes: decreasing fats, increasing whole grains, dairy products and other calcium-rich foods, and fruits and vegetables. Also received a copy of “The American Dietetic Association's Complete Food & Nutrition Guide” and contact information of study staff for any questions.	NR	MI: Booklet on healthy diet
Carpenter, 2004[84]	IG2	HD Low	Mailed materials and website	Received 2 weekly print curriculum sessions twice a month via regular mail with weekly reminders, which focused on teaching the "process" of behavior change. In addition, had access to a Web site through which they could post questions and review responses, read restaurant critiques, obtain recipes, and participate in a weekly live on-line chat session. Dietary goals same as in weekly meeting group. Curriculum focused on process of behavior change and focused on 4 main dietary changes: decreasing fats, increasing whole grains, dairy products and other calcium-rich foods, and fruits and vegetables. Also received a copy of “The American Dietetic Association's Complete Food & Nutrition Guide” and contact information of study staff for any questions.	NR	MI: Booklet on healthy diet
Carroll, 2010[85]	IG1	PA Low	Tailored print mailings	Participants completed physical activity surveys mailed to them at baseline, 1, 3, and 6 months. The surveys asked about current physical activity habits, self-efficacy, decision making about physical activity, health status, and chronic conditions. After completing and returning each physical activity survey, a tailored ipsative feedback report was mailed to the participant, designed to motivate them to increase physical activity personalized to their needs. The reports were based on both psychosocial measure (stage of change, processes of change, self-efficacy, and pros and cons) and the individual’s reported amount of physical activity. The tailored reports provided congratulatory messages for participants obtaining the recommended physical activity, and tips on increasing activity for those not meeting the recommendations. The reports also contained an activity prescription (in which physicians could prescribe a type of activity, intensity [moderate/hard], frequency, and duration), with instructions to bring the prescription to their next physician visit.	89% received the intervention materials; 86.2% reported reading all or most of the materials.	AC: Four feedback reports containing information on recommended preventive tests and screening tests

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Coates, 1999[86]	IG1	HD High	Group counseling	Up to 18 group (8-15 people per group) counseling sessions with research nutritionist. Groups met weekly for the first 6 weeks, biweekly for the next 6-weeks, and monthly thereafter for an additional 9 months or until the end of the study. Each session integrated nutritional and behavioral change strategies. Nutritionists encouraged participants to substitute low fat for high fat foods and recipes. Group members shared experiences, role played, provided support, and helped each other solve problems. Sessions incorporated regional and ethnic foods and local terminology. Groups reinforced success in changing eating patterns and in bringing interesting low-fat dishes to sessions. Nutritionists invited family members to selected sessions and encouraged a friendly group environment. Each participant monitored her dietary intake with a goal for grams of fat equivalent to ~20% of total energy, using self-monitoring tools. For individuals having difficulty making changes or continuing participation, nutritionists provided individualized attention.	96% attended at least 1 session, 83% attended sessions for ≥6 months, 79% attended sessions for ≥12 months. Adherence was somewhat lower among Hispanic women.	MI: Received copy of "Dietary Guidelines for Americans"
de Vet, 2009[87]	IG1	PA, SB Low	Self-directed and self-selected activity plan (with repeat planning)	All participants were asked to increase their PA level by 2 hours/week and to explicitly decide and write down their plan (i.e., implementation intentions) for what activity, when, where, and how long they would do the activities. This group self-selected up to 3 activities and made repeated plans after 2 weeks and 3 months. The plan was set autonomously with no help of an interventionist.	Of respondents asked to form implementation intentions, 89%, 89%, and 86% did so at baseline, 2 weeks, and 3 months	MI: Questionnaire with information about benefits of exercise and recommendation to increase activity level by 2 hours/week
de Vet, 2009[87]	IG2	PA Low	Self-directed and self-selected activity plan (one-time plan)	All participants were asked to increase their PA level by 2 hours/week and to explicitly decide and write down their plan (i.e., implementation intentions) for what activity, when, where, and how long they would do the activities. This group self-selected up to 3 activities. The plan was set autonomously with no help of an interventionist.	Of respondents asked to form implementation intentions, 89%, 89%, and 86% did so at baseline, 2 weeks, and 3 months	MI: Questionnaire with information about benefits of exercise and recommendation to increase activity level by 2 hours/week
de Vet, 2009[87]	IG3	PA Low	Self-directed walking plan	All participants were asked to increase their PA level by 2 hours/week and to explicitly decide and write down their plan (i.e., implementation intentions) for what activity, when, where, and how long they would do the activities. This group	Of respondents asked to form implementation	MI: Questionnaire with

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
			(one-time plan)	was assigned their activity, which was walking. The plan was set autonomously with no help of an interventionist.	intentions, 89%, 89%, and 86% did so at baseline, 2 weeks, and 3 months	information about benefits of exercise and recommendation to increase activity level by 2 hours/week
Delichatsios, 2001[88]	IG1	HD Medium	Automated telephone counseling	Home monitoring, education, and counseling delivered via a telephone-linked communication system (TLC-Eat) once a week for 6 months lasting 5-7 minutes focused on specific food groups or eating behaviors. TLC monitored the participants behaviors and health conditions and provided education and behavioral reinforcement for targeted behaviors, such as diet. TLC-eat focused on fruits, vegetables, red and processed meats, whole fat dairy foods, and whole grain foods using SCT as a guide to behavior change focusing on intrapersonal factors linking eating behaviors to personally valued outcomes. Responses were compared between conversations and provided feedback on change, along with education, advice, and counseling tailored to the participants reported eating behaviors, and follow up on goals set in previous conversations. Data was also utilized to generate written reports for participants and their health care providers as needed.	24% never called the system, 36% called 1-10 times, 23% called 11-19 times, 18% called >20 times	AC: PA counseling using the same TLC automated technology
Elley, 2003[89]	IG1	PA Medium	Counseling with tailored prescription	One 10 min consultation with PCP discussing increasing physical activity and goal setting. The goals, usually home-based physical activity or walking were written on a standard “Green Prescription” and given to participants. The delivery of the “Green Prescription” was followed up by three 10-20 min phone calls over 3 months from exercise physiologists to encourage and support them including motivational interviewing and specific advice about exercise or community groups was provided if appropriate. Quarterly newsletters were sent over the course of a year, containing information about community exercise initiatives and motivational material.	95% of participants who attended follow up recalled receiving a green prescription	UC: Not described
Estabrooks, 2011[90]	IG1	PA Medium	Group counseling	The Move More intervention consisted of two 2-hour group sessions (averaged 8 participants per group, 4 weeks apart) and one telephone contact (12 weeks following randomization). Group dynamics principles were used in each session: providing team points and rewards for class attendance, completion of activities between sessions, and tracking behaviors; creating small teams and team goals; discussing barriers of behavior change; identifying strategies to overcome barriers; presenting resources, such as supportive people to achieve their goals; and discussing personal benefits of PA as well as the components of an effective PA plan. In addition, handouts were provided on how to determine exercise intensity and complete stretches and strength training at home, and personal	NR	MI: "Enhanced standard care" with 2 mailings, including self-help guide, 1 telephone call to discuss materials

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				action plan. Instructors also led each small team through a series of group strength, flexibility, and cardiovascular exercises that could be completed at home. Eight weeks after the second group session, participants received a follow-up telephone call where counselors used the 5 A's to assess, advise, agree, assist, and arrange strategies for increasing or maintaining physical activity.		
Fischer, 2019[70]	IG1	PA Medium	Tailored telephone counseling and text messages	12 bi-weekly 15-40 min coaching phone calls, 48 tailored short text message prompts, and self-monitoring via website. All intervention arms received the same coaching regimen. The coaching facilitated a client-centered, goal-oriented discussion between participant and coach. Each coaching session contained the use of behavioral change techniques (BCTs). Participants were asked to set and adapt goals, to plan their PA behavior, to analyze and overcome barriers and to gradually habituate to a physically active lifestyle. During the first session, coaches focused on the development of a functional relationship and delivered information on the procedure of the coaching. Established activity plans were inserted in the personal profile on the website homepage and visible for participant and coach. Additionally, participants received four individually tailored SMS (text) prompts during each two-week period (48 in total). Prompts were sent at varying times and there was no possibility to respond. The SMS prompts either contained information to discussed BCTs, feedback, PA knowledge, or a reminder. All participants had access to a password protected online platform (http://www.movingcall.com) for planning and self-monitoring of PA.	N=71 completed intervention	MI: Single written recommendation with tailored information on training concepts and information on PA; asked to follow the recommendation and had access to the same password protected online platform
Fischer, 2019[70]	IG2	PA Medium	Tailored telephone counseling	12 bi-weekly 15-40 min coaching phone calls, 48 tailored short text message prompts, and self-monitoring via website. All intervention arms received the same coaching regimen. The coaching facilitated a client-centered, goal-oriented discussion between participant and coach. Each coaching session contained the use of behavioral change techniques (BCTs). Participants were asked to set and adapt goals, to plan their PA behavior, to analyze and overcome barriers and to gradually habituate to a physically active lifestyle. During the first session, coaches focused on the development of a functional relationship and delivered information on the procedure of the coaching. Established activity plans were inserted in the personal profile on the website homepage and visible for participant and coach. All participants had access to a password protected online platform (http://www.movingcall.com) for planning and self-monitoring of PA.	N=75 completed interventions	MI: Single written recommendation with tailored information on training concepts and information on PA; asked to follow the recommendation and had access to the same password protected online platform

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Fjeldsoe, 2015[91]	IG1	PA Medium	Counseling and regular text messages	Intervention began with one 24-45min face-to-face counseling session with a trained MobileMums behavioral counselor, after which participants received 12 weeks of individually tailored theory-based text messages (52 total text messages) and a follow-up telephone counseling session with their behavioral counselor at 6 weeks. Participants also received supplementary resources including a MobileMums Participant Handbook, a MobileMums goal tracking refrigerator magnet, and standard physical activity information brochures, as well as details for joining a dedicated MobileMums Facebook group and a MobileMums website with a searchable online exercise directory. Each participant was asked to identify a support person who also received 12 weeks of individually tailored, theory-based text messages.	98% completed face-to-face counseling session (mean duration 50 min); 83% completed telephone FU (mean duration 14 min). On average, 58 text messages were sent per participant and 33 sent per support person	MI: PA brochures; access to a separate information-only website and a separate Facebook group; one-page feedback summary of their accelerometer-derived PA levels following each assessment
Franko, 2008[92]	IG1	HD, PA Medium	Web-based intervention	Used MyStudentBody.com-Nutrition (MSB-N) for 2 web sessions plus a subsequent booster session. This interactive, internet-based program specifically targets the needs of college students and aims to improve nutrition behaviors, increase nutritional knowledge, and increase physical activity. MSB-N is comprised of: (1) three information links (Ask the Expert, Student Voices, College News); (2) Rate Myself assessment (questions that are part of the website that are used to provide feedback to the user); (3) four main topic pages (Nutrition 101, Eating on the Run, Weighing In, Fitness); and (4) Resources. Participants were instructed to log into the site and begin by completing the Rate Myself questionnaires, which assessed current dietary intake and patterns as well as physical activity levels and beliefs. Participants were then directed to visit the four main topic pages, which contained text-based and audio information, interactive activities, and goal-setting areas. The first session lasted ~45 min and the second session was conducted 2 weeks later with the web session being ~45 min, followed by the post-test assessment. Additionally, participants were asked to log on to the website remotely for 45 min approximately 3 weeks after completion of the post-test assessment and were instructed to visit any areas of the site that interested them. In return for their participation, participants received $25 for completing the baseline assessment, $40 for completing the post-test assessment, $40 for completing the 3-month follow-up and $55 for completing the 6-month follow-up assessments.	NR	AC: Interactive website on anatomy

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Franko, 2008[92]	IG2	HD, PA Medium	Web-based intervention	Used MyStudentBody.com-Nutrition (MSB-N) for 2 web sessions. This interactive, internet-based program specifically targets the needs of college students and aims to improve nutrition behaviors, increase nutritional knowledge, and increase physical activity. MSB-N is comprised of: (1) three information links (Ask the Expert, Student Voices, College News); (2) Rate Myself assessment (questions that are part of the website that are used to provide feedback to the user); (3) four main topic pages (Nutrition 101, Eating on the Run, Weighing In, Fitness); and (4) Resources. Participants were instructed to log into the site and begin by completing the Rate Myself questionnaires, which assessed current dietary intake and patterns as well as physical activity levels and beliefs. Participants were then directed to visit the four main topic pages, which contained text-based and audio information, interactive activities, and goal-setting areas. The first session lasted ~45 min and the second session was conducted 2 weeks later with the web session being ~45 min, followed by the post-test assessment. Additionally, participants were asked to log on to the website remotely for 45 min approximately 3 weeks after completion of the post-test assessment and were instructed to visit any areas of the site that interested them.	NR	AC: Interactive website on anatomy
Fries, 2005[93]	IG1	HD Low	Tailored print mailing and brief counseling call	One mailing of individually tailored fat and fiber feedback with physician endorsement, minimal brief counseling call, and 5 low-literacy self-help booklets. Tailored mailing consisted of two feedback forms and two recommendation forms (one each for fat and fiber) based on baseline fat and fiber questionnaire plus physician endorsement letter. Feedback categorized into STOP (poor eating habits), YIELD (needs improvement), and GO (good habits) messages. Participants received minimal brief counseling call 2-weeks after personalized mailing; call was designed to remind and reinforce and offer to answer questions. 5 low-literacy self-help booklets mailed during weeks 2-6 focused on behavior and skills for healthy eating; booklets adapted from the Eating Patterns Study (Beresford, 1997). Community advisory board provided input for tailoring intervention to rural audience.	82% of participants received one follow-up call. 74% reported receiving materials and 63.9% feedback; materials resent to all participants not receiving them.	WL: Waitlist
Fukuoka, 2019[69]	IG1	PA Medium	Brief counseling and mobile-phone application with tailored feedback for 3 months plus a 6-month maintenance phase	Three brief in-person counseling sessions and daily use of mobile phone (mPED app) and accelerometer for 9 months. The in-person counseling session included 7 domains: (1) overview of the physical activity program and tailored short- and long-term goal setting based on each participant's baseline physical activity data, (2) education about duration and intensity of brisk walking and the health benefits of physical activity, (3) identification of barriers to increasing physical activity and development of strategies to overcome these barriers, (4) value and identification of social support while increasing physical activity, (5) relapse prevention, (6) education about healthy diet and weight maintenance, and (7) physical activity safety. At the counseling session, participants developed a written individualized physical activity plan that was reevaluated at the 6-week and 3-month brief counseling sessions/visits. Participants were instructed to use mPED app and	100% attended baseline visit, 94.3% attended 6-week visit, and 96% attended 3-month visit, 85.5% used app, across all interventions	MI: Daily use of accelerometer

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				accelerometer every day. The mPED app had two main functions: (1) a daily message or video clip and (2) a daily diary. The app also included "summary," "help," "talk to us," and "weekly goals" menu options. The summary option included the material provided in the brief in-person counseling session; the help option listed the research office contact information; and the talk to us option allowed the participant to directly send a text message to researchers from the application. Activity goals, displayed in the weekly goals option, were automatically increased by 20% each week, relative to the participant's baseline, until a goal of 10,000 steps per day, 7 days per week, was reached. At 3 months, the group was encouraged to continue using the mPED app and accelerometer for the next 6 months.		
Fukuoka, 2019[69]	IG2	PA Medium	Brief counseling and mobile-phone application with tailored feedback for 3 months	Three brief in-person counseling sessions and daily use of mobile phone (mPED app) for 3 months and accelerometer for 6 months. The in-person counseling session included 7 domains: (1) overview of the physical activity program and tailored short- and long-term goal setting based on each participant's baseline physical activity data, (2) education about duration and intensity of brisk walking and the health benefits of physical activity, (3) identification of barriers to increasing physical activity and development of strategies to overcome these barriers, (4) value and identification of social support while increasing physical activity, (5) relapse prevention, (6) education about healthy diet and weight maintenance, and (7) physical activity safety. At the counseling session, participants developed a written individualized physical activity plan that was reevaluated at the 6-week and 3-month brief counseling sessions/visits. Participants were instructed to use mPED app and accelerometer every day. The mPED app had two main functions: (1) a daily message or video clip and (2) a daily diary. The app also included "summary," "help," "talk to us," and "weekly goals" menu options. The summary option included the material provided in the brief in-person counseling session; the help option listed the research office contact information; and the talk to us option allowed the participant to directly send a text message to researchers from the application. Activity goals, displayed in the weekly goals option, were automatically increased by 20% each week, relative to the participant's baseline, until a goal of 10,000 steps per day, 7 days per week, was reached. At 3 months, the mPED app was removed from the mobile phones of this "regular" group while the "plus" group was encouraged to continue using the diary app for the next 6 months.	100% attended baseline visit, 94.3% attended 6-week visit, and 96% attended 3 month visit, 85.5% used app, across all interventions	MI: Daily use of accelerometer
Gao, 2016[94]	IG1	PA Medium	Individual counseling and tailored print materials	Participants attended one 60-min individually tailored counseling session based on medical conditions identified in their medical record and their baseline assessment. This session included guided goal setting to gradually increase moderate-intensity physical activity to at least 150 min/week. Subsequently, they received 14 expert system-tailored mailings weekly during month 1, bi-weekly for months 2 and 3, monthly for months 4 through 6, and then bi-monthly for or the	NR	AC: Mailed 14 wellness newsletters

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				final 6 months of the study. Participants complete a physical activity questionnaire during months 1-6 and bimonthly during months 7-12 and then individualized feedback reports were mailed along with self-help booklets matched to the participant's stage of motivational readiness and newsletters with suggestions for increasing physical activity.		
Gell, 2015[95]	IG1	PA Medium	Targeted text messages	Participants were sent 3 text messages per week to their personal cell phone via SMS for 24 weeks. While messages were not sent at a specific time each day, the majority of messages were sent based on optimal time availability for physical activity planning such as early morning for time management of the day, in the hour prior to the lunch break which was standard across campus, and in the hour prior to the official close of university offices. All participants received the same content for messages and the same number of messages. Content of the messages included the following: 1) Recommended amounts of physical activity needed to meet guidelines; 2) Specific suggestions for ways to meet the guidelines; 3) Self-regulation strategies such as goal setting, relapse prevention, engaging social support, self-monitoring, time management and reinforcement; and 4) Strategies to address the most common barriers identified from the baseline and mid-point self-efficacy instrument. Content was adjusted for weather conditions. In addition, all participants were provided with three maps displaying walking routes of 1, 2, and 3 miles from each subject’s worksite location and a fourth map provided an alternative 1-mile route or a parking option approximately 1-mile from the worksite. All participants were also provided a link to the intervention website which included physical activity guidelines, PDF versions of all the campus walking maps, and links and suggestions on ways to begin an exercise program and increase physical activity levels.	NR	MI: Tailored walking maps and educational website
Gill, 2019[151]	IG1	HD, PA, SB Medium	Individual counseling with tailored PA and HD prescriptions	In-person counseling over 12 months. During the first 6-month active phase, participants met with a trained HealtheSteps coach every other month. Sessions were conducted at the clinic sites and lasted 30-40 minutes. In-person coaching sessions were personalized to set participants' exercise (moderate to vigorous intensity), physical activity (steps/day) and healthy eating prescriptions and discuss strategies to achieve their goals. Sessions focused on setting S.M.A.R.T. (specific, measurable, attainable, realistic, and timely) goals. For the exercise prescription, participants completed a validated Step and Exercise Prescription (STEP) Test providing a personalized target heart rate to measure and assist participants meeting their personal recommendations for moderate to vigorous activity. Coaches also discussed strategies with participants on how to increase the amount of time that they spent exercising at their target heart rate (i.e., encouraging participants to slowly increase time spent during exercise at their target heart rate). For the physical activity prescription, participants used a pedometer to record their average daily step-count for 1 week (baseline). A paper chart was used to guide participants to incrementally increase their step-count to	5% attended 0 sessions, 17% attended 1 session, 10% attended 2 sessions, 20% attended 3 sessions, and 48% attended all 4 sessions. Of the 68% classified as completers (attended at least 2 of 4 sessions): 30% attended 3 in-person sessions and the remaining	MI: Provided publicly available resources related to healthy lifestyles

Appendix E Table 2. Intervention Details for All Studies, by Author

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				10,000 steps per day. For aiding in further reducing sedentary behavior, participants were instructed to reduce their sitting time in addition to increasing their step count daily. Lastly, participants were asked about their diet from the previous week in order to determine their baseline eating habits. From this, a heathy eating prescription was planned so that the participant would increase (or decrease) their intake of fruits and vegetables, fats, carbohydrates, and protein until they met the recommendations set out by Health Canada through "Eating Well with Canada's Food Guide." Participants had access to eHealth technology tools and resources including: 1) phone coaching through a third-party organization trained in the HealtheSteps™ protocol, 2) online HealtheSteps™ social network to connect with other participants and their coach, 3) HealtheSteps™ smartphone app with a virtual coach and step counter, 4) HealtheSteps™ website (healthesteps.ca). All participants (IG and CG groups) were provided with copies of "Eating Well with Canada's Food Guide" and the "Canadian Physical Activity Guidelines for Adults". During the minimally supported phase 1 (months 7-12) and 2 (months 13-18) the in-person coaching was removed, but participants continued to have access to the eHealth tools and resources. No set protocol for using the tools was provided; participants were encouraged to use the supports as needed.	70% attended all 4 sessions.	
Goldstein, 1999[96]	IG1	PA Low	Brief counseling with tailored prescription	One 5-min patient-centered counselling session with PCP based on Stages of Change with stage-matched written exercise prescription and patient manual plus one 5-min follow up visit for additional physical activity counseling and a new exercise prescription. Also received 5 monthly mailings including another copy of the manual, and 4 newsletters providing information on specific exercise activities appropriate for older adults, local resources, quizzes, and tips.	93% reported receiving PA counseling at initial visit, 67% recalled receiving exercise prescription	UC: Not described
Gomez Quinonez, 2016[59]	IG1	PA Low	Tailored feedback via text messages (mHealth)	mHealth intervention (SmartMobile) to be used with a mobile phone consisting of tailored feedback via 9 e-mail text messages. Messages were sent over 3 rounds with 3 messages sent per week. The main goal was to stimulate participants' awareness, ability factors (i.e., action plans and goal action), and self-efficacy to engage in more physical activity. Feedback was provided merely by means of text, without any additional visual content (in both the eHealth and mHealth versions). Based on the baseline questionnaire, participants received 3 feedback messages regarding their PA level, their intention to engage in PA, and on planning precisely when, where, and in what type of PA participants planned to engage in the following week. After a second questionnaire, participants received 3 more tailored messages focused on comparing their current PA level to their baseline level, on their sedentary behavior, and their self-efficacy regarding to overcoming situations in which it was difficult to be physically active. During the third round, another survey was filled out and then 3 more messages focused on encouraging participants to act on their plans.	NR	None

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Gomez Quinonez, 2016[59]	IG2	PA Low	Tailored feedback via email (eHealth)	eHealth intervention (SmartMobile) to be used on the computer consisting of tailored feedback via 9 e-mail messages. Messages were sent over 3 rounds with 3 messages sent per week. The main goal was to stimulate participants' awareness, ability factors (i.e., action plans and goal action), and self-efficacy to engage in more physical activity. Feedback was provided merely by means of text, without any additional visual content (in both the eHealth and mHealth versions). Based on the baseline questionnaire, participants received 3 feedback messages regarding their PA level, their intention to engage in PA, and on planning precisely when, where, and in what type of PA participants planned to engage in the following week. After a second questionnaire, participants received 3 more tailored messages focused on comparing their current PA level to their baseline level, on their sedentary behavior, and their self-efficacy regarding overcoming situations in which it was difficult to be physically active. During the third round, another survey was filled out and then 3 more messages focused on encouraging participants to act on their plans.	NR	None
Grandes, 2009[97]	IG1	PA Low	Brief counseling	One brief (assumed <15 min) counseling session with PCP using web-based software primarily discussing the benefits of physical activity and risks of inactivity, including a 4-page nontailored brochure. Patients then offered an optional 15 min followup session to develop a 3-month prescription-based action plan.	69.6% received advice only, 30.4% received advice + prescription	UC: Not described
Green, 2002[98]	IG1	PA Medium	Telephone counseling	One nontailored letter from PCP encouraging physical activity including reading materials on fitness and a workbook containing self-help materials on how to get 30 mins of moderate physical activity, setting targets, ways to overcome barriers, and measuring progress. Print materials were followed by three 20 to 30 min phone calls with behavioral specialists monthly for 3 months to assess current exercise status and motivational stage, to assist in making a reasonable and measurable goal, to identify and problem solve barriers, and to identify resources and support.	38% received the intervention, of those, 77% received all three self-management support calls, 15% received two calls, 5% received one call, and 3% received no calls	MI: One-time delivery of print materials on improving overall health and preventive practices including PA
Greene, 2008[99]	IG1	HD Medium	Tailored print mailings and telephone counseling	Monthly print or telephone contact over 12 months focused on increasing fruit and vegetable intake including a tailored manual; nine monthly mailings of stage-specific tailored newsletters; three computer-based expert system generated tailored reports; and three 15-min coaching calls from trained counselors to reinforce the expert systems reports, including motivational interviewing.	NR	AC: Falls prevention manual or PA intervention
Guagliano, 2020[157]	IG1	PA High	Web-based goal setting and tailored feedback	Participants received a goal-setting and self-monitoring intervention (theory-based), delivered online, and aimed at increasing physical activity in whole families. Each family participated in a one-hour kickoff meeting with a facilitator. The facilitator introduced families to the intervention components, accompanying materials (e.g., family action planner) and distributed pedometers. Families also received their first of four pieces of generic PA/ walking information. The main	86% of families uploaded steps >6 times in first 3 months (M±SD=11±4 uploads)	None

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				goals of this meeting was to familiarize families with the intervention website and their pedometers and to prompt weekly ‘family time’ meetings in which they completed their action planners and selected a new challenge city to ‘walk to’ on the FRESH (Families Reporting Every Step to Health) intervention website. Designated ‘index children’ (aged 7-11 years) were allocated as their family’s ‘team captain’ leading in challenge selection and uploading steps on the FRESH website. Family action planners prompted families to plan weekly family physical activities to assist in meeting their step challenge for a given week. It was intended that families would plan activities they would do together as a family; however, participants had the flexibility to also set individual level goals. The action planners also prompted families to monitor weekly step counts, discuss any potential upcoming barriers for physical activity and strategies to overcome them. Families also received a followup phone call a week after the kickoff meeting to discuss any issues or ask clarifying questions.	Families selected an average of 11 challenges and completed 9 of those. Google Analytics data indicated that 59 users accessed the website (~ 4 users/family) with a median (IQR) of 2 (1–5) sessions/user, viewing about 5 (2–11) pages/session, for about 7 (3–12) minutes/session.	
	IG2	PA Low	Pedometer only	Families were mailed their pedometers and generic family physical activity promotion information produced by Walk4Life, a sub-brand of Change4Life (www.nhs.uk/change4life). Information continued to be emailed to families every two weeks on four occasions. The information provided families with tips to get walking daily and games that can be played by walking.	NR	None
Halbert, 2000[100]	IG1	PA Medium	Counseling	One session with exercise physiologist discussing the benefit of PA, individualized advice, and a pamphlet containing a PA plan for next 3 months. The focus was on incorporating physical activity into the individuals’ usual activities and on increasing self-efficacy. Spouses were invited to attend initial session. Individualized advice was also given at 3- and 6-month in-person follow-up visits to discuss progress.	NR	AC: Visit with exercise physiologist discussing nutrition pamphlet
Halperin, 2019[68]	IG1	HD, PA High	Peer counseling	Participants assigned to the experimental condition were invited to participate in 10 weekly peer support groups, which focused on identifying and promoting dietary and other lifestyle changes, including encouragement of physical activity, as well as techniques to reduce stress and increase mindfulness. Two support groups were formed (each containing 9 members). The weekly sessions were 75 minutes long and were held in an activity room at the college. To address dietary behavior, sessions focused on a key theme each week: consumption of sweetened beverages; snacks; fast foods; carbohydrates; stress-related eating; whole grains/fiber; cravings and hunger cues/portion sizes; good and bad fats; and strategies for maintaining behavioral change. There was also ongoing discussion regarding practical strategies for increasing levels of physical activity: for example, developing the habit of parking one’s car a few blocks from destinations, as well as using stairs instead of the elevator.	NR	UC: Provision of basic educational resource materials on diet and physical activity

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Hargreaves, 2016[101]	IG1	PA Medium	Tailored walking program	The intervention consisted of 2 components: (1) an individualized pedometer-based walking program with weekly step goals, and (2) a website where individuals entered their step counts, received goal feedback, their next weekly goal (from the walking program) and tailored motivational feedback, and created a physical activity plan. At one face-to-face session, the intervention components were discussed with each participant and the participant left with an information sheet summarizing the discussion. The walking program was structured around each participant's baseline step counts and designed so that physical activity increased gradually. By the seventh week, participants had the goal of walking an extra 3,000 steps per day over their baseline and meeting the physical activity guidelines. In addition, participants were sent an email at the end of each week prompting them to log-in to the website and enter their weekly step counts (read from the pedometer memory). The website algorithm calculated whether or not they had achieved their weekly step goal and generated a motivational message relating to whether they had been successful or unsuccessful in achieving their goal. Finally, participants were prompted to use the activity diary feature to write an action plan for how they would achieve their step goals and a coping plan to overcome any barriers they might face in trying to achieve that plan.	82% logged into the website weekly	MI: Pedometer, plus information on PA guidelines, access to a non-interactive PA website, and weekly e-mails about PA and encouragement to visit the website
Harland, 1999[102]	IG1	PA Medium	Counseling and PA vouchers	One initial brief session where participants received their baseline test results, brief advice comparing their test results with recommended levels, and print materials on the benefits of physical activity, recommended activity levels, and 19 brochures on leisure facilities and activities available locally. Initial brief session was followed by six 40 min motivational interviews plus offered 30 PA vouchers valid during intervention period for use at local authority leisure center, swimming pool, or other voluntary or leisure center.	82% attended at least 1 motivational interview (median, 3 of 6), across all intervention groups	MI: Brief information and advice on benefits of PA
Harland, 1999[102]	IG2	PA Medium	Counseling	One initial brief session where participants received their baseline test results, brief advice comparing their test results with recommended levels, and print materials on the benefits of physical activity, recommended activity levels, and 19 brochures on leisure facilities and activities available locally. Initial brief session was followed by six 40 min motivational interviews.	82% attended at least 1 motivational interview (median, 3 of 6), across all intervention groups	MI: Brief information and advice on benefits of PA
Harland, 1999[102]	IG3	PA Medium	Brief counseling and PA vouchers	One initial brief session where participants received their baseline test results, brief advice comparing their test results with recommended levels, and print materials on the benefits of physical activity, recommended activity levels, and 19 brochures on leisure facilities and activities available locally. Initial brief session was followed by one 40-min in-person motivational interview within 2 weeks to promote safe and effective physical activity plus offered 30 PA vouchers valid during intervention period for use at local authority leisure center, swimming pool, or other voluntary or leisure center.	82% attended at least 1 motivational interview (median, 3 of 6), across all intervention groups	MI: Brief information and advice on benefits of PA
Harland, 1999[102]	IG4	PA Medium	Brief counseling	One initial brief session where participants received their baseline test results, brief advice comparing their test results with recommended levels, and print materials on the benefits of physical activity, recommended activity levels, and 19	82% attended at least 1 motivational interview (median,	MI: Brief information

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				brochures on leisure facilities and activities available locally. Initial brief session was followed by one 40-min in-person motivational interview within 2 weeks to promote safe and effective physical activity.	3 of 6), across all intervention groups	and advice on benefits of PA
Harris, 2015[103]	IG1	PA Medium	Counseling and self-monitoring	One 45-minute initial PA consultation session with a nurse focused on individual walking/PA plan to encourage adding in both steps and time spent walking in moderate intensity PA in bouts of at least 10 minutes, followed by three 30-minute sessions occurring at weeks 3, 7, and 11 with a nurse focused on feedback from pedometer and activity logs and accelerometer data. In addition, participants wore pedometers and kept activity logs for the entire intervention period of 12 weeks, participants also wore an accelerometer for 7 days before each follow up session to monitor progress and aid in feedback by relating specific PA log activities to accelerometer recorded PA intensities. Participants wore an accelerometer for 7 days and completed a questionnaire at 12 months to assess maintenance of PA levels achieved at 3 months.	86% attended all four nurse-led sessions; accelerometer was worn 98% of the requested time before sessions occurred	UC: Provision of basic educational resource materials on diet and physical activity
Harris, 2018[50]	IG1	PA Medium	Pedometer-based walking intervention with nurse support	Key intervention components were as follows: pedometers; patient handbook; PA diary (including individual 12-wk walking plan); and three individually tailored practice nurse PA (10- to 20-min) consultations (nurse-support group only) were offered at approximately weeks 1, 5, and 9. The interventions incorporated behavior change techniques (BCTs) and included individualized step-count, PA goals, and the “3,000-in-30” PA intensity message. The handbook and diary are available on the Pedometer and Consultation Evaluation (PACE-UP) website www.paceup.sgul.ac.uk/materials and both explain that adding 3,000 steps/d (approximating a 30-min walk) on five or more days weekly to an individual’s baseline step-count, progressing over 12 weeks, would help achieve PA guidelines. BCTs, including goals and planning, self-monitoring and feedback, and encouraging social support, were included in the handbook, diary, and nurse consultations. Participants in both postal and nurse intervention groups were encouraged to continue using the pedometer to monitor their walking and step-count beyond the 3-mo intervention period if they found this helpful. Three dedicated PA consultations (week 1, week 5 and week 9) were arranged with the practice nurse, to individually tailor and support the 12-week pedometer-based walking program. At their first appointment, participants were given the same pedometer, diary, and handbook that the postal group received. Participants were asked to wear a pedometer and keep a diary record of daily steps for 4 weeks between appointments, in order to review targets and goals at their next appointment. Participants were seen individually or as a couple.	74% of the nurse-support group attended all three sessions and 81% sent back PA diaries completed with their pedometer step-counts after the intervention	WL: Waitlist
Harris, 2018[50]	IG2	PA Low	Pedometer-based walking intervention	Key intervention components were as follows: pedometers; patient handbook and PA diary (including individual 12-wk walking plan). The intervention incorporated behaviour change techniques (BCTs) and included individualized step-count, PA goals, and the “3,000-in-30” PA intensity message. The handbook and diary are available on the Pedometer and Consultation Evaluation (PACE-UP) website	79% of the postal group sent back PA diaries completed with their pedometer step-	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				www.paceup.sgul.ac.uk/materials and both explain that adding 3,000 steps/d (approximating a 30-min walk) on five or more days weekly to an individual's baseline step-count, progressing over 12 weeks, would help achieve PA guidelines. BCTs, including goals and planning, self-monitoring and feedback, and encouraging social support, were included in the handbook and diary. Participants in both postal and nurse intervention groups were encouraged to continue using the pedometer to monitor their walking and step-count beyond the 3-mo intervention period if they found this helpful. At the end of the 12-month follow-up period, the postal group were offered a single practice nurse PA appointment, if they wanted it.	counts after the intervention	
Herghelegiu, 2017[54]	IG1	HD, PA, SB Medium	Individual counseling	Participants met with a geriatrician after completing a health risk assessment (HRA) to discuss their current physical activity levels, fruit and vegetable consumption and othe preventive care. The initial counselling session with the geristrician lasted approximately 30 minutes. Health counselling started with recommendations related to physical activity, followed by nutrition counseliing (focused on consuming 5 portion of fruti and vegetables a day), and advice on additional topics, such as preventive care. The counselor and participant agreed on an action plan with realistic, goal-oriented recommendations guided by the HRA. Monthly followup visits occurred for 6 months, with each visit lasting between 15-30 minutes.	Average number of counseling sessions: 5.4	None
Hivert, 2007[104]	IG1	HD, PA High	Group counseling	Twenty-three 45-min small-group interactive seminars over 2 years for undergraduate students aimed to educate and introduce behavioral modification methods to prevent weight gain. Seminars offered every 2 weeks for the first 2 months of the academic calendar and every month thereafter for the remaining 2 years. The first three seminars aimed at increasing knowledge about weight gain and its complications, national dietary recommendations, exercise categories, and expected benefits and recommendations for the maintenance of health. Remaining seminars were designed to introduce behavioral modification methods such as problem-solving, goal setting and monitoring. Role models were introduced to promote a positive image of a healthy lifestyle.	53% attended more >60% of seminars during the first year and 26% attended more than >60% in the second year	None
Horton, 2018[48]	IG1	HD High	Home visits and print communicati on	Delivery of the Entre Familia intervention consisted of 11 home visits and four telephone calls made over a 4-month period. For the first 2 months, promotora contact consisted of an initial introductory telephone call and then weekly home visits with the family. Contact was then modified to weekly contact, alternating between home visits and telephone calls during the third month. This was further tapered to one home visit and one telephone call on alternating weeks during the fourth month. The intervention schedule was designed to ensure the family took ownership of the knowledge and skills acquired over time and to minimize dependence on the promotoras for continued accountability. Each home visit lasted 1.5 to 2 hours and telephone calls were approximately 15–30 minutes in length. The home visits were structured along a sequence of activities including	A majority of the families (97%) assigned to the intervention received the intervention, with an average dose of 16.5 hours.	WL: Waitlist

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				watching the DVD episode with the promotora, followed by a family discussion of the key themes of the episode, a family goal-setting activity, and a fun family activity designed to teach a behavior related to the goal. Telephone calls followed a different format with the promotora checking in with the mother to determine her family's progress with completing their goals and homework assignments. Visits were scheduled to maximize the involvement of all family members (e.g., after school/work). Once all 15 contacts were completed, families received a certificate of completion and were congratulated on their dedication and effort.		
Jacobs, 2011[105]	IG1	HD, PA High	Counseling	Initial telephone session with a health psychologist to individually tailor each participants intervention and determine delivery mode (email, telephone, or face to face). Additional access to a tailored website and one-on-one coaching was available. The intervention intensity varied, and the delivery mode of coaching was self-selected by the participants to allow for a combination of different target behaviors and delivery modes. Counseling sessions were mainly delivered via email (100%) or by telephone (97%), and less face-to-face (10%) with a mean time for 22 minutes for diet sessions and 37 minutes for PA coaching sessions. Intensity varied by dose groups; low (<5 hours, mean 227.81 mins), medium (5-7 hours, mean 343.74 mins), and high (>7 hours, mean 727.03 minutes).	Intervention was self-selected: half of participants chose no or low dose. Low-dose (mean of 227.8 min), medium-dose (mean of 343.7 min), and high-dose (mean of 727.0 min) of intervention; weighted mean intensity was 380.6 min. Participants selected to be coached by e-mail (100%), telephone (97%), and/or face-to-face (10%). The mean number of sessions to promote physical activity was 15.5 sessions and for dietary behavior was 13.7 sessions. The mean session length to promote physical activity was 37 min and for dietary behavior was 22 min.	UC: Provision of basic educational resource materials on diet and physical activity

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
James, 2017[63]	IG1	PA Medium	Individual counseling	Participants attended one 60-minute initial consultation and four 30-minute follow-up appointments with an accredited exercise physiologist (AEP). The initial consultation comprised an assessment of the participant's ability to safely undertake PA, and the application of behavior change strategies to enhance participation in PA. At follow-up visits, progress against goals was assessed, new goals set, and any challenges discussed using the same collaborative problem-solving approach. All consultations followed a patient-centered counseling model with tailoring to the participant's PA preferences; capability; medical limitations (if present); and personal social cognitive factors, including barriers	8% did not attend any sessions. Of those that did, 76% attended all five sessions and 84% attended ≥4 sessions. Mean number of contacts=4, mean contact=133 min, mean duration=54 days.	UC: UC from their PCP and were mailed a generic health promotion brochure promoting PA and outlining the National Physical Activity Guidelines for Australians
James, 2017[63]	IG2	PA Medium	Individual and telephone counseling	Participants attended one face-to-face consultation (60 minutes) with an AEP and participated in four telephone counseling sessions with the same AEP over the 13-week intervention period. The telephone calls were expected to take 30 minutes. The aims and content of the initial and subsequent consultations were the same as for Group 1.	8% did not attend any sessions. Of those that did, 76% attended all five sessions and 84% attended ≥4 sessions. Mean number of contacts=4, mean contact=133 min, mean duration=54 days.	UC: UC from their PCP and were mailed a generic health promotion brochure promoting PA and outlining the National Physical Activity Guidelines for Australians
Jeffery, 1999[106]	IG1	HD, PA Low	Nontailored print mailings	The intervention delivered educational messages in 36 monthly newsletters, 2 to 4 pages in length, that encouraged paying attention to weight and making small changes in diet and exercise habits. Education messages emphasized 5 major themes: (1) weighing oneself regularly (at least once a week); (2) eating more fruit (2 servings per day), (3) eating more vegetables (3 servings per day); (4) reducing consumption of high-fat foods, and (5) increasing exercise, with a particular emphasis on walking. Reduction in energy intake was not specifically recommended. The educational messages also included practical guides for behavior (e.g., recipes and locations in the community for walking or other types of physical activity). Once every 6 months, intervention participants were offered the opportunity to participate in additional low-cost intervention activities. Activities offered during the 3 years of the study included the following: (1) 4-session weight control classes staffed by nutritionists at local health departments, (2) educational seminars on physical activity, (3) aerobics dance, (4) a free membership for 1	80% read most or all newsletters, 25% participated in ≥ 1 of the extra activities that were offered, across all intervention groups	None

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				month to a community exercise facility, (5) a walking group, (6) a mail-based weight loss course, and (7) a home-based walking competition.		
Jeffery, 1999[106]	IG2	HD, PA Low	Nontailored print mailings plus incentives	The intervention delivered educational messages in 36 monthly newsletters, 2 to 4 pages in length, that encouraged paying attention to weight and making small changes in diet and exercise habits. Education messages emphasized 5 major themes: (1) weighing oneself regularly (at least once a week); (2) eating more fruit (2 servings per day), (3) eating more vegetables (3 servings per day); (4) reducing consumption of high-fat foods, and (5) increasing exercise, with a particular emphasis on walking. Reduction in energy intake was not specifically recommended. The educational messages also included practical guides for behavior (e.g., recipes and locations in the community for walking or other types of physical activity). Once every 6 months, intervention participants were offered the opportunity to participate in additional low-cost intervention activities. Activities offered during the 3 years of the study included the following: (1) 4-session weight control classes staffed by nutritionists at local health departments, (2) educational seminars on physical activity, (3) aerobics dance, (4) a free membership for 1 month to a community exercise facility, (5) a walking group, (6) a mail-based weight loss course, and (7) a home-based walking competition. In addition to mailed newsletters, participants were asked to return monthly postcards monitoring behavior, and these were used for a $100 lottery drawing each month. The intent of the incentive lottery was to encourage participants to open and read their newsletters and thus to learn more about weight gain prevention.	80% read most or all newsletters, 25% participated in ≥ 1 of the extra activities that were offered, across all intervention groups	None
Jenkins, 2017[52]	IG1	HD Medium	Telephone counseling	Participants were given a copy of Health Canada's Food Guide and received dietary advice weekly for the first month and then monthly for the following 5 months as a 20-30-minute telephone calls. For family units participating, the interview was conducted with the families' primary food shopper or cook. The advice addressed benefits, strategies for change, and barrier to change for each participating family member. Participants were encouraged to increase consumption of fruit, vegetables, whole grain cereals, to reduce meat and sweets, and to increase consumption of cholesterol-lowering functional foods including soy foods, nuts, and viscous fiber sources such as oats and barley. Exercise patterns were recorded, but no additional advice about PA was given.	NR	MI: Received a Health Canada Food Guide
John, 2002[107]	IG1	HD Medium	Counseling	A 25-minute dietary intervention with research nurse presenting the benefits of eating more fruit and vegetables with a pictorial portion guide; eliciting meal and snack patterns with an eating pattern assessment questionnaire (EPAQ) to show where increases in consumption might be made; using the brief negotiation method to encourage participants to identify specific and practical ways that were consistent with their habits and preferences of eating more fruit and vegetables; and discussing possible barriers to eating more fruit and vegetables. Two weeks after the initial intervention, a research nurse telephoned participants to reinforce the message and discuss any problems. At 3 months, a letter was sent reinforcing	96.4% completed the initial session	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				the five-a-day message, together with a booklet of seasonal recipes, and a strategy check list suggesting various ways of incorporating additional portions of fruit and vegetables into the diet. As needed, participants received prepared leaflets that addressed these difficulties. Participants also received a copy of their action plan, a magnet with the 5-a-day logo, a portion guide, and a 2-week self-monitoring record book.		
Kallings, 2009[108]	IG1	PA Medium	Counseling with tailored prescription	One 30-min individualized patient-centered counseling session based on individual readiness to change and the 5A's and written prescription of physical activity. Participants were provided pedometers, encouraged to keep a PA log for at least 3 months, written materials on PA and health, and booklet with ideas for everyday activities. Within one month of initial session one 60-minute group session was offered, an individualized letter with advice from PCP on increasing PA, and short follow up 3-5 min telephone call. One 30 minutes individualized patient-centered counseling session and written PA prescription delivered at the 6 month follow up.	NR (65% adhered to the physical activity prescription)	UC: UC and one-time written information about importance of PA for health
Kattelmann, 2014[109]	IG1	HD, PA Medium	Web-based intervention	The first 10 weeks of the intervention consisted of 3 stages-of-change tailored e-mails with motivational messages. One of the 3 e-mails each week encouraged participants to visit a tailored website to view a "mini" educational session. Within the website, participants were asked to set goals for 1-3 targeted behaviors (eating behavior, physical activity, stress management); within their personal Web portal, participants could see their progress toward their goal. From weeks 10 to 64 (15 months), the frequency of e-mails was reduced to 4 times per month. The website remained active, but no new lessons were added.	NR	WL: Waitlist
Katz, 2008[110]	IG1	PA High	Provider training	Physicians were trained on the Pressure System Model (PSM), covering a decision algorithm, motivational interviewing, decisional balance, strategies for overcoming barriers, and role play. Physicians participated in 5 interactive group sessions lasting 1.5 hours over 5-6 months led by PA and preventive medicine specialist, with mock patient encounters. Providers applied the PSM during existing patient appointments focused on overcoming barriers to PA with varied patient session frequency.	NR	UC: Providers received their usual residency curriculum
Kegler, 2016[57]	IG1	HD, PA Medium	In-person tailored home environment coaching with nutrition and PA focus	Three in-person home visits and 4 coaching calls over 16 weeks. The intervention was based on social-cognitive theory. At each coaching contact, coaches reviewed a tailored home environment profile, goal setting, and behavioral contracting for 6 healthy actions with participants. Baseline data was used to generate a tailored home environment profile showing areas in need of improvement and positive aspects of the home environment. Coaches used the home environment profile to guide participants in choosing from 12 healthy actions (half were nutrition-focused, and half were physical activity-focused). Examples of nutrition-focused healthy actions included always having a low-calorie beverage available instead of sugar-sweetened soda or sweet tea, identifying 1 unhealthy drink and not allowing it in the house, and purchasing	74.4% received the entire intervention, 12.2% had <4 contacts with a coach	AC: Mailed 3 packets of educational booklets encouraging adoption of US dietary and PA guidelines at 6-week intervals

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				fresh fruits and vegetables at least once a week and making them easy to see and grab. On the basis of the healthy actions chosen, participants received supporting materials via mail (e.g., portion size plate).		
Kerr, 2016[111]	IG1	HD Low	Tailored text messages	Participants recorded their food intake for four consecutive days, including taking pictures of their meals, using an app on their mobile device. After an analysis of their food intake, they received two tailored dietary feedback text messages one week apart. One text message focused on fruits and vegetables and the other text message focused on energy dense nutrient poor foods and beverages. Participants also received 32 text messages once or twice weekly for 24 weeks including motivational and informational messages focused on fruits, vegetables, and junk foods and beverages. The messages used an autonomous supportive style of communication using principles of motivational interviewing. Messages also included web links to recipes and nutrition information. Message were delivered between 4:00 and 6:00 pm on different days of the week. Participants were able to stop receiving text messages at any point by replying “stop.”	NR	None
Kerr, 2016[111]	IG2	HD Low	Text messages	Participants recorded their food intake for four consecutive days, including taking pictures of their meals, using an app on their mobile device. After an analysis of their food intake, they received two tailored dietary feedback text messages one week apart. One text message focused on fruits and vegetables and the other text message focused on energy dense nutrient poor foods and beverages.	NR	None
King, 2007[113]	IG1	PA Medium	Automated telephone counseling	Initial in person 30-40-minute health educator led session, including individualized plan development focused on gradually increasing frequency, duration, and intensity of PA towards a goal of ≥30 minutes moderate intensity PA on most days of the week. Followed by brief individualized structured phone calls delivered by automate telephone-linked counseling (TLC) system occurring biweekly and monthly with each participant receiving 15 total calls over one year focused on support and problem-solving around barriers to PA based on participant’s ongoing reports of PA levels, goals, and problem areas. Phone calls were supplemented with mailings and pedometer and PA log to track activity and allow feedback provided to participants.	11.8 (out of 15 planned) average calls completed; average call length was 6.6 minutes	AC: Offered 50 weekly health education classes focused on non-PA topics and not asked to change their usual PA patterns
King, 2007[113]	IG2	PA Medium	Telephone counseling	Initial in person 30-40-minute health educator led session, including individualized plan development focused on gradually increasing frequency, duration, and intensity of PA towards a goal of ≥30 minutes moderate intensity PA on most days of the week. Followed by brief individualized structured phone calls delivered by health educator occurring biweekly and monthly with each participant receiving 15 total calls over one year focused on support and problem-solving around barriers to PA based on participant’s ongoing reports of PA levels, goals, and problem areas. Phone calls were supplemented with mailings and pedometer and PA log to track activity and allow feedback provided to participants.	13.1 (out of 15 planned) average calls completed; average call length was 10.7 minutes	AC: Offered 50 weekly health education classes focused on non-PA topics and not asked to change

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
						their usual PA patterns
King, 2013[112]	IG1	HD, PA Medium	Telephone counseling with self-monitoring (PA and diet simultaneous)	One individual in-person introductory session followed by 15 30-40-minute phone counseling sessions over 12 months. PA and diet were addressed simultaneously with half of each call covering each topic. PA goal was to meet national guidelines of ≥150 minutes/week of MVPA, diet goals were to reduce saturated fat intake and increase fruit and vegetable servings to 9 per day. PA component included mailings and pedometer where participants recorded PA and reported it to their advisor during calls. Diet component included recording of dietary intake and reporting back during calls; participants given homework and reading materials such as recipes. Intervention focused on facilitating mastery through self-regulatory skill building (social support, realistic expectations, cognitive and behavioral processes of change, problem solving).	11.6 (out of 15 planned) average calls completed	AC: Fifteen 30-40-minute telephone counseling calls focused on stress management
King, 2013[112]	IG2	HD, PA High	Telephone counseling with self-monitoring (diet discussions first)	One individual in-person introductory session followed by 21 phone counseling sessions over 12 months. Counseling topics were introduced sequentially, beginning with diet for the first 4 months (6 15-20-minute calls). Both diet and PA were addressed in the remaining 8 months in longer counselling calls (9 30-40-minute calls) with 6 15-20-minute booster calls focused on PA to ensure equivalent exposure to each behavior target. PA goal was to meet national guidelines of ≥150 minutes/week of MVPA, diet goals were to reduce saturated fat intake and increase fruit and vegetable servings to 9 per day. PA component included mailings and pedometer where participants recorded PA and reported it to their advisor during calls. Diet component included recording of dietary intake and reporting back during calls; participants given homework and reading materials such as recipes. Intervention focused on facilitating mastery through self-regulatory skill building (social support, realistic expectations, cognitive and behavioral processes of change, problem solving).	15.5 (out of 21 planned) average calls completed	AC: Fifteen 30-40-minute telephone counseling calls focused on stress management
King, 2013[112]	IG3	HD, PA High	Telephone counseling with self-monitoring (PA discussions first)	One individual in-person introductory session followed by 21 phone counseling sessions over 12 months. Counseling topics were introduced sequentially, beginning with PA for the first 4 months (6 15-20-minute calls). Both PA and diet were addressed in the remaining 8 months in longer counselling calls (9 30-40-minute calls) with 6 15-20-minute booster calls focused on diet to ensure equivalent exposure to each behavior target. PA goal was to meet national guidelines of ≥150 minutes/week of MVPA, diet goals were to reduce saturated fat intake and increase fruit and vegetable servings to 9 per day. PA component included mailings and pedometer where participants recorded PA and reported it to their advisor during calls. Diet component included recording of dietary intake and reporting back during calls; participants given homework and reading materials such as recipes. Intervention focused on facilitating mastery through self-regulatory skill building (social support, realistic expectations, cognitive and behavioral processes of change, problem solving).	15.1 (out of 21 planned) average calls completed	AC: Fifteen 30-40-minute telephone counseling calls focused on stress management

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Kinmonth, 2008[114]	IG1	PA Medium	Telephone counseling	Initial counseling session in the home of the participant focused on increasing opportunities and reducing barriers to becoming more physically active using eight self-regulatory techniques for behavioral change, including goal setting, action-planning, self-monitoring, using rewards, goal-review, using prompts, building social supports, and prevention of relapses. Four 45-min telephone support calls and two 15-min support calls over 5-month intensive phase, followed by monthly mailings for 7 months.	88% completed all "core" counseling sessions	MI: Mailed 1 leaflet with brief motivational advice on benefits of PA
Kinmonth, 2008[114]	IG2	PA High	In-home, individual counseling	Initial counseling session in the home of the participant focused on increasing opportunities and reducing barriers to becoming more physically active using eight self-regulatory techniques for behavioral change, including goal setting, action-planning, self-monitoring, using rewards, goal-review, using prompts, building social supports, and prevention of relapses. Four 60 min home visits and two 15 min support calls over 5-month intensive phase, followed by monthly 30 minute follow-up phone calls for the remaining 7 months.	83% completed all "core" counseling sessions	MI: Mailed 1 leaflet with brief motivational advice on benefits of PA
Kolt, 2007[115]	IG1	PA Medium	Telephone counseling	Eight individualized telephone counseling sessions ranging 10-17 minutes over 12 weeks occurring weekly for first 4 weeks and then biweekly for the remaining 8 weeks. Phone calls followed a script based on the appropriate stage of change for each individual in relation to adoption of PA and drew on earlier calls and motivational interviewing techniques and set PA activity goals with an exercise counselor assess progress towards goals. In addition, supplementary mailings, including a walking log and pamphlets to support counseling were sent.	NR	None
Koniak-Griffin, 2015[46]	IG1	HD, PA High	Group education plus individual home visits and telephone calls	Mujeres Sanas y Precavidas (Healthy Women Prepared for Life) was comprised of group education plus Individual Teaching and Coaching. The first 2 months included 8 weekly classes based upon Your Heart, Your Life (Su Corazón, Su Vida), a culturally relevant, promotora-led educational program developed for Latino communities by the National Heart, Lung and Blood Institute (2008). The primary goal of this curriculum was to promote healthy lifestyle behaviors (diet and physical activity) for reduction of cardiovascular disease risk. During each 2-hour class, held in community settings, promotoras worked in pairs to deliver the standardized content from the intervention manual. Ten minutes of each class were devoted to instructor-led stretching and exercising presented in a DVD produced by the Los Angeles County Department of Public Health. Individual sessions were available to make up missed group classes. After completion of this component, participants received Individual Teaching and Coaching from their promotora, designed to reinforce class content, assist them achieve personal goals, support behavior change, and provide guidance on how to overcome barriers to lifestyle behavior change. The Individual Teaching and Coaching included 8 contacts (4 home visits plus 4 telephone calls) delivered over 4 months. Coaching guidelines and a binder of visual displays were created with involvement of the promotoras, The Lifestyle Behavior Intervention was implemented in Spanish as preferred by participants. Strategies emphasized	37.8% attended all classes, 82% attended at least half, and 71.2% attended at least three-fourths of the classes. 77.5% received all 4 home visits. Only 5.4% received none of the planned followup intervention. 27.9% received all components of the intervention.	AC: 6-month safety/disaster preparedness educational program delivered through 8 group classes and 8 individual counseling sessions

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				information on heart functioning, heart attack symptoms, heart-healthy eating for Latino families, physical activity, cholesterol, living smoke free, diabetes, and hypertension. Participants learned how to plan, choose, and prepare heart healthy diets for traditional Latino meals (e.g., fruits, vegetables, low-fat or fat-free milk and milk products, lean meats, poultry and fish) and about serving sizes. A variety of approaches were applied to motivate behavioral changes; e.g., videos, role play (skits), and supplementary low-literacy, culturally appropriate brochures published by the National Heart, Lung and Blood Institute were distributed. Participants established personal goals for lifestyle changes. Four key messages were emphasized: (1) healthy food choices, (2) portion control, (3) managing emotional eating, and (4) increasing physical activity, with the goal of walking 10,000 steps per day. To promote self-monitoring and physical activity, participants received an Accusplit Eagle pedometer and a copy of the exercise DVD used in class. Use of food and physical activity diaries was encouraged to enhance self-awareness of lifestyle behaviors. The diaries were discussed with promotoras during Individual Teaching and Coaching sessions rather than collected for program evaluation.		
Kristal, 2000[116]	IG1	HD Low	Tailored print mailings and telephone counseling	Computer-generated tailored self-help intervention had four components: (1) a package of self-help materials, sent within a week of randomization (including “Help-Yourself: A Smart and Simple Guide for Healthy Eating” manual with skills for implementing and maintaining dietary changes; decreasing fat and increasing fruits and vegetables; modifying specific meals to reduce fat/increase fruits and vegetables); (2) dietary analysis with behavioral feedback, available anytime participants returned a food frequency questionnaire, providing positive feedback on current food choices, quantitative goals to reach 30% energy from fat and 5 servings of fruits and vegetables per day, and food sources of fat and fruits and vegetables and recommendations for change; (3) one motivational phone call, completed within a month of randomization by a trained health educator; and (4) twice-a-month newsletters, sent until 1 year post-randomization to maintain salience of intervention messages; additional, seasonal information on food purchasing and preparation; enhance and reinforce motivation through use of “Personal Stories”. Computer programs generated instructions to mailing staff on where to place flags, write notes, and place highlights on intervention materials that were particularly relevant to each participant.	90.3% reported reading some to more than half of the print materials, 90.8% reported receiving FU counseling call	None
Larsen, 2020[156]	IG1	PA Medium	Counseling and 225 individually tailored print materials and text messages	The PA intervention was based on the Social Cognitive Theory and Transtheoretical Model and emphasized behavioral strategies for increasing PA (e.g., goal setting, self-monitoring, problem solving barriers, increasing social support). The baseline session was conducted by a PhD-level interventionist trained in motivational interviewing techniques. Participants set short-term goals, anticipated and problem-solved potential barriers, and were encouraged to gradually increase their activity to 150 minutes/week. Participants were given a	NR	AC: Received publications available Spanish-language print materials from the NHLBI on

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				pedometer and asked to track their number of steps. Participants also received recommendations for walking/jogging routes, gyms, parks, and other places to be active near their work or home. Remote participants received all information in the mail before their scheduled phone call and completed goal setting via telephone. Throughout the 6-month intervention, participants received tailored PA information in the mail weekly in Month 1, biweekly in Months 2 and 3, and monthly in Months 4−6. These mailings consisted of (1) manuals matched to the participant's current level of motivational readiness to change, based on the Transtheoretical Model; (2) individually tailored computerized expert system feedback reports based on the participant's answers to monthly questionnaires that compared participants' responses with their previous responses and with individuals who were physically active on self-efficacy for PA and cognitive and behavioral strategies associated with PA behavior change (processes of change); and (3) PA tip sheets addressing barriers to being active (such as work and family obligations). Participants also received 2 text messages weekly throughout the intervention: the first provided a useful or motivational tip, and the second prompted the participant to report their minutes of MVPA in the previous week. Participants also received regularly scheduled phone calls from a Spanish-speaking Latino interventionist during the initial 3 months of the study as follows: after 1 week (to ensure proper pedometer use and receipt of text messages), after 1 month (20- to 30-minute call to review progress and set new goals), and after 2 and 3 months (addressing text messaging engagement). The intervention was adapted by bilingual English/Spanish) and bicultural (Mexican American and Puerto Rican) study staff for Latino men from the team's existing PA interventions for Latina women through a formative research process.		the promotion of heart-healthy behaviors for Latinos through mail and text messages. Also received 2 text messages weekly throughout the study and received phone calls on the same schedule verifying receipt of text messages and answering any questions.
Lawton, 2008[117]	IG1	PA Medium	Counseling with tailored prescription	Brief, 7-13-minute, counseling session with primary care nurse using motivational interviewing techniques to increase physical activity. A Green Prescription was given to the participants with individualized exercise advice with the goal of achieving 30 minutes of moderate intensity exercise, such as brisk walking, 5 days a week, and sent to a community-based exercise facilitator who provided telephone counseling and support focused on activity choice, goal setting, and overcoming barriers to PA. An average of 5 calls lasting 15 minutes over 9 months as follow-up, and one additional 30-minute visit with the primary care nurse at 6 months occurred.	NR	UC: Not described
Lewis, 2013[118]	IG1	PA Low	Tailored print mailings	Eleven individually tailored PA print mailings plus stage-matched manuals, tip sheets, and PA logs. Mailings were weekly in month 1, bi-weekly in months 2 and 3, monthly in months 4 through 6. PA mailings were 3-pages and computer-tailored based on responses to monthly questionnaires about cognitive and behavioral processes, self-efficacy, and decisional balance. Mailings included motivational, educational, and normative feedback. 14-page stage-matched manual provided at the start of intervention and additional manuals given if	NR	AC: Mailed 11 health and wellness pamphlets or newsletters

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				participant moved to a different stage of change. Participants also provided 14 tip sheets covering various PA topics (e.g., rewarding yourself, exercising in bad weather) and PA logs.		
Lombard, 2016[62]	IG1	HD, PA Medium	One group session, personalized program manual, monthly text messages, and one telephone session	The intervention (HeLP-her) was based on the self-determination and cognitive behavioral theory, with motivational interviewing the primary method of interaction with participants. Behavioral strategies were informed by established practices. Participants attended one facilitator-led interactive small group session held in each town. The trained facilitator presented lifestyle information related to weight gain in the form of five simple health messages (e.g., try to eat two servings of fruit and five servings of vegetables per day; take a brisk walk for at least 30 min on most days of the week). Using the topics and activities in the program manual as a guide, participants identified personal health priorities and practiced skills in goal setting, problem solving, relapse prevention, and self-monitoring. Participants were assisted by the facilitator to generate goals and action plans based on their personal priorities. Each participant therefore developed a personalized weight gain prevention strategy. Participants were instructed to work through the manual over the next four weeks in their own time. Intervention participants received an SMS text message every 4 weeks to reinforce program messages. At 12 weeks, they participated in one 20-min phone coaching session, delivered by staff trained in motivational interviewing, which utilized client-orientated counselling to explore and resolve ambivalence and review progress.	74% received phone coaching	MI: One 45-min group education session on general women's health topics, including dietary advice
Lutz, 1999[119]	IG1	HD Low	Tailored print mailings with tailored prescription	Four monthly newsletters with tailored nutrition and tailored goal-setting information, based on the baseline survey (intake, eating behaviors, nutrition-related activities, psychosocial factors). Tailored messages determined from a computer algorithm were delivered based on baseline response. The newsletters also provided 3 tailored subgoals to achieve the goal of 5 a day, based on the baseline survey. Participants were given a specific goal of "increasing fruit and vegetable intake to 5 or more servings each day."	71% (across all 3 intervention groups) reported reading most or all 3 newsletters	None
Lutz, 1999[119]	IG2	HD Low	Tailored print mailings	Four monthly newsletters with tailored information and no goal-setting component, based on the baseline survey (intake, eating behaviors, nutrition-related activities, psychosocial factors). Tailored messages determined from a computer algorithm were delivered based on baseline response. Participants were given the vague goal of "eating more fruits and vegetables."	71% (across all 3 intervention groups) reported reading most or all 3 newsletters	None
Lutz, 1999[119]	IG3	HD Low	Nontailored print mailings	Four monthly traditional newsletters with nontailored nutrition information. Participants were given the vague goal of "eating more fruits and vegetables."	71% (across all 3 intervention groups) reported reading most or all 3 newsletters	None
Mailey, 2014[120]	IG1	PA Medium	Group counseling	The intervention consisted of two interactive 1.5-2-hour group-based sessions, spaced 3 weeks apart, which taught participants behavior modification strategies based on social cognitive principles. Participants in the ''intervention only'' and	NR	WL: Waitlist

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				‘‘intervention plus’’ groups were scheduled to attend separate sessions to avoid contamination between groups, but the content each group received was identical and results of each group were combined for analyses. The sessions were interactive and incorporated small and large group discussions and problem-solving activities. They also received a pedometer and an accompanying electronic log for tracking their daily steps to facilitate goal setting and self-monitoring. All participants received a 1-hour session with a personal trainer, who worked with them to devise an exercise program that could be completed at home. Each participant received a handbook containing information, worksheets, and resources that complemented the topics addressed during the workshop sessions. Participants assigned to the intervention plus followup support condition received monthly telephone support calls from a study investigator to monitor their progress following the structured intervention. These contacts were brief (3 to 8 min) and designed to provide support, feedback, and active problem-solving strategies which were individualized based on the individual’s current activity level and goal adherence. The phone calls were semi structured in that they focused on topics specified in an interview guide (e.g., barriers encountered or anticipated, pedometer use, goals for the following month) but were flexible to accommodate participants’ individual needs.		
Marcus, 2007[122]	IG1	PA Medium	Telephone counseling	Initial 45-minute session with health educator, then fourteen 13-minute telephone calls over 12 months with a counselor guided tailored message generated by an expert system report, stage-matched manual, and tip sheets focused on the goal of increasing moderate intensity physical activity to meet CDC/ACSM recommendation of ≥30 minutes of moderate activity five days a week. Phone calls occurred weekly for the first month, biweekly for months 2 and 3, monthly for months 4-7, and then bimonthly for months 8-12. Participants also completed a PA log and brief questionnaire each month.	90.5% of all scheduled calls were completed	AC: General health informational pamphlets via mail
Marcus, 2007[122]	IG2	PA Medium	Tailored print materials	Initial 45 min session with health educator, then fourteen individually tailored printed reports focused on increasing PA to meet CDC/ACSM recommendation of ≥30 minutes of moderate intensity exercise five days a week. Reports were based on feedback generated by a computer expert system along with manuals matched to participant’s stage of motivational readiness for PA adoption, and supplementary materials including stage-targeted booklets, and PA related sheets over 12 months. Mailings occurred weekly for the first month, biweekly for months 2 and 3, monthly for months 4-7, and then bimonthly for months 8-12. Participants completed a monthly PA log and brief questionnaire each month.	NR	AC: General health informational pamphlets via mail
Marcus, 2013[121]	IG1	PA Low	Tailored print mailings and self-monitoring	Fourteen culturally adapted, Spanish-language, individually tailored PA print mailings matched to motivational readiness based on monthly questionnaires and generated by a Computer Expert System. Mailings were weekly in month 1, bi-weekly in months 2 and 3, monthly in months 4 through 6, with booster mailings in months 8, 10, and 12. Intervention emphasized behavioral strategies for	86.4% reported reading most or all the print materials	AC: Mailed 14 Spanish-language pamphlets on wellness,

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				increasing activity levels, including: goal-setting, self-monitoring, problem-solving barriers, increasing social support, and rewarding oneself for meeting physical activity goals. Mailings included normative feedback and feedback on progress over time. Pedometers and PA logs provided to encourage self-monitoring. Cultural adaptation based on formative research that included modification of intervention based on PA barriers identified by Latinas in focus groups.		including heart-healthy behaviors (but not PA) developed by NHLBI
Marcus, 2016[61]	IG1	PA Low	Tailored internet intervention	Participants randomized to the Intervention Group received access to a study website including the following features: 1) self-monitoring of minutes of activity and steps; 2) goal setting with graphs to compare goals to recorded minutes; 3) message board to foster social support between participants; 4) "ask the expert" where participants could anonymously ask questions to a PhD level researcher; 5) online resources such as maps to create walking routes and free exercise videos. In addition, participants completed monthly questionnaires that generated automated tailored physical activity reports. These reports included information regarding: 1) current stage of motivational readiness for physical activity; 2) current self-efficacy; 3) cognitive and behavioral strategies associated with physical activity (processes of change); 4) how the participant compares to individuals who are physically active and meeting national guidelines of 150 min per week of MVPA (normative feedback); 5) how the participant compares to her prior responses (progress feedback-provided after the first month); and 6) useful facts about physical activity, such as health benefits, stretching, and heart rate monitoring. The reports draw from a bank of more than 300 messages addressing different levels of these psychosocial and environmental factors affecting physical activity. In addition, they received an online manual that was matched to their motivational readiness for physical activity. The manual emphasized strategies for increasing PA, such as goal setting, self-monitoring, problem-solving barriers, methods for increasing social support, and rewarding oneself for meeting physical activity goals. Staff also reviewed physical activity informational pages on the website with the participant at baseline. This includes several ways to determine if they were exercising at moderate intensity: target heart rate; rating of perceived exertion; mile pace (15–20 min mile); and reference to the 10-min treadmill walk participants completed. Participants also received information on exercising safely and how to report an injury to the study. Lastly, the website provided links to several online and community resources. The Intervention Group received email prompts to access the intervention website weekly during month 1, biweekly during months 2 and 3, and monthly during months 4–6, with new physical activity information tip sheets made available on this schedule.	Participants logged on to the website an average of 22 times (SD 28) over 12 months, with intervention participants logging on significantly more than controls (29 vs 14.7, p < .001)	AC: Access to Spanish language website with information on health topics other than physical activity (e.g., healthy diet, smoking cessation)
Marsaux, 2015[123]	IG1	HD, PA Low	Tailored web-based advice (diet, PA, and phenotype)	Web-based personalized advice was provided for weight, waist circumference, physical activity, dietary intake, and blood markers (phenotypic data). In addition, participants received feedback at 4, 8, and 12 weeks on how their intakes of specific food groups compared with guideline amounts, as well as tailored advice	NR	MI: Non-personalized dietary and

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				to increase or maintain physical activity based on current physical activity level and BMI and tips on how to be more physically active. Additional information about physical activity and tips was provided on participant's web account and hyperlinks were included in the tailored report and encouraged to visit website.		physical activity advice
Marsaux, 2015[123]	IG2	HD, PA Low	Tailored web-based advice (diet & PA only)	Web-based personalized advice was provided for weight, physical activity, and dietary intake (no phenotypic or genotypic data). In addition, participants received feedback at 4, 8, and 12 weeks on how their intakes of specific food groups compared with guideline amounts, as well as tailored advice to increase or maintain physical activity based on current physical activity level and BMI and tips on how to be more physically active. Additional information about physical activity and tips was provided on participant's web account and hyperlinks were included in the tailored report and encouraged to visit website.	NR	MI: Non-personalized dietary and physical activity advice
Marsaux, 2015[123]	IG3	HD, PA Low	Tailored web-based advice (diet, physical activity, phenotype, and genotype)	Web-based personalized advice was provided for weight, waist circumference, physical activity, dietary intake, and blood markers (phenotypic data) plus specific information provided about whether the participant carried the risk allele for the FTO (fat mass and obesity associated) gene (genotypic data). In addition, participants received feedback at 4, 8, and 12 weeks on how their intakes of specific food groups compared with guideline amounts, as well as tailored advice to increase or maintain physical activity based on current physical activity level and BMI and tips on how to be more physically active. Additional information about physical activity and tips was provided on participant's web account and hyperlinks were included in the tailored report and encouraged to visit website.	NR	MI: Non-personalized dietary and physical activity advice
Marshall, 2003[124]	IG1	PA Low	Tailored print mailing	One time mailing of a personally addressed letter tailored to individual's stage of change, and the corresponding Active Living booklet for the individual's current stage of change, plus any booklets aimed at the higher stages of change.	81.5% recalled receiving the print materials and of those, 87% reported reading the materials related to their stage of change	None
Martinson, 2008[125]	IG1	PA High	Counseling	One 60 minute in person group orientation session to meet activity coach and review goals and materials, including a course workbook, a PA log for recording activity, and a pedometer. The initial session was followed by seven 20-minute individualized course sessions twice a month delivered over the phone with assigned activity coach focused on current PA level, PA goals, and barriers to PA. Following completion of the 7-session course, participants received monthly follow-up calls for 8 months, and then bimonthly follow-up calls for the subsequent year. In addition, a lending library of PA books, videos, and DVDs were available, motivational contests, and 4 optional in person support sessions over 24 months were provided.	92% completed ≥1 (of 7) phone sessions and 39.8% completed all 7 sessions. The mean was 5.12 sessions.	MI: Information about the 10,000 steps PA program offered by the health plan, and 4 newsletters focused on general health

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
						and wellness over 2 years of the intervention
Maselli, 2017[53]	IG1	PA Medium	Individual counseling	Individuals in the individual counseling group (ICG) took part in an initial one-hour in-person group meeting, where they were invited to discuss the importance of PA, moreover they attended every second week individual video-call meetings (via Skype) and received two informative e-mails a week. The counselling intervention was highly personalized, tailored according to the stage of change of each participant and by taking into consideration his/her individual characteristics in order to meet his/her personal needs. Overall, the counselling intervention aimed at rising participants' awareness about the importance on being physically active, helping them forming the intention to exercise regularly, and providing them with basic knowledge and skills to being able to exercise autonomously. Online video-calls were used to deliver the intervention to facilitate participants' adherence. In the first sessions, the counsellor discussed with each participant about his/her previous experiences, beliefs, and expectations regarding exercise. The following sessions were tailored according to the educational needs emerged from the previous sessions or from the exercise-related experiences of the participants during the intervention period. Topics for discussion could therefore emerge from both the counsellor and the students. Informative e-mails were used to support the counselling sessions, providing participants with information about benefits of PA, the risks of a sedentary lifestyle, behavioral change techniques (e.g., goal-setting, planning, time management), and basic principles about how to perform different types of exercise (endurance exercise, strength exercise, stretching), that could be discussed with the tutor during the counselling sessions. ICG participants attended one counselling session every two weeks (seven sessions in total). Each session lasted from half hour up to a maximum of one hour, depending on the content of the session.	NR	No intervention: No treatment
Maselli, 2017[53]	IG2	PA Low	PA monitor	Participants in the physical activity monitors group received a wearable PA monitor (the MyWellness Key) and were instructed on how to use the device and the dedicated website. They were asked to wear the monitor for the entire 12-week experimental period. The device automatically sets a goal of moves to achieve every day, based on the measurement of the previous seven days. It also provides a direct feedback to the user showing the number of moves accumulated during the day on a white bar displayed on the device. When the bar reaches its full length, the daily PA goal is achieved. Data could be downloaded, and a user could look at his/her results on a personal web page, where it was possible to plan exercise and keep track of current and past PA.	NR	No231ntervention: No treatment
Metzgar, 2016[65]	IG1	HD High	Weight gain prevention	24 nutrition education sessions over the course of the 12-month intervention period. All sessions were one hour in length and emphasized portion control,	NR	None

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
			intervention delivered by registered dietician	planning ahead, and vegetable consumption. For the first 16 weeks of the intervention (months 1-4), participants attended weekly sessions; for the remaining 8 months of the study (months 5-12), participants attended monthly sessions. Weekly sessions focused on general nutrition education topics, including basic nutrition and food groups, food selection and preparation, recipe modification, nutrition snack choices and snacking and nutrient density. Monthly sessions addressed other areas of lifestyle behavior such as stress management, problem solving, and motivation.		
Metzgar, 2016[65]	IG2	HD High	Weight gain prevention intervention delivered by a counselor	24 nutrition education sessions over the course of the 12-month intervention period. All sessions were one hour in length and emphasized portion control, planning ahead, and vegetable consumption. For the first 16 weeks of the intervention (months 1-4), participants attended weekly sessions; for the remaining 8 months of the study (months 5-12), participants attended monthly sessions. Weekly sessions focused on general nutrition education topics, including basic nutrition and food groups, food selection and preparation, recipe modification, nutrition snack choices and snacking and nutrient density. Monthly sessions addressed other areas of lifestyle behavior such as stress management, problem solving, and motivation.	NR	None
Mosca, 2008[126]	IG1	HD, PA Medium	Counseling	Regular contact between the participant and the health educator was in person or over the telephone at 2 weeks, 6 weeks, 3 months, 6 months, and 9 months (30 to 60 minutes). At each follow-up, lifestyle changes were reinforced and potential barriers to attaining risk factor goals were discussed. At the 6-week and 6-month follow-up, a validated dietary assessment of adherence to therapeutic lifestyle change (TLC) diet was administered, and results were used to counsel subjects. In addition, at 3 months, 6 months, and 9 months, participants with previously abnormal lipid panels were offered measurement and immediate feedback of lipid levels. Risk factor results for participants were given to their PCPs in the form of progress reports sent via facsimile to physician offices. Education focused on avoiding foods that contain saturated fat, cholesterol, partially hydrogenated fats, trans fats, refined sugars, as well as recommendations to eat at ≥2 servings of fruits, ≥3 servings vegetables, and ≥20 g of fiber per day. The counseling focused on foods and encouraged moderate physical activity, for at least 30 minutes daily (60 minutes if weight loss was desired). Smokers were given educational handouts, encouraged to discontinue smoking, and referred to a hospital-based smoking-cessation program. All participants received a 1-page handout to (1) avoid tobacco, (2) choose good nutrition, and (3) be more active. A report was sent to their healthcare providers if a critical threshold value for a CVD risk factor was determined (i.e., blood pressure ≥140/90 mm Hg, LDL-C ≥190 mg/dL, high-density lipoprotein cholesterol [HDL-C] <25 mg/dL, triglycerides ≥500 mg/dL, total cholesterol >300 mg/dL).	NR	MI: 1-pg handout on tobacco, nutrition, and physical activity; report sent to PCP if high-risk for CVD risk factor

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Napolitano, 2006[127]	IG1	PA Low	Tailored print mailings	Completion of Jumpstart 65-item questionnaire related to PA readiness, responses were entered into an expert system computer program which generated tailored feedback letters sent to participants. Questionnaire and feedback letters were delivered once at baseline, months 1, 3, and 6. Tailored feedback letters addressed self-efficacy, barriers, benefits, social support, and goal setting, in addition a stage matched booklet and letter explaining how to utilize materials was included.	NR	AC: One mailing of women's health information
Napolitano, 2006[127]	IG2	PA Low	Nontailored print mailings	One time mailing of American Heart Association's Choose to Move booklet and letter explaining how to utilize the materials. Choose to Move is a 12-week program targeted to women with each week covering a topic of relevance from SCT and TTM.	NR	AC: One mailing of women's health information
Norris, 2000[128]	IG1	PA Medium	Counseling	One-time completion of PACE questionnaire to determine baseline PACE score, followed by the receipt of PA information relevant to individual's stage of change containing tips on overcoming barriers to PA. One-time PCP counseling session using PACE protocol appropriate for stage of change, reviewed informational sheet, and gave written exercise prescription. At 4 weeks one 15-min follow-up phone with research assistant occurred to reinforce counseling, identify any barriers to PA regimen, and to arrange mailings of educational materials if requested. One-third of the intervention patients were randomly selected to receive booster telephone calls at 2, 3,4, and 5 months; no significant increases were found in PA measures among those receiving booster calls (enhanced PACE protocol).	Within the subset of participants scheduled to receive follow-up phone calls, 64% received ≥3 calls	UC: Not described
Oddone, 2018[47]	IG1	HD, PA Medium	Health risk assessment and individual coaching	A Coaching by Telephone Intervention for Veterans and Care Team Engagement (ACTIVATE) program which includes two telephone-based coaching sessions after a patient completes the VHA's online health risk assessment (HRA). All participants completed the VA's online health risk assessment. Output included a calculation of health age, which was based on risk modeling. The HRA user's health age could show a value higher or lower than their chronological age based on lifestyle choices, family risk, and biological values. Participants also had access to detailed information for each health topic. Coaches worked with participants to co-develop a goal to reduce their modifiable CVD risk by choosing a prevention program to enroll in that was aligned with the participant's own values and preferences and that addressed their chosen risk factor (e.g., smoking) from their personalized list, displayed within their HRA report. Coaches used HRA-generated health summary outputs to facilitate patients' understanding of their current risks and how much that risk could be reduced by improved diet, increased physical activity, losing weight, and/or quitting tobacco use. Program choices included both VA and community-based structured prevention programs. There were two planned coaching telephone calls: the first occurred within 1 week of baseline surveys and the second 1 month later. Patients had the same health	93% completed the first coaching call, 88% completed the second, 7% did not complete either call. The mean duration of the first coaching call was 34 min (SD 14 min), and the mean duration of the second coaching call was 12 min (SD 10 min).	UC: UC patients received a printed copy of their HRA output and were encouraged to discuss any questions they had with their primary care team. The primary care team was also alerted to their patients' participation in

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				coach for both calls. The first call followed a semi-scripted approach that included the following steps: (1) review of HRA results focusing on the difference between modifiable and nonmodifiable risk; (2) assessment of patient preferences and values related to modifiable risk factors; (3) prioritization of approaches to impact modifiable risks; (4) helping patients choose a prevention program that would best meet their needs and preferences; (5) collaboratively developing a SMART (small, measurable, attainable, relevant, and timely) goal aimed at enrolling in the chosen prevention program to address modifiable risk factor; and (6) assessing readiness and confidence to take the final steps needed to enroll and participate in that program. The patient's prevention goal was documented in a Prevention Action Plan that was mailed to the participant and included as a note in the electronic medical record. One month after the initial coaching call, each patient received a follow-up coaching call from their health coach. The purpose of this call was to review progress toward completing their goal to engage in a structured prevention program. If the participant enrolled in their chosen prevention program, the coach congratulated them and encouraged their continued participation. If the participant had not yet enrolled, or was encountering challenges, the coach problem-solved with the patient to help overcome those challenges and set a new goal, which may have included a different program. Main messages could include: quit smoking, get 2.5 hours a week or more of moderate PA, eat a variety of fruits and vegetables every day, select lean meats and poultry, limit red or processed meat, take daily aspirin if your doctor recommends it, be safe on the road every day, avoid smoking environments and secondhand smoke, seek resources to help manage stress, talk with your health care team about your trouble sleeping.		the study via a standard note in the electronic medical record.
Parekh, 2014[129]	IG1	HD, PA Low	Computer-tailored print mailings (two contacts)	A one-paged, personalized computer-tailored feedback letter was mailed after each completion of the assessment questionnaire at baseline and at 3-months. The feedback letter was printed on treating PCP's letter head and encouraged the participant to improve at least one behavior not adhering to health recommendation guidelines by the National Health and Medical Research Council and the National Heart Foundation of Australia. The guidelines focused on six dietary behaviors: meat, fish, vegetables and fruit, use of unsaturated fats as spreads, avoidance of added salt, as well as responses to smoking behavior, alcohol intake, physical activity and BMI. In addition, one-page health promotion information sheets were mailed to participants only for behaviors not meeting national guidelines.	NR	AC: Mailed 1 or 2 personalized computer-tailored feedback letters and health promotion information sheets at baseline and/or at 3-months
Parekh, 2014[129]	IG2	HD, PA Low	Computer-tailored print	A one-paged, personalized computer-tailored feedback letter was mailed after completing the assessment questionnaire at baseline only. The feedback letter was printed on treating PCP's letter head and encouraged the participant to	NR	AC: Mailed 1 or 2 personalized

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
			mailing (one contact)	improve at least one behavior not adhering to health recommendation guidelines by the National Health and Medical Research Council and the National Heart Foundation of Australia. The guidelines focused on six dietary behaviors: meat, fish, vegetables and fruit, use of unsaturated fats as spreads, avoidance of added salt, as well as responses to smoking behavior, alcohol intake, physical activity and BMI. In addition, one-page health promotion information sheets were mailed to participants only for behaviors not meeting national guidelines.		computer-tailored feedback letters and health promotion information sheets at baseline and/or at 3-months
Patel, 2017[51]	IG1	PA Medium	Gamification (incentive-based family intervention) including daily goal-related feedback	Participants were asked to wear an accelerometer to track their steps and were instructed to select a step goal increase of 33%, 40%, 50%, or any goal of at least 1,000 steps greater than baseline accelerometer count; all family members selected their individual step goal increases. All participants received daily feedback by text message, email, or both during the 24-week study about whether they met their step goals the prior day. Participants in the gamification arm were entered into a game with their family for 12 weeks. During these 12 weeks, every Monday, the family was endowed with 70 points (10 for each day of the week). Each day, the family was informed of the one member who was selected at random to represent their team. If that member achieved his or her step goal on the prior day, the family kept its points; otherwise, 10 points were lost. Each individual had 5 lifelines to use on days when they were sick or activity was infeasible. If the family had 50 or more points at the end of the week, they advanced up a level (bronze, silver, gold, platinum). If not, they dropped a level. Families were informed if they finished the intervention period at the gold or platinum level they each would receive a coffee mug with the study logo as a reward.	NR	MI: Daily feedback on whether or not they had achieved their step goal on the prior day
Patel, 2019[153]	IG1	PA Low	Gamification with competition and goal feedback	Twenty-four-week gamification with competitive social incentive and wearing a device to track daily steps. Each participant was informed of his or her baseline step count and then asked to choose a step goal increase that was 33%, 40%, or 50% higher than the baseline (each goal rounded up to the next hundred), or the participant could select another goal as long as it was at least 1,500 steps greater than baseline. First, participants signed a precommitment pledge to strive to achieve their step goal during the 36-week study. Participants had a ramp-up period during the first 4 weeks in which daily step goal targets increased by 25% per week from baseline to the goal. Participants were asked to strive for this step goal for the rest of the trial but could change the goal at any point as long as it was within the original options provided to them. Second, every Monday the participant received 70 points (10 for each day of the week). If the participant did not achieve their step goal on the prior day, they lost 10 points from their balance.	N=143 completed intervention	MI: Asked to use the wearable device and strive for their daily step goal for 36 weeks and received regular feedback from the wearable device and its

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				Third, at the end of each week, participants could move up or down levels (from lowest to highest: blue, bronze, silver, gold, or platinum). Participants started each week with a fresh set of 70 points. A new component was added to help reengage participants who were struggling to meet their goals at weeks 8 and 16 (defined as being in the blue or bronze levels of the game). These participants were sent an email that stated that they would get a fresh start by being reset to the silver level and offered the opportunity to readjust their goals among the initial options. The 3 intervention arms differed by the social incentive arm (competition, collaboration, or support). In this competition arm, participants were placed into a group of 3 total participants. These participants typically did not know each other before the study but were introduced to each other by email. At the end of each week, the participants received an email with a leaderboard that ranked them on their cumulative points in the study thus far and displayed their level. This feedback may have helped induce participants to compete for the top spot in their group.		smartphone application
Patel, 2019[153]	IG2	PA Low	Gamification with collaboration and goal feedback	Twenty-four-week gamification with collaborative social incentive and wearing a device to track daily steps. Each participant was informed of his or her baseline step count and then asked to choose a step goal increase that was 33%, 40%, or 50% higher than the baseline (each goal rounded up to the next hundred), or the participant could select another goal as long as it was at least 1500 steps greater than baseline. First, participants signed a precommitment pledge to strive to achieve their step goal during the 36-week study. Participants had a ramp-up period during the first 4 weeks in which daily step goal targets increased by 25% per week from baseline to the goal. Participants were asked to strive for this step goal for the rest of the trial but could change the goal at any point as long as it was within the original options provided to them. Second, every Monday the participant received 70 points (10 for each day of the week). If the participant did not achieve their step goal on the prior day, they lost 10 points from their balance. Third, at the end of each week, participants could move up or down levels (from lowest to highest: blue, bronze, silver, gold, or platinum). Participants started each week with a fresh set of 70 points. A new component was added to help reengage participants who were struggling to meet their goals at weeks 8 and 16 (defined as being in the blue or bronze levels of the game). These participants were sent an email that stated that they would get a fresh start by being reset to the silver level and offered the opportunity to readjust their goals among the initial options. The 3 intervention arms differed by the social incentive arm (competition, collaboration, or support). In this collaboration arm, participants were placed into a team of 3 total participants. These participants typically did not know each other before the study but were introduced to each other by email. Each day, 1 of the members of the group was randomly selected to represent his or her team for that day and that information was shared with the entire group. If the selected participant met his or her step goal on the previous day, the team kept their	N=148 completed intervention	MI: Asked to use the wearable device and strive for their daily step goal for 36 weeks and received regular feedback from the wearable device and its smartphone application

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				points. If he or she did not meet the goal, then the entire team lost 10 points. In this design, each person is accountable to the others on the team, which may induce a collaborative effort to meet their daily goals. The entire team moved up a level only if the team had at least 40 points by the end of the week.		
Patel, 2019[153]	IG3	PA Low	Gamification with support and goal feedback	24-week gamification with supportive social incentive and wearing a device to track daily steps. Each participant was informed of his or her baseline step count and then asked to choose a step goal increase that was 33%, 40%, or 50% higher than the baseline (each goal rounded up to the next hundred), or the participant could select another goal as long as it was at least 1500 steps greater than baseline. First, participants signed a precommitment pledge to strive to achieve their step goal during the 36-week study. Participants had a ramp-up period during the first 4 weeks in which daily step goal targets increased by 25% per week from baseline to the goal. Participants were asked to strive for this step goal for the rest of the trial but could change the goal at any point as long as it was within the original options provided to them. Second, every Monday the participant received 70 points (10 for each day of the week). If the participant did not achieve their step goal on the prior day, they lost 10 points from their balance. Third, at the end of each week, participants could move up or down levels (from lowest to highest: blue, bronze, silver, gold, or platinum). Participants started each week with a fresh set of 70 points. A new component was added to help reengage participants who were struggling to meet their goals at weeks 8 and 16 (defined as being in the blue or bronze levels of the game). These participants were sent an email that stated that they would get a fresh start by being reset to the silver level and offered the opportunity to readjust their goals among the initial options. The 3 intervention arms differed by the social incentive arm (competition, collaboration, or support). In this support arm, participants were asked to identify a family member or friend who would be a support sponsor and be emailed a weekly report on the participant's performance in the game, including points and level. This sponsor was sent a message at the start of the study to do their best to support the participant in their progress during the study.	N=146 completed intervention	MI: Asked to use the wearable device and strive for their daily step goal for 36 weeks and received regular feedback from the wearable device and its smartphone application
Pekmezi, 2009[130]	IG1	PA Low	Tailored print mailings and self-monitoring	Six monthly mailings of PA manuals matched to participant's current level of readiness and individually tailored computer expert-system feedback reports based on monthly questionnaire responses focused on goal setting, self-monitoring, problem-solving, barriers, increasing social support, and rewarding oneself for meeting PA goals. Participants received PA logs and pedometers to track and monitor progress, along with tip sheets on related topics such as stretching.	85% reported reading most or all of the print materials, 72% reported wearing pedometers	AC: General nutrition and CVD risk brochures
Pinto, 2002[131]	IG1	PA Medium	Automated telephone counseling	Weekly 10-minute phone calls for 12 weeks with a telephone-linked communication system (TLC-PA) focused on activity counseling and promoting moderate intensity physical activity, followed by bimonthly calls for 3 months. Responses from phone conversations generated one initial and six monthly	24% never called the system, 36% called 1-10 times, 23% called 11-20	AC: Dietary counseling using the same TLC

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				individualized printed reports with text and graphs showing PA level of participants based off of data collected during phone calls with TLC-PA and pedometer readings. Reports were also sent to PCP with expectation reports would prompt the PCPs to reinforce the value of PA.	times, 18% called >20 times	automated technology
Pinto, 2005[132]	IG1	PA Medium	Counseling with tailored prescription	Three 30-45-minute face to face counseling sessions with health educator at 0, 1, and 3 months, a one-time individually tailored PA prescription, along with twelve 10-15 minute PA counseling phone calls occurring weekly for 3 months and the biweekly for next 3 months, and 12 PA tip sheets mailed at the same time of the phone calls. All materials and sessions were tailored to the participant's individual stage of readiness to change PA levels.	47% received brief advice from their physician. 100% attended the first in-person counseling session, 83% attended the second visit, and 78% attended the third visit. 86% of the scheduled calls were completed and the mean length of the calls was 14.8 minutes.	MI: Brief (3-5 min) physician counseling
Roderick, 1997[133]	IG1	HD Medium	Counseling	One dietary advice session (assume 30 min), based on negotiated change, which aimed for food substitution (i.e., the nurse and patient negotiated and agreed up to five changes) after review of the type, quantity and frequency of key foods consumed. Specially designed dietary sheets were given out according to whether weight loss was required; all foods were classified as "to eat plentifully," "in moderation" or "on special occasions only." Special leaflets covering, for example, snacking, were given out where appropriate. Patients who were overweight (BMI over 25 kg/m2) were given special advice, including a self-monitoring chart and a choice of a calorie-restricted diet. At 4-6 weeks, progress with dietary change was assessed, weight remeasured, and further changes made if appropriate. Patients (N=NR) who had a high baseline serum cholesterol (over 6.5 mmol/l in men or 7.0 mmol/l in women) or BMI over 27.5 kg/m2 or two or more other CHD risk factors (male, smokers, hypertensive, family or past history of CHD) were asked to return at 3 and 6 months for further assessment. Leaflets of standard health education were given to all participants: "Guide to Healthy Eating", "Giving up smoking", "Look After Your Heart", "Heart Disease", and "Exercise, Why Bother?"	NR	MI: Standard health education leaflets
Ruffin, 2011[134]	IG1	HD, PA Low	Computer-tailored web-based intervention	Participants completed an online baseline survey, followed by Family Healthware tool. Participants could log on anytime to complete the instruments over multiple sessions. Familial risk assessments and tailored prevention messages were instantly received on-screen that were based on familial risk for CHD; stroke; diabetes; and colorectal, breast, and ovarian cancer. Some participants	91% viewed their risk report and messages online	UC: Standard prevention messages

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				responded by telephone with data entered online by study personnel. Printed reports were either mailed or given to the participants at their scheduled PCP appointment.		
Sacerdote, 2006[135]	IG1	HD Low	Brief counseling	One 15-minute personalized nutrition counseling session, based on a brochure about diet and health and a short explanation by the PCP. The intervention focused on the importance of higher consumption of fruits, vegetables, fish, and olive oil and lower consumption of red meat, snack, and sweets and was modulated on the basis of sex- and age-specific energy consumption and on unbalanced nutritional habits of each subject.	NR	UC: Simple and non-personalized conversation without use of brochure with GP at the first visit.
Samdal, 2019[67]	IG1	PA Medium	Individual counseling and optional group-based PA sessions	Interventions were based on the general recommendations of the HLC (Healthy Life Center) model by the Norwegian Directorate of Health. The model consists of referral by general practitioner, other public service personnel, or self-referral to a group-based behavior change intervention for 12 weeks, with an individual counselling session based on Motivational Interviewing (MI) at entry and exit. In the first individual session (30–60 minutes) the counsellor offered information tailored to the needs and abilities of the individual and supported change based on a mutually agreed plan. At 12 weeks a second individual counselling session de Vede Vecreviewed goals and outcome of change. The counsellor offered feedback on the results and if there was a need and motivation, the prescription period could be extended up to one year. Group-based PA interventions consisting of elements from aerobic training, such as Nordic walking, light strength training, stretching and games, were encouraged twice a week. The implementation of interventions varied across the HLCs depending on local policy, resources and competence. Some HLCs organized their own PA groups, while others cooperated with and refer to public, voluntary or private services. Participants were encouraged to monitor their behavior (e.g., in a logbook) and use web-based applications for support (e.g., the national stop smoking app).	NR	WL: Waitlist
Simkin-Silverman, 1995[136]	IG1	HD, PA High	Group counseling	Participants attended 15 group sessions (assume 60 minutes each), that were held weekly for 10 weeks, then biweekly for remaining 10 weeks. Trained nutritional and behavioral interventionists educated and encouraged participants to lower intake of total fat to 25% of daily calories, saturated fat to 7%, and total cholesterol to 100 mg/day and prevent future weight gain by achieving a modest weight loss goal. Participants were asked to follow a 1,300 or 1,500 kcal meal plan for 4 weeks, and subsequently encouraged to modify or adapt the meal plan to include favorite foods while still maintaining dietary and caloric goals. Participants kept a dietary log throughout the 20 weeks using a 7-day pocket diary. Participants were given education and guidance on gradually increasing PA level to 1,000 kcal/week (e.g., walking 10 miles/week over 3-5 days). Behavioral strategies, including problem solving, stimulus control, goal setting, assertiveness	Participants attended an average of 11.4 of 15 sessions during initial 20-week phase of intervention	None

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				training, relapse prevention, and cognitive techniques to help implement and maintain dietary and exercise changes. Following the 20-week intensive period, participants entered the maintenance phase, which consisted of 6 bimonthly meetings (assume 60 minutes each). Thereafter, participants were provided group, mail, or telephone contact on average every 2-3 months. All participants were invited to 6-week refresher programs (between months 14 and 54) and received quarterly newsletters. Social and educational gatherings were held for all participants 2-3 times a year. Additional consultation was available to participants who could not attend group meetings and consisted of instruction on additional skills, support, and motivation to help with maintenance of behavior change.		
Smith, 2014[137]	IG1	HD, PA Medium	Counseling	One 1-hour face to face counseling session, followed by a telephone support contact at 2 weeks, and a second face to face counseling session at 4 weeks. An additional 4 monthly short telephone calls were made, supplemented by text messages and mailed postcards. Participants were also given pedometers, logbooks, and dietary journals.	93.1% received both face-to-face sessions, 89.7% received four telephone contacts, 86.2% received four postcard and four follow up text messages	None
Spring, 2018[60]	IG1	HD, PA, SB High	Smartphone app and remote coaching (simultaneous behaviors)	One in-person training session where participants were trained to estimate portion sizes, use a custom-built smartphone app to record behaviors (dietary intake, leisure screen time, stress level, relaxation exercises, and sleep), and wear an accelerometer. Intervention apps provided users with continuously updated feedback about their performance of targeted behaviors related to their goals. In addition to giving participants goal attainment feedback from targeted behaviors, apps wirelessly transmitted this information to coaches, who used it to tailor telephone counseling. The two intervention groups were similar, except that the physical activity interface for sequential treatment remained inactive until week seven. End goals for the 12-week simultaneous or sequential intervention were: 1) ≤90 min per day of sedentary leisure screen time; 2) ≥5 servings of fruits and vegetables; and 3) ≥150 min per week of MVPA. Those receiving simultaneous treatment were asked to gradually modify all three target behaviors from the outset of the intervention. Those receiving sequential treatment were asked to modify only sedentary leisure screen time and fruit and vegetables for the first 6 weeks. Between weeks 7 and 12, they were asked to maintain goal levels for leisure screen time and fruit and vegetables, while progressively increasing MVPA. During treatment initiation (weeks 1-12), a trained paraprofessional telephoned each participant weekly for a 15-minute coaching session. Coaches delivered a sequence of online didactic lessons specific to each condition and used motivational interviewing to tailor counseling using data from the participant's app and accelerometer. Coaching call frequency decreased to	57.7% to 66% of coaching calls were completed during the first half and second half of treatment, respectively. Self-monitoring decreased from 96.3% at baseline to 54.6% at 9 months. No differences between groups.	AC: Access to a smartphone app focused on sleep and stress were coached to perform three relaxation exercises per day (a progressive muscle relaxation technique, a mindfulness meditation, and a self-hypnosis technique), and to achieve end goals of ≥7.5 hours of

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Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				biweekly in weeks 13-24 and monthly in weeks 25-40, and call duration decreased to 10 minutes.		sleep per day and a 30% reduction in stress over the 12-week intervention
Spring, 2018[60]	IG2	HD, PA, SB High	Smartphone app and remote coaching (sequential behaviors – MVPA delayed by 7 weeks)	One in-person training session where participants were trained to estimate portion sizes, use a custom-built smartphone app to record behaviors (dietary intake, leisure screen time, stress level, relaxation exercises, and sleep), and wear an accelerometer. Intervention aps provided users with continuously updated feedback about their performance of targeted behaviors related to their goals. In addition to giving participants goal attainment feedback from targeted behaviors, apps wirelessly transmitted this information to coaches, who used it to tailor telephone counseling. The two intervention groups were similar, except that the physical activity interface for sequential treatment remained inactive until week seven. End goals for the 12-week simultaneous or sequential intervention were: 1) ≤90 min per day of sedentary leisure screen time; 2) ≥5 servings of fruits and vegetables; and 3) ≥150 min per week of MVPA. Those receiving simultaneous treatment were asked to gradually modify all three target behaviors from the outset of the intervention. Those receiving sequential treatment were asked to modify only sedentary leisure screen time and fruit and vegetables for the first 6 weeks. Between weeks 7 and 12, they were asked to maintain goal levels for leisure screen time and fruit and vegetables, while progressively increasing MVPA. During treatment initiation (weeks 1-12), a trained paraprofessional telephoned each participant weekly for a 15-minute coaching session. Coaches delivered a sequence of online didactic lessons specific to each condition and used motivational interviewing to tailor counseling using data from the participant's app and accelerometer. Coaching call frequency decreased to biweekly in weeks 13-24 and monthly in weeks 25-40, and call duration decreased to 10 minutes.	57.7% to 66% of coaching calls were completed during the first half and second half of treatment, respectively. Self-monitoring decreased from 96.3% at baseline to 54.6% at 9 months. No differences between groups.	AC: Access to a smartphone app focused on sleep and stress were coached to perform three relaxation exercises per day (a progressive muscle relaxation technique, a mindfulness meditation, and a self-hypnosis technique), and to achieve end goals of ≥7.5 hours of sleep per day and a 30% reduction in stress over the 12-week intervention
Springvloet, 2015[138]	IG1	HD Medium	Web-based tailored education-plus feedback	Four web-based tailored nutrition modules (i.e., fruit, vegetables, high-energy snacks, and fat) were structured to target knowledge, awareness, intention, attitude, self-efficacy, goal setting, and action and coping plans, except for the fat module that did not contain methods to target attitude and self-efficacy to limit participant burden. Each module contained 3 sessions that could be worked through during 6 consecutive weeks. Each session was arranged according to the self-regulation phases: pre-action, action and evaluation of the behavioral	NR	MI: Four web-based, non-tailored nutrition education modules

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				change. Before starting the first session, participants could choose which behavior(s) they wanted to receive feedback and guidance on and state at which supermarket they buy their food products (e.g., fruit). The first session (20-40 minutes) provided tailored feedback on self-selected potential barriers, difficult situations, and availability and price of products in their supermarket. At the end of the first session, participants could set a goal and formulate an implementation intention for when, where, and how to make the behavior change, as well as start enacting their plans and initiate performing their new behavior for 2 weeks. The second and third sessions (10-20 minutes) provided the opportunity to evaluate the progress of the behavior change. Participants first monitored their goal achievement in the past week and were provided with feedback on their progress. When the goal was not achieved, attitude and self-efficacy were targeted to stimulate participants to take a second attempt. All participants were stimulated to formulate coping plans for expected difficult situations. If necessary, goals could be adapted to make them more achievable or more challenging. The third session additionally provided information on how to maintain the behavior change over time. Completion of all 4 modules took approximately 160 minutes. Email reminders were sent to prompt returning to the intervention program. Additionally, environmental-level feedback on the availability and prices of healthy foods nearby was provided.		
Springvloet, 2015[138]	IG2	HD Medium	Web-based tailored education	Four web-based computer-tailored nutrition education modules (i.e., fruit, vegetables, high-energy snacks, and fat) were structured to target knowledge, awareness, intention, attitude, self-efficacy, goal setting, and action and coping plans, except for the fat module that did not contain methods to target attitude and self-efficacy to limit participant burden. Each module contained 3 sessions that could be worked through during 6 consecutive weeks. Each session was arranged according to the self-regulation phases: pre-action, action and evaluation of the behavioral change. Before starting the first session, participants could choose which behavior(s) they wanted to receive feedback and guidance on. The first session (20-30 minutes) provided tailored feedback on self-selected potential barriers and difficult situations. At the end of the first session, participants could set a goal and formulate an implementation intention for when, where, and how to make the behavior change, as well as start enacting their plans and initiate performing their new behavior for 2 weeks. The second and third sessions (10-20 minutes) provided the opportunity to evaluate the progress of the behavior change. Participants first monitored their goal achievement in the past week and were provided with feedback on their progress. When the goal was not achieved, attitude and self-efficacy were targeted to stimulate participants to take a second attempt. All participants were stimulated to formulate coping plans for expected difficult situations. If necessary, goals could be adapted to make them more achievable or more challenging. The third session additionally provided information on how to maintain the behavior change over time.	NR	MI: Four web-based, non-tailored nutrition education modules

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				Completion of all 4 modules took approximately 160 minutes. Email reminders were sent to prompt returning to the intervention program.		
Stewart, 2001[139]	IG1	PA High	Group counseling	One informational meeting, one individual planning session, and 10 monthly group workshops focused on discussing participant's readiness to increase PA, ways to overcome barriers to PA, how to exercise safely and avoid injury, and how to engage in appropriate levels of PA given individual health conditions. Participants also kept PA diaries, received monthly newsletters, and functional fitness assessments. Two booklets were provided on PA and benefits of PA and heart health.	NR	WL: Waitlist
Sun, 2017[56]	IG1	HD, PA, SB Medium	Interactive online educational modules	The intervention consisted of 8 weekly 30-minute, interactive, Cantonese, educational modules accessed online via tablet computers. The family-centered modules were developed as a tablet-based educational tool adapted from the National Heart, Lung, and Blood Institute's (2014) "We Can!" (Ways to Enhance Children's Activity & Nutrition) program, the Consortium to Lower Obesity in Chicago Children's "5-4-3-2-1-Go!" program, and the Barbara Bush Children's Hospital at Maine Medical Center "5-2-1-0 Let's Go!" campaign. These programs contain recommendations (5 servings of fruits and vegetables, 4 cups of water, 3 servings of dairy, 2 hours of screen time, 1 hour of physical activity, 0 sugary drinks) for children and families to achieve a healthy lifestyle. Images, food items, and sample menus familiar to the Chinese culture were used, and examples of easy family physical activities specific to inner cities where participants resided were provided. The topics were as follows: (a) Introduction to the 5-4-3-2-1-0 program, (b) Energy balance—maintain a healthy weight, (c) What to feed my family—energy IN, (d) Grocery shopping, € Find fun in physical activity—energy OUT, (f) Less sit, more fit—decrease screen time, (g) Smart parenting, and (h) Maintain a healthy weight for life.	NR	AC: Weekly mailings of printed health information relevant to preschool-aged children. The topics included an introduction to the study, food safety, choking hazards, oral health, immunizations, appropriate antibiotic use, injury prevention, and disaster preparation.
Thompson, 2008[140]	IG1	HD, PA High	Group counseling	Five group sessions of 2-2.5 hours (one per month for five months) using social cognitive theory strategies. Sessions involved written and oral didactic material and small-group discussions; topics included learning to read food labels, strategies for healthy food choices when eating out, taste-testing healthy meals, and recipes to support study goals. A 15-minute outdoor walk was conducted at the beginning of each session. In all sessions, goal setting, feasible action steps, addressing barriers, enhancing behavior change through nonfood rewards were emphasized, and discussion of how strategy implementation proceeded during previous month. For missed sessions, participants received didactic materials and a brief review of content prior to the subsequent session.	53% attended 3 or fewer (of the 5) group sessions	WL: Waitlist

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Thompson, 2014[141]	IG1	PA High	Counseling and self-monitoring	Participants wore Fitbit accelerometers for 24 weeks with feedback from the device and 24 weekly telephone delivered exercise counseling calls with a counselor, along with 3 face-to-face counseling sessions with a counselor every 2 months. Counselors worked with subjects to increase PA using Go4Life materials developed by the National Institute on Aging at NIH. The Go4Life curriculum focuses on exercise which promotes endurance, strength, balance, and flexibility, with overall goal of increasing activity level by 20%.	NR	WL: Waitlist
Tinker, 2008[142]	IG1	HD High	Group counseling	Group sessions (assume 60 minutes) of 10-12 participants met weekly with a trained nutrition interventionist for 6 weeks, every other week for an additional 6 weeks, and then monthly for the course of the first year (18 group sessions in first year). Each participant had 1 individual dietary counseling session (assume 30 minutes) with interventionist in first 12-16 weeks to ensure nutritional balance of new dietary pattern. Dietary-maintenance group sessions occurred quarterly after the first year, along with optional peer-led monthly meetings. Relative focus on nutrition highest in earlier sessions during the time of most intensive dietary change, while later emphasis was on maintenance of dietary change. Participants received individualized fat gram goal estimating 20% of energy from fat and a common goal of 5 or more daily servings of vegetables and fruits and 6 more daily servings of grains (whole grains encouraged). Participants encouraged to maintain usual energy intake by replacing fat calories with calories from other sources (mainly carbohydrates).	43% participated in at least 9 (of 18) sessions and at least 2 (of 4) maintenance sessions	MI: Received copy of "Dietary Guidelines for Americans"
Tokunaga-Nakawatase, 2014[143]	IG1	HD, PA Low	Computer-tailored print mailings	Over 6 months, 3 tailored, concrete lifestyle recommendations were generated using a computer-tailored system (Lifestyle Intervention Support Software for Diabetes Prevention and mailed to participants. Each mailing included a free-comment section for use by the clinical diabetes educator to add additional advice. Also, participants received a pamphlet about general information on diabetes prevention with regard to favorable behavior related to diet and physical activity.	NR	UC: Pamphlet and routine care
Valve, 2013[144]	IG1	HD, PA Medium	Counseling	One initial one-on-one 20-minute solution-focused individualized lifestyle counseling session with a study nurse where a behavioral change goal focused on physical activity, diet, or sleep was set, along with printed materials covering the topics discussed. Details of the discussion were determined by the participants' needs, interests, and current life circumstances. Initial session was followed by 3-5 follow up support sessions up to 1.5-2.5 years to revisit behavioral goals. Both treatment groups received counseling on sexual health as part of the HPV vaccination study.	Median duration of the initial counseling session was 15 minutes. 47% of participants chose to discuss PA, 36% chose to discuss dietary behaviors, and 20% chose to discuss sleeping behaviors. 71% participants chose	UC: Received lifestyle counseling according to standard care in Finland

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
					to discuss any of the target behaviors.	
Van Hoecke, 2014[145]	IG1	PA Medium	Counseling	Participants first attended a 15-min informative session in which a fitness coach referred them to locally organized PA opportunities and distributed a self-help booklet and pedometer. The self-help booklet included detailed practical information of local PA opportunities for older adults, recommendations to achieve 30 minutes of moderate intensity PA a day, and on how individuals can integrate more PA into their daily routines. Then, over 10 weeks, regular contact between the coach and participant took place including an initial 60-min face-to-face individually tailored PA coaching session and six 30-min booster contacts or phone calls. Coaching sessions were based on self-determination theory (SDT) and were designed to determine individual PA goals according to the particip'nt's preferences and abilities. Goals, which were specified by PA type, location, time frame, company, possible barriers, and solutions, were written down in a personal weekly schedule. Besides endurance activities like walking, the coach provided home-based exercises to improve the participant's strength, flexibility, and balance. Every 10 days, participants were supported through face-to-face contacts or booster phone calls (maximum 30 min). PA goals were evaluated and modified if necessary, barriers were identified, and participants were stimulated to persist in PA by using behavior-change techniques and applying motivational interviewing.	NR	MI: One 15-min informative session and received a self-help booklet and pedometer
	IG2	PA Low	Tailored prescription	Participants first attended a 15-min informative session in which a fitness coach referred them to locally organized PA opportunities and distributed a self-help booklet and pedometer. The self-help booklet included detailed practical information of local PA opportunities for older adults, recommendations to achieve 30 minutes of moderate intensity PA a day, and on how individuals can integrate more PA into their daily routines. In addition to the self-help booklet, participants were given an individualized walking program based on their baseline walking level (based on the 6-min walk test). The written program consisted of structured weekly schedules of uninterrupted walks (described as number of steps) on most days of the week. Walking volume and intensity increased gradually, and participants were encouraged to progress through the different levels of the walking program according to their individual abilities. Participants could accomplish the program on their own or in a social context (e.g., with significant others, in a social organization).	NR	MI: One 15-min informative session and received a self-help booklet and pedometer
van Keulen, 2011 [158]	IG1	HD, PA Medium	Tailored print mailing and telephone motivational interviewing	Participants received two tailored print letters and two telephone motivational interviews in turns. The first letter and call addressed PA (physical activity); the second letter and call focused on fruit and vegetable consumption. Participants could also choose to discuss fat intake in the second call. The PA letter (3-6 pages) was personalized with the participant's name and included the following	NR	None

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				elements: introduction, specific behavioral feedback on targeted behavior and related social-cognitive determinants, stage-matched advice to change behavior and conclusions. The second letter on fruit and vegetable consumption was also personalized and reinforced tailored feedback on behavioral progress and stages of change, similar structure to that in PA letter. The two telephone interviews were performed as follows: giving introduction, assessing current behaviors and progress, discussing the public health guideline, assessing and enhancing motivation and self-efficacy for behavior change, assessing readiness to change, and summarizing and closing the session. Additional topics could be discussed (e.g., the current situation and progress on action plans in subsequent interviews, the tailored letters and values in life).		
	IG2	HD, PA Medium	Telephone sessions only	Participants could choose the order of the conversation topics in motivational interviews 1 and 3; if PA was preferred in interview 1, fruit and vegetable consumptions were discussed in interview 2, and vice versa. Procedures were performed as follows: giving introduction, assessing current behaviors and progress, discussing the public health guideline, assessing and enhancing motivation and self-efficacy for behavior change, assessing readiness to change, and summarizing and closing the session. Additional topics could be discussed (e.g., the current situation and progress on action plans in subsequent interviews, and values in life). Participants could also choose to discuss fat intake in the fourth call.	NR	None
	IG3	HD, PA Low	Computer-tailored print mailings only	Study participants received stage-matched advice. The tailoring variables were age, sex, awareness, attitude (pros and cons), self-efficacy expectations, action plans, stage of change and current behavior according to the self-report questionnaire. Data on these variables were gathered with written questionnaires. A computer algorithm connected survey items to a feedback message file in order to provide written individual feedback. The two letters on PA, each 3-6 pages, were personalized with the participant's name and included the following elements: introduction, specific behavioral feedback on targeted behavior and related social-cognitive determinants, stage-matched advice to change behavior and conclusions. The subsequent letters on fruit and vegetable consumption, 2-4 pages and 4-6 pages, respectively, were also personalized and reinforced tailored feedback on behavioral progress and stages of change, similar structure to that in PA letters.	50% read their letters more than once	None
Van Stralen, 2010[146]	IG1	PA Low	Tailored print mailings with environmental focus	Three motivationally- and environmentally focused computer-tailored letters were mailed to each participant including personalized PA advice. The first and second tailored letters were based on personal data gathered at baseline and were sent 2 weeks and 2 months after baseline, respectively. The third letter was sent 2 weeks after receiving the 3-month questionnaire and was based on the data gathered at baseline and 3 months; it addressed any changes each adult had undertaken during these 3 months. Several psychosocial determinants that	98% read tailored letters, 68% saved the letters, and 37% discussed letters with others, among all intervention groups	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				underlie PA behavior change (e.g., awareness, attitude, social influence, self-efficacy, intention, and self-regulation skills) were targeted. The environmental information comprised handouts on walking and cycling routes in their neighborhood, examples of exercises to do at home, and contact information for local sports clubs matching their interests and abilities combined with access to a forum and e-buddy system on a website to increase social and environmental determinants. The letters comprised between three and 11 pages depending on (changes in) PA level and determinant scores.		
Van Stralen, 2010[146]	IG2	PA Low	Tailored print mailings	Three motivationally focused computer-tailored letters were mailed to each participant including personalized PA advice. The first and second tailored letters were based on personal data gathered at baseline and were sent 2 weeks and 2 months after baseline, respectively. The third letter was sent 2 weeks after receiving the 3-month questionnaire and was based on the data gathered at baseline and 3 months; it addressed any changes each adult had undertaken during these 3 months. Several psychosocial determinants that underlie PA behavior change (e.g., awareness, attitude, social influence, self-efficacy, intention, and self-regulation skills) were targeted. The letters comprised between three and 11 pages depending on (changes in) PA level and determinant scores.	98% read tailored letters, 68% saved the letters, and 37% discussed letters with others, among all intervention groups	WL: Waitlist
Vandelanotte, 2005[147]	IG1	HD, PA Medium	Computer-based sessions with tailored feedback (PA and diet simultaneous)	At one session, participants completed two interactive computer-tailored interventions (approximately 50 minutes each) targeted towards increasing physical activity and reducing fat intake that were entirely computerized and delivered at a local university computer lab at baseline. After reading the purpose of the intervention, participants filled out an electronic questionnaire consisting of demographics, health behavior, and psychosocial variables. Tailored feedback was displayed immediately on the computer screen and based on the theory of planned behavior and the stages of change concept from the transtheoretical model. Feedback consisted of normative feedback, which related participants' physical activity or fat intake to current recommendations (30 minutes of moderate PA /day and consume <30% energy from fat) and tips and suggestions on how to increase physical activity or decrease fat intake. Tailored advice was printed and taken home.	95.3% read the PA advice and 96.2% read the diet advice, across all intervention groups	WL: Waitlist
	IG2	HD, PA Medium	Computer-based sessions with tailored feedback (PA feedback first)	Participants completed two interactive computer-tailored interventions (approximately 50 minutes each) targeted towards increasing physical activity and reducing fat intake that were entirely computerized and delivered at a local university computer lab. The tailored physical activity intervention was delivered at baseline and the tailored fat intake intervention at 3 months post baseline. After reading the purpose of the intervention, participants filled out an electronic questionnaire consisting of demographics, health behavior, and psychosocial variables. Tailored feedback was displayed immediately on the computer screen and based on the theory of planned behavior and the stages of change concept from the transtheoretical model. Feedback consisted of normative feedback,	95.3% read the PA advice and 96.2% read the diet advice, across all intervention groups	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				which related participants' physical activity or fat intake to current recommendations (30 minutes of moderate PA /day and consume <30% energy from fat) and tips and suggestions on how to increase physical activity or decrease fat intake. Tailored advice was printed and taken home.		
	IG3	HD, PA Medium	Computer-based sessions with tailored feedback (diet feedback first)	Participants completed two interactive computer-tailored interventions (approximately 50 minutes each) targeted towards increasing physical activity and reducing fat intake that were entirely computerized and delivered at a local university computer lab. The tailored fat-intake intervention was delivered at baseline and the tailored physical activity intervention at 3 months post baseline. After reading the purpose of the intervention, participants filled out an electronic questionnaire consisting of demographics, health behavior, and psychosocial variables. Tailored feedback was displayed immediately on the computer screen and based on the theory of planned behavior and the stages of change concept from the transtheoretical model. Feedback consisted of normative feedback, which related participants' physical activity or fat intake to current recommendations (30 minutes of moderate PA /day and consume <30% energy from fat) and tips and suggestions on how to increase physical activity or decrease fat intake. Tailored advice was printed and taken home.	95.3% read the PA advice and 96.2% read the diet advice, across all intervention groups	WL: Waitlist
Vidoni, 2019[152]	IG1	HD, PA Medium	Home visits and newsletter discussions	Delivery of Tu Salud ¡Si Cuenta! (Your Health Matters!) at Home Intervention consisted of 6 home visits over a 6-month period. Each of the 6 monthly home visits consisted of a bilingual community health worker (CHW) delivering and reviewing that month's TSSC (Tu Salud ¡Si Cuenta!) newsletter with the participant, emphasizing the role model story, and discussing physical activity and healthful food choices using brief motivational interviewing strategies and educational modules. The educational modules and conversations were based on the Transtheoretical Model and Brief Motivational Interviewing, and topics included physical activity, fruit and vegetable intake, portion control, high blood pressure, diabetes management, and cancer. These strategies allowed the participant to discuss their own goals for making change, while the CHW reflectively listened and summarized their comments. During monthly home visits, the CHW invited the participants to relevant and accessible opportunities for physical activity and healthful food choices, such as neighborhood walking groups, exercise classes, the farmers market, and nutrition and cooking classes. Other tools and resources the CHWs used at the home visits included showing the participant how to access recipes and resources on the TSSC website and viewing relevant TSSC TV clips on a laptop. The participants were invited to an annual celebration of the TSSC media campaign, which featured speakers, cooking, exercise demonstrations, and opportunities for networking. Depending on the conversations, most home visits (69.2%) lasted between 33 and 65 minutes with an SD of 18 minutes.	N=193 completed ≥3 CHW home visits, N=49 completed <3 home visits. Median number of home visits = 4.7.	UC: Received an initial welcome newsletter and were potentially exposed to a community-wide campaign including mass media, free exercise classes in the community, and environmental changes

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
Vrdoljak, 2014[148]	IG1	HD, PA Medium	Provider training	Primary care physicians received instructions for helping patients fill out questionnaires on adherence to the traditional Mediterranean diet, physical activity, smoking, and alcohol use and received training on using non-pharmacological and/or pharmacological interventions in accordance with recommendations when suboptimal behavior was reported. In addition to the training, physicians received a booklet on the intervention, patient education flyers, and precise protocols for monitoring of the participants. Physicians received repeated group training over one year.	NR	No intervention: Providers were not instructed to perform any specific interventions for their patients and did not receive any training or materials
Wadsworth, 2010[149]	IG1	PA Medium	Web-based intervention	Attended 1 orientation face-to-face session (assume 30 mins) that provided written information regarding exercise: terminology, recommendations, safety precautions, and campus physical activity opportunities, as well as encouraging the participant to begin a moderate exercise program and to ask any questions regarding their exercise program. Results from the dual-energy X-ray absorptiometry (DXA) scan was given to each participant and shown how they compare to individuals their same age and sex. Six weekly e-mails directed participants to Web pages that targeted goal settings, time management, self-monitoring, social support, reinforcements, relapse prevention, realistic expectations of exercise, expectancies of exercise, overcoming barriers to exercise, anticipation of exercise relapse, natural history of exercise, and building of exercise self-efficacy. Each of these 6 Web pages directed the subject to complete a short survey at the end of the Web page. Access to an e-counselor who was a trained exercise physiologist was provided. In addition, a Web site that contained discussion boards, exercise information, exercise suggestions, sample workouts, and community events tailored to the campus community was accessible to participants. In addition, 4 monthly booster e-mails were sent to prevent relapse and overcome barriers to exercise.	55% did not initiate contact with the e-counselor. Of those who did, out of 6 weekly e-mails, 69% responded to all 6, 11% responded to 5, 2% responded to 4, 2% responded to 3, 9% responded to 2, 90% accessed the Web site weekly, 4% accessed the Web site monthly, 6% did not access the Web site	MI: One orientation session with printed materials that included brief information about exercise and encouraged PA
Walthouwer, 2015[154]	IG1	HD, PA Medium	Web-based computer-tailored videos	Six weekly video-based advice sessions: The video version delivered most of the educational content via videos with actors providing the tailored information, which was identical to the information that was delivered via text in the text version. The intervention tailored specific health messages to the participant's answers to online questions regarding energy intake, physical activity level, and socio-cognitive constructs (e.g., intention and self-efficacy). The feedback was very specific and, for example, clearly indicated which specific behavior changes participants could make (e.g., decrease intake of chocolate with X per day). Derived from self-regulation theories and the I-Change Model, the intervention includes several behavior-change techniques such as goal setting, action and	70.5% completed session 1; across all interventions total average of completed sessions=2.15; 10.9% completed all 6 sessions	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				coping planning, evaluation of progress toward goal achievement, consciousness raising, and tailored feedback on behavior and cognitions. There were six weekly sessions of approximately 15 min: (1) session one informed participants about the different intervention sessions, provided feedback regarding their weight, behavior, and socio-cognitive beliefs, and asked participants to set goals; (2) session two provided participants with feedback on the chosen behavior and asked participants to make if-then plans to specify when, where, and how they would take specific actions to realize the behavior change; (3) session three provided participants the option to make coping plans and provided them tailored feedback regarding their change progress in order to realize and maintain behavior changes; and (4) sessions four to six were similar to session three with slight changes, introducing new elements to the intervention (e.g., role models narrating about their own change process and how they dealt with difficult situations). Participants could use the assigned intervention for a maximum period of 3 months.		
	IG2	HD, PA Medium	Web-based computer-tailored text messages	Six weekly text-based advice sessions: The text version delivered tailored information, which was identical to the information that was delivered via video in the video version. The intervention tailored specific health messages to the participant's answers to online questions regarding energy intake, physical activity level, and socio-cognitive constructs (e.g., intention and self-efficacy). The feedback was very specific and, for example, clearly indicated which specific behavior changes participants could make (e.g., decrease intake of chocolate with X per day). Derived from self-regulation theories and the I-Change Model, the intervention includes several behavior-change techniques such as goal setting, action and coping planning, evaluation of progress toward goal achievement, consciousness raising, and tailored feedback on behavior and cognitions. There were six weekly sessions of approximately 15 min: (1) session one informed participants about the different intervention sessions, provided feedback regarding their weight, behavior, and socio-cognitive beliefs, and asked participants to set goals; (2) session two provided participants with feedback on the chosen behavior and asked participants to make if-then plans to specify when, where, and how they would take specific actions to realize the behavior change; (3) session three provided participants the option to make coping plans and provided them tailored feedback regarding their change progress in order to realize and maintain behavior changes; and (4) sessions four to six were similar to session three with slight changes, introducing new elements to the intervention (e.g., role models narrating about their own change process and how they dealt with difficult situations). Participants could use the assigned intervention for a maximum period of 3 months.	74.1% completed session 1; across all interventions total average of completed sessions=2.15; 10.9% completed all 6 sessions	WL: Waitlist
Warner, 2016[150]	IG1	PA Medium	Group counseling	One 170 min interactive group sessions (3-8 participants/group) designed to increase PA through social support and ongoing goal setting plus targeting	Group sessions averaged 166 mins	AC: One 2hr 45min group

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
			with views-on-aging component	positive views-on-ageing. Information on PA opportunities for older adults (for all city districts where the participants lived) was available for free in the intervention room. Participants were also informed that they should consult their physician in order to clarify what kind of PA would be suitable for their health status.	with 5.9 participants on average per group session	session focused on volunteering
Warner, 2016[150]	IG2	PA Medium	Group counseling	One 170 min interactive group sessions (3-8 participants/group) designed to increase PA through social support and ongoing goal setting plus targeting positive views-on-ageing. Instead, this group received one extra action planning sheet to increase PA. Information on PA opportunities for older adults (for all city districts where the participants lived) was available for free in the intervention room. Participants were also informed that they should consult their physician in order to clarify what kind of PA would be suitable for their health status.	Group sessions averaged 170 mins with 6.3 participants on average per group session	AC: One 2hr 45min group session focused on volunteering
Wieland, 2018[55]	IG1	HD, PA, SB High	Home visits and telephone calls	The intervention consisted of 12 content modules: 4 for physical activity (increasing physical activity, muscle strength and flexibility, reducing screen time, and overcoming barriers to physical activity), 6 for nutrition (increasing fruits and vegetables, healthful beverages, reducing dietary fats, healthful snacks, portion control, and smart shopper strategies), and 2 for synthesizing and reinforcing information (exercise/food/work-life balance and celebrating accomplishments). To promote behavior change outside of sessions, the intervention also included a focal asset map of physical activity and nutrition resources within Rochester, Minnesota. Newsletters were created that highlighted key messages from each module and incorporated success stories from community members from each group; these were included in the manual. Family health promotors (FHPs) delivered the intervention to participating families through 12 home visits in a 6-month period, followed by phone calls every 2 weeks (up to 12 calls total) during the next 6-month period. Home visits were used to sequentially deliver each of the 12 content modules. At each visit, FHPs also monitored progress on family goals and provided social support and mentoring to problem-solve barriers and to set realistic future goals. FHPs facilitated the family's participation in existing community-based physical activity or group fitness programs. FHPs incorporated counseling strategies consistent with social cognitive theory, including role-modeling, feedback and reinforcement, shaping, and social support to enhance self-efficacy and behavior change. FHPs, who were recruited from each of the 3 immigrant populations, modeled healthful behaviors during family sessions (e.g., they measured foods, demonstrated movements, and provided specific examples of healthful food choices). Each visit for the delivery of a content module included the following components: 1) assessment of existing subject knowledge and current behaviors related to each module topic, 2) delivery of information and "key" concepts, 3) engagement in an interactive activity (e.g., working with food models), 4) discussion of perceived barriers and potential solutions with household members, and 5) individual and family goal setting. After completion of home visits, FHPs initiated follow-up 15-minute phone calls to each participating	100% of the participating families met the predefined criteria for treatment adherence, and every family had at least 1 individual receiving the entire intervention (12 visits). Most visits included at least 1 adult (91%) and 1 adolescent (88%).	WL: Waitlist

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				family every 2 weeks, making up to 12 phone calls over the next 6 months. FHPs spoke with an adult participant representing the family and began by obtaining a progress report about the family's physical activity and diet. Conversations ended with a brief content summary reinforcing points pertaining to 1 of the 12 modules.		
Wing, 2016[155]	IG1	HD, PA High	Group counseling and tailored feedback on large behavior changes	Intervention began with 10 face-to-face group meetings over 4 months followed by maintenance phase delivered primarily online over 3 years. Each year, participants were invited to join 2 4-week online refresher campaigns reinforcing the behaviors taught during the initial program. Based on self-regulation theory, intervention emphasized on daily self-weighing; provided basic information about healthy eating and physical activity, and taught participants behavior modification skills to facilitate the prescribed behavior changes (small or large). Self-regulation involved the following techniques 1) a negative feedback loop, in which there was a goal to not exceed baseline weight; error detector which was the scale and daily self-weighing; and 3) controlling responses which involved changes in diet and exercise consistent with the prescribed behavior changes. Participants in the large behavior changes focused on losing weight (2.3 kg if normal weight; 4.5 kg if overweight) during the initial 4-month program to create a buffer against subsequent weight gain. To achieve this, participants were prescribed a calorie goal based on a 500- to 1,000-kcal deficit from baseline to use during the initial 8 weeks. They were also encouraged to gradually increase moderate-intensity physical activity to a goal of 250 minutes/week, the level recommended for weight loss maintenance, and to maintain this over time. If weight exceeded baseline, they were to return to their calorie goal and confirm that they were achieving the activity goal. After 4 months of initial program and during maintenance phase over 3 years, participants were instructed to continue weighing themselves daily and submit their weight via the study website, text message, or email. They received monthly email feedback on their weight, which was based on a color-coded system and either reinforced their success, encouraged problem solving, or recommended additional strategies to help reverse weight gain. Participants who gained above baseline were invited to contact a study interventionist for problem-solving assistance via email, telephone, or face to face. All participants received identical quarterly newsletters and personalized feedback reports on their assessment data.	87.4% attended 10 sessions, 75% reported daily self-weighing	MI: Attended 1 face-to-face meeting where they were introduced to the issue of weight gain, the concept of self-regulation, and an overview of both the small- and large changes approaches to potentially prevent weight gain, and received a quarterly newsletter
Wing, 2016[155]	IG2	HD, PA High	Group counseling and tailored feedback on small behavior changes	Intervention began with 10 face-to-face group meetings over 4 months followed by maintenance phase delivered primarily online over 3 years. Each year, participants were invited to join 2 4-week online refresher campaigns reinforcing the behaviors taught during the initial program. Based on self-regulation theory, intervention emphasized on daily self-weighing; provided basic information about healthy eating and physical activity, and taught participants behavior modification skills to facilitate the prescribed behavior changes (small or large). Self-regulation involved the following techniques 1) a negative feedback loop, in which there was	86.0% attended 10 sessions, 72% reported daily self-weighing	MI: Attended 1 face-to-face meeting where they were introduced to the issue of weight gain, the concept of

Appendix E Table 2. Intervention Details for All Studies, by Author

Author, Year	Group	Beh target Intensity	Intervention	Detailed description	Adherence	Control group
				a goal to not exceed baseline weight; error detector which was the scale and daily self-weighing; and 3) controlling responses which involved changes in diet and exercise consistent with the prescribed behavior changes. Participants in small behavior changes were taught to make daily small changes (approximately 100 kcal/d) in both diet (e.g., select lower-calorie coffee drinks, reduce portion sizes) and physical activity (e.g., park farther from store when shopping, use stairs). Participants were given pedometers and instructed to add 2,000 steps per day (equivalent to 1.7 km) above baseline. If participants in small changes experienced weight gains above baseline, they were encouraged to make additional daily small changes. After 4 months of initial program and during maintenance phase over 3 years, participants were instructed to continue weighing themselves daily and submit their weight via the study website, text message, or email. They received monthly email feedback on their weight, which was based on a color-coded system and either reinforced their success, encouraged problem solving, or recommended additional strategies to help reverse weight gain. Participants who gained above baseline were invited to contact a study interventionist for problem-solving assistance via email, telephone, or face to face. All participants received identical quarterly newsletters and personalized feedback reports on their assessment data.		self-regulation, and an overview of both the small- and large changes approaches to potentially prevent weight gain, and received a quarterly newsletter

Abbreviations: 5 A's=5 A's Intervention Strategy (Ask, Advise, Assess, Assist, and Arrange); AC=attention control; ACSM=American College of Sports Medicine; Beh=behavioral; BMI=body mass index; CDC=Centers for Disease Control and Prevention; CG=control group; CHD=coronary heart disease; CVD=cardiovascular disease; DHI=digital health intervention; dL=deciliter; DVD=digital versatile disc; FU=followup; g=grams; GP=general practitioner; HD=healthy diet; HDL-C=high-density lipoprotein cholesterol; HPV=human papillomavirus; HRA=health risk assessment; IG=intervention group; IQR=interquartile range; kcal=kilocalorie; kg=kilograms; LDL-C=low-density lipoprotein cholesterol; M±SD=mean, standard deviation; mg=milligrams; MI=minimal intervention; Min=minutes; mm Hg=millimeter of mercury; Mo=month; MVPA=moderate to vigorous physical activity; NHLBI=National Heart, Lung, and Blood Institute; NIH=National Institutes of Health; NR=not reported; PA=physical activity; PACE=Physician-Based Assessment and Counseling for Exercise; PCP=primary care provider; PDF=portable document format; SB=sedentary behavior; SCT=Social Cognitive Theory; SD=standard deviation; SMS=short message service; TTM=Transtheoretical Model; UC=usual care; VA/VHA=Veterans Affairs/Veterans Health Administration; WL=waitlist; YMCA=Young Men's Christian Association.

Appendix E Table 3. Intervention Behavioral Targets and Techniques for All Studies, by Author

Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
Aadahl, 2014[71]	IG1	Counseling	SB							NR	X	X			X	X	
Aittasalo, 2006[72]	IG1	Brief counseling	PA							NR							X
	IG2	Self-monitoring	PA							NR		X					
Albright, 2014[73]	IG1	Tailored telephone counseling plus website	PA							NR	X	X	X		X	X	
Aldana, 2006[74]	IG1	Group counseling	HD, PA	X	X	X	X			NR		X					
Alexander, 2010[75]	IG1	Tailored web-based + e-mail counseling	HD			X				SCT, TTM, HBM	X	X		X	X	X	
	IG2	Tailored web-based counseling	HD			X				SCT, TTM, HBM	X	X		X	X		
Allman-Farinelli, 2016[49]	IG1	Counseling telephone calls and tailored feedback via text and email messages	HD, PA	X*		X				TTM	X	X				X	
Anand, 2016[66]	IG1	Email messages targeting HD and PA	HD, PA, SB			X				TTM	X	X					
Ball, 2016[64]	IG1	Skill-building newsletters and optional supermarket tour	HD			X				SCT	X						
Baron, 1990[76]	IG1	Counseling	HD	X			X			NR							
Bennett, 2013[77]	IG1	Counseling, tailored print materials, and self-monitoring	HD, PA	X		X				SCT	X	X	X		X	X	
Beresford, 1997[78]	IG1	Brief counseling and	HD				X			SCT	X						

Appendix E Table 3. Intervention Behavioral Targets and Techniques for All Studies, by Author

Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
		self-help material															
Bernstein, 2002[79]	IG1	Home-based education	HD			X				NR	X	X		X			
Bickmore, 2013[80]	IG1	Computer-based counseling	PA							NR	X	X					
Brekke, 2005[81]	IG1	Group counseling (diet)	HD			X	X			NR			X				
	IG2	Group counseling (diet and PA)	HD, PA			X	X			NR	X		X				
Bryan, 2013[82]	IG1	Tailored print mailings	PA							SCT, TTM	X	X		X	X		
Burke, 2013[83]	IG1	Self-help booklet and phone and e-mail counseling	HD, PA	X						Precede-Proceed Model, SCT	X	X	X		X		
Caplette, 2017[58]	IG1	Access to a healthy eating blog (Salsa Etcetera)	HD			X				NR	X						
Carpenter, 2004[84]	IG1	Group counseling	HD		X	X	X			SCT, TTM	X	X	X	X			
	IG2	Mailed materials and website	HD		X	X	X			SCT, TTM	X	X	X	X			
Carroll, 2010[85]	IG1	Tailored print mailings	PA							TTM	X	X		X	X		
Coates, 1999[86]	IG1	Group counseling	HD				X			NR	X	X	X				
de Vet, 2009[87]	IG1	Self-directed and self-selected activity plan (with repeat planning)	PA, SB							NR	X						

Appendix E Table 3. Intervention Behavioral Targets and Techniques for All Studies, by Author

Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
	IG2	Self-directed and self-selected activity plan (one-time plan)	PA							NR	X						
	IG3	Self-directed walking plan (one-time plan)	PA							NR	X						
Delichatsios, 2001[88]	IG1	Automated telephone counseling	HD	X						SCT	X	X		X	X		
Elley, 2003[89]	IG1	Counseling with tailored prescription	PA			X	X			TTM	X			X			
Estabrooks, 2011[90]	IG1	Group counseling	PA							Group Dynamics Model	X	X	X		X		X
Fischer, 2019[70]	IG1	Tailored telephone counseling and text messages	PA							Behavior Change Wheel Framework (BCW) and MoVo (motivation and volition) Process	X	X	X	X	X		
	IG2	Tailored telephone counseling	PA							Behavior Change Wheel Framework (BCW) and MoVo (motivation and volition) Process	X	X	X	X	X		
Fjeldsoe, 2015[91]	IG1	Counseling and regular text messages	PA							SCT	X	X	X	X	X		
Franko, 2008[92]	IG1	Web-based intervention	HD, PA	X						TTM							

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	IG2	Web-based intervention	HD, PA	X						TTM	X	X		X	X		
Fries, 2005[93]	IG1	Tailored print mailing and brief counseling call	HD				X			SCT, TTM	X			X	X		
Fukuoka, 2019[69]	IG1	Brief counseling and mobile-phone application with tailored feedback for 3 months plus a 6-month maintenance phase	PA							SCT	X	X	X				
	IG2	Brief counseling and mobile-phone application with tailored feedback for 3 months	PA							SCT	X	X	X				
Gao, 2016[94]	IG1	Individual counseling and tailored print materials	PA							SCT, TTM		X					
Gell, 2015[95]	IG1	Targeted text messages	PA							Behavior Choice Theory	X		X		X		
Gill, 2019[151]	IG1	Individual counseling with tailored PA and HD prescriptions	HD, PA, SB	X		X	X			NR							
Goldstein, 1999[96]	IG1	Brief counseling with tailored prescription	PA							SCT, TTM, Theory of health education	X						X

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
Gomez Quinonez, 2016[59]	IG1	Tailored feedback via text messages (mHealth)	PA							I-Change model, Health Action Process Approach	X	X			X		
	IG2	Tailored feedback via email (eHealth)	PA							I-Change Model, Health Action Process Approach	X	X			X		
Grandes, 2009[97]	IG1	Brief counseling	PA							HBM, SCT	X	X					
Green, 2002[98]	IG1	Telephone counseling	PA							TTM	X	X					
Greene, 2008[99]	IG1	Tailored print mailings and telephone counseling	HD			X				TTM							
Guagliano, 2020 [157]	IG1	Web-based goal setting and tailored feedback	PA							Socio-ecological model; family systems theory; SDT	X	X	X		X		
	IG2	Pedometer only	PA							NR	X						
Halbert, 2000[100]	IG1	Counseling	PA							NR	X				X		
Halperin, 2019[68]	IG1	Peer counseling	HD, PA			X			X	Health Self-empowerme nt Model			X		X		
Hargreaves, 2016[101]	IG1	Tailored walking program	PA							SCT, SRT	X	X			X		
Harland, 1999[102]	IG1	Counseling and PA vouchers	PA							TTM	X			X			
	IG2	Counseling	PA							TTM	X			X			

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
	IG3	Brief counseling and PA vouchers	PA							TTM	X			X			
	IG4	Brief counseling	PA							TTM	X			X			
Harris, 2015[103]	IG1	Counseling and self-monitoring	PA							NR	X	X	X		X		
Harris, 2018[50]	IG1	Pedometer-based walking intervention with nurse support	PA							NR	X	X	X	X	X		
	IG2	Pedometer-based walking intervention	PA							NR	X	X	X	X	X		
Herghelegiu, 2017[54]	IG1	Individual counseling	HD, PA, SB			X				TTM	X	X	X				
Hivert, 2007[104]	IG1	Group counseling	HD, PA	X						SCT	X	X		X			
Horton, 2018[48]	IG1	Home visits and print communication	HD	X		X				SCT, Family Systems Theory	X	X			X		
Jacobs, 2011[105]	IG1	Counseling	HD, PA				X			SCT, TPB	X	X			X		
James, 2017[63]	IG1	Individual counseling	PA							SCT	X	X	X	X			
	IG2	Individual and telephone counseling	PA							SCT	X	X	X	X			
Jeffery, 1999[106]	IG1	Nontailored print mailings	HD, PA			X	X			NR							
	IG2	Nontailored print mailings plus incentives	HD, PA			X	X			NR							
Jenkins, 2017[52]	IG1	Telephone counseling	HD	X						NR	X						
John, 2002[107]	IG1	Counseling	HD			X				NR	X						X

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Kallings, 2009[108]	IG1	Counseling with tailored prescription	PA							SCT, TTM	X		X	X	X	X	X
Kattelmann, 2014[109]	IG1	Web-based intervention	HD, PA			X				TTM	X						
Katz, 2008[110]	IG1	Provider training	PA							NR	X			X		X	
Kegler, 2016[57]	IG1	In-person tailored home environment coaching with nutrition and PA focus	HD, PA	X					X	SCT	X	X	X				
Kerr, 2016[111]	IG1	Tailored text messages	HD	X		X				SDT		X		X		X	
	IG2	Text messages	HD			X				SDT		X		X		X	
King, 2007[113]	IG1	Automated telephone counseling	PA							SCT, TTM	X	X		X	X		
	IG2	Telephone counseling	PA							SCT, TTM	X	X		X	X		
King, 2013[112]	IG1	Telephone counseling with self-monitoring (PA and diet simultaneous)	HD, PA			X	X			SCT, TTM	X	X	X	X	X		
	IG2	Telephone counseling with self-monitoring (diet discussions first)	HD, PA			X	X			SCT, TTM	X	X	X	X	X		
	IG3	Telephone counseling with self-monitoring (PA discussions first)	HD, PA			X	X			SCT, TTM	X	X	X	X	X		

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
Kinmonth, 2008[114]	IG1	Telephone counseling	PA							TPB	X	X	X		X		
	IG2	In-home, individual counseling	PA							TPB	X	X	X		X		
Kolt, 2007[115]	IG1	Telephone counseling	PA							TTM	X		X	X	X	X	
Koniak-Griffin, 2015[46]	IG1	Group education plus individual home visits and telephone calls	HD, PA	X						NR	X	X			X		
Kristal, 2000[116]	IG1	Tailored print mailings and telephone counseling	HD			X	X			SCT, TTM	X	X					
Larsen, 2020[156]	IG1	Counseling and individually tailored print materials and text messages	PA							SCT, TTM	X	X				X	
Lawton, 2008[156]	IG1	Counseling with tailored prescription	PA							NR	X						
Lewis, 2013[118]	IG1	Tailored print mailings	PA							SCT, TTM	X	X		X	X		
Lombard, 2016[62]	IG1	One group session, personalized program manual, monthly text messages, and one telephone session	HD, PA	X		X			X	SDT, CBT	X					X	
Lutz, 1999[119]	IG1	Tailored print mailings with tailored prescription	HD			X				SCT, TTM, HBM	X						

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
	IG2	Tailored print mailings	HD			X				SCT, TTM, HBM							
	IG3	Nontailored print mailings	HD			X				SCT, TTM, HBM							
Mailey, 2014[120]	IG1	Group counseling	PA							SCT	X				X		
Marcus, 2007[122]	IG1	Telephone counseling	PA							SCT, TTM	X	X		X	X		
	IG2	Tailored print materials	PA							SCT, TTM	X	X		X	X		
Marcus, 2013[121]	IG1	Tailored print mailings and self-monitoring	PA							SCT, TTM	X	X	X	X	X		
Marcus, 2016[61]	IG1	Tailored internet intervention	PA							TTM, SCT	X	X					
Marsaux, 2015[123]	IG1	Tailored web-based advice (diet, PA, and phenotype)	HD, PA			X				NR		X					
	IG2	Tailored web-based advice (diet & PA only)	HD, PA			X				NR		X					
	IG3	Tailored web-based advice (diet, physical activity, phenotype, and genotype)	HD, PA			X				NR		X					
Marshall, 2003[124]	IG1	Tailored print mailing	PA							TTM	X			X	X		
Martinson, 2008[125]	IG1	Counseling	PA							SCT	X	X	X				
Maselli, 2017[53]	IG1	Individual counseling	PA							TTM, SCT		X			X		
	IG2	PA monitor	PA							TTM, SCT	X				X		
Metzgar, 2016[65]	IG1	Weight gain prevention intervention delivered by	HD			X			X	NR							

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
		registered dietician (RDG)															
	IG2	Weight gain prevention intervention delivered by a counselor (CSG)	HD			X			X	NR							
Mosca, 2008[126]	IG1	Counseling	HD, PA	X		X	X			TTM	X	X		X	X		X
Napolitano, 2006[127]	IG1	Tailored print mailings	PA							TTM	X	X		X	X		
	IG2	Nontailored print mailings	PA							SCT, TTM	X			X	X		
Norris, 2000[128]	IG1	Counseling	PA							TTM	X		X	X	X		
Oddone, 2018[47]	IG1	Health risk assessment and individual coaching	HD, PA	X						NR	X	X				X	
Parekh, 2014[129]	IG1	Computer-tailored print mailings (two contacts)	HD, PA		X	X	X			NR	X	X					
	IG2	Computer-tailored print mailing (one contact)	HD, PA		X	X	X			NR	X	X					
Patel, 2017[51]	IG1	Gamification (incentive-based family intervention) including daily goal-related feedback	PA							Behavioral economics	X	X					
Patel, 2019[153]	IG1	Gamification with competition and goal feedback	PA							Behavioral economics	X		X	X			

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	IG2	Gamification with collaboration and goal feedback	PA							Behavioral economics	X		X	X			
	IG3	Gamification with support and goal feedback	PA							Behavioral economics	X		X	X			
Pekmezi, 2009[130]	IG1	Tailored print mailings and self-monitoring	PA							SCT, TTM	X	X	X	X	X		
Pinto, 2002[131]	IG1	Automated telephone counseling	PA							SCT, TTM	X	X		X	X		
Pinto, 2005[132]	IG1	Counseling with tailored prescription	PA							TTM	X			X	X		
Roderick, 1997[133]	IG1	Counseling	HD	X						NR							
Ruffin, 2011[134]	IG1	Computer-tailored web-based intervention	HD, PA			X				TTM	X	X			X		
Sacerdote, 2006[135]	IG1	Brief counseling	HD	X		X				NR	X						
Samdal, 2019[67]	IG1	Individual counseling and optional group-based PA sessions	PA							SDT	X	X	X		X	X	
Simkin-Silverman, 1995[136]	IG1	Group counseling	HD, PA	X						NR	X	X	X	X	X		
Smith, 2014[137]	IG1	Counseling	HD, PA	X						NR	X	X		X	X		
Spring, 2018[60]	IG1	Smartphone app and remote coaching	HD, PA, SB			X	X			NR	X	X		X		X	

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
		(simultaneous behaviors)															
	IG2	Smartphone app and remote coaching (sequential behaviors – MVPA delayed by 7 weeks)	HD, PA, SB			X	X			NR	X	X		X		X	
Springvloet, 2015[138]	IG1	Web-based tailored education-plus feedback	HD			X	X			SRT, TPB, Precaution Adoption Process Model	X	X			X		
	IG2	Web-based tailored education	HD			X	X			SRT, TPB, Precaution Adoption Process Model	X	X			X		
Stewart, 2001[139]	IG1	Group counseling	PA							SCT	X				X		
Sun, 2017[56]	IG1	Interactive online educational modules	HD, PA, SB	X		X			X	IBM	X						
Thompson, 2008[140]	IG1	Group counseling	HD, PA			X	X			SCT, TTM	X			X	X		
Thompson, 2014[141]	IG1	Counseling and self-monitoring	PA							NR	X	X					
Tinker, 2008[142]	IG1	Group counseling	HD			X	X			NR	X	X	X		X		
Tokunaga-Nakawatase, 2014[143]	IG1	Computer-tailored print mailings	HD, PA	X						NR	X	X					
Valve, 2013[144]	IG1	Counseling	HD, PA	X						NR	X	X	X		X		
Van Hoecke, 2014[145]	IG1	Counseling	PA							SCT	X				X	X	
	IG2	Tailored prescription	PA							NR							

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Author, Year	Grp	Intv	Beh tar	Diet, GHH	Diet, Sdm	Diet, F&V	Diet, Fat	Diet, Medit	Wt Gn Prev	Theory	BCT, Goals	BCT, Tailored feedback	BCT, Soc Sup	BCT, Comp out	BCT, Self-belief	MI	5As
Van Keulen, 2011[158]	IG1	Tailored print mailing and telephone motivational	HD, PA			X	X			SCT; TTM; I-change model	X	X			X	X	
	IG2	Telephone sessions only	HD, PA			X	X			SCT; TTM; I-change model	X	X			X	X	
	IG3	Computer-tailored print mailings only	HD, PA			X	X			SCT; TTM; I-change model	X	X			X		
Van Stralen, 2010[146]	IG1	Tailored print mailings with environmental focus	PA							TTM	X	X	X		X		
	IG2	Tailored print mailings	PA							TTM	X	X	X		X		
Vandelanotte, 2005[147]	IG1	Computer-based sessions with tailored feedback (PA and diet simultaneous)	HD, PA				X			TPB, TTM	X	X			X		
	IG2	Computer-based sessions with tailored feedback (PA feedback first)	HD, PA				X			TPB, TTM	X	X			X		
	IG3	Computer-based sessions with tailored feedback (diet feedback first)	HD, PA				X			TPB, TTM	X	X			X		
Vidoni, 2019[152]	IG1	Home visits and newsletter discussions	HD, PA	X		X				TTM	X		X			X	
Vrdoljak, 2014[148]	IG1	Provider training	HD, PA					X		NR							

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Wadsworth, 2010[149]	IG1	Web-based intervention	PA							SCT	X	X	X	X	X		
Walthouwer, 2015[154]	IG1	Web-based computer-tailored videos	HD, PA	X					X	I-Change Model, Self-Regulation theory	X	X		X	X		
	IG2	Web-based computer-tailored text messages	HD, PA	X					X	I-Change Model, SRT	X	X		X	X		
Warner, 2016[150]	IG1	Group counseling with views-on-aging component	PA							Health Action Process Approach	X	X	X		X		
	IG2	Group counseling	PA							Health Action Process Approach	X	X	X		X		
Wieland, 2018[55]	IG1	Home visits and telephone calls	HD, PA, SB			X				SCT	X	X	X		X		
Wing, 2016[155]	IG1	Group counseling and tailored feedback on large behavior changes	HD, PA	X					X	SRT	X	X		X			
	IG2	Group counseling and tailored feedback on small behavior changes	HD, PA	X					X	SRT	X	X		X			

Abbreviations: 5As=Ask, Advise, Assess, Assist, and Arrange; BCT=Behavior Change Technique; Beh tar=behavioral target; Comp out=compares outcomes; F&V=fruit and vegetables; GHH=general heart healthy; HBM=Health Belief Model; HD=healthy diet; IBM= Information Behavioral Skills Model; IG=intervention group; Intv=intervention; Medt=Mediterranean; MI=motivational interviewing; NR=not reported; PA=physical activity; SB=sedentary behavior; SCT=Social Cognitive Theory; Sdm=sodium; SDT=Self-Determination Theory; Soc sup=social support; Sod=sodium; SRT=Self-regulation Theory; TPB=Theory of Planned Behavior; TTM=Transtheoretical Model of Change; Wt Gn Prev=weight gain prevention.

* Focus on reducing intake of sugar-sweetened beverages

Appendix F Table 1. Mortality and Cardiovascular Disease Health Outcomes (Key Question 1)

Author, year (Study name) Quality	Population (N rand)	Intervention	FU (mo)	Outcome*	IG n/N (%)	CG n/N (%)	Study-reported HR (95% CI), p-value
Harris, 2015[103, 160] (PACE-Lift) Good	Adults aged 60-75 yrs (N=298)	IG1: PA counseling and self-monitoring	48	Nonfatal CVD events	1/133 (0.8)	3/132 (2.3)	NR
				Fatal and nonfatal CVD events	2/133 (1.5)	4/132 (3.0)	NR
Harris, 2018[50, 160] (PACE-UP) Good	Adults aged 45-75 yrs (N=1023)	IG1: Pedometer-based walking intervention with nurse support	12	Nonfatal CVD events	2/340 (0.6)	8/334 (2.4)	NR
		IG2: Pedometer-based walking intervention	12	Nonfatal CVD events	1/331 (0.3)	8/334 (2.4)	NR
		IG1+IG2: Pedometer-based walking intervention with and without nurse support	12	Nonfatal CVD events	3/671 (0.4)	8/334 (2.4)	NR, p=0.04
			48	Nonfatal CVD events	3/636 (0.5)	6/301 (1.9)	NR
			48	Fatal and nonfatal CVD events	3/636 (0.5)	6/301 (1.9)	NR
Harris, 2015 (PACE-Lift) and Harris, 2018 (PACE-UP) combined samples[160]	Adults aged 45-75 yrs (N=1,321)	Pedometer-based walking interventions	48	Nonfatal CVD events	4 (0.5)	9 (2.0)	0.27 (0.08 to 0.88), p=0.03
				Fatal and nonfatal CVD events	5 (0.7)	10 (2.3)	0.31 (0.11 to 0.93), p=0.04
Tinker, 2008[142, 162, 163] (WHI DMT) Good	Postmenopausal women aged 50-79 yrs (N=47,179)	IG1: Healthy diet group counseling	102†	All-cause mortality	885/19541 (4.5)	1391/29294 (4.7)	0.96 (0.86 to 1.04), NSD
				CVD mortality	124/18633 (0.7)	185/27925 (0.7)	1.01 (0.81 to 1.27), NSD
				CHD	490/19541 (2.5)	797/29294 (2.7)	0.92 (0.83 to 1.03), NSD
				Total CVD events	1187/19541 (6.1)	1800/29294 (6.1)	0.96 (0.89 to 1.03), NSD
				Total stroke	385/19541 (2.0)	558/29294 (1.9)	1.04 (0.91 to 1.18), NSD
			160‡	All-cause mortality	4950/19541 (25.3)	7605/29294 (26.0)	0.97 (0.94 to 1.01), NSD
				CHD	792/19541 (4.1)	1225/29294 (4.2)	0.99 (0.90 to 1.08), NSD
				Total CVD events	1860/19541 (9.5)	2898/29294 (9.9)	0.98 (0.92 to 1.03), NSD
				Total stroke	652/19541 (3.3)	1004/29294 (3.4)	0.99 (0.90 to 1.09), NSD

Abbreviations: CG=control group; CHD=coronary heart disease; CI=confidence interval; CVD=cardiovascular disease; FU=followup; HR=hazard ratio; IG=intervention group; MI=myocardial infarction; Mo=months; NR=not reported; NSD=non-significant difference; PA=physical activity; PACE-Lift=Pedometer Accelerometer Consultation Evaluation; PACE-UP=Pedometer and Consultation Evaluation; Rand=randomized; WHI DMT=Women's Health Initiative Dietary Modification Trial.

* In PACE-Lift and PACE-UP, nonfatal CVD events were defined as MI, coronary artery bypass graft, angioplasty, transient ischemic attack, and stroke and fatal and nonfatal CVD events included these nonfatal events as well as fatal CVD. In the WHI-DMT, CHD was defined as nonfatal MI plus CHD death, total CVD events were defined as CHD plus coronary artery bypass graft or percutaneous coronary intervention plus stroke, and total stroke equaled ischemic plus hemorrhagic stroke
† Median followup of 8.5 years
‡ Median followup of 13.4 years

Appendix F Table 2. Quality of Life/Subjective Well-being Outcomes (Key Question 1)

Author, year Quality	Intv focus Intensity	Intv arm	FU (mo)	Instrument	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Between-group mean difference in change, p-value
Allman-Farinelli, 2016[49] Fair	HD, PA Medium	IG1	9	WHO-5	96	11.8 (4.7)	3.4 (4.5)	104	12.9 (4.5)	1.4 (5.2)	0.80 (-0.50 to 2.10), 0.20
Fukuoka, 2019[69] Good	PA Medium	IG1	9	SF-12 MC	70	49.1 (9.2)	NR (NR)	69	47.5 (9)	NR (NR)	NR, 0.43
				SF-12 PC	70	50.9 (6.1)	NR (NR)	69	51.5 (6.8)	NR (NR)	NR, 0.60
		IG2	9	SF-12 MC	71	49 (8.8)	NR (NR)	69	47.5 (9)	NR (NR)	NR, 0.43
				SF-12 PC	71	52.1 (5.6)	NR (NR)	69	51.5 (6.8)	NR (NR)	NR, 0.60
Gill, 2019[151] Fair	HD, PA, SB Medium	IG1	6	EQ-VAS	59	NR (NR)	5.9 (14.3)	59	NR (NR)	4.3 (13.8)	1.55 (-3.25 to 6.35), 0.52
Grandes, 2009[97] Good	PA Low	IG1	6	SF-36 MC	1886	45.8 (11.7)	0.9 (27.9)	1766	46.7 (11.5)	0.6 (27.0)	0.43 (-0.15 to 1.02), NSD
				SF-36 PC	1886	48.1 (8.2)	1.4 (17.6)	1766	47.7 (8.3)	1.4 (17.1)	-0.05 (-0.48 to 0.38), NSD
			12	SF-36 MC	1886	45.8 (11.7)	1.1 (28.0)	1766	46.7 (11.5)	1.3 (27.1)	0.06 (-0.55 to 0.67), NSD
				SF-36 PC	1886	48.1 (8.2)	1.2 (17.8)	1766	47.7 (8.3)	1.3 (17.3)	-0.10 (-0.58 to 0.38), NSD
			24	SF-36 MC	1886	45.8 (11.7)	1.6 (28.0)	1766	46.7 (11.5)	1.8 (27.2)	0.00 (-0.63 to 0.63), NSD
				SF-36 PC	1866	48.1 (8.2)	1.2 (17.9)	1766	47.7 (8.3)	1.2 (17.4)	-0.06 (-0.44 to 0.55), NSD
Guagliano, 2020 Fair[157]	PA High	IG1	12	EQ-5D	15	75.4 (14.0)	6.5 (11.4)	18	86.5 (8.3)	-2.8 (10.0)	9.30 (2.00 to 16.60)*, ≤0.05
	PA Low	IG2	12	EQ-5D	13	82.7 (11.1)	1.3 (7.9)	18	86.5 (8.3)	-2.8 (10.0)	4.10 (-2.46 to 10.66)*, NSD
Harris, 2015[103] Good	PA Medium	IG1	12	EQ-5D	137	NR (NR)	NR (NR)	136	NR (NR)	NR (NR)	-0.01 (-0.04 to 0.02), 0.55
			48	EQ-5D	108	NR (NR)	NR (NR)	117	NR (NR)	NR (NR)	0.04 (0.00 to 0.08), 0.08
Harris, 2018[50] Good	PA Medium	IG1	12	EQ-5D	319	0.85 (0.13)	-0.02 (0.14)	318	0.84 (0.14)	0 (0.15)	-0.01 (-0.03 to 0.01), 0.23
			36	EQ-5D	231	0.85 (0.13)	NR (NR)	214	0.84 (0.14)	NR (NR)	0.00 (-0.02 to 0.03), 0.80
	PA Low	IG2	12	EQ-5D	311	0.85 (0.12)	-0.01 (0.13)	318	0.84 (0.14)	0 (0.15)	-0.01 (-0.03 to 0.01), 0.30
			36	EQ-5D	236	0.85 (0.12)	NR (NR)	214	0.84 (0.14)	NR (NR)	0.00 (-0.03 to 0.02), 0.86

Appendix F Table 2. Quality of Life/Subjective Well-being Outcomes (Key Question 1)

Author, year Quality	Intv focus Intensity	Intv arm	FU (mo)	Instrument	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Between-group mean difference in change, p-value
Van Hoecke, 2014[145] Fair	PA Medium	IG1	12	Study-defined	124	5.25 (0.89)	0.16 (0.84)	114	5.28 (0.89)	0.13 (0.82)	0.03 (-0.18 to 0.24)*, NSD
			24	Study-defined	113	5.25 (0.89)	0.01 (0.81)	112	5.28 (0.85)	-0.07 (0.81)	0.08 (-0.13 to 0.29)*, NSD
	PA Low	IG2	12	Study-defined	110	5.31 (0.8)	0.19 (0.82)	114	5.28 (0.89)	0.13 (0.82)	0.06 (-0.15 to 0.28)*, NSD
			24	Study-defined	119	5.31 (0.8)	-0.07 (0.83)	112	5.28 (0.85)	-0.07 (0.81)	0.00 (-0.21 to 0.21)*, NSD
Wieland, 2018[55] Fair	HD, PA, SB High	IG1	12	Study-defined	36	NR (NR)	0.4 (0.9)	34	NR (NR)	0 (1.2)	0.40 (-0.10 to 0.90)*, 0.25

Abbreviations: BL=baseline; CG=control group; EQ-5D=EuroQol- 5 Dimension; EQ-VAS=EuroQual Visual Analog Scale; FU=followup; HD=healthy diet; IG=intervention group; Intv=intervention; MC=mental component; mPED=mobile phone based physical activity education; mo=months; NR=not reported; NSD=non-significant difference**;** PA=physical activity; PACE-Lift=Pedometer Accelerometer Consultation Evaluation; PACE-UP=Pedometer And Consultation Evaluation; PC=physical component; SB=sedentary behavior; SD=standard deviation; SF-12=Short Form 12; SF-36=Short Form 36; WHO=World Health Organization.

* Calculated

Appendix G Table 1. Blood Pressure Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aldana, 2006[74] Fair	IG1	HD, PA High	SBP (mm Hg)	6*	174	129 (16)	-5 (15.31)	174	128 (17)	-4 (14.67)	-1.00 (-4.00 to 2.00), 0.51
			DBP (mm Hg)	6*	174	78.3 (9.2)	-5.5 (8.46)	174	76.7 (9.6)	-3.8 (8.07)	-1.70 (-3.50 to 0.00), 0.04
			Percent with hypertension, SBP 140-159 mm Hg (%)	6	174	35 (20.1)	28 (16.1)	174	40 (23.0)	21 (12.1)	OR=1.40 (0.76 to 2.57), NSD
			Percent with hypertension, SBP ≥160 mm Hg (%)	6	174	8 (4.6)	6 (3.4)	174	5 (2.9)	8 (4.6)	OR=0.74 (0.25 to 2.18), NSD
			Percent with hypertension, DBP 90-99 mm Hg (%)	6	174	20 (11.5)	7 (4.0)	174	18 (10.3)	5 (2.9)	OR=1.42 (0.44 to 4.55), NSD
			Percent with hypertension, DBP ≥100 mm Hg (%)	6	174	2 (1.2)	1 (0.6)	174	2 (1.2)	2 (1.1)	OR=0.50 (0.04 to 5.53), NSD
Anand, 2016[66] Good	IG1	HD, PA, SB Medium	SBP (mm Hg)	12*	164	127 (18)	0 (15.68)	173	127 (20)	-1 (16)	1.00 (-2.38 to 4.38), NSD
			DBP (mm Hg)	12*	164	83 (10)	-1 (8.94)	173	81 (12)	0 (9.66)	-1.00 (-2.99 to 0.99), NSD
			Percent with hypertension (%)†	12	164	35 (20.7)	33 (20.1)	173	35 (20.1)	40 (23.1)	OR=0.84 (0.50 to 1.41), NSD
Bennett, 2013[77] Good	IG1	HD, PA High	SBP (mm Hg)	6	91	123.2 (15.3)	-1.7 (12.4)	94	122.9 (14.5)	-1.2 (12.6)	-0.50 (-4.20 to 3.20), NSD
			DBP (mm Hg)	6	91	80.9 (10.7)	-2.5 (9.54)	94	80.4 (11.3)	-1.3 (9.7)	-1.10 (-4.00 to 1.70), NSD
			SBP (mm Hg)	12*	91	123.2 (15.3)	-1.6 (14.31)	94	122.9 (14.5)	-1.6 (14.54)	0.01 (-4.10 to 4.20), NSD
			DBP (mm Hg)	12*	91	80.9 (10.7)	-2.3 (11.45)	94	80.4 (11.3)	-1.6 (10.66)	-0.70 (-3.90 to 2.50), NSD
			SBP (mm Hg)	18	90	123.2 (15.3)	-3 (13.28)	94	122.9 (14.5)	0.8 (12.6)	-3.80 (-7.60 to 0.20), NSD
			DBP (mm Hg)	18	90	80.9 (10.7)	-1.9 (10.44)	94	80.4 (11.3)	-1 (10.66)	-0.90 (-3.90 to 2.20), NSD
Coates, 1999[86] Fair	IG1	HD High	SBP (mm Hg)	6*	1101	127.1 (19.1)	-3.1 (NR)	648	127.3 (18.3)	-1.4 (NR)	-1.70 (-3.15 to -0.32), <0.05
			DBP (mm Hg)	6*	1101	76.3 (9.7)	-1.1 (NR)	648	76.9 (9.5)	-0.6 (NR)	-0.40 (-1.17 to 0.31), NSD

Appendix G Table 1. Blood Pressure Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Elley, 2003[89] Good	IG1	PA Medium	SBP (mm Hg)	12[*]	451	135.1 (19.6)	-2.58 (15.7)	427	135.4 (17.9)	-1.21 (14.3)	-1.31 (-3.51 to 0.89), 0.2
			DBP (mm Hg)	12[*]	451	82.4 (12.2)	-2.62 (10.9)	427	81.8 (12.1)	-0.81 (10.2)	-1.40 (-3.35 to 0.56), 0.2
Gill, 2019[151] Fair	IG1	HD, PA, SB Medium	SBP (mm Hg)	6[*]	59	128.5[‡]	-6.38 (15.5)	59	131.0[‡]	-6.61 (15)	0.23 (-5.02 to 5.48), 0.93
			DBP (mm Hg)	6[*]	59	76.0[‡]	-1.57 (9.86)	59	77.0[‡]	-1.84 (9.63)	0.27 (-3.26 to 3.81), 0.88
Grandes, 2009[97] Good	IG1	PA Low	SBP (mm Hg)	12[*]	1456	130.0 (18.4)	-3.35 (47.9)	1389	129.9 (19.2)	-2.93 (46.9)	-0.20 (-1.24 to 0.84), 0.706
			DBP (mm Hg)	12[*]	1456	78.49 (10.6)	-1.4 (23.26)	1389	78.08 (10.6)	-1.81 (22.7)	0.52 (-0.10 to 1.15), 0.101
Hargreaves, 2016[101] Fair	IG1	PA Medium	DBP (mm Hg)	6[*]	35	76.6 (9.45)	-6.66 (12.4)	39	76.13 (13.23)	-3.13 (10.09)	-3.17 (-5.55 to -0.78), 0.03
Hivert, 2007[104] Fair	IG1	HD, PA High	SBP (mm Hg)	24[*]	58	111 (7.62)	5 (15.23)	57	110 (15.1)	7 (15.1)	-2.00 (-7.54 to 3.54), 0.40
			DBP (mm Hg)	24[*]	58	70 (7.62)	2 (7.62)	57	71 (7.55)	0 (7.55)	2.00 (-0.77 to 4.77), 0.09
Jenkins, 2017[52] Fair	IG1	HD Medium	SBP (mm Hg)	6[*]	145	114.8 (11.98)	-1.3 (11.37)	486	114.7 (12.37)	-0.9 (10.12)	-0.40 (-2.20 to 1.40), 0.691
			DBP (mm Hg)	6[*]	145	72.2 (8.6)	-0.9 (7.68)	486	73.3 (8.44)	-1 (7.31)	-0.20 (-1.40 to 1.10), 0.810
			SBP (mm Hg)	18	145	114.8 (11.98)	-1.8 (9.52)	486	114.7 (12.37)	-1 (11.25)	-0.70 (-2.60 to 1.20), 0.480
			DBP (mm Hg)	18	145	72.2 (8.6)	-1.8 (7.07)	486	73.3 (8.44)	-1.5 (10.69)	-0.60 (-2.10 to 0.90), 0.402
John, 2002[107] Fair	IG1	HD Medium	SBP (mm Hg)	6[*]	344	130.2 (19.7)	-2 (13.5)	346	129.3 (19.6)	1.4 (14.6)	-4.00 (-6.00 to -2.00), <0.0001
			DBP (mm Hg)	6[*]	344	79.2 (11.4)	-1.6 (8.7)	346	79.9 (11.9)	-0.3 (8.7)	-1.50 (-2.70 to -0.20), 0.02
Kallings, 2009[108] Good	IG1	PA Medium	SBP (mm Hg)	6[*]	41	137.6 (2.2)	0.2 (14.7)	50	142.3 (2.6)	-4.1 (12.4)	4.30 (-1.27 to 9.87), 0.12
			DBP (mm Hg)	6[*]	41	79.9 (1.5)	-1 (8.3)	50	81.6 (1.3)	-1.7 (9.6)	0.70 (-3.03 to 4.43), 0.68
Kinmonth, 2008[114] Fair	IG1	PA Medium	SBP (mm Hg)	12[*]	107	124.2 (13)	-3.2 (12.16)	111	122.6 (12.6)	-3.4 (10.72)	0.20 (-2.84 to 3.24), NSD
	IG2	PA High	SBP (mm Hg)	12[*]	103	122.6 (12.6)	-3 (11.23)	111	122.6 (12.6)	-3.4 (10.72)	0.40 (-2.54 to 3.34), NSD
	IG1	PA Medium	DBP (mm Hg)	12	107	79.1 (10.6)	-1.7 (9.86)	111	78.2 (9)	-3.1 (7.8)	1.40 (-0.96 to 3.76), NSD
	IG2	PA High	DBP (mm Hg)	12	103	77.9 (9)	-1.7 (8.39)	111	78.2 (9)	-3.1 (7.8)	1.40 (-0.77 to 3.57), NSD
Koniak-Griffin, 2015[46] Fair	IG1	HD, PA High	SBP (mm Hg)	6	98	111.97 (13.18)	-1.77 (12.14)	95	116.17 (13.05)	-3.4 (10.64)	1.63 (-1.59 to 4.85), NSD
			DBP (mm Hg)	6	98	74.55 (9.14)	-0.74 (7.95)	95	76.31 (8.78)	-0.22 (7.36)	-0.52 (-2.68 to 1.64), NSD

Appendix G Table 1. Blood Pressure Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			SBP (mm Hg)	9[*]	100	111.97 (13.18)	-1.34 (12.33)	94	116.17 (13.05)	-1.62 (10.9)	0.28 (-3.00 to 3.56), NSD
			DBP (mm Hg)	9[*]	100	74.55 (9.14)	-1.42 (8.21)	94	76.31 (8.78)	-0.13 (7.66)	-1.29 (-3.53 to 0.95), NSD
Lawton, 2008[117] Good	IG1	PA Medium	SBP (mm Hg)	12[*]	544	122.8 (16.3)	-2.2 (14.58)	545	123.4 (18.7)	-1.5 (14.8)	-0.70 (-2.45 to 1.05), NSD
			DBP (mm Hg)	12[*]	544	73.8 (9.3)	-2.3 (8.32)	545	74.7 (9.3)	-2.3 (7.78)	0.00 (-0.96 to 0.96), NSD
			SBP (mm Hg)	24	544	122.8 (16.3)	-3.7 (14.58)	545	123.4 (18.7)	-3.9 (14.8)	0.20 (-1.55 to 1.95), 0.50
			DBP (mm Hg)	24	544	73.8 (9.3)	-2.2 (8.32)	545	74.7 (9.3)	-3.3 (7.78)	1.10 (0.14 to 2.06), 0.96
Metzgar, 2016[65] Fair	IG1	HD High	SBP (mm Hg)	6[*]	26	107.2 (14.28)	-3.3 (12)	25	102.1 (16.5)	5.6 (13.09)	-8.90 (-15.79 to -2.01), ≤0.05
	IG2	HD High	SBP (mm Hg)	6	29	109 (10.23)	-1 (8.55)	25	102.1 (16.5)	5.6 (13.09)	-6.60 (-12.42 to -0.78), ≤0.05
	IG1	HD High	DBP (mm Hg)	6[*]	26	68.9 (12.75)	-4.2 (10.98)	25	70.9 (14.5)	-8.5 (11.75)	4.30 (-1.94 to 10.54), NSD
	IG2	HD High	DBP (mm Hg)	6	29	72.7 (9.15)	-4.6 (7.96)	25	70.9 (14.5)	-8.5 (11.75)	3.90 (-1.39 to 9.19), NSD
Mosca, 2008[126] Good	IG1	HD, PA Medium	SBP (mm Hg)	12[*]	250	126.7 (15.33)	3 (15.67)	251	126.4 (16.17)	3.4 (14.49)	-0.40 (-3.04 to 2.24), 0.90
			DBP (mm Hg)	12[*]	250	77.9 (11.29)	1.1 (10.7)	251	77 (11.72)	1.9 (10.17)	-0.80 (-2.63 to 1.03), 0.59
Roderick, 1997[133] Fair	IG1	HD Medium	SBP (mm Hg)	12[*]	473	124.4 (18)	-1.14 (NR)	483	125.2 (15.9)	-0.39 (NR)	-0.59 (-2.43 to 1.24), NSD
			DBP (mm Hg)	12[*]	473	77.8 (11.8)	-0.19 (NR)	483	77.1 (11.7)	-0.09 (NR)	0.09 (-4.90 to 5.00), NSD
Sacerdote, 2006[135] Fair	IG1	HD Low	SBP (mm Hg)	12[*]	1488	128.7 (14.5)	0.15 (20.86)	1489	128.8 (19.4)	-0.2 (49.42)	0.35 (-2.38 to 2.72), 0.93
			DBP (mm Hg)	12[*]	1488	78.5 (8.6)	0.44 (12.79)	1489	78.7 (8.1)	0.61 (30.32)	-0.17 (-1.77 to 1.05), 0.85
Simkin-Silverman, 1995[136] Good	IG1	HD, PA High	SBP (mm Hg)	6	236	110 (12.5)	-3.4 (10.5)	253	110.1 (13)	-1.4 (10.46)	-2.00 (-3.86 to -0.14), <0.05
			DBP (mm Hg)	6	236	68.5 (7.6)	-2.5 (6.55)	253	67.9 (8.5)	-0.3 (6.92)	-2.20 (-3.40 to -1.00), <0.05
			SBP (mm Hg)	18[*]	236	110 (12.5)	-2.7 (11.51)	253	110.1 (13)	-0.5 (10.6)	-2.20 (-4.16 to -0.24), <0.05
			DBP (mm Hg)	18[*]	236	68.5 (7.6)	1.4 (7.04)	253	67.9 (8.5)	2 (6.95)	-0.60 (-1.84 to 0.64), NSD
			SBP (mm Hg)	54	246	110 (12.5)	-0.12 (NR)	263	110.1 (13)	0.2 (NR)	NR, NR
			DBP (mm Hg)	54	246	68.5 (7.6)	1.5 (NR)	263	67.9 (8.5)	2.2 (NR)	NR, NR
Thompson, 2008[140] Fair	IG1	HD, PA High	SBP (mm Hg)	6	100	115.8 (13.2)	-0.5 (12.04)	100	116.6 (11.2)	0.3 (11.03)	-0.80 (-4.00 to 2.40), NSD
			DBP (mm Hg)	6	100	67.6 (10.8)	-1.5 (9.33)	100	68.7 (9.4)	1.2 (8.44)	-2.70 (-5.17 to -0.23), ≤0.05

Appendix G Table 1. Blood Pressure Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			SBP (mm Hg)	12*	100	115.8 (13.2)	-1.4 (11.76)	100	116.6 (11.2)	0.1 (10.91)	-1.50 (-4.64 to 1.64), NSD
			DBP (mm Hg)	12*	100	67.6 (10.8)	0.4 (9.49)	100	68.7 (9.4)	0.4 (8.33)	0.00 (-2.47 to 2.47), NSD
			SBP (mm Hg)	18	100	115.8 (13.2)	-0.9 (11.39)	100	116.6 (11.2)	0.4 (10.84)	-1.30 (-4.38 to 1.78), NSD
			DBP (mm Hg)	18	100	67.6 (10.8)	0.3 (9.09)	100	68.7 (9.4)	0.1 (7.99)	0.20 (-2.17 to 2.57), NSD
Thompson, 2014[141] Good	IG1	PA High	SBP (mm Hg)	6*	24	138.8 (17.2)	-5 (15.9)	24	137 (20)	3 (27.5)	-8.00 (-20.71 to 4.71), 0.22
			DBP (mm Hg)	6*	24	72.5 (11.4)	-1.2 (8.8)	24	75.4 (9.4)	2 (13.1)	-3.20 (-9.51 to 3.11), 0.34
Tinker, 2008[142] Good	IG1	HD High	SBP (mm Hg)	12*	17126	127.1 (17.2)	-2.7 (15.34)	25173	127.4 (17.1)	-2 (14.18)	-0.66 (-0.89 to -0.44), <0.001
			DBP (mm Hg)	12*	17125	75.9 (9.1)	-2 (8.18)	25169	76 (9)	-1.3 (7.57)	-0.64 (-0.76 to -0.51), <0.001
			SBP (mm Hg)	72	14543	127.1 (17.2)	-2.6 (15.08)	22532	127.4 (17.1)	-2.8 (13.99)	0.20 (-0.10 to 0.50), NSD
			DBP (mm Hg)	72	14540	75.9 (9.1)	-4.2 (8.18)	22532	76 (9)	-4.1 (7.62)	-0.10 (-0.26 to 0.06), NSD
			Incident hypertension (%)	100	12566	NR	NR	18580	NR	NR	HR=0.96 (0.93 to 0.99), ≤0.05
Wieland, 2018[55] Fair	IG1	HD, PA, SB High	SBP (mm Hg)	6	36	NR (NR)	0.5 (12.1)	34	NR (NR)	-3 (9.6)	3.50 (-1.64 to 8.64), 0.11
			DBP (mm Hg)	6	36	NR (NR)	-0.8 (8)	34	NR (NR)	-2 (7.2)	1.20 (-2.37 to 4.77), 0.41
			SBP (mm Hg)	12	36	NR (NR)	0.7 (11.3)	34	NR (NR)	-2.7 (13.5)	3.40 (-2.42 to 9.22), 0.13
			DBP (mm Hg)	12	36	NR (NR)	0.3 (9.1)	34	NR (NR)	-1.2 (9.9)	1.50 (-2.95 to 5.95), 0.48

Abbreviations: BL=baseline; CG=control group; DBP=diastolic blood pressure; FU=followup; HD=healthy diet; HR=hazard ratio; IG=intervention group; Invt=intervention; mm Hg=millimeters of mercury; Mos=months; NR=not reported; NSD=non-significant difference; PA=physical activity; SB=sedentary behavior; SBP=systolic blood pressure; SD=standard deviation.

* Included in meta-analysis
† Self-reported
‡ Median

Appendix G Table 2. Lipid Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aadahl, 2014[71] Good	IG1	SB Medium	HDL-C (mg/dL)	6*	81	61.78 (15.44)	-1.16 (7.72)	68	57.92 (15.44)	-0.77 (7.72)	-0.02 (-2.97 to 2.93), 0.89
			LDL-C (mg/dL)	6*	81	123.55 (34.75)	-8.11 (208.49)	68	123.55 (38.61)	-2.32 (19.31)	-5.79 (-12.74 to 1.54), 0.15
			TC (mg/dL)	6*	81	204.63 (34.75)	-10.04 (27.03)	68	204.63 (42.47)	-3.09 (23.17)	-6.95 (-15.06 to 11.97), 0.12
Aldana, 2006[74] Fair	IG1	HD, PA High	HDL-C (mg/dL)	6*	174	45 (12.2)	1.4 (9.3)	174	45 (10.4)	2.8 (7.35)	-1.40 (-2.90 to 0.00), 0.045
			LDL-C (mg/dL)	6*	174	122 (29)	5 (25.94)	174	121 (33)	9 (28.04)	-4.00 (-9.00 to 2.00), 0.16
			TC (mg/dL)	6*	174	193 (33)	6 (29.98)	174	190 (39)	11 (32.63)	-5.00 (-11.00 to 1.00), 0.08
Baron, 1990[76] Fair	IG1	HD Medium	HDL-C (mg/dL)	12*	165	57.14 (13.9)	-1.16 (9.95)	165	58.69 (13.9)	-0.77 (9.19)	-0.39 (-2.45 to 1.68), NSD
			LDL-C (mg/dL)	12*	164	109.27 (30.5)	-11.58 (26.63)	164	108.49 (33.59)	-11.58 (27.64)	0.00 (-5.87 to 5.87), NSD
			TC (mg/dL)	12*	167	187.64 (31.66)	-7.72 (29.43)	166	186.87 (33.2)	-6.95 (28.11)	-0.77 (-6.95 to 5.41), NSD
Bennett, 2013[77] Good	IG1	HD, PA High	HDL-C (mg/dL)	6	91	53.7 (15.8)	-3.2 (10.49)	94	53.9 (16.4)	-3.2 (10.66)	-0.03 (-3.10 to 3.00), NSD
				12*	91	53.7 (15.8)	-1.6 (11.45)	94	53.9 (16.4)	-1.4 (11.63)	-0.20 (-3.40 to 3.10), NSD
				18	90	53.7 (15.8)	-1.2 (11.38)	94	53.9 (16.4)	-1.6 (11.63)	0.40 (-3.00 to 3.80), NSD
			LDL-C (mg/dL)	6	91	107.3 (34.6)	-0.8 (29.57)	94	106.8 (34.3)	2.6 (28.12)	-3.40 (-11.70 to 4.90), NSD
				12*	91	107.3 (34.6)	-5.2 (29.57)	94	106.8 (34.3)	0.1 (27.15)	-5.40 (-13.70 to 2.90), NSD
				18	90	107.3 (34.6)	-3.3 (29.41)	94	106.8 (34.3)	-1.6 (28.12)	-1.70 (-10.00 to 6.70), NSD
			TC (mg/dL)	6	91	176.4 (36.4)	-1.5 (24.8)	94	181.3 (38.6)	0.9 (25.21)	-2.40 (-9.70 to 4.80), NSD
				12*	91	176.4 (36.4)	-4.9 (25.76)	94	181.3 (38.6)	-2.4 (25.21)	-2.50 (-9.80 to 4.90), NSD
				18	90	176.4 (36.4)	-4.3 (26.56)	94	181.3 (38.6)	-4.5 (26.18)	0.10 (-7.60 to 7.80), NSD
Brekke, 2005[81] Fair	IG1	HD High	HDL-C (mg/dL)	12	24	48.65 (10.42)	3.09 (9.6)	19	50.58 (10.42)	-1.54 (5.61)	4.63 (-0.24 to 9.50), 0.111
			LDL-C (mg/dL)	12	24	118.15 (23.17)	0.39 (22.86)	19	124.71 (39)	10.81 (17.62)	-10.42 (-22.90 to 2.05), 0.236
			TC (mg/dL)	12	24	186.87 (27.8)	3.86 (23.32)	19	194.21 (44.4)	9.27 (20.83)	-5.41 (-18.80 to 7.99), 0.749

Appendix G Table 2. Lipid Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
	IG2	HD, PA High	HDL-C (mg/dL)	12*	25	44.79 (10.42)	4.25 (6.08)	19	50.58 (10.42)	-1.54 (5.61)	5.79 (2.28 to 9.30), 0.037
			LDL-C (mg/dL)	12*	25	105.41 (33.98)	8.88 (20.11)	19	124.71 (39)	10.81 (17.62)	-1.93 (-13.31 to 9.45), 0.944
			TC (mg/dL)	12*	25	183.01 (28.96)	14.29 (26.66)	19	194.21 (44.4)	9.27 (20.83)	5.02 (-9.49 to 19.53), 0.770
Elley, 2003[89] Good	IG1	PA Medium	TC (mg/dL)	12*	451	223.17 (38.61)	-0.73 (27.03)	427	217.76 (38.61)	0.39 (22.39)	-0.77 (-4.63 to 3.47), 0.7
Grandes, 2009[97] Good	IG1	PA Low	HDL-C (mg/dL)	12*	1456	57.64 (14.69)	2.67 (22)	1389	58.32 (14.77)	1.73 (21.3)	0.94 (0.08 to 1.81), 0.033
			LDL-C (mg/dL)	12*	1456	134.22 (33.23)	-2.14 (43.22)	1389	133.53 (32.66)	-1.24 (41.93)	-0.91 (-2.90 to 1.08), 0.372
			TC (mg/dL)	12*	1456	213.86 (38.58)	0.87 (41.56)	1389	213.55 (36.29)	-0.07 (40.69)	0.87 (-1.44 to 3.19), 0.458
Hargreaves, 2016[101] Fair	IG1	PA Medium	TC (mg/dL)	6*	35	180.31 (32.43)	8.49 (28.81)	39	189.58 (34.77)	14.67 (27.83)	14.67 (7.72 to 21.62), <0.001
Hivert, 2007[104] Fair	IG1	HD, PA High	HDL-C (mg/dL)	24*	58	50.19 (8.82)	7.72 (8.82)	57	50.58 (11.66)	10.42 (8.74)	-2.70 (-5.91 to 0.51), 0.11
			LDL-C (mg/dL)	24*	58	103.47 (29.4)	-5.41 (20.58)	57	97.3 (23.32)	-2.32 (20.4)	-3.09 (-10.58 to 4.40), 0.35
			TC (mg/dL)	24*	58	175.68 (35.29)	0.77 (29.4)	57	167.18 (29.15)	10.04 (23.32)	-9.27 (-18.98 to 0.44), 0.06
Jenkins, 2017[52] Fair	IG1	HD Medium	HDL-C (mg/dL)	6*	145	50.97 (15.42)	-0.77 (8.3)	486	49.03 (13.03)	-0.39 (8.69)	0.00 (-1.54 to 1.16), 0.865
				18	145	50.97 (15.42)	1.54 (13.05)	486	49.03 (13.03)	1.93 (8.69)	0.00 (-2.32 to 1.93), 0.902
			LDL-C (mg/dL)	6*	145	127.41 (30.84)	-1.54 (22.53)	486	126.25 (32.57)	-1.54 (34.74)	0.39 (-4.25 to 5.02), 0.827
				18	145	127.41 (30.84)	-1.93 (33.21)	486	126.25 (32.57)	-3.09 (30.4)	1.16 (-5.79 to 8.11), 0.729
			TC (mg/dL)	6*	145	199.61 (35.58)	0 (37.95)	486	196.52 (36.91)	-1.93 (36.91)	2.70 (-5.02 to 10.04), 0.456
				18	145	199.61 (35.58)	1.16 (28.46)	486	196.52 (36.91)	-0.39 (30.4)	2.32 (-3.09 to 7.34), 0.401
John, 2002[107] Fair	IG1	HD Medium	TC (mg/dL)	6*	340	194.48 (37.07)	-0.69 (33.59)	344	197.8 (39.38)	-1.39 (21.62)	0.39 (-3.75 to 4.48), 0.86
Kallings, 2009[108] Good	IG1	PA Medium	HDL-C (mg/dL)	6*	41	65.64 (2.7)	0 (12.74)	50	65.64 (1.93)	0 (13.9)	0.00 (-5.53 to 5.53), 0.75
			LDL-C (mg/dL)	6*	41	131.27 (4.63)	-3.86 (18.92)	50	123.55 (3.47)	3.86 (27.8)	-7.72 (-17.72 to 2.28), 0.13

Appendix G Table 2. Lipid Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			TC (mg/dL)	6*	41	216.22 (3.86)	-11.58 (37.84)	50	212.35 (3.86)	3.86 (13.9)	-11.58 (-27.03 to -0.39), 0.042
Kinmonth, 2008[114] Fair	IG1	PA Medium	HDL-C (mg/dL)	12*	107	54.05 (14.29)	-1.16 (10.79)	111	56.37 (15.83)	0.77 (11.65)	-1.93 (-4.91 to 1.05), NSD
			LDL-C (mg/dL)	12*	107	117.76 (32.82)	3.86 (29.53)	111	124.32 (32.82)	1.93 (28.14)	1.93 (-5.72 to 9.59), NSD
			TC (mg/dL)	12*	107	194.21 (36.68)	2.32 (33.71)	111	204.25 (35.14)	0.77 (29.24)	1.54 (-6.82 to 9.91), NSD
	IG2	PA High	HDL-C (mg/dL)	12	103	56.37 (15.83)	0 (11.86)	111	56.37 (15.83)	0.77 (11.65)	-0.77 (-3.92 to 2.38), NSD
			LDL-C (mg/dL)	12	103	121.24 (38.22)	7.34 (34.36)	111	124.32 (32.82)	1.93 (28.14)	5.41 (-2.98 to 13.80), NSD
			TC (mg/dL)	12	103	198.07 (39.77)	8.88 (36.1)	111	204.25 (35.14)	0.77 (29.24)	8.11 (-0.67 to 16.88), NSD
Koniak-Griffin, 2015[46] Fair	IG1	HD, PA High	HDL-C (mg/dL)	6	98	42.46 (12.38)	0.85 (13.13)	95	46.54 (14.05)	-0.57 (11.77)	1.42 (-2.10 to 4.94), NSD
				9*	100	42.46 (12.38)	1.62 (9.72)	94	46.54 (14.05)	0.61 (9.81)	1.01 (-1.74 to 3.76), NSD
			LDL-C (mg/dL)	6	98	109.93 (26.67)	-1.81 (24.29)	95	113.19 (31.62)	2.66 (25.92)	-4.47 (-11.55 to 2.61), NSD
				9*	100	109.93 (26.67)	-2.08 (23.8)	94	113.19 (31.62)	-1.36 (25.79)	-0.72 (-7.70 to 6.26), NSD
			TC (mg/dL)	6	98	187.26 (31.6)	-5.42 (27.96)	95	189.61 (36.05)	2.71 (30.01)	-8.13 (-16.31 to 0.05), NSD
				9*	100	187.26 (31.6)	-1.78 (27.79)	94	189.61 (36.05)	-0.31 (28.8)	-1.47 (-9.43 to 6.49), NSD
Lawton, 2008[117] Good	IG1	PA Medium	HDL-C (mg/dL)	12*	544	63.71 (18.15)	3.09 (14.06)	545	62.93 (18.15)	3.09 (12.83)	0.00 (-1.60 to 1.60), NSD
				24	544	63.71 (18.15)	0.39 (14.06)	545	62.93 (18.15)	1.16 (12.83)	-0.77 (-2.37 to 0.83), 0.40
			TC (mg/dL)	12*	544	235.52 (45.17)	-9.27 (37.2)	545	232.82 (45.17)	-7.72 (34.95)	-1.54 (-5.83 to 2.74), NSD
				24	544	235.52 (45.17)	-17.37 (37.2)	545	232.82 (45.17)	-16.99 (34.95)	-0.39 (-4.67 to 3.90), 0.90
Metzgar, 2016[65] Fair	IG1	HD High	HDL-C (mg/dL)	6*	26	54.6 (18.87)	-3.2 (14.09)	24	45.6 (21.56)	2.2 (14.66)	-5.40 (-13.37 to 2.57), NSD
			LDL-C (mg/dL)	6*	26	97.2 (35.69)	12.5 (32.16)	23	95.3 (40.76)	18.2 (34.31)	-5.70 (-24.32 to 12.92), NSD
			TC (mg/dL)	6*	26	169 (44.87)	9.7 (39.91)	24	156.2 (51.44)	14.2 (42.83)	-4.50 (-27.43 to 18.43), NSD
	IG2	HD High	HDL-C (mg/dL)	6	29	52.5 (13.46)	-0.9 (9.92)	24	45.6 (21.56)	2.2 (14.66)	-3.10 (-9.75 to 3.55), NSD
			LDL-C (mg/dL)	6	28	96.9 (24.87)	10.9 (22.49)	23	95.3 (40.76)	18.2 (34.31)	-7.30 (-22.97 to 8.37), NSD

Appendix G Table 2. Lipid Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			TC (mg/dL)	6	28	163 (31.75)	11.3 (28.16)	24	156.2 (51.44)	14.2 (42.83)	-2.90 (-22.35 to 16.55), NSD
Mosca, 2008[126] Good	IG1	HD, PA Medium	HDL-C (mg/dL)	12*	250	58.5 (18.15)	0.2 (15.38)	251	59.9 (19.4)	-2.3 (14.37)	2.50 (-0.11 to 5.11), 0.01
			LDL-C (mg/dL)	12*	232	128.5 (35.57)	-4.4 (31.08)	232	130.6 (36.3)	-4.5 (24.09)	0.10 (-4.96 to 5.16), 0.64
			TC (mg/dL)	12*	250	202.7 (38.32)	-0.5 (36.92)	251	205.9 (40.42)	-2.8 (35.29)	2.30 (-4.02 to 8.62), 0.89
Roderick, 1997[133] Fair	IG1	HD Medium	TC (mg/dL)	12*	473	235.52 (NR)	-8.88 (NR)	483	235.52 (NR)	-0.03 (NR)	-7.72 (-14.67 to -1.16), <0.05
Simkin-Silverman, 1995[136] Good	IG1	HD, PA High	HDL-C (mg/dL)	6	236	59.7 (13)	-2.4 (9.73)	253	58.4 (12.1)	-0.2 (8.49)	-2.20 (-3.82 to -0.58), <0.05
				18*	236	59.7 (13)	1 (9.67)	253	58.4 (12.1)	2.9 (9)	-1.90 (-3.55 to -0.25), <0.05
				54	246	59.7 (13)	2.3 (NR)	263	58.4 (12.1)	3.1 (NR)	NR, NR
			LDL-C (mg/dL)	6	236	114.7 (21.8)	-11.3 (20.74)	253	116.3 (21.8)	-0.1 (19.21)	-11.20 (-14.74 to -7.66), <0.05
				18*	236	114.7 (21.8)	-4.2 (20.68)	253	116.3 (21.8)	2.7 (20.18)	-6.90 (-10.52 to -3.28), <0.05
				54	246	114.7 (21.8)	3.5 (NR)	263	116.3 (21.8)	8.9 (NR)	NR, <0.01
			TC (mg/dL)	6	236	189.7 (24.5)	-13.8 (23.69)	253	189.6 (24.3)	0.9 (21.29)	-14.70 (-18.69 to -10.71), <0.05
				18*	236	189.7 (24.5)	-1.6 (23.86)	253	189.6 (24.3)	7.8 (22.14)	-9.40 (-13.48 to -5.32), <0.05
Thompson, 2008[140] Fair	IG1	HD, PA High	HDL-C (mg/dL)	6	100	48.65 (11.97)	0 (9.13)	100	50.58 (11.97)	-0.39 (8.05)	0.39 (-2.00 to 2.77), NSD
				12*	100	48.65 (11.97)	1.16 (9.6)	100	50.58 (11.97)	1.16 (8.61)	0.00 (-2.53 to 2.53), NSD
				18	100	48.65 (11.97)	0 (9)	100	50.58 (11.97)	-0.39 (8.22)	0.39 (-2.00 to 2.78), 0.94
			LDL-C (mg/dL)	6	100	93.44 (25.1)	-5.41 (22.62)	100	91.89 (20.08)	-3.86 (16.64)	-1.54 (-7.05 to 3.96), NSD
				12*	100	93.44 (25.1)	-6.18 (22.11)	100	91.89 (20.08)	-5.79 (17.5)	-0.39 (-5.91 to 5.14), NSD
				18	100	93.44 (25.1)	-5.41 (21.8)	100	91.89 (20.08)	-4.25 (17.69)	-1.16 (-6.66 to 4.34), 0.88
			TC (mg/dL)	6	100	167.57 (31.27)	-5.41 (27.47)	100	168.34 (25.1)	-3.09 (20.54)	-2.32 (-9.04 to 4.41), NSD
				12*	100	167.57 (31.27)	-5.41 (27.64)	100	168.34 (25.1)	-5.41 (21.69)	0.00 (-6.89 to 6.89), NSD
				18	100	167.57 (31.27)	-6.18 (27.47)	100	168.34 (25.1)	-3.47 (20.84)	-2.70 (-9.46 to 4.06), 0.60
Thompson, 2014[141] Good	IG1	PA High	HDL-C (mg/dL)	6*	24	59.07 (11.58)	-1.54 (6.56)	24	54.44 (15.44)	-0.39 (3.86)	-1.16 (-4.20 to 1.89), 0.59

Appendix G Table 2. Lipid Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			TC (mg/dL)	6*	24	202.32 (31.27)	-10.04 (20.46)	24	194.21 (29.34)	-0.77 (15.44)	-9.27 (-19.52 to 0.99), 0.09

Abbreviations: BL=baseline; CG=control group; dL=deciliter; FU=followup; HD=healthy diet; HDL-C=high-density lipoprotein cholesterol; IG=intervention group; Intv=intervention; LDL-C=low-density lipoprotein cholesterol; MA=included in meta-analysis; Mg=milligrams; Mos=months; NR=not reported; NSD=non-significant difference; PA=physical activity; SB=sedentary behavior; SD=standard deviation; TC=total cholesterol.

* Included in meta-analysis

Appendix G Table 3. Glucose Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aadahl, 2014[71] Good	IG1	SB Medium	Fasting glucose (mg/dL)	6*	81	99.11 (16.22)	-3.6 (9.01)	68	104.52 (19.82)	-3.6 (12.61)	0.05 (-3.60 to 3.42), 0.98
			HbA1c (%)	6	81	5.6 (0.5)	0.08 (0.3)	66	5.6 (0.6)	0.07 (0.2)	0.01 (-0.07 to 0.09), 0.73
Aldana, 2006[74] Fair	IG1	HD, PA High	Fasting glucose (mg/dL)	6*	174	103 (23)	-3 (19.42)	174	100 (19)	-1 (17.37)	-2.00 (-6.00 to 0.40), 0.09
			Percent with diabetes, Fasting glucose ≥126 mg/dL (n, [%])	6	174	21 (12.1)	17 (9.8)	174	4 (4.0)	9 (5.2)	OR=1.99 (0.86 to 4.58), NSD
Anand, 2016[66] Good	IG1	HD, PA, SB Medium	HbA1c (%)	12	164	5.85 (0.77)	-0.13 (0.77)	173	5.8 (0.8)	-0.1 (0.8)	-0.03 (-0.20 to 0.14), NSD
			Percent with diabetes (n, [%])†	12	164	21 (12.4)	22 (13.4)	173	20 (11.5)	22 (12.7)	OR=1.06 (0.56 to 2.00), NSD
Bennett, 2013[77] Good	IG1	HD, PA High	Fasting glucose (mg/dL)	6	91	103.4 (35.5)	5.8 (35.3)	94	105.4 (49.8)	5.7 (34.9)	0.10 (-10.20 to 10.30), NSD
				12*	91	103.4 (35.5)	-1.6 (28.62)	94	105.4 (49.8)	-5.1 (28.12)	3.50 (-4.70 to 11.70), NSD
				18	90	103.4 (35.5)	-3.1 (30.36)	94	105.4 (49.8)	-7.4 (31.03)	4.30 (-4.50 to 13.10), NSD
Brekke, 2005[81] Fair	IG1	HD High	Fasting glucose (mg/dL)	12	24	86.86 (9.01)	-5.95 (9.18)	19	87.58 (8.47)	-3.78 (8.6)	-2.16 (-7.54 to 3.21), 0.740
	IG2	HD, PA High	Fasting glucose (mg/dL)	12*	25	87.76 (8.83)	-7.75 (10.04)	19	87.58 (8.47)	-3.78 (8.6)	-3.96 (-9.60 to 1.67), 0.361
Coates, 1999[86] Fair	IG1	HD High	Fasting glucose (mg/dL)	6*	660	95.51 (27.03)	-3.6 (NR)	407	95.51 (28.83)	-1.8 (NR)	-1.80 (-3.24 to 0.36), NSD
Grandes, 2009[97] Good	IG1	PA Low	Fasting glucose (mg/dL)	12*	1456	98.13 (22.12)	1.88 (20.54)	1389	99.19 (23.63)	1.49 (20.25)	0.52 (-0.61 to 1.65), 0.366
Jenkins, 2017[52] Fair	IG1	HD Medium	Glucose (unspec) (mmol/L)	6	145	4.87 (0.61)	-0.02 (0.55)	486	4.81 (0.51)	0.02 (0.67)	-0.03 (-0.13 to 0.08), 0.611
				18	145	4.87 (0.61)	0 (0.68)	486	4.81 (0.51)	0.01 (0.51)	0.00 (-0.13 to 0.13), 0.953

Appendix G Table 3. Glucose Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Kallings, 2009[108] Good	IG1	PA Medium	Fasting glucose (mg/dL)	6*	41	99.11 (1.8)	-3.6 (11.54)	50	97.31 (1.8)	-1.8 (12.74)	-1.80 (-6.85 to 3.24), 0.48
			HbA1c (%)	6	41	5 (0.1)	-0.1 (0.32)	50	4.8 (0.1)	0.2 (0.35)	-0.25 (-0.37 to -0.12), 0.001
Kinmonth, 2008[114] Fair	IG1	PA Medium	Fasting glucose (mg/dL)	12*	107	86.5 (9.19)	2.52 (8.22)	111	88.12 (10.27)	-0.18 (8.26)	2.70 (0.52 to 4.89), ≤0.05
			HbA1c (%)	12	107	5.21 (0.42)	0.19 (0.42)	111	5.23 (0.38)	0.09 (0.35)	0.10 (0.00 to 0.20), NR
	IG2	PA High	Fasting glucose (mg/dL)	12	103	87.22 (9.73)	0.72 (8.7)	111	88.12 (10.27)	-0.18 (8.26)	0.90 (-1.37 to 3.17), NSD
			HbA1c (%)	12	103	5.16 (0.43)	0.18 (0.41)	111	5.23 (0.38)	0.09 (0.35)	0.09 (-0.01 to 0.19), NSD
Koniak-Griffin, 2015[46] Fair	IG1	HD, PA High	Fasting glucose (mg/dL)	6	98	100.26 (18.56)	1.59 (16.88)	95	100.59 (19.08)	-0.5 (14.97)	2.09 (-2.42 to 6.60), NSD
				9*	100	100.26 (18.56)	-0.95 (16.27)	94	100.59 (19.08)	-1.15 (15.34)	0.20 (-4.26 to 4.66), NSD
Lawton, 2008[117] Good	IG1	PA Medium	Fasting glucose (mg/dL)	12*	544	90.46 (12.61)	-0.9 (11.28)	545	89.38 (8.41)	0 (9.59)	-0.90 (-2.14 to 0.34), NSD
				24	544	90.46 (12.61)	-1.8 (11.28)	545	89.38 (8.41)	-1.62 (7.04)	-0.18 (-1.30 to 0.94), 0.99
			HbA1c (%)	12	544	5.55 (0.47)	0.15 (0.47)	545	5.46 (0.7)	0.15 (0.62)	0.00 (-0.07 to 0.07), NSD
				24	544	5.55 (0.47)	0.19 (0.47)	545	5.46 (0.7)	0.23 (0.62)	-0.04 (-0.11 to 0.03), 0.60
Metzgar, 2016[65] Fair	IG1	HD High	Glucose (unspec) (mg/dL)	6	23	82.1 (22.54)	11.2 (19.52)	23	90.6 (25.42)	-0.1 (22.01)	11.30 (-0.72 to 23.32), NSD
	IG2	HD High	Glucose (unspec) (mg/dL)	6	25	87.4 (15.5)	4.8 (13.43)	23	90.6 (25.42)	-0.1 (22.01)	4.90 (-5.32 to 15.12), NSD
Mosca, 2008[126] Good	IG1	HD, PA Medium	Fasting glucose (mg/dL)	12*	250	97.9 (15.33)	0.2 (14.09)	251	99.3 (19.4)	-0.7 (15.62)	0.90 (-1.71 to 3.51), 0.22
Simkin-Silverman, 1995[136] Good	IG1	HD, PA High	Fasting glucose (mg/dL)	6	236	98.1 (8)	-1 (7.07)	253	97.8 (8.3)	0.9 (6.82)	-1.90 (-3.13 to -0.67), <0.05
				18*	236	98.1 (8)	1.3 (7.71)	253	97.8 (8.3)	2.8 (7.58)	-1.50 (-2.86 to -0.14), <0.05
				54	246	98.1 (8)	1.6 (NR)	263	97.8 (8.3)	3.3 (NR)	NR, <0.05

Appendix G Table 3. Glucose Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Thompson, 2008[140] Fair	IG1	HD, PA High	Fasting glucose (mg/dL)	6	100	93.7 (8.29)	-1.08 (7.19)	100	92.98 (9.01)	0.9 (7.78)	-1.98 (-4.06 to 0.09), NSD
				12*	100	93.7 (8.29)	-0.54 (7.67)	100	92.98 (9.01)	-0.18 (7.62)	-0.36 (-2.48 to 1.76), NSD
				18	100	93.7 (8.29)	-1.44 (8.16)	100	92.98 (9.01)	0 (7.46)	-1.44 (-3.61 to 0.73), 0.21
Thompson, 2014[141] Good	IG1	PA High	Fasting glucose (mg/dL)	6*	24	94.06 (11.53)	3.96 (15.32)	24	92.44 (14.96)	1.8 (8.11)	2.16 (-4.77 to 9.10), 0.54
			HbA1c (%)	6	24	5.61 (0.44)	-0.05 (0.17)	24	5.75 (0.53)	-0.09 (0.16)	0.04 (-0.05 to 0.13), 0.38
Tinker, 2008[142] Good	IG1	HD High	Incident diabetes (n [%])	97	18376	NR	1303 (7.1)	27511	NR	2039 (7.4)	HR=0.96 (0.90 to 1.03), 0.25

Abbreviations: BL=baseline; CG=control group; dL=deciliter; FU=followup; HbA1c=hemoglobin A1c; HD=healthy diet; HR=hazard ratio; IG=intervention group; Intv=intervention; Mg=milligram; Mos=months; NR=not reported; NSD=non-significant difference; PA=physical activity; SB=sedentary behavior; SD=standard deviation; Unspec=unspecified.

* Included in meta-analysis
† Self-reported

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aadahl, 2014[71] Good	IG1	SB Medium	Waist circumference (cm)	6*	81	93.5 (12.9)	-1.18 (4)	68	95.5 (14.5)	0.24 (2.7)	-1.42 (-2.54 to -0.29), 0.01
			Weight (kg)	6*	81	79.7 (15.7)	-0.84 (3.1)	68	82.1 (17.6)	0.01 (2.2)	-0.83 (-1.73 to 0.06), 0.07
Aldana, 2006[74] Fair	IG1	HD, PA High	BMI (kg/m2)	6*	174	33.3 (8)	-1.6 (3.6)	174	31.4 (9)	-0.3 (4.07)	-1.30 (-1.65 to -0.96), <0.0001
			Weight (kg)	6*	174	93.3 (24.1)	-4.5 (10.76)	174	87.7 (25.9)	-0.6 (11.61)	-3.90 (-5.00 to -2.80), <0.0001
Bennett, 2013[77] Good	IG1	HD, PA High	BMI (kg/m2)	6	91	30.1 (2.7)	-0.3 (1.91)	94	30.2 (2.4)	0.1 (1.94)	-0.40 (-0.80 to 0.03), NSD
				12*	91	30.1 (2.7)	-0.3 (1.91)	94	30.2 (2.4)	0.3 (1.94)	-0.60 (-1.10 to -0.10), 0.02
				18	91	30.1 (2.7)	-0.2 (1.91)	94	30.2 (2.4)	0.4 (1.94)	-0.60 (-1.20 to -0.10), 0.03
			Waist circumference (cm)	6	91	98.2 (8.5)	-1.4 (6.68)	94	97.3 (8)	-0.8 (5.82)	-0.60 (-2.40 to 1.20), NSD
				12*	91	98.2 (8.5)	-1 (6.68)	94	97.3 (8)	0.3 (6.79)	-1.30 (-3.10 to 0.50), NSD
				18	90	98.2 (8.5)	-1.4 (7.59)	94	97.3 (8)	-0.2 (7.76)	-1.20 (-3.40 to 1.00), NSD
			Weight (kg)	6	91	81.3 (8.8)	-1 (3.82)	94	81 (8.8)	0.1 (3.88)	-1.10 (-2.30 to 0.04), NSD
				12*	91	81.3 (8.8)	-1 (4.77)	94	81 (8.8)	0.5 (4.85)	-1.40 (-2.80 to -0.10), 0.04
				18	90	81.3 (8.8)	-0.9 (5.69)	94	81.1 (8.8)	0.8 (5.82)	-1.70 (-3.30 to -0.20), 0.03
Brekke, 2005[81] Fair	IG1	HD High	BMI (kg/m2)	12	24	25 (3.3)	-0.15 (0.83)	19	26.1 (2.5)	0.22 (1.27)	-0.37 (-1.00 to 0.26), 0.518
			Waist circumference (cm)	12	24	88.7 (10.6)	-1.2 (3.08)	19	90.6 (10.6)	0.4 (3.84)	-1.60 (-3.67 to 0.47), 0.396
			Weight (kg)	12	24	78.7 (12.6)	-0.45 (2.69)	19	78 (12)	0.52 (3.88)	-0.97 (-2.94 to 1.00), 0.616
	IG2	HD, PA High	BMI (kg/m2)	12*	25	26.1 (3.1)	-0.72 (1.14)	19	26.1 (2.5)	0.22 (1.27)	-0.94 (-1.65 to -0.23), 0.017
			Waist circumference (cm)	12*	25	90.9 (8.86)	-1.2 (4.6)	19	90.6 (10.6)	0.4 (3.84)	-1.60 (-4.16 to 0.96), 0.388
			Weight (kg)	12*	25	79.8 (10.3)	-2.16 (3.55)	19	78 (12)	0.52 (3.88)	-2.68 (-4.88 to -0.48), 0.029

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Bryan, 2013[82] Fair	IG1	PA Low	BMI (kg/m2)	12*	113	24.99 (4.51)	0.56 (2.05)	105	25.52 (5.09)	0.02 (2.25)	0.54 (-0.03 to 1.11), NSD
Caplette, 2017[58] Fair	IG1	HD High	BMI (kg/m2)	6	40	27.7 (5.2)	NR (NR)	40	27.1 (6.4)	NR (NR)	Cohen's D=0.14 (NR), NSD
Coates, 1999[86] Fair	IG1	HD High	BMI (kg/m2)	6*	1094	28.7 (4.6)	-0.7 (NR)	646	29.1 (4.8)	-0.1 (NR)	-0.60 (-0.70 to -0.44), <0.05
			Waist circumference (cm)	6*	1094	86.1 (10.8)	-1.8 (NR)	647	86.4 (10.8)	-0.1 (NR)	-1.70 (-2.14 to -1.23), <0.05
			Weight (kg)	6*	1094	75.1 (12.5)	-1.8 (NR)	646	75.8 (12.7)	-0.3 (NR)	-1.50 (-1.83 to -1.13), <0.05
Elley, 2003[89] Good	IG1	PA Medium	BMI (kg/m2)	12*	451	30 (6.7)	-0.11 (1.46)	427	29.9 (6.4)	-0.05 (1.32)	-0.06 (-0.24 to 0.12), 0.5
Gill, 2019[151] Fair	IG1	HD, PA, SB Medium	BMI (kg/m2)	6*	59	32.0†	-0.34 (1.84)	59	30.9†	-0.1 (1.75)	-0.23 (-0.89 to 0.42), 0.48
			Waist circumference (cm)	6*	59	103.4 (17.1)	-1.52 (6.14)	59	102.8 (15.7)	0.01 (6.04)	-1.53 (-3.74 to 0.69), 0.17
			Weight (kg)	6*	59	84.2 (20.6)	-0.81 (5.26)	59	86.1 (23.6)	-0.35 (4.95)	-0.46 (-2.35 to 1.42), 0.63
Grandes, 2009[97] Good	IG1	PA Low	BMI (kg/m2)	12*	1456	27.7 (4.63)	0.06 (2.04)	1389	27.58 (4.66)	0.02 (2)	0.05 (-0.02 to 0.11), 0.17
			Waist circumference (cm)	12*	1456	93.36 (13.09)	0.35 (17.42)	1389	93.12 (13.02)	0.37 (17.02)	0.04 (-0.27 to 0.35), 0.809
Guagliano, 2020 Fair[157]	IG1	PA High	BMI (kg/m2)	12*	15	27.5 (5.0)	-0.5 (1.0)	18	26.3 (5.3)	0.5 (0.7)	-1.00 (-1.58 to -0.42), ≤0.05
			Waist circumference (cm)	12*	15	93.4 (12.0)	-2.2 (5.5)	18	86.9 (11.3)	2.4 (4.4)	-4.60 (-7.98 to -1.22), ≤0.05
			Weight (kg)	12*	13	81.3 (13.8)	-1.4 (2.8)	18	76.3 (15.7)	1.4 (2.2)	-2.80 (-4.56 to -1.04), ≤0.05
	IG2	PA Low	BMI (kg/m2)	12	13	25.6 (3.4)	-2.1 (8.7)	18	26.3 (5.3)	0.5 (0.7)	-2.60 (-6.61 to 1.41), NSD
			Waist circumference (cm)	12	13	86.6 (12.5)	-8.4 (30.8)	18	86.9 (11.3)	2.4 (4.4)	-10.80 (-25.14 to 3.54), NSD
			Weight (kg)	12	13	76.5 (13.0)	0.3 (2.3)	18	76.3 (15.7)	1.4 (2.2)	-1.10 (-2.70 to 0.50), NSD
Halperin, 2019[68] Fair	IG1	HD, PA High	BMI (kg/m2)	6	16	32.7 (4.3)	-1.2 (NR)	21	29.5 (3.1)	0.8 (NR)	NR, <0.001

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Harris, 2018[50] Good	IG1	PA Medium	BMI (kg/m2)	12*	321	37.6 (5.2)	-10.1 (2.33)	323	27.7 (5.4)	-0.2 (2.38)	-0.03 (-0.20 to 0.10), 0.71
			Waist circumference (cm)	12*	321	93.2 (14.1)	0.5 (6.19)	323	93.1 (14.3)	0.3 (6.5)	0.08 (-0.60 to 0.80), 0.23
	IG2	PA Low	BMI (kg/m2)	12	314	28 (5.5)	-0.3 (2.48)	323	27.7 (5.4)	-0.2 (2.38)	-0.10 (-0.30 to 0.10), 0.24
			Waist circumference (cm)	12	314	94.1 (13.9)	0.2 (6.26)	323	93.1 (14.3)	0.3 (6.5)	-0.04 (-0.80 to 0.70), 0.92
Hivert, 2007[104] Fair	IG1	HD, PA High	BMI (kg/m2)	12*	58	22.4 (3.05)	-0.1 (0.76)	57	22.4 (2.26)	0.4 (1.51)	-0.50 (-0.94 to -0.06), ≤0.05
				24	58	22.4 (3.05)	-0.3 (1.52)	57	22.4 (2.26)	0.2 (1.51)	-0.50 (-1.05 to 0.05), 0.01
			Waist circumference (cm)	12*	58	72 (7.62)	-1 (0)	57	72 (7.55)	0 (0)	-1.00 (-1.00 to -1.00), ≤0.05
				24	58	72 (7.62)	-1 (7.62)	57	72 (7.55)	0 (7.55)	-1.00 (-3.77 to 1.77), 0.11
			Weight (kg)	12*	58	62.9 (10.66)	-0.2 (3.05)	57	63.5 (9.81)	1.2 (3.77)	-1.40 (-2.65 to -0.15), ≤0.05
				24	58	62.9 (10.66)	-0.6 (3.81)	57	63.5 (9.81)	0.7 (4.53)	-1.30 (-2.83 to 0.23), 0.04
Jeffery, 1999[106] Fair	IG1	HD, PA Low	Weight (kg)	12*	197	NR (NR)	0.5 (4.21)	414	NR (NR)	0.6 (4.07)	-0.10 (-0.80 to 0.60), NSD
				24	197	NR (NR)	1.3 (5.61)	414	NR (NR)	1.4 (6.1)	-0.10 (-1.11 to 0.91), NSD
				36	197	NR (NR)	1.6 (7.02)	414	NR (NR)	1.8 (6.1)	-0.20 (-1.29 to 0.89), NSD
	IG2	HD, PA Low	Weight (kg)	12	198	NR (NR)	0.4 (4.22)	414	NR (NR)	0.6 (4.07)	-0.20 (-0.90 to 0.50), NSD
				24	198	NR (NR)	1.2 (5.63)	414	NR (NR)	1.4 (6.1)	-0.20 (-1.21 to 0.81), NSD
				36	198	NR (NR)	1.5 (7.04)	414	NR (NR)	1.8 (6.1)	-0.30 (-1.39 to 0.79), NSD
Jenkins, 2017[52] Fair	IG1	HD Medium	BMI (kg/m2)	6*	145	31.7 (5.84)	-0.4 (1.84)	486	32.5 (5.62)	-0.3 (1.69)	-0.10 (-0.50 to 0.20), 0.463
				18	145	31.7 (5.84)	-0.3 (2.76)	486	32.5 (5.62)	-0.2 (1.69)	-0.10 (-0.70 to 0.40), 0.601
				6*	145	100.6 (13.82)	-1.8 (8.29)	486	101.2 (14.06)	-1.2 (7.31)	-0.70 (-2.20 to 0.80), 0.339

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Waist circumference (cm)	18	145	100.6 (13.82)	-1.3 (7.07)	486	101.2 (14.06)	-1.5 (9)	0.10 (-1.30 to 1.60), 0.849
			Weight (kg)	6*	145	86.2 (17.82)	-1.2 (7.37)	486	88 (16.87)	-1 (5.62)	-0.20 (-1.50 to 1.00), 0.695
				18	145	86.2 (17.82)	-1 (5.22)	486	88 (16.87)	-0.8 (6.19)	-0.30 (-1.30 to 0.70), 0.584
John, 2002[107] Fair	IG1	HD Medium	Weight (kg)	6*	344	76.1 (13.8)	0.6 (2.6)	346	75.6 (14.9)	0.6 (2.6)	-0.10 (-0.40 to 0.60), 0.68
Kallings, 2009[108] Good	IG1	PA Medium	BMI (kg/m2)	6*	41	29.7 (3.4)	-0.6 (0.98)	50	30.4 (2.9)	-0.2 (0.72)	-0.40 (-0.80 to -0.10), 0.023
			Waist circumference (cm)	6*	41	105.2 (9.2)	-2.3 (3.84)	50	106.4 (7.8)	-1.4 (2.83)	-0.90 (-2.27 to 0.47), 0.20
			Weight (kg)	6*	41	88 (14.2)	-1.8 (3.2)	50	88.3 (11.1)	-0.5 (2.12)	-1.30 (-2.40 to -0.20), 0.023
Kattelmann, 2014[109] Fair	IG1	HD, PA Medium	BMI (kg/m2)	15*	497	23.9 (3.9)	0.1 (1.74)	476	24.4 (4.9)	0.2 (2.19)	-0.10 (-0.35 to 0.15), 0.50
			Waist circumference (cm)	15*	497	82 (10.3)	-0.1 (4.55)	476	83.1 (11.6)	-0.1 (5.17)	0.00 (-0.61 to 0.61), 0.64
			Weight (kg)	15*	497	68.6 (14)	0.5 (6.22)	476	69.9 (16.2)	0.7 (7.27)	-0.20 (-1.05 to 0.65), 0.39
Kerr, 2016[111] Fair	IG1	HD Low	BMI (kg/m2)	6*	78	23.8 (4.1)	0.1 (0.88)	69	24.6 (5.6)	0.4 (1.66)	-0.20 (-0.70 to 0.30), NSD
			Weight (kg)	6*	78	67.9 (14.1)	0.4 (3.53)	69	71.9 (17.6)	1.1 (5.81)	-0.80 (-2.20 to 0.70), NSD
	IG2	HD Low	BMI (kg/m2)	6	72	24.7 (6.2)	-0.3 (1.7)	69	24.6 (5.6)	0.4 (1.66)	-0.60 (-1.10 to -0.10), 0.02
			Weight (kg)	6	72	70.4 (17.7)	-0.6 (4.24)	69	71.9 (17.6)	1.1 (5.81)	-1.70 (-3.20 to -0.30), 0.02
Kinmonth, 2008[114] Fair	IG1	PA Medium	BMI (kg/m2)	12*	107	27.8 (5.2)	0.6 (2.38)	111	27.8 (5.2)	0 (2.31)	0.60 (-0.02 to 1.22), NSD
			Waist circumference (cm)	12*	107	92.7 (13.4)	1.9 (6.12)	111	93 (13.9)	0.8 (6.14)	1.10 (-0.53 to 2.73), NSD
			Weight (kg)	12*	107	79.9 (18)	1.7 (8.12)	111	80.3 (18.5)	-0.2 (8.13)	1.90 (-0.26 to 4.06), NSD
	IG2	PA High	BMI (kg/m2)	12	103	27.7 (4.6)	0 (2.04)	111	27.8 (5.2)	0 (2.31)	0.00 (-0.58 to 0.58), NSD

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Waist circumference (cm)	12	103	92.4 (12.8)	1.2 (5.77)	111	93 (13.9)	0.8 (6.14)	0.40 (-1.20 to 2.00), NSD
			Weight (kg)	12	103	78.6 (15.6)	0.5 (7.05)	111	80.3 (18.5)	-0.2 (8.13)	0.70 (-1.35 to 2.75), NSD
Koniak-Griffin, 2015[46] Fair	IG1	HD, PA High	BMI (kg/m2)	6	98	32.37 (5)	-0.33 (2.31)	95	32.86 (6.29)	-0.42 (2.82)	0.09 (-0.64 to 0.82), NSD
				9*	100	32.37 (5)	-0.41 (2.32)	94	32.86 (6.29)	0.13 (2.86)	-0.54 (-1.27 to 0.19), NSD
			Waist circumference (cm)	6	98	102.31 (10.55)	-1.53 (5)	95	100.48 (12.28)	-0.73 (5.47)	-0.80 (-2.28 to 0.68), NSD
				9*	100	102.31 (10.55)	-2.99 (4.97)	94	100.48 (12.28)	-0.71 (5.59)	-2.28 (-3.77 to -0.79), 0.04
			Weight (kg)	6	98	78.75 (13.48)	-0.66 (6.28)	95	80.02 (16.01)	-1.26 (7.05)	0.60 (-1.28 to 2.48), NSD
				9*	100	78.75 (13.48)	-1.02 (6.2)	94	80.02 (16.01)	0.07 (7.22)	-1.09 (-2.98 to 0.80), NSD
Kristal, 2000[116] Fair	IG1	HD Low	Weight (kg)	12	601	NR (NR)	0.08 (NR)	604	NR (NR)	0.39 (NR)	-0.34 (NR), 0.088
Lawton, 2008[117] Good	IG1	PA Medium	Waist circumference (cm)	12*	544	86.7 (13.99)	0.6 (6.17)	545	86.2 (14.01)	1.1 (6.18)	-0.50 (-1.23 to 0.23), NSD
				24	544	86.7 (13.99)	2 (6.26)	545	86.2 (14.01)	2.5 (6.26)	-0.50 (-1.24 to 0.24), 0.70
			Weight (kg)	12*	544	73.2 (14)	-0.6 (6.26)	545	72.7 (14)	0 (6.26)	-0.60 (-1.34 to 0.14), NSD
				24	544	73.2 (14)	-0.6 (6.26)	545	72.7 (14)	-0.2 (6.26)	-0.40 (-1.14 to 0.34), 0.60
Lombard, 2016[62] Fair	IG1	HD, PA Medium	Waist circumference (cm)	12*	259	95.07 (15.26)	-0.43 (5.75)	233	93.03 (15.2)	0.63 (6.62)	-0.96 (-2.30 to 0.41), NSD
			Weight (kg)	12*	259	77.99 (18.01)	-0.48 (4.19)	233	76.16 (18.73)	0.44 (4.13)	-0.87 (-1.62 to -0.13), <0.05
Metzgar, 2016[65] Fair	IG1	HD High	BMI (kg/m2)	6*	26	26.1 (2.55)	0.3 (1.35)	25	29.3 (3.5)	-0.4 (1.57)	0.70 (-0.10 to 1.50), NSD
			Waist circumference (cm)	6*	26	80.2 (6.63)	0.1 (2.96)	25	85.9 (7.5)	-2.3 (3.35)	2.40 (0.66 to 4.14), ≤0.05
			Weight (kg)	6*	26	73.9 (8.16)	1 (4)	25	77.9 (9.5)	-1.3 (4.58)	2.30 (-0.06 to 4.66), NSD
	IG2	HD High	BMI (kg/m2)	6	29	27.4 (2.15)	0.4 (0.96)	25	29.3 (3.5)	-0.4 (1.57)	0.80 (0.12 to 1.48), ≤0.05

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Waist circumference (cm)	6	29	82.5 (4.85)	0.2 (2.17)	25	85.9 (7.5)	-2.3 (3.35)	2.50 (1.01 to 3.99), ≤0.05
			Weight (kg)	6	29	74.2 (5.92)	0.8 (2.82)	25	77.9 (9.5)	-1.3 (4.58)	2.10 (0.10 to 4.10), ≤0.05
Mosca, 2008[126] Good	IG1	HD, PA Medium	BMI (kg/m2)	12*	250	27.8 (5.65)	-0.1 (2.82)	251	28.4 (6.47)	0 (3.01)	-0.10 (-0.61 to 0.41), 0.88
			Waist circumference (cm)	12*	250	90.4 (14.52)	1.5 (6.72)	251	91.2 (15.36)	1.8 (7.24)	-0.30 (-1.52 to 0.92), 0.43
Roderick, 1997[133] Fair	IG1	HD Medium	BMI (kg/m2)	12*	473	26.3 (4.4)	0.01 (NR)	483	25.9 (4.7)	0.14 (NR)	-0.12 (-0.30 to 0.05), NSD
			Weight (kg)	12*	473	NR (NR)	-0.1 (NR)	483	NR (NR)	0.44 (NR)	-0.56 (-1.04 to -0.07), <0.05
Sacerdote, 2006[135] Fair	IG1	HD Low	BMI (kg/m2)	12*	1488	24.8 (4.2)	-0.41 (4.72)	1489	24.3 (3.5)	0 (3.84)	-0.41 (-0.53 to -0.11), 0.02
Simkin-Silverman, 1995[136] Good	IG1	HD, PA High	BMI (kg/m2)	6	236	24.9 (3.2)	-1.8 (1.41)	253	25.1 (3.3)	-0.1 (1.48)	-1.70 (-1.96 to -1.44), <0.05
				18*	236	24.9 (3.2)	-1.1 (1.43)	253	25.1 (3.3)	0.1 (1.5)	-1.20 (-1.46 to -0.94), <0.05
				54	246	24.9 (3.2)	0.05 (2)	263	25.1 (3.3)	0.96 (1.8)	-0.91 (-1.24 to -0.58), <0.001
			Waist circumference (cm)	6	246	78.6 (8.1)	-4.2 (4)	263	78.4 (9)	-0.36 (3.72)	-3.84 (-4.51 to -3.17), <0.01
				18	246	78.6 (8.1)	-3.5 (NR)	263	78.4 (9)	-0.68 (NR)	NR, <0.01
				54	246	78.6 (8.1)	-2.9 (NR)	263	78.4 (9)	-0.46 (NR)	NR, <0.01
			Weight (kg)	6	236	67.12 (9.66)	-4.94 (4.25)	253	66.94 (9.93)	-0.36 (4.43)	-4.58 (-5.35 to -3.81), <0.05
				18*	236	67.12 (9.66)	-3.04 (4.27)	253	66.94 (9.93)	0.27 (4.47)	-3.31 (-4.09 to -2.53), <0.05
				54	246	67.12 (9.66)	-0.08 (NR)	263	66.94 (9.93)	2.36 (NR)	NR, <0.01
Sun, 2017[56] Fair	IG1	HD, PA, SB Medium	BMI (kg/m2)	6*	16	24.67 (2.89)	-0.18 (1.27)	16	25.3 (2.57)	0.3 (1.17)	Cohen's d=0.53 (NR), NR
			Waist circumference (cm)	6*	16	86.33 (6.15)	-4.88 (2.91)	16	85.04 (6.45)	-1.32 (3.36)	Cohen's d=1.32 (NR), NR
	IG1	HD, PA High	BMI (kg/m2)	6	100	29.5 (5.9)	-0.1 (2.62)	100	29.2 (6.7)	0.1 (2.93)	-0.20 (-0.97 to 0.57), NSD

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Thompson, 2008[140] Fair				12*	100	29.5 (5.9)	-0.1 (2.66)	100	29.2 (6.7)	0.3 (2.94)	-0.40 (-1.18 to 0.38), NSD
				18	100	29.5 (5.9)	-0.1 (2.66)	100	29.2 (6.7)	0.4 (2.96)	-0.50 (-1.28 to 0.28), 0.08
			Waist circumference (cm)	6	100	93.3 (14.7)	-1.2 (6.5)	100	91.8 (15.6)	-1 (6.81)	-0.20 (-2.04 to 1.64), NSD
				12*	100	93.3 (14.7)	-1.6 (6.55)	100	91.8 (15.6)	-0.9 (6.87)	-0.70 (-2.56 to 1.16), NSD
				18	100	93.3 (14.7)	-1.4 (6.57)	100	91.8 (15.6)	-1.3 (6.95)	-0.10 (-1.98 to 1.78), 0.77
			Weight (% change)	6	100	NR (NR)	-2.1 (3.2)	100	NR (NR)	-1.7 (3.9)	-0.40 (-1.39 to 0.59), NSD
				18	100	NR (NR)	-4.7 (4.2)	100	NR (NR)	-4.8 (4)	0.10 (-1.04 to 1.24), NSD
Thompson, 2014[141] Good	IG1	PA High	Waist circumference (cm)	6*	24	102.7 (10.8)	-1.57 (7.56)	24	107.2 (11.8)	-1.96 (7.16)	0.39 (-3.78 to 4.56), 0.85
			Weight (kg)	6*	24	75.7 (13.4)	-1.01 (2.34)	24	81 (13.6)	-0.99 (1.85)	-0.02 (-1.21 to 1.17), 0.97
Tinker, 2008[142] Good	IG1	HD High	BMI (kg/m2)	12*	17026	28.9 (5.8)	-0.9 (2.59)	24977	28.9 (5.8)	-0.2 (2.57)	-0.70 (-0.75 to -0.65), <0.001
				72	14409	28.9 (5.8)	-0.1 (2.62)	22321	28.9 (5.8)	0.2 (2.59)	-0.30 (-0.35 to -0.25), <0.001
			Waist circumference (cm)	12*	16864	88.3 (13.6)	-2 (6.04)	24800	88.3 (13.4)	-0.4 (5.97)	-1.60 (-1.72 to -1.48), <0.001
			Weight (kg)	12*	17026	76.4 (16.5)	-2.4 (7.38)	24977	76.2 (16.3)	-0.3 (7.34)	-2.10 (-2.24 to -1.96), <0.001
				72	14409	76.4 (16.5)	-0.8 (7.45)	22321	76.2 (16.3)	0 (7.36)	-0.80 (-0.95 to -0.65), <0.001
Valve, 2013[144] Fair	IG1	HD, PA Medium	BMI (kg/m2)	24*	1244	22 (5.93)	0.57 (2.32)	1294	22.3 (6.08)	0.5 (2.57)	0.07 (-0.12 to 0.26), 0.769
			Percent with obesity (n [%])	24	1243	NR	75 (6.0)	1293	NR	101 (7.8)	OR=0.76 (0.56 to 1.03), NSD
			Percent with overweight (n [%])	24	1243	NR	245 (19.7)	1293	NR	261 (20.2)	OR=0.97 (0.80 to 1.18), NSD
	IG1	PA Medium	BMI (kg/m2)	6	34	26.92 (NR)	-0.58 (NR)	37	27.97 (NR)	-1.3 (NR)	NR, NR

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Wadsworth, 2010[149] Fair			Percent with obesity (n [%])	6	34	NR	7 (20.6)	37	NR	9 (24.3)	OR=0.81 (0.26 to 2.47), NSD
			Percent with overweight (n [%])	6	34	NR	7 (20.6)	37	NR	7 (18.9)	OR=1.11 (0.35 to 3.58), NSD
Wieland, 2018[55] Fair	IG1	HD, PA, SB High	BMI (kg/m2)	6*	36	NR (NR)	-1.3 (1.3)	34	NR (NR)	-0.9 (1.5)	-0.40 (-1.06 to 0.26), 0.29
				12	36	NR (NR)	0.2 (1.6)	34	NR (NR)	0.6 (1.7)	-0.40 (-1.17 to 0.37), 0.24
			Waist circumference (cm)	6	36	NR (NR)	-0.9 (5.9)	34	NR (NR)	-3.6 (6.3)	2.70 (-0.16 to 5.56), 0.20
				12*	36	NR (NR)	0.6 (7)	34	NR (NR)	1.5 (5.8)	-0.90 (-3.92 to 2.12), 0.60
Wing, 2016[155] Good	IG1	HD, PA High	Gaining ≥ 0.45 kg (n [%])	12	197	NR	41 (20.8)	202	NR	70 (34.7)	OR=0.50 (0.32 to 0.78), ≤0.05
				24	197	NR	63 (32.0)	202	NR	100 (49.5)	OR=0.48 (0.32 to 0.72), ≤0.05
				36	197	NR	80 (40.6)	202	NR	110 (54.5)	OR=2.28 (1.64 to 3.19), <0.001
			Percent with obesity (n [%])	12	193	NR	4 (2.1)	195	NR	17 (8.7)	OR=0.22 (0.07 to 0.67), ≤0.05
				24	193	NR	10 (5.2)	195	NR	25 (12.8)	OR=0.37 (0.17 to 0.80), ≤0.05
				36	197	NR	21 (10.7)	195	NR	35 (17.9)	OR=2.13 (1.12 to 4.10), 0.02
			Weight (% change)	12	197	NR (NR)	-3.32 (5.89)	202	NR (NR)	-0.75 (5.97)	-2.57 (-3.73 to -1.41), ≤0.05
				24	197	NR (NR)	-2.01 (6.18)	202	NR (NR)	0.61 (6.25)	-2.62 (-3.84 to -1.40), ≤0.05
				36	197	NR (NR)	-0.03 (7.02)	202	NR (NR)	1.67 (6.96)	-1.70 (-3.07 to -0.33), <0.001
			Weight (kg)	12*	197	70.8 (11)	-2.4 (4.21)	202	71.4 (10.2)	-0.49 (4.26)	-1.91 (-2.74 to -1.08), ≤0.05
				24	197	70.8 (11)	-1.5 (4.77)	202	71.4 (10.2)	0.54 (4.69)	OR=2.04 (1.11 to 2.98), <0.001
				36	197	70.8 (11)	-0.14 (5.75)	202	71.4 (10.2)	1.14 (5.26)	OR=2.64 (2.05 to 3.22), 0.001
	IG2	HD, PA High	Gaining ≥ 0.45 kg (n [%])	12	200	NR	61 (30.5)	202	NR	70 (34.7)	OR=0.83 (0.54 to 1.26), NSD

Appendix G Table 4. Adiposity Outcomes (Key Question 2)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
				24	200	NR	74 (37.0)	202	NR	100 (49.5)	OR=0.60 (0.40 to 0.89), ≤0.05
				36	200	NR	98 (49.0)	202	NR	110 (54.5)	OR=1.41 (1.02 to 1.98), 0.09
			Percent with obesity (n [%])	12	195	NR	7 (3.6)	195	NR	17 (8.7)	OR=0.39 (0.16 to 0.96), ≤0.05
				24	195	NR	14 (7.2)	195	NR	25 (12.8)	OR=0.53 (0.26 to 1.05), NSD
				36	195	NR	15 (7.7)	195	NR	35 (17.9)	OR=2.36 (1.23 to 4.52), 0.002
			Weight (% change)	12	200	NR (NR)	-1.69 (6.22))	202	NR (NR)	-0.75 (5.97)	-0.94 (-2.13 to 0.25), NSD
				36	200	NR (NR)	0.42 (7.21)	202	NR (NR)	1.67 (6.96)	-1.25 (-2.64 to 0.14), 0.03
			Weight (kg)	12	200	71.9 (11)	-1.2 (4.38)	202	71.4 (10.2)	-0.49 (4.26)	-0.71 (-1.56 to 0.14), NSD
				24	200	71.9 (11)	-0.77 (4.67)	202	71.4 (10.2)	0.54 (4.69)	OR=1.31 (0.39 to 2.24), 0.02
				36	200	71.9 (11)	0.62 (5.23)	202	71.4 (10.2)	1.14 (5.26)	OR=0.82 (0.23 to 1.41), 0.02

Abbreviations: BL=baseline; BMI=body mass index; CG=control group; Cm=centimeters; FU=followup; HD=healthy diet; IG=intervention group; Intv=intervention; Kg=kilograms; M=meters; MA=meta-analysis; Mos=months; NR=not reported; NSD=non-significant different; OR=odds ratio; PA=physical activity; SB=sedentary behavior; SD=standard deviation.

* Included in meta-analysis
† Median

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aldana, 2006[74] Fair	IG1	HD, PA High	Fruit (serv/day)	6	174	1.3 (1)	0.9 (1.11)	174	1.6 (1.1)	0 (1.1)	0.90 (0.60 to 1.10), <0.0001
			Fruits and Vegetables (serv/day)	6*	174	4.6 (2.74)	2.3 (2.94)	174	5 (2.91)	0.1 (2.22)	2.20 (1.65 to 2.75), ≤0.05
			MUFA (g/day)	6	174	34.3 (21.6)	-15.5 (18.85)	174	29.7 (17.2)	-1.8 (16.77)	-13.70 (-16.60 to -10.60), <0.0001
			PUFA (g/day)	6	174	21.2 (14)	-7.6 (12.19)	174	19.3 (12)	-1.6 (11.29)	-6.00 (-16.60 to -10.60), <0.0001
			Saturated fat (g/day)	6*	174	26.3 (17.3)	-13 (16.25)	174	21.8 (12.1)	-1.3 (12.05)	-11.60 (-13.90 to -9.30), <0.0001
			Sodium (mg/day)	6	174	2941 (1530)	-609 (1399.67)	174	2712 (1233)	-226 (1187.04)	-383.00 (-590.00 to -176.00), <0.0003
			Vegetables (serv/day)	6	174	3.3 (2.1)	1.4 (2.39)	174	3.4 (2.2)	0.1 (2.15)	1.30 (0.90 to 1.90), <0.0001
Alexander, 2010[75] Fair	IG1	HD Medium	Fruits and Vegetables (serv/day)	12*	578	4.46 (2.7)	2.8 (2.96)	611	4.57 (2.9)	2.34 (2.54)	0.46 (0.15 to 0.77), 0.050
	IG2	HD Medium	Fruits and Vegetables (serv/day)	12	599	4.23 (2.7)	2.68 (3.16)	611	4.57 (2.9)	2.34 (2.54)	0.34 (0.02 to 0.66), 0.177
Allman-Farinelli, 2016[49] Fair	IG1	HD, PA Medium	Fruit (score)	9	96	2.4 (0.7)	0.61 (0.79)	104	2.54 (0.93)	0.09 (0.91)	0.36 (0.17 to 0.54), <0.001
			Fruit, meeting diet recommendations, ≥2 fruit serv/day (n, %)	9	96	41 (33.3)	NR	104	48 (38.4)	NR	OR=3.82 (2.10 to 6.99), 0.001
			Vegetables (score)	9	96	3.28 (1.22)	0.85 (1.22)	104	3.28 (1.13)	0.35 (1.18)	0.41 (0.18 to 0.65), 0.001
			Vegetables, meeting diet recommendations ≥3 vegetable serv/day (n, %)	9	96	19 (15.4)	NR	104	18 (14.4)	NR	OR=2.42 (1.32 to 4.44), 0.005
Anand, 2016[66] Good	IG1	HD, PA, SB Medium	Fruit (serv/day)	12	164	2.06 (1.28)	0.06 (1.3)	173	1.88 (1.2)	0.04 (1.2)	0.02 (-0.25 to 0.29), NSD
			Vegetables (serv/day)	12	164	2.72 (1.59)	-0.02 (1.56)	173	2.67 (1.59)	-0.23 (1.64)	0.21 (-0.13 to 0.55), NSD
Ball, 2016[64] Fair	IG1	HD Medium	Fruit (serv/day)	6	103	1.5 (1)	NR (NR)	103	1.6 (1)	NR (NR)	-0.05 (-0.30 to 0.19), 0.666†

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
				12	108	1.5 (1)	NR (NR)	108	1.6 (1)	NR (NR)	0.02 (-0.20 to 0.24), 0.855†
			Vegetables (serv/day)	6	103	1.83 (1.22)	0.43 (1.27)	108	1.82 (0.94)	-0.05 (0.99)	0.49 (0.25 to 0.72), <0.0005†
				12	103	1.83 (1.22)	0.33 (1.22)	108	1.82 (0.94)	0.05 (0.99)	0.29 (0.05 to 0.52), 0.016†
Baron, 1990[76] Fair	IG1	HD Medium	Fiber (g/day)	12*	121	19.68 (7.32)	2.37 (8.29)	137	17.87 (6.8)	-0.1 (7.38)	2.47 (0.56 to 4.38), ≤0.05
			Fiber (g/day)‡	12	56	20.4 (7.88)	2.4 (8.42)	69	19.3 (6.71)	0.8 (7.64)	1.60 (-1.22 to 4.42), <0.001
			Fiber (g/day)§	12	65	18.9 (6.6)	2.5 (8.13)	68	16.4 (6.6)	-1 (6.6)	3.50 (0.99 to 6.01), <0.001
Beresford, 1997[78] Fair	IG1	HD Low	Fiber (g/1000 kcal)	12*	859	10 (2.93)	0.55 (4.19)	959	10 (3.1)	0.22 (4.11)	0.32 (-0.06 to 0.70), NSD
Bernstein, 2002[79] Fair	IG1	HD High	Fiber (g/day)	6*	38	17 (6)	4 (4.99)	32	18 (7)	2 (4.02)	2.00 (-0.15 to 4.15), 0.26
			Fruit (serv/day)	6	38	2.8 (1.8)	1.1 (1.29)	32	3 (1.3)	0.1 (1.07)	1.00 (0.44 to 1.56), 0.01
			Fruits and Vegetables (serv/day)	6*	38	5.1 (2.31)	2.2 (2.16)	32	5.8 (2.17)	0.4 (1.89)	1.80 (0.84 to 2.76), ≤0.05
			Vegetables (serv/day)	6	38	2.3 (0.8)	1.1 (1.17)	32	2.8 (1.2)	0.1 (1.02)	1.00 (0.48 to 1.52), <0.01
Brekke, 2005[81] Fair	IG1	HD High	Fiber (g/1000 kcal)	12*	24	9.3 (3.2)	3.5 (4.38)	19	9.7 (2.7)	-0.5 (2.39)	4.00 (1.81 to 6.19), 0.002
			Saturated fat (% energy)	12*	24	15 (3.6)	-4.7 (3.32)	19	14.1 (3.9)	-0.6 (3.42)	-4.10 (-6.12 to -2.08), 0.001
	IG2	HD, PA High	Fiber (g/1000 kcal)	12	25	8.6 (3)	2.5 (3.63)	19	9.7 (2.7)	-0.5 (2.39)	3.00 (1.11 to 4.89), 0.025
			Saturated fat (% energy)	12	25	13.8 (3.5)	-3.9 (3.76)	19	14.1 (3.9)	-0.6 (3.42)	-3.30 (-5.46 to -1.14), 0.010
Burke, 2013[83] Fair	IG1	HD, PA Medium	Fiber (score)	6*	176	16.77 (5.6)	1.3 (5.98)	199	16.14 (6.05)	0.6 (6.05)	0.70 (-0.52 to 1.92), 0.025
			Fruit (Study defined, n, %)	6	176	153 (86.9)	164 (93.2)	199	167 (83.9)	163 (81.9)	OR=3.02 (1.52 to 6.01), 0.001
			Vegetables (Study defined, n, %)	6	176	155 (88.1)	165 (93.8)	199	170 (85.4)	177 (88.9)	OR=1.86 (0.88 to 3.96), 0.072

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Caplette, 2017[58] Fair	IG1	HD High	Fruits and Vegetables (serv/day)	6*	38	2.44 (1.91)	1.79 (2.47)	40	3.05 (1.7)	0.17 (1.39)	0.54 (NR), <0.001**
Carpenter, 2004[84] Fair	IG1	HD High	Fruit (score)	6	28	4.9 (3.5)	2.2 (2.53)	33	4.3 (3.5)	-0.54 (2.59)	2.74 (1.45 to 4.03), 0.0001
			Saturated fat (score)	6*	28	7.3 (3.5)	-1.24 (3.21)	33	6.8 (3.5)	-0.59 (3.31)	-0.65 (-2.30 to 1.00), 0.04
			Sodium (score)	6	28	7.5 (2.8)	1.18 (2.62)	33	7 (3)	0.44 (2.71)	0.74 (-0.60 to 2.08), 0.30
			Vegetables (score)	6	28	6.8 (2.8)	-0.24 (2.68)	33	7.8 (2.5)	-1.12 (2.78)	0.88 (-0.50 to 2.26), 0.23
	IG2	HD Low	Fruit (score)	6	32	4.9 (3.4)	-0.18 (2.55)	33	4.3 (3.5)	-0.54 (2.59)	0.36 (-0.89 to 1.61), 0.59
			Saturated fat (score)	6	32	7.3 (3.4)	-0.09 (3.23)	33	6.8 (3.5)	-0.59 (3.31)	0.50 (-1.09 to 2.09), 0.43
			Sodium (score)	6	32	7.2 (2.9)	1.37 (2.65)	33	7 (3)	0.44 (2.71)	0.93 (-0.37 to 2.23), 0.19
			Vegetables (score)	6	32	6.8 (2.7)	0.05 (2.69)	33	7.8 (2.5)	-1.12 (2.78)	1.17 (-0.16 to 2.50), 0.10
Coates, 1999[86] Fair	IG1	HD High	Fruit (serv/day)	6	1071	1.53 (1.13)	0.4 (1.13)	649	1.52 (1.09)	0.03 (108.46)	0.37 (0.26 to 0.48), ≤0.05
			Fruits and Vegetables (serv/day)	6*	1071	3.15 (1.92)	0.66 (1.82)	649	3.17 (1.88)	0.05 (1.46)	0.61 (0.44 to 0.78), ≤0.05
			Saturated fat (% energy)	6*	1071	13.26 (2.84)	-4.21 (3.11)	649	12.97 (2.82)	-0.71 (2.82)	-3.49 (-3.80 to -3.18), ≤0.05
			Saturated fat (g/day)	6	1071	27.83 (17.17)	-14.4 (NR)	649	26.29 (15.81)	-3.7 (NR)	-10.70 (-12.10 to -9.20), ≤0.05
			Vegetables (serv/day)	6	1071	1.62 (1.09)	0.26 (1.09)	649	1.65 (1.08)	0.02 (1.08)	0.24 (0.13 to 0.35), ≤0.05
Delichatsios, 2001[88] Fair	IG1	HD Medium	Fiber (g/day)	6	148	6.2 (NR)	1.1 (NR)	150	6 (NR)	0.2 (NR)	1.00 (0.40 to 1.60), <0.05
			Fruit (serv/day)	6	148	1.1 (NR)	0.4 (NR)	150	1.2 (NR)	0 (NR)	0.40 (0.20 to 0.60), <0.05
			Saturated fat (% energy)	6	148	12.6 (NR)	-1.9 (NR)	150	12.2 (NR)	-0.7 (NR)	-1.00 (-1.90 to -0.20), <0.05
			Vegetables (serv/day)	6	148	1.3 (NR)	0.2 (NR)	150	1.2 (NR)	0.2 (NR)	0.10 (-0.10 to 0.30), NSD
Franko, 2008[92] Fair	IG1	HD, PA Medium	Fruits and Vegetables (serv/day)	6	148	5.2 (2.56)	-0.16 (NR)	135	5.1 (2.42)	-0.18 (NR)	NR, NR

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
	IG2	HD, PA Medium	Fruits and Vegetables (serv/day)	6	139	5.4 (2.57)	-0.35 (NR)	135	5.1 (2.42)	-0.18 (NR)	NR, NR
Fries, 2005[93] Fair	IG1	HD Low	Fiber (score)	6	221	2.24 (0.35)	-0.17 (0.39)	249	2.24 (0.36)	-0.08 (0.37)	-0.09 (-0.16 to -0.02), 0.0011
				12*	238	2.24 (0.35)	-0.12 (0.41)	278	2.24 (0.36)	-0.08 (0.37)	-0.04 (-0.11 to 0.03), 0.0862
Gill, 2019[151] Fair	IG1	HD, PA, SB Medium	Dietary pattern score (score)	6	59	6.7 (2.6)	-1.84 (2.74)	59	6.4 (2.7)	-0.35 (2.63)	-1.50 (-2.42 to -0.58), 0.002
			Fruits and vegetables, meeting diet recommendations, ≥3 F/V serv/day (n, %)	6	42	25 (42.4)	31 (73.8)	46	34 (57.6)	27 (58.7)	OR=1.98 (0.80 to 4.90), 0.16
Greene, 2008[99] Fair	IG1	HD Medium	Fruits and Vegetables (serv/day)	12*	410	5.72 (2.22)	0.92 (2.1)	424	5.48 (2.21)	0.34 (1.64)	0.58 (0.32 to 0.84), ≤0.05
				24	410	5.72 (2.22)	1.01 (2.08)	424	5.48 (2.21)	0.78 (1.75)	0.23 (-0.03 to 0.49), <0.001
Herghelegiu, 2017 Good	IG1	HD, PA, SB Medium	Fruits and Vegetables (serv/day)	6	90	3.8 (1.4)§§	NR (NR)	88	3.8 (1.1)§§	NR (NR)	1.40 (1.10, 1.70), <0.001***
			Fruit and vegetables, meeting diet recommendations, ≥5 F/V serv/day (n, %)	6	90	15 (15.0)	35 (38.9)	88	14 (14.0)	1 (1.1)	55.40 (7.40, 415.80), <0.001***
Horton, 2018[48] Fair	IG1	HD High	Fruit (serv/day)	10	166	NR (NR)	NR (NR)	161	NR (NR)	NR (NR)	0.22 (NR), <0.05
			Vegetables (serv/day)	10	166	NR (NR)	NR (NR)	161	NR (NR)	NR (NR)	0.04 (NR), 0.69
Jacobs, 2011[105] Fair	IG1	HD, PA High	Fruits and Vegetables (serv/day)	12	194	1.51 (1.13)	23.93 (105.62)††	93	1.46 (1.08)	16.62 (95.5)††	7.31 (-18.02 to 32.64), 0.81‡‡
			Saturated fat (g/day)	12*	194	41.37 (17.53)	-0.54 (34.25)††	93	40.06 (14.74)	0.32 (27.18)††	-0.86 (-8.80 to 7.08), 0.51
Jenkins, 2017[52] Fair	IG1	HD Medium	Fiber (g/1000 kcal)	6*	87	12.3 (4.61)	2.7 (4.52)	317	12.6 (3.93)	1.6 (4.09)	0.90 (-0.40 to 2.30), 0.296
				18	75	12.3 (4.61)	1.9 (3.76)	278	12.6 (3.93)	1.7 (3.83)	0.10 (-1.20 to 1.40), 0.995

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Fruit (serv/day)	6	87	1.4 (1.23)	0.6 (1.43)	317	1.5 (1.12)	0.3 (1.36)	0.30 (-0.10 to 0.70), 0.175
				18	75	1.4 (1.23)	0.5 (1.33)	278	1.5 (1.12)	0.4 (1.28)	0.10 (-0.30 to 0.50), 0.965
			MUFA (% energy)	6	87	13.5 (3.99)	0 (3.57)	317	13.5 (3.93)	-0.2 (4.54)	0.10 (-1.00 to 1.20), 0.995
				18	75	13.5 (3.99)	1 (3.31)	278	13.5 (3.93)	-0.3 (4.25)	1.20 (-0.10 to 2.40), 0.069
			PUFA (% energy)	6	87	6 (1.54)	0.2 (1.67)	317	6.2 (2.24)	0 (1.82)	0.10 (-0.50 to 0.60), 0.978
				18	75	6 (1.54)	0.5 (1.77)	278	6.2 (2.24)	0.2 (2.13)	0.20 (-0.50 to 0.80), 0.883
			Saturated fat (% energy)	6*	87	10.3 (2.76)	-1 (2.62)	317	10.1 (2.81)	-0.4 (2.27)	-0.40 (-1.00 to 0.20), 0.360
				18	75	10.3 (2.76)	-0.4 (2.43)	278	10.1 (2.81)	-0.3 (2.13)	0.30 (-0.40 to 0.90), 0.738
			Vegetables (serv/day)	6	87	1.3 (1.23)	0.8 (1.43)	317	1.5 (1.68)	0.4 (1.36)	0.30 (-0.10 to 0.70), 0.208
				18	75	1.3 (1.23)	0.6 (1.33)	278	1.5 (1.68)	0.3 (1.28)	0.20 (-0.20 to 0.60), 0.648
John, 2002[107] Fair	IG1	HD Medium	Fruits and Vegetables (serv/day)	6*	329	3.4 (1.7)	1.4 (1.7)	326	3.4 (1.5)	0.1 (1.3)	1.40 (1.20 to 1.60), <0.0001
Kattelmann, 2014[109] Fair	IG1	HD, PA Medium	Fruits and Vegetables (cups/day)	15*	497	2.6 (2.1)	0.1 (1.99)	476	2.7 (1.9)	-0.3 (1.47)	0.40 (0.18 to 0.62), 0.001
Kegler, 2016[57] Fair	IG1	HD, PA Medium	Dietary pattern score (score)	6	136	51.1 (11.61)	3.4 (13.43)	152	49.5 (11.09)	2 (12.26)	1.40 (-1.57 to 4.37), 0.009
				12	125	51.1 (11.61)	1.7 (13.44)	143	49.5 (11.09)	0.9 (12.66)	0.80 (-2.33 to 3.93), 0.009
			Fruit (score)	6	136	1.5 (1.63)	0.4 (1.85)	152	1.6 (1.59)	0.2 (1.95)	0.20 (-0.24 to 0.64), 0.009
				12	125	1.5 (1.63)	0.1 (2)	143	1.6 (1.59)	-0.1 (1.81)	0.20 (-0.26 to 0.66), 0.009
			Sodium (score)	6	136	3.5 (2.75)	0.7 (3.8)	152	4 (2.81)	0.1 (3.32)	0.60 (-0.22 to 1.42), 0.78
				12	125	3.5 (2.75)	-0.1 (3.61)	143	4 (2.81)	-0.4 (3.28)	0.30 (-0.53 to 1.13), 0.78
			Vegetables (score)	6	136	2.6 (1.38)	0.4 (1.88)	152	2.3 (1.33)	0.3 (1.91)	0.10 (-0.34 to 0.54), 0.02

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
				12	125	2.6 (1.38)	0.4 (1.7)	143	2.3 (1.33)	0.3 (1.7)	0.10 (-0.31 to 0.51), 0.02
Kerr, 2016[111] Fair	IG1	HD Low	Fruit (serv/day)	6	78	1.1 (1.1)	-0.2 (0.88)	69	0.9 (0.8)	-0.2 (0.83)	-0.10 (-0.40 to 0.20), NSD
			Fruits and Vegetables (serv/day)	6*	78	3.1 (1.94)	0 (1.63)	69	2.8 (1.76)	0.2 (1.53)	-0.20 (-0.71 to 0.31), NSD
			Vegetables (serv/day)	6	78	2 (1)	0.2 (0.88)	69	1.9 (1.1)	0.4 (0.83)	-0.10 (-0.50 to 0.20), NSD
	IG2	HD Low	Fruit (serv/day)	6	72	1 (1.1)	-0.1 (0.85)	69	0.9 (0.8)	-0.2 (0.83)	0.10 (-0.20 to 0.40), NSD
			Fruits and Vegetables (serv/day)	6	72	2.7 (1.85)	0.3 (1.56)	69	2.8 (1.76)	0.2 (1.53)	0.10 (-0.41 to 0.61), NSD
			Vegetables (serv/day)	6	72	1.7 (0.9)	0.4 (0.85)	69	1.9 (1.1)	0.4 (0.83)	0.10 (-0.30 to 0.40), NSD
King, 2013[112] Good	IG1	HD, PA Medium	Fruits and Vegetables (serv/day)	12*	50	3.5 (1.9)	2.8 (2.68)	49	3.5 (1.6)	0.7 (1.57)	2.10 (1.23 to 2.97), <0.001
			Saturated fat, meeting diet recommendations, <10% calories from SF (n, %)	12	50	0 (0)	29 (58)	49	0 (0)	15 (30.6)	OR=3.13 (1.37 to 7.16), 0.02
			Fruits and vegetables, meeting diet recommendations, 5-9 F/V serv/day (n, %)	12	50	0 (0)	29 (58)	49	0 (0)	16 (32.7)	OR=2.85 (1.25 to 6.46), 0.02
			Saturated fat (% energy)	12*	50	12 (2.8)	-2.5 (2.75)	49	12.6 (3.4)	-1.2 (3.08)	-1.30 (-2.45 to -0.15), <0.001
	IG2	HD, PA High	Fruits and Vegetables (serv/day)	12	48	3.9 (2.1)	3.7 (2.93)	49	3.5 (1.6)	0.7 (1.57)	3.00 (2.07 to 3.93), <0.001
			Fruits and vegetables, meeting diet recommendations, 5-9 F/V serv/day (n, %)	12	48	0 (0)	39 (81.2)	49	0 (0)	16 (32.7)	OR=8.94 (3.49 to 22.86), <0.0001

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Saturated fat, meeting diet recommendations, <10% calories from SF (n, %)	12	48	0 (0)	27 (56.2)	49	0 (0)	15 (30.6)	OR=2.91 (1.27 to 6.71), 0.02
			Saturated fat (% energy)	12	48	12 (1.8)	-2.3 (2.15)	49	12.6 (3.4)	-1.2 (3.08)	-1.10 (-2.16 to -0.04), <0.001
	IG3	HD, PA High	Fruits and Vegetables (serv/day)	12	50	3.6 (2.1)	3 (2.93)	49	3.5 (1.6)	0.7 (1.57)	2.30 (1.37 to 3.23), <0.001
			Fruits and vegetables, meeting diet recommendations, 5-9 F/V serv/day (n, %)	12	50	0 (0)	27 (54)	49	0 (0)	16 (32.7)	OR=2.42 (1.07 to 5.48), 0.05
			Saturated fat, meeting diet recommendations, <10% calories from SF (n, %)	12	50	0 (0)	20 (40)	49	0 (0)	15 (30.6)	OR=1.51 (0.66 to 3.47), NSD
			Saturated fat (% energy)	12	50	12.2 (3.3)	-1.8 (3.37)	49	12.6 (3.4)	-1.2 (3.08)	-0.60 (-1.87 to 0.67), 0.056
Koniak-Griffin, 2015[46] Fair	IG1	HD, PA High	Dietary pattern score (score)	6	98	1.8 (0.41)	0.43 (0.38)	95	1.77 (0.42)	0.26 (0.39)	0.17 (0.06 to 0.28), <0.01
				9	100	1.8 (0.41)	0.46 (0.39)	94	1.77 (0.42)	0.31 (0.4)	0.15 (0.04 to 0.26), 0.009
Kristal, 2000[116] Fair	IG1	HD Low	Fruits and Vegetables (serv/day)	12*	601	3.62 (1.49)	0.47 (1.83)	604	3.47 (1.41)	0.14 (1.8)	0.46 (0.26 to 0.66), <0.0001
Lombard, 2016[62] Fair	IG1	HD, PA Medium	Dietary pattern score (score)	12	114	83 (16.6)	5.5 (12.26)	106	84.2 (17.6)	-0.07 (11.82)	5.80 (2.50 to 9.10), 0.001
			Fiber (g/day)	12*	114	22.9 (6.7)	-0.29 (6.54)	106	21.5 (5.5)	-0.35 (4.49)	0.32 (-1.10 to 1.70), 0.65
			Fruit (g/day)	12	259	181.56 (115.89)	16.45 (114.54)	233	189.11 (109.88)	4.38 (107.86)	9.17 (-9.22 to 27.55), NSD
			Fruit (serv/day)	12	114	1.7 (1.1)	-0.01 (0.87)	106	1.6 (0.9)	0 (0.71)	0.04 (-0.17 to 0.25), 0.71
			MUFA (g/day)	12	114	29.6 (9.2)	-1.7 (9.15)	106	28.6 (7.7)	-1.4 (7.28)	-0.17 (-2.50 to 2.10), 0.88

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			PUFA (g/day)	12	114	11.4 (4)	-0.6 (3.89)	106	10.6 (3.9)	-0.16 (3.36)	0.46 (-1.60 to 0.67), 0.41
			Saturated fat (g/day)	12*	114	34.5 (11.9)	-2.8 (9.26)	106	34.4 (11)	-2.1 (9.09)	-0.83 (-3.40 to 1.80), 0.52
			Sodium (mg/day)	12	114	2605.9 (755.4)	-184.2 (634.9)	106	2557.1 (713.1)	-177.5 (575.19)	-4.90 (-159.20 to 149.30), 0.95
			Vegetables (g/day)	12	259	169.7 (74.27)	3.09 (69.1)	233	171.71 (76.01)	2.11 (68.73)	0.18 (-11.53 to 11.89), NSD
			Vegetables (serv/day)	12	114	2.5 (1.1)	-0.07 (0.93)	106	2.4 (1.1)	0.02 (0.71)	-0.08 (-0.26 to 0.11), 0.41
Lutz, 1999[119] Fair	IG1	HD Low	Fruits and Vegetables (serv/day)	6*	146	3.5 (2.54)	0.9 (2.41)	151	3.5 (2.46)	0.1 (1.86)	0.80 (0.31 to 1.29), <0.002
	IG2	HD Low	Fruits and Vegetables (serv/day)	6	136	3.3 (2.22)	0.8 (2.22)	151	3.5 (2.46)	0.1 (1.86)	0.70 (0.23 to 1.17), <0.002
	IG3	HD Low	Fruits and Vegetables (serv/day)	6	140	3.4 (2.13)	0.7 (2.08)	151	3.5 (2.46)	0.1 (1.86)	0.60 (0.15 to 1.05), <0.002
Metzgar, 2016[65] Fair	IG1	HD High	Fiber (g/day)	6*	26	18.9 (5.1)	0.7 (5.59)	26	17.5 (5.1)	0.9 (5.1)	-0.20 (-3.11 to 2.71), NSD
			Fruit (serv/day)	6	26	1.9 (1.07)	0.2 (1)	26	1.6 (1.07)	-0.5 (1)	0.70 (0.15 to 1.25), <0.01
			Vegetables (serv/day)	6	26	3.4 (1.27)	-0.1 (1.25)	26	3.3 (1.17)	0 (1.2)	-0.10 (-0.77 to 0.57), NSD
	IG2	HD High	Fiber (g/day)	6	29	19.3 (5.39)	0.6 (5.62)	26	17.5 (5.1)	0.9 (5.1)	-0.30 (-3.15 to 2.55), NSD
			Fruit (serv/day)	6	29	1.4 (1.08)	0 (1.01)	26	1.6 (1.07)	-0.5 (1)	0.50 (-0.03 to 1.03), NSD
			Vegetables (serv/day)	6	29	3.3 (1.29)	-1.1 (11.42)	26	3.3 (1.17)	0 (1.2)	-1.10 (-5.51 to 3.31), NSD
Mosca, 2008[126] Good	IG1	HD, PA Medium	Fiber (g/day)	12*	250	18.3 (9.28)	-0.1 (10.39)	251	18.8 (8.89)	-1.1 (8.89)	1.00 (-0.69 to 2.69), 0.26
			Fruits and Vegetables (serv/day)	12*	250	4.8 (2.42)	-0.1 (2.3)	251	4.9 (2.83)	0 (2.19)	-0.10 (-0.49 to 0.29), 0.65
			Saturated fat (% energy)	12*	232	10.7 (2.42)	-0.7 (2.33)	232	10.7 (2.83)	-0.39 (2.56)	-0.31 (-0.76 to 0.14), 0.11
Parekh, 2014[129] Fair	IG1	HD, PA Low	Fruits and vegetables, meeting diet	12	667	79 (11.8)	141 (21.1)	1406	163 (11.6)	171 (12.2)	OR=1.94 (1.52 to 2.47), ≤0.05

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			recommendations, 5-9 F/V serv/day (n, %)								
	IG2	HD, PA Low	Fruits and vegetables, meeting diet recommendations, 5-9 F/V serv/day (n, %)	12	800	111 (13.9)	150 (18.8)	1406	163 (11.6)	171 (12.2)	OR=1.67 (1.31 to 2.12), ≤0.05
Roderick, 1997[133] Fair	IG1	HD Medium	Fiber (g/day)	12*	473	23.3 (8)	0.86 (8.76)	483	23.2 (9.3)	-0.19 (9.3)	1.02 (-0.20 to 2.23), NSD
			Fruit (serv/day)	12	473	NR (NR)	0.11 (NR)	483	NR (NR)	0.04 (NR)	0.06 (-0.03 to 0.16), NSD
			Saturated fat (% energy)	12*	473	13.7 (3.6)	-1.5 (3.94)	483	14 (3.9)	-0.6 (3.9)	-0.90 (-1.50 to -0.20), <0.05
			Vegetables (serv/day)	12	473	NR (NR)	0.05 (NR)	483	NR (NR)	-0.04 (NR)	0.07 (-0.13 to 0.27), NSD
Ruffin, 2011[134] Fair	IG1	HD, PA Low	Fruits and vegetables, meeting diet recommendations, 5-9 F/V serv/day (n, %)	6	2111	388 (16.4)	454 (21.5)	1278	160 (11.3)	248 (19.4)	OR=1.29 (1.05 to 1.58), ≤0.05
Sacerdote, 2006[135] Fair	IG1	HD Low	Fruits and Vegetables (serv/day)	12*	1488	2.73 (1.2)	0.41 (6.99)	1489	2.76 (1.21)	0.23 (5.81)	0.19 (0.13 to 0.63), 0.09
Simkin-Silverman, 1995[136] Good	IG1	HD, PA High	Saturated fat (% energy)	6	236	11.8 (3)	-4 (3)	253	11.4 (3)	-0.2 (3.16)	-3.80 (-4.35 to -3.25), <0.05
				18*	236	11.8 (3)	-3.8 (3.09)	253	11.4 (3)	-0.5 (3.1)	-3.30 (-3.85 to -2.75), <0.05
Smith, 2014[137] Fair	IG1	HD, PA Medium	Fiber (g/day)	6*	29	24.8 (8.4)	0.4 (8.94)	30	25.5 (10.4)	-1.9 (9.49)	2.10 (-1.10 to 5.20), 0.20
			Saturated fat (g/day)	6*	29	22.3 (12.7)	-8.6 (11.83)	30	26.9 (17.7)	-3.3 (17.5)	-7.20 (-12.20 to -2.10), 0.01
Spring, 2018[60] Fair	IG1	HD, PA, SB High	Fruits and Vegetables (serv/day)	6	84	1.9 (1.83)	6.6 (2.32)	44	1.2 (1.99)	0.5 (2.39)	6.10 (5.25 to 6.95), ≤0.05
				9*	84	1.9 (1.83)	6.5 (1.74)	44	1.24 (1.99)	0.86 (2.39)	5.64 (4.92 to 6.36), ≤0.05
			Saturated fat (% cal/day)	6	84	11.57 (2.11)	-3.37 (2.91)	44	11.99 (1.99)	-1.85 (2.63)	-1.52 (-2.55 to -0.49), ≤0.05

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
				9*	84	11.57 (2.11)	-3.92 (2.85)	44	11.99 (1.99)	-0.89 (3)	-3.03 (-4.09 to -1.97), ≤0.05
	IG2	HD, PA, SB High	Fruits and Vegetables (serv/day)	6	84	1.9 (1.83)	7.3 (1.74)	44	1.2 (1.99)	0.5 (2.39)	6.80 (6.08 to 7.52), ≤0.05
				9	84	1.9 (1.83)	6.5 (1.74)	44	1.24 (1.99)	0.86 (2.39)	5.64 (4.92 to 6.36), ≤0.05
			Saturated fat (% cal/day)	6	84	12.56 (2.11)	-6.14 (2.59)	44	11.99 (1.99)	-1.85 (2.63)	-4.29 (-5.24 to -3.34), ≤0.05
				9*	84	12.56 (2.11)	-4.59 (2.53)	44	11.99 (1.99)	-0.89 (3)	-3.70 (-4.68 to -2.72), ≤0.05
Springvloet, 2015[138] Fair	IG1	HD Medium	Fruit (serv/day)	6	459	1.83 (1.29)	0.35 (1.64)	434	1.81 (1.25)	0.19 (1.54)	0.16 (-0.05 to 0.37), NSD
				11	459	1.82 (1.29)	0.16 (1.37)	434	1.81 (1.25)	0.07 (1.28)	0.09 (-0.08 to 0.26), NSD
			Saturated fat (score)	6	459	18.09 (6.21)	-1.42 (5.79)	434	17.96 (6.04)	-0.83 (5.31)	-0.59 (-1.32 to 0.14), 0.11
				11*	459	18.09 (6.21)	-1.93 (6.01)	434	17.96 (6.04)	-1.19 (5.63)	-0.74 (-1.51 to 0.03), NSD
			Vegetables (g/day)	6	459	158.96 (69.2)	8.66 (77.17)	434	158.93 (68.96)	-0.27 (70.95)	8.93 (-0.81 to 18.67), NSD
				11	459	158.96 (69.2)	8.25 (111.71)	434	158.93 (68.96)	-1.19 (104.06)	9.44 (-4.74 to 23.62), NSD
	IG2	HD Medium	Fruit (serv/day)	6	456	1.94 (1.28)	0.2 (1.58)	434	1.81 (1.25)	0.19 (1.54)	0.01 (-0.20 to 0.22), NSD
				11	456	1.94 (1.28)	0.16 (1.31)	434	1.81 (1.25)	0.07 (1.28)	0.09 (-0.08 to 0.26), NSD
			Saturated fat (score)	6	456	17.6 (6.19)	-1.77 (8.55)	434	17.96 (6.04)	-0.83 (5.31)	-0.94 (-1.66 to -0.22), 0.01
				11	456	17.6 (6.19)	-1.77 (5.83)	434	17.96 (6.04)	-1.19 (5.63)	-0.58 (-1.33 to 0.17), NSD
			Vegetables (g/day)	6	456	163.24 (68.76)	10.03 (74.69)	434	158.93 (68.96)	-0.27 (70.95)	10.30 (0.72 to 19.88), NSD
				11	456	163.24 (68.76)	10.4 (109.49)	434	158.93 (68.96)	-1.19 (104.06)	11.59 (-2.46 to 25.64), NSD
Thompson, 2008[140] Fair	IG1	HD, PA High	Fruit (serv/day)	6	96	1.03 (0.73)	0.24 (0.8)	95	1.12 (0.85)	0.05 (0.91)	0.19 (-0.05 to 0.43), NSD
				12	96	1.03 (0.73)	0.2 (0.82)	95	1.12 (0.85)	-0.04 (0.85)	0.24 (0.00 to 0.48), NR
				18	96	1.03 (0.73)	0.28 (0.84)	95	1.12 (0.85)	0 (0.9)	0.28 (0.03 to 0.53), 0.002

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Fruits and Vegetables (serv/day)	6	96	3.93 (2.17)	0.55 (2.52)	95	3.85 (2.24)	0.18 (1.89)	0.37 (-0.26 to 1.00), NSD
				12[*]	96	3.93 (2.17)	0.11 (2.09)	95	3.85 (2.24)	-0.09 (1.73)	0.20 (-0.35 to 0.75), NSD
				18	96	3.93 (2.17)	0.55 (2.31)	95	3.85 (2.24)	0.1 (1.89)	0.45 (-0.15 to 1.05), NSD
			Saturated fat (g/day)	6	96	29.7 (14.2)	-4 (14.26)	95	30 (15.2)	-3.8 (14.08)	-0.20 (-4.22 to 3.82), NSD
				12[*]	96	29.7 (14.2)	-4.7 (14.02)	95	30 (15.2)	-3.6 (14.05)	-1.10 (-5.08 to 2.88), NSD
				18	96	29.7 (14.2)	-4.8 (13.71)	95	30 (15.2)	-3.6 (14.43)	-1.20 (-5.19 to 2.79), 0.76
			Vegetables (serv/day)	6	96	2.9 (1.71)	0.31 (2.15)	95	2.73 (1.69)	0.13 (1.84)	0.18 (-0.39 to 0.75), NSD
				12	96	2.9 (1.71)	-0.09 (1.69)	95	2.73 (1.69)	-0.05 (1.69)	-0.04 (-0.52 to 0.44), NSD
				18	96	2.9 (1.71)	0.27 (1.9)	95	2.73 (1.69)	0.1 (1.84)	0.17 (-0.36 to 0.70), 0.02
Tinker, 2008[142] Good	IG1	HD High	Fiber (g/1000 kcal)	12[*]	17117	8.8 (2.4)	3.5 (3.44)	25182	8.8 (2.4)	0.9 (2.82)	2.60 (2.54 to 2.66), <0.001
				72	14117	8.8 (2.4)	3.2 (3.67)	21759	8.8 (2.4)	0.8 (2.88)	2.40 (2.33 to 2.47), <0.001
			Fruits and Vegetables (serv/day)	12[*]	17117	3.6 (1.8)	1.5 (1.99)	25182	3.6 (1.8)	0.3 (1.48)	1.20 (1.17 to 1.23), <0.001
				72	14117	3.6 (1.8)	1.4 (2.13)	21759	3.6 (1.8)	0.2 (1.48)	1.20 (1.16 to 1.24), <0.001
			Saturated fat (% energy)	12[*]	17117	12.7 (2.5)	-4.7 (2.91)	25182	12.7 (2.5)	-1 (2.72)	-3.70 (-3.75 to -3.65), <0.001
				72	14117	12.7 (2.5)	-3.2 (3.18)	21759	12.7 (2.5)	-0.3 (2.85)	-2.90 (-2.96 to -2.84), <0.001
Van Keulen, 2011[158]	IG1	HD, PA Medium	Vegetables (g/day)	11	290	163 (81.0)	25 (83.61)	332	167 (80.0)	9 (81.54)	0.19 (0.04 to 0.35), NSD[ǁ**]
				17	285	163 (81.0)	11 (83.07)	327	167 (80.0)	-3 (80.5)	0.15 (-0.01 to 0.30),NSD[ǁ**]
			Fruit (servings/day)	11	284	2.04 (1.63)	0.66 (1.90)	326	2.10 (1.69)	0.26 (1.79)	0.17 (0.02 to 0.32), NSD[ǁ**]
				17	285	2.04 (1.63)	0.24 (1.61)	327	2.10 (1.69)	-0.01 (1.64)	0.16 (0.00 to 0.31), NSD[ǁ**]
			Vegetables,	11	290	116 (28.7)	119 (41.0)	332	112 (30.2)	119 (35.8)	OR=1.73 (1.05 to 2.85), <0.05[ǁ]

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			meeting diet recommdations (n, %)	17	285	116 (28.7)	97 (34.0)	327	112 (30.2)	93 (28.4)	OR=1.50 (0.9 to 2.51), NSD[‖]
			Fruit, meeting diet recommendations (n, %)	11	284	157 (40.8)	152 (53.5)	326	177 (45.3)	177 (45.3)	OR=1.31 (0.81 to 2.13), NSD[‖]
				17	285	157 (40.8)	137 (48.1)	327	177 (45.3)	177 (45.3)	OR=1.33 (0.82 to 2.16), NSD[‖]
	IG2	HD, PA Medium	Vegetables (g/day)	11	310	164 (81.0)	19 (83.61)	332	167 (80.0)	9 (81.54)	0.14 (-0.01 to 0.29), NSD[‖**]
				17	302	164 (81.0)	11 (84.72)	327	167 (80.0)	-3 (80.5)	0.17 (0.02 to 0.33), NR[‖**]
			Fruit (servings/day)	11	307	2.04 (1.55)	0.74 (1.90)	326	2.10 (1.69)	0.26 (1.79)	0.23 (0.08 to 0.39), NSD[‖**]
				17	302	2.04 (1.55)	0.26 (1.57)	327	2.10 (1.69)	-0.01 (1.64)	0.20 (0.05 to 0.36), NSD[‖**]
			Vegetables, meeting diet recommdations (n, %)	11	310	131 (32.3)	123 (39.7)	332	112 (30.2)	119 (35.8)	OR=1.51 (0.92 to 2.48), NSD[‖]
				17	302	131 (32.3)	108 (35.8)	327	112 (30.2)	93 (28.4)	OR=1.62 (0.97 to 2.71), NSD[‖]
			Fruit, meeting diet recommendations (n, %)	11	307	165 (42.7)	181 (59.0)	326	177 (45.3)	166 (50.9)	OR=1.76 (1.09 to 2.86), <0.05[‖]
				17	302	165 (42.7)	150 (49.7)	327	177 (45.3)	144 (44.0)	OR=1.53 (0.95 to 2.48), NSD[‖]
	IG3	HD, PA Low	Vegetables (g/day)	11	267	166 (88.0)	39 (92.26)	332	167 (80.0)	9 (81.54)	0.40 (0.24 to 0.56), NSD[‖**]
				17	272	166 (88.0)	21 (90.07)	327	167 (80.0)	-3 (80.5)	0.25 (0.09 to 0.41), NSD[‖**]
			Fruit (servings/day)	11	267	2.16 (1.69)	0.86 (2.01)	326	2.10 (1.69)	0.26 (1.79)	0.30 (0.14 to 0.46), NSD[‖**]
				17	272	2.16 (1.69)	0.52 (1.75)	327	2.10 (1.69)	-0.01 (1.64)	0.33 (0.17 to 0.49), NSD[‖**]
			Vegetables, meeting diet recommdations (n, %)	11	267	128 (32.0)	136 (50.9)	332	112 (30.2)	119 (35.8)	2.90 (1.74 to 4.83), <0.001[‖]
				17	272	128 (32.0)	109 (40.1)	327	112 (30.2)	93 (28.4)	2.06 (1.22 to 3.46), <0.01[‖]
			Fruit, meeting diet recommendations (n, %)	11	267	172 (45.3)	165 (61.8)	326	177 (45.3)	166 (50.9)	OR=1.83 (1.10 to 3.02), <0.05[‖]

Appendix H Table 1. Dietary Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
				17	272	172 (45.3)	165 (60.7)	327	177 (45.3)	144 (44.0)	OR=2.45 (1.49 to 4.03), <0.001‖
Wieland, 2018[55] Fair	IG1	HD, PA, SB High	Dietary pattern score (score)	6	36	NR (NR)	5.6 (74.4)	34	NR (NR)	0.9 (16.9)	4.70 (-20.92 to 30.32), 0.17
				12	36	NR (NR)	8.6 (13.3)	34	NR (NR)	-4.4 (21)	13.00 (4.81 to 21.19), 0.004

Abbreviations: BL=baseline; Cal=calories; CG=control group; F/V=fruit/vegetable; FU=followup; g/day=grams per day; HD=healthy diet; IG=intervention group; Intv=intervention; kcal=kilocalories; Mg=milligrams; Mos=months; MUFA=monounsaturated fatty acids; NR=not reported; NSD=non-significant difference; OR=odds ratio; PA=physical activity; PUFA=polyunsaturated fatty acids; SB=sedentary behavior; SD=standard deviation; Serv=servings; SF=saturated fat.

* Included in meta-analysis
† Study-reported beta coefficient
‡ Results for men
§ Results for women
‖ Adjusted
** Study-reported Cohen's d
†† Percent change
‡‡ Mean difference in percent change
§§ Median (IQR)
*** Median difference

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aittasalo, 2006[72] Fair	IG1	PA Low	MPA (min/wk)		6	130	69 (57.01)	30 (79.81)	73	81 (51.26)	7 (61.61)	16.00 (-6.00 to 37.00), 0.15
			Total PA (min/wk)		6†	130	344 (331)	182 (432.98)	73	430 (701)	50 (617.06)	79.00 (-28.00 to 186.00), 0.15
	IG2	PA Low	MPA (min/wk)		6	62	84 (55.12)	10 (64.45)	73	81 (51.26)	7 (61.61)	6.00 (-20.00 to 31.00), 0.67
			Total PA (min/wk)		6	62	419 (512)	136 (477.43)	73	430 (701)	50 (617.06)	79.00 (-46.00 to 205.00), 0.22
Albright, 2014[73] Fair	IG1	PA Medium	MVPA (min/wk)		12†	154	44 (18.99)	202 (149.7)	157	46 (22.37)	110 (96.26)	92.00 (64.08 to 119.92), 0.027
Aldana, 2006[74] Fair	IG1	HD, PA High	Total PA (steps/wk)		6†	174	40579 (22631)	12372 (23476.89)	174	43869 (23466)	5661 (23018.85)	6711.00 (3026.00 to 10396.00), 0.0002
Allman-Farinelli, 2016[49] Fair	IG1	HD, PA Medium	Total PA (days/wk)		9	96	6.6 (3.3)	2.1 (4.3)	104	7.4 (3.8)	1.3 (4.4)	0.20 (-0.80 to 1.30), 0.679
			Total PA (MET-min/wk)		9†	96	1620 (1581)	872 (1918)	104	1647 (1475)	797 (2115)	70.00 (-474.00 to 614.00), 0.801
Anand, 2016[66] Good	IG1	HD, PA, SB Medium	Meeting PA recs (n, %)		12†	164	64 (37.9)	58 (35.4)	173	60 (34.5)	55 (31.8)	OR=1.17 (0.75 to 1.85), NSD
Bennett, 2013[77] Good	IG1	HD, PA High	Meeting PA recs (n, %)	X	12†	60	45 (75)	38 (63.3)	61	47 (77)	46 (75.4)	OR=0.56 (0.26 to 1.23), 0.17
			MVPA (min/wk)	X	12†	59	329.47 (266.88)	20.5 (497.29)	59	546.11 (549.90)	-80.04 (495.66)	100.54 (-82.20 to 283.29), 0.29
Bickmore, 2013[80] Fair	IG1	PA Medium	Total PA (steps/day)	X	12	55	NR (NR)	NR (NR)	73	NR (NR)	NR (NR)	NR, 0.09
Brekke, 2005[81] Fair	IG1	HD High	Leisure PA (MET-min/wk)		24	24	1140 (0-2310) ‡	5 (-860-7750) §	16	780 (0-4180)‡	105 (2315-4195)§	NR, NR
	IG2	HD, PA High	Leisure PA (MET-min/wk)		24	25	700 (0-2920)‡	330 (-1434-1325)§	16	780 (0-4180)‡	105 (2315-4195)§	NR, NR
Bryan, 2013[82] Fair	IG1	PA Low	PA score (study defined)		12	113	-0.07 (0.79)	0.24 (0.84)	105	0.05 (0.86)	-0.27 (0.85)	0.51 (0.28 to 0.74), 0.004
			Total PA (min/wk)		12†	113	18.07 (24.45)	84.94 (101.28)	105	16.54 (27.49)	51.88 (63.48)	33.06 (10.42 to 55.70), 0.02

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Burke, 2013[83] Fair	IG1	HD, PA Medium	MPA (study-defined, n, %)		6	176	124 (70.5)	145 (82.4)	199	143 (71.9)	154 (77.4)	OR=1.37 (0.82 to 2.28), 0.229
			Strength exercise (study-defined, n, %)		6	176	34 (19.3)	70 (39.8)	199	55 (27.6)	55 (27.6)	OR=1.73 (1.12 to 2.67), 0.013
			VPA (study-defined, n, %)		6	176	33 (18.8)	49 (27.8)	199	55 (27.6)	51 (25.6)	OR=1.12 (0.71 to 1.77), 0.629
			Walking (study-defined, n, %)		6	176	152 (86.4)	166 (94.3)	199	171 (85.9)	173 (86.9)	OR=2.49 (1.17 to 5.33), 0.015
Carroll, 2010[85] Fair	IG1	PA Low	MPA (min/wk)		6	165	NR (NR)	106.55 (349.21)	188	NR (NR)	83.63 (321.55)	22.92 (-64.36 to 110.20), 0.52
			MVPA (min/wk)		6†	165	NR (NR)	138.95 (385.36)	188	NR (NR)	109.39 (351.98)	29.56 (-66.38 to 125.50), 0.45
			VPA (min/wk)		6	165	NR (NR)	33.03 (124.59)	188	NR (NR)	28.51 (116.06)	4.52 (-26.80 to 35.84), 0.72
de Vet, 2009[87] Fair	IG1	PA, SB Low	MPA (min/wk)		6	134	435 (475)	83 (511.8)	163	519 (657)	43 (653.53)	40.00 (-95.72 to 175.72), NSD
			Total PA (min/wk)		6†	134	2745 (1237)	-16 (1245.59)	163	2789 (1163)	81 (1351.05)	-97.00 (-395.16 to 201.16), NSD
			Walking (min/wk)		6	134	127 (226)	4 (203.58)	163	124 (161)	59 (340.37)	-55.00 (-120.57 to 10.57), NSD
	IG2	PA Low	MPA (min/wk)		6	136	441 (544)	24 (506.51)	163	519 (657)	43 (653.53)	-19.00 (-153.58 to 115.58), NSD
			Total PA (min/wk)		6	136	2777 (1118)	-70 (1183.72)	163	2789 (1163)	81 (1351.05)	-151.00 (-441.84 to 139.84), NSD
			Walking (min/wk)		6	136	140 (208)	49 (469.9)	163	124 (161)	59 (340.37)	-10.00 (-102.06 to 82.06), NSD
	IG3	PA Low	MPA (min/wk)		6	127	500 (490)	62 (503.5)	163	519 (657)	43 (653.53)	19.00 (-118.47 to 156.47), NSD
			Total PA (min/wk)		6	127	2748 (1076)	-3 (1166.68)	163	2789 (1163)	81 (1351.05)	-84.00 (-379.47 to 211.47), NSD
			Walking (min/wk)		6	127	146 (232)	26 (234.03)	163	124 (161)	59 (340.37)	-33.00 (-102.26 to 36.26), NSD
Elley, 2003[89] Good	IG1	PA Medium	Meeting PA recs (n, %)		12†	451	80 (17.7)	146 (32.4)	427	91 (21.3)	112 (26.2)	OR=1.35 (0.93 to 1.96), 0.003
			MVPA (kcal/kg/wk)		12	451	6 (12.2)	4.32 (11.49)	427	6.5 (11.1)	1.29 (12.44)	2.67 (0.48 to 4.86), 0.02

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			MVPA (min/wk)		12†	451	NR (NR)	54.6 (146.27)	427	NR (NR)	16.8 (139.17)	33.60 (2.40 to 64.20), 0.04
Estabrooks, 2011[90] Fair	IG1	PA Medium	MPA (min/wk)		9†	35	28.3 (55.38)	104.4 (139.93)	35	42.1 (56.07)	31.1 (139.81)	73.30 (7.77 to 138.83), <0.05
Fischer, 2019[70] Fair	IG1	PA Medium	MVPA (min/wk)		6	78	95.6 (134.82)	252.3 (251.43)	71	99.1 (129.29)	86.9 (252.78)	165.40 (84.40 to 246.30), ≤0.05
			MVPA (min/wk)	X	6	71	222.6 (127.07)	28.5 (92.43)	60	196.7 (143.03)	-5.1 (93.47)	33.50 (1.60 to 65.50), ≤0.05
			MVPA (min/wk)	X	12†	63	222.6 (127.07)	15.6 (90.71)	57	196.7 (143.03)	-26.1 (90.45)	41.70 (8.90 to 74.50), ≤0.05
			MVPA (min/wk)		12	74	95.6 (134.82)	212.1 (252.36)	60	99.1 (129.29)	98.9 (245.62)	113.20 (28.60 to 197.80), ≤0.05
	IG2	PA Medium	MVPA (min/wk)		6	90	131.3 (166.07)	259.9 (250.72)	71	99.1 (129.29)	86.9 (252.78)	173.00 (94.50 to 251.50), ≤0.05
			MVPA (min/wk)	X	6	82	205.7 (123.14)	26.5 (95.4)	60	196.7 (143.03)	-5.1 (93.47)	31.50 (0.10 to 62.90), ≤0.05
			MVPA (min/wk)		12	85	131.3 (166.07)	211.4 (255.65)	60	99.1 (129.29)	98.9 (245.62)	112.40 (29.70 to 195.20), ≤0.05
			MVPA (min/wk)	X	12	71	205.7 (123.14)	6.9 (92.86)	57	196.7 (143.03)	-26.1 (90.45)	33.00 (0.70 to 65.20), ≤0.05
Fjeldsoe, 2015[91] Fair	IG1	PA Medium	Meeting PA recs (n, %)	X	9†	133	113 (85)	108 (81.2)	130	111 (85.4)	108 (83.1)	RR=0.98 (0.86 to 1.13), NSD
			MVPA (min/wk)		9	85	80.0 (0-228.0)	54.3 (155.7)	97	108.0 (0-221.3)**	29 (140.2)	25.30 (-12.50 to 62.80), NSD
			MVPA (min/wk)	X	9†	83	402.0 (218.8, 636.5)**	-54.8 (225.2)	87	358.0 (203.9 565.0)**	-57.2 (189.4)	2.40 (-46.80 to 51.30), NSD
Franko, 2008[92] Fair	IG1	HD, PA Medium	Total PA (MET-min/wk)		6	148	1718 (909.24)	133.41 (NR)	135	1820 (982.07)	-68 (NR)	NR, NR
	IG2	HD, PA Medium	Total PA (MET-min/wk)		6	139	1878 (1027.62)	112.75 (NR)	135	1820 (982.07)	-68 (NR)	NR, NR
Fukuoka, 2019[69] Good	IG1	PA Medium	MVPA (min/wk)	X	6	70	304.5 (207.2)	150.5 (NR)	69	319.9 (233.8)	23.1 (NR)	NR, NR

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Total PA (steps/day)	X	6	70	5837 (3235)	2318 (NR)	69	5384 (2920)	660 (NR)	NR, NR
			MVPA (min/wk)	X	9	70	304.5 (207.2)	122.5 (NR)	69	319.9 (233.8)	30.1 (NR)	NR, 0.01
			Total PA (kcal/kg/day)		9	70	7.91 (0.26)	NR (NR)	69	7.86 (0.33)	NR (NR)	NR, 0.08
			Total PA (steps/day)	X	9	70	5837 (3235)	2029 (NR)	69	5384 (2920)	779 (NR)	NR, 0.001
	IG2	PA Medium	MVPA (min/wk)	X	6	71	266 (170.8)	147 (NR)	69	319.9 (233.8)	23.1 (NR)	NR, NR
			Total PA (steps/day)	X	6	71	5063 (2526)	2345 (NR)	69	5384 (2920)	660 (NR)	NR, NR
			MVPA (min/wk)	X	9	71	266 (170.8)	105 (NR)	69	319.9 (233.8)	30.1 (NR)	NR, 0.01
			Total PA (kcal/kg/day)		9	71	7.86 (0.26)	NR (NR)	69	7.86 (0.33)	NR (NR)	NR, 0.08
			Total PA (steps/day)	X	9	71	5063 (2526)	1847 (NR)	69	5384 (2920)	779 (NR)	NR, 0.001
Gao, 2016[94] Fair	IG1	PA Medium	Meeting PA recs (n, %)		6	101	NR	NR	107	NR	NR	OR=1.54 (0.56 to 4.23), 0.40
			Meeting PA recs (n, %)		12†	98	NR	NR	105	NR	NR	OR=2.86 (1.03 to 7.96), 0.04
Gell, 2015[95] Fair	IG1	PA Medium	Total PA (steps/day)	X	6†	37	6752.1 (2653.3)	115.6 (2467.92)	37	6737.9 (2619.3)	-548.9 (2473.95)	664.50 (-461.46 to 1790.46), 0.06
Gill, 2019[151] Fair	IG1	HD, PA, SB Medium	Total PA (MET-min/wk)		6	59	1188 (2376)	2.13 (25.79)	59	1451 (2781)	1.37 (25.67)	0.76 (-8.22 to 9.74), 0.87
			Total PA (steps/day)	X	6†	59	5716 (4033)††	1646 (3301.98)	59	5585 (4001)††	-1485 (3171.51)	3132.00 (1969.00 to 4294.00), <0.001
Goldstein, 1999[96] Fair	IG1	PA Low	Meeting PA recs (n, %)		8†	159	26 (14.9)	45 (28.3)	157	29 (17.2)	38 (24.2)	OR=1.26 (0.72 to 2.22), 0.41
			PA score (Study defined)		8	158	108.53 (68.78)	4.05 (70.87)	154	108.82 (65.07)	2.21 (67.05)	1.84 (-13.48 to 17.16), 0.74

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Gomez Quinonez, 2016[59] Fair	IG1	PA Low	Total PA (min/wk)		6	81	387.03 (246.4)	-3.57 (NR)	91	382.83 (238)	-48.3 (NR)	13.44 (-41.65 to 68.53), 0.63
	IG2	PA Low	Total PA (min/wk)		6	117	369.04 (253.96)	36.33 (NR)	91	382.83 (238)	-48.3 (NR)	42.91 (-6.86 to 92.61), 0.09
Grandes, 2009[97] Good	IG1	PA Low	Meeting PA recs (n, %)		6	2248	0 (0)	423 (18.8)	2069	0 (0)	310 (15)	OR=1.30 (1.10 to 1.60), ≤0.05
			MVPA (MET-min/wk)		6	2248	142.2 (357.6)	342 (2358.56)	2069	141.6 (356.4)	265.2 (2276.63)	76.20 (22.80 to 129.60), ≤0.05
			MVPA (min/wk)		6	2248	34.4 (90.9)	82.58 (547.79)	2069	33.2 (79.5)	65.14 (527.73)	18.15 (5.66 to 30.65), ≤0.05
			Meeting PA recs (n, %)		12†	1906	0 (0)	447 (23.5)	1785	0 (0)	391 (21.9)	RD=1.80 (-1.97 to 5.85), NR
			MVPA (MET-min/wk)		12	1906	147.6 (364.8)	465.6 (3000.36)	1785	142.2 (352.8)	437.4 (2910.03)	29.40 (-36.00 to 95.40), NSD
			MVPA (min/wk)		12†	1906	35.94 (94.81)	128.6 (732.16)	1785	33.45 (77.81)	127.33 (709.83)	2.01 (-12.56 to 16.59), NSD
			Meeting PA recs (n, %)		24	1906	0 (0)	531 (27.9)	1785	0 (0)	459 (25.7)	RD=2.14 (-1.81 to 6.32), NR
			MVPA (MET-min/wk)		24	1906	147.6 (364.8)	545.4 (3047.13)	1785	142.2 (352.8)	497.4 (2961.76)	37.20 (-37.20 to 111.60), NSD
			MVPA (min/wk)		24	1906	35.94 (94.81)	148.82 (744.19)	1785	33.45 (77.81)	139.97 (721.79)	7.33 (-9.75 to 24.42), NSD
Green, 2002[98] Fair	IG1	PA Medium	PA score (Study defined)		6	128	5.03 (2.01)	0.43 (1.8)	128	4.73 (2.11)	0.1 (1.8)	0.32 (-0.12 to 0.76), 0.145
Guaglinao, 2020[157] Fair	IG1	PA High	Walking (steps/wk)	X	12†	15	56022 (15915)	-10368 (16319)	18	58287 (18428)	705 (17782)	-11073 (-22815 to 669.27), NSD
			MVPA (min/wk)	X	12†	15	364 (123.9)	-32.2 (114.1)	18	334.6 (114.1)	4.9 (123.2)	-39.90 (-116.90 to 37.10), NSD††††
	IG2	PA Low	Walking (steps/wk)	X	12	13	59174 (19245)	-5259 (11781)	18	58287 (18428)	705 (17782)	-5964 (-17080 to 5152), NSD
			MVPA (min/wk)	X	12	13	364 (134.4)	-6.3 (73.5)	18	334.6 (114.1)	4.9 (123.2)	-48.30 (-135.10 to 38.50), NSD††††
Halbert, 2000[100] Fair	IG1	PA Medium	VPA (min/session)		12	149	0 (0-0)**	NR (NR)	150	0 (0-0)**	NR (NR)	NR, <0.05

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj[*]	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Walking (min/session)		12	149	0 (0-25)[**]	NR (NR)	150	0 (0-20)[**]	NR (NR)	NR, NSD
Hargreaves, 2016[101] Fair	IG1	PA Medium	Walking (steps/wk)	X	6	35	50971 (19229)	18258 (19013.04)	39	53480 (19426.68)	6810 (19334.43)	11447.00 (3346.00 to 19548.00), 0.006
Harland, 1999[102] Fair	IG1	PA Medium	MPA (n, %)		12	79	NR	15 (19)	91	NR	17 (18.7)	0.00 (-12.00 to 12.00), NSD
			PA score (n, %)		12	79	NR	21 (26.6)	91	NR	21 (23.1)	4.00[§§] (-10.00 to 17.00), NSD
			VPA (n, %)[‡‡]		12	79	NR	14 (17.7)	91	NR	11 (12.1)	6.00[§§] (-5.00 to 16.00), NSD
	IG2	PA Medium	MPA (n, %)[‡‡]		12	88	NR	23 (26.1)	91	NR	17 (18.7)	8.00[§§] (-5.00 to 20.00), NSD
			PA score (n, %)[***]		12	88	NR	27 (30.7)	91	NR	21 (23.1)	8.00[§§] (-5.00 to 21.00), NSD
			VPA (n, %)[‡‡]		12	88	NR	19 (21.6)	91	NR	11 (12.1)	10.00[§§] (-12.00 to 21.00), NSD
	IG3	PA Medium	MPA (n, %)[‡‡]		12	88	NR	18 (20.5)	91	NR	17 (18.7)	23.00[§§] (-10.00 to 14.00), NSD
			PA score (n, %)[***]		12	88	NR	22 (25)	91	NR	21 (23.1)	3.00[§§] (-10.00 to 15.00), NSD
			VPA (n, %)[†]		12	88	NR	19 (21.6)	91	NR	11 (12.1)	10.00[§§] (-1.00 to 21.00), NSD
	IG4	PA Medium	MPA (n, %)[‡‡]		12	96	NR	20 (20.8)	91	NR	17 (18.7)	22.00[§§] (-9.00 to 14.00), NSD
			PA score (n, %)[***]		12	96	NR	22 (22.9)	91	NR	21 (23.1)	0.00[§§] (-12.00 to 12.00), NSD
			VPA (n, %)[‡‡]		12	96	NR	17 (17.7)	91	NR	11 (12.1)	6.00[§§] (-5.00 to 16.00), NSD
Harris, 2015[103] Good	IG1	PA Medium	MVPA (min/wk)[159†††]	X	12	137	96 (104)	22 (119.15)	136	88 (113)	-13 (110.58)	39.0 (16 to 62), p<0.001

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Total PA (steps/day) [159]	X	12†	137	7314 (2693)	200 (2957.39)	136	7380 (2988)	-508 (2894.98)	610 (104 to 1,117), 0.002
			MVPA (min/wk)[159]†††	X	48	108	96 (104)	30 (126.62)	117	88 (113)	5 (111.53)	32.00 (5.00 to 60.00), 0.02
			Total PA (steps/day)[159]	X	48	108	7314 (2693)	-17 (3002.2)	117	7380 (2988)	-357 (3022.06)	407.00 (-177.00 to 992.00), 0.17
Harris, 2018[50] Good	IG1	PA Medium	Meeting PA recs (n, %)	X	12†	213	183 (85.9)	193 (90.6)	228	199 (87.3)	200 (87.7)	OR=1.70 (0.70 to 3.80), 0.24
			MVPA (min/wk) [159]†††	X	12	321	105 (116)	33 (130.31)	323	84 (97)	5 (95.54)	35.00 (19.00 to 51.00), <0.001
			Total PA (steps/day)[159, 167]	X	12†	321	7653 (2826)	478 (3046.95)	323	7379 (2696)	-133 (2683.59)	677.00 (365.00 to 989.00), <0.001
			MVPA (min/wk) [159]†††	X	36	231	105 (116)	33 (143.88)	214	84 (97)	10 (99.59)	24.00 (3.00 to 45.00), 0.03
			Total PA (steps/day)[159]	X	36	231	7653 (2826)	478 (3158.75)	214	7379 (2696)	-98 (2708.59)	670.00 (237.00 to 1102.00), 0.002
	IG2	PA Low	Meeting PA recs (n, %)	X	12	205	180 (87.8)	185 (90.2)	228	199 (87.3)	200 (87.7)	OR=1.70 (0.70 to 3.90), 0.24
			MVPA (min/wk) [159]†††	X	12	312	92 (90)	37 (110.98)	323	84 (97)	5 (95.54)	33.00 (17.00 to 49.00), <0.001
			Total PA (steps/day)[159, 167]	X	12	312	7402 (2476)	608 (2726.5)	323	7379 (2696)	-133 (2683.59)	642.00 (329.00 to 955.00), <0.001
			MVPA (min/wk) [159]†††	X	36	236	92 (90)	40 (110.98)	214	84 (97)	10 (99.59)	28.00 (7.00 to 49.00), 0.009
			Total PA (steps/day)[159]	X	36	236	7402 (2476)	494 (2684.43)	214	7379 (2696)	-98 (2708.59)	627.00 (198.00 to 1056.00), 0.004
Herghelegiu, 2017[54] Good	IG1	HD, PA, SB Medium	Meeting PA recs. ≥450 MET-min/wk (n, %)		6†	90	NR	86 (95.6)	88	NR	69 (78.4)	OR=5.90 (1.90 to 16.70), <0.01
			Meeting PA recs, ≥900 MET-min/wk (n, %)		6	90	NR	64 (71.1)	88	NR	34 (38.6)	OR=3.90 (2.10 to 7.30), <0.001
			MVPA at least 1 day/wk (n, %)		6	90	NR	45 (50.0)	88	NR	19 (21.6)	OR=3.60 (1.90 to 70.00), <0.001

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj[*]	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Total PA (MET-min/wk)		6	90	1089.0 (795.7)[**]	180 (43.4 to 316.6)[§]	88	1053.0 (968.2)[**]	-346.5 (-514.6 to -178.4)[§]	420.00 (212.70 to 627.30)[‖], <0.001
			Walking (min/wk)		6	90	210 (190)[**]	NR (NR)	88	210 (225)[**]	NR (NR)	120.00 (55.30 to 184.70)[‖], <0.001
Hivert, 2007[104] Fair	IG1	HD, PA High	Total PA (kcal/kg/year)		12[†]	58	1216 (852.97)	-81 (700.65)	57	1378 (1094.73)	-260 (838.03)	179.00 (-103.13 to 461.13), NSD
			Total PA (kcal/kg/year)		24	58	1216 (852.97)	-89 (967.2)	57	1378 (1094.73)	-292 (830.48)	203.00 (-126.74 to 532.74), 0.15
Jacobs, 2011[105] Fair	IG1	HD, PA High	Total PA (min/wk)		6	168	343 (234)	10 (240.22)	84	352 (215)	-1 (207.91)	11.00 (-49.24 to 71.24), NSD
			Total PA (min/wk)		12[†]	194	343 (234)	83.25 (213.6)	93	352 (215)	76.16 (200.87)[‡‡‡]	7.09 (-44.72 to 58.90), 0.44
James, 2017[63] Fair	IG1	PA Medium	Total PA (steps/day)	X	12[†]	76	4433 (1557)	1240 (2437.44)	40	4415 (1529)	321 (1943.42)	1001.50 (244.10 to 1758.90), 0.01
Jeffery, 1999[106] Fair	IG1	HD, PA Low	PA score (Study defined)		12	197	42.9 (NR)	1.4 (30.88)	414	46.6 (NR)	-1.2 (30.52)	2.60 (-2.60 to 7.80), NSD
			PA score (Study defined)		24	197	42.9 (NR)	0.4 (28.07)	414	46.6 (NR)	-1.9 (28.49)	2.30 (-2.51 to 7.11), NSD
			PA score (Study defined)		36	197	42.9 (NR)	0.9 (29.47)	414	46.6 (NR)	-4.5 (30.52)	5.40 (0.28 to 10.52), ≤0.05
	IG2	HD, PA Low	PA score (Study defined)		12	198	48 (NR)	-0.3 (30.96)	414	46.6 (NR)	-1.2 (30.52)	0.90 (-4.29 to 6.09), NSD
			PA score (Study defined)		24	198	48 (NR)	-1.6 (28.14)	414	46.6 (NR)	-1.9 (28.49)	0.30 (-4.51 to 5.11), NSD
			PA score (Study defined)		36	198	48 (NR)	-2.3 (29.55)	414	46.6 (NR)	-4.5 (30.52)	2.20 (-2.92 to 7.32), NSD
Kallings, 2009[108] Good	IG1	PA Medium	MVPA (min/wk)		6	41	120 (0-220)[**]	NR (NR)	54	130 (40-215)[**]	NR (NR)	NR, <0.05
Kattelmann, 2014[109] Fair	IG1	HD, PA Medium	Total PA (MET-min/wk)		15[†]	497	2212 (1639)	56 (1648.58)	476	2136 (1668)	94 (1649.33)	-38.00 (-245.27 to 169.27), 0.89
Katz, 2008[110] Fair	IG1	PA High	Leisure walking (score)		6	185	11.38 (13.55)	-0.2 (9.79)	117	13.39 (12.98)	-1.36 (8.33)	1.16 (-1.11 to 3.43), NSD
			Total PA (score)		6	185	27.09 (18.85)	1.77 (11.43)	117	28.12 (19.25)	0.35 (10.82)	1.42 (-1.33 to 4.17), NSD

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			VPA (score)		6	185	9.94 (15.22)	1.47 (10.47)	117	9.25 (16.28)	0.57 (10.17)	0.90 (-1.64 to 3.44), NSD
			Leisure walking (score)		12	185	11.38 (13.55)	0.22 (12.38)	117	13.39 (12.98)	-1.75 (10.49)	1.97 (-0.90 to 4.84), NSD
			Total PA (score)		12†	185	27.09 (18.85)	1.94 (13.33)	117	28.12 (19.25)	0.99 (16.44)	0.95 (-2.64 to 4.54), NSD
			VPA (score)		12	185	9.94 (15.22)	2.29 (12.79)	117	9.25 (16.28)	1.75 (15.25)	0.54 (-2.85 to 3.93), NSD
Kegler, 2016[57] Fair	IG1	HD, PA Medium	MVPA (min/wk)	X	6†	136	234 (354)	6 (378)	152	210 (348)	-48 (378)	54.00 (-33.45 to 141.45), 0.38
			MVPA (min/wk)		12	125	234 (354)	-78 (270)	143	210 (348)	-54 (252)	-24.00 (-86.53 to 38.53), 0.38
King, 2007[113] Fair	IG1	PA Medium	MVPA (kcal/kg/day)		6	61	0.8 (1.2)	0.8 (1.2)	62	0.95 (1.3)	0.08 (1.25)	0.72 (0.29 to 1.15), ≤0.01
			MVPA (min/wk)		6	61	78.4 (113.3)	107 (138.29)	62	92.2 (126.7)	19.1 (142.65)	87.90 (38.24 to 137.56), ≤0.01
			MVPA (kcal/kg/day)		12†	61	0.8 (1.2)	0.75 (1.25)	62	0.95 (1.3)	0.15 (1.3)	0.60 (0.15 to 1.05), ≤0.05
			MVPA (min/wk)		12	61	78.4 (113.3)	77.9 (126.82)	62	92.2 (126.7)	20.1 (132.04)	57.80 (12.03 to 103.57), 0.056
	IG2	PA Medium	MVPA (kcal/kg/day)		6	66	0.85 (1)	0.82 (1.11)	62	0.95 (1.3)	0.08 (1.25)	0.74 (0.33 to 1.15), ≤0.01
			MVPA (min/wk)		6	66	99.7 (147.6)	69.4 (153.62)	62	92.2 (126.7)	19.1 (142.65)	50.30 (-1.14 to 101.74), ≤0.05
			MVPA (kcal/kg/day)		12	66	0.85 (1)	0.81 (1.18)	62	0.95 (1.3)	0.15 (1.3)	0.66 (0.23 to 1.09), ≤0.01
			MVPA (min/wk)		12	66	99.7 (147.6)	66.1 (142.51)	62	92.2 (126.7)	20.1 (132.04)	46.00 (-1.68 to 93.68), ≤0.05
King, 2013[112] Good	IG1	HD, PA Medium	Meeting PA recs (n, %)		12†	50	0 (0)	20 (40)	49	0 (0)	11 (22.4)	OR=2.30 (0.96 to 5.54), NSD
			MVPA (min/wk)		12†	50	30.1 (40.6)	139.5 (127.64)	49	24.9 (40.1)	75.7 (109.03)	63.80 (17.00 to 110.60), <0.05
	IG2	HD, PA High	Meeting PA recs (n, %)		12	48	0 (0)	18 (37.5)	49	0 (0)	11 (22.4)	OR=2.07 (0.85 to 5.05), NSD
			MVPA (min/wk)		12	48	26.9 (33.5)	106.3 (88.44)	49	24.9 (40.1)	75.7 (109.03)	30.60 (-8.96 to 70.16), NSD

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
	IG3	HD, PA High	Meeting PA recs (n, %)		12	50	0 (0)	24 (48)	49	0 (0)	11 (22.4)	OR=3.19 (1.34 to 7.62), 0.01
			MVPA (min/wk)		12	50	49.7 (85.8)	133.2 (142.16)	49	24.9 (40.1)	75.7 (109.03)	57.50 (7.52 to 107.48), <0.01
Kinmonth, 2008[114] Fair	IG1	PA Medium	Total PA (MET-min/wk)		6	107	5358 (3126)	894 (3120.02)	111	5064 (3342)	882 (3378.58)	12.00 (-852.12 to 876.12), NSD
			Total PA (MET-min/wk)		12	107	5358 (3126)	954 (3117.04)	111	5064 (3342)	1020 (3432.31)	-66.00 (-937.32 to 805.32), NSD
			Total PA (Ratio to REE)	X	12†	107	1.83 (0.62)	0.12 (0.68)	111	1.85 (0.54)	0.15 (0.56)	-0.03 (-0.19 to 0.13), NSD
	IG2	PA High	Total PA (MET-min/wk)		6	103	5244 (2832)	624 (2853.23)	111	5064 (3342)	882 (3378.58)	-258.00 (-1099.13 to 583.13), NSD
			Total PA (MET-min/wk)		12	103	5244 (2832)	582 (2788.09)	111	5064 (3342)	1020 (3432.31)	-438.00 (-1279.69 to 403.69), NSD
			Total PA (Ratio to REE)	X	12†	103	1.91 (0.69)	0.03 (0.64)	111	1.85 (0.54)	0.15 (0.56)	-0.12 (-0.28 to 0.04), NSD
Kolt, 2007[115] Good	IG1	PA Medium	Leisure PA (min/wk)		6	86	165.5 (220.4)	33.6 (220.8)	83	121 (172.6)	-1.8 (161.6)	35.40 (-23.11 to 93.91), NSD
			Leisure walking (min/wk)		6	86	72.4 (85.3)	16.2 (86.73)	83	59.2 (74.6)	4.7 (79.14)	11.50 (-13.56 to 36.56), NSD
			MPA (min/wk)		6	86	108.6 (163.8)	45.3 (186.78)	83	88.6 (168.2)	8.8 (159.71)	36.50 (-15.98 to 88.98), NSD
			Leisure PA (min/wk)		12	83	165.5 (220.4)	78.5 (318.92)	82	121 (172.6)	-3.7 (158.43)	82.20 (5.21 to 159.19), 0.05
			Leisure walking (min/wk)		12	83	72.4 (85.3)	19 (88.78)	82	59.2 (74.6)	4.5 (81.94)	14.50 (-11.58 to 40.58), 0.68
			Meeting PA recs (n, %)		12†	83	24 (25.8)	35 (42.2)	82	21 (22.6)	19 (23.2)	OR=2.90 (1.33 to 6.32), 0.007
			MPA (min/wk)		12†	83	108.6 (163.8)	89.1 (280.08)	82	88.6 (168.2)	-5.3 (152.7)	94.40 (25.45 to 163.35), 0.007
Koniak-Griffin, 2015[46] Fair	IG1	HD, PA High	Total PA (steps/day)	X	6	98	8579 (3268)	190 (3041.16)	95	8571 (3130)	-91 (3333.94)	281.00 (-618.82 to 1180.82), NSD
			Total PA (steps/day)	X	9†	100	8579 (3268)	-2 (3089.1)	94	8571 (3130)	-1330 (2964)	1328.00 (475.09 to 2180.91), 0.04

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Larsen, 2020[156] Fair	IG1	PA Medium	Meeting PA recs (n, %)		6†	22	NR	10 (45.5)	24	NR	6 (25)	OR=2.70 (0.70 to 10.47), NSD
			MVPA (min/wk)	X	6	22	10 (0-42.5)**	47.5 (NR)§	24	21 (0-59)**	2.0 (NR)§	37.52 (32.32 to 42.72)‖, 0.04
			MVPA (min/wk)		6	22	10 (0-45)**	85.0 (NR)	24	5 (0-43.75)**	47.5 (NR)	42.36 (NR)‖, 0.10
Lawton, 2008[117] Good	IG1	PA Medium	Meeting PA recs (n, %)		12†	544	56 (10.3)	233 (42.8)	545	62 (11.4)	165 (30.3)	OR=1.73 (1.34 to 2.21), ≤0.05
			Total PA (min/wk)		12†	544	81.77 (151.55)	75.28 (170.04)	545	81.77 (151.55)	42.3 (152.54)	32.98 (13.79 to 52.17), ≤0.05
			Meeting PA recs (n, %)		24	544	56 (10.3)	214 (39.3)	545	62 (11.4)	179 (32.8)	OR=1.33 (1.03 to 1.70), <0.001
			Total PA (min/wk)		24	544	81.77 (151.55)	70.06 (169.11)	545	81.77 (151.55)	57.51 (161.76)	12.55 (-7.11 to 32.21), 0.01
Lewis, 2013[118] Good	IG1	PA Low	Total PA (min/wk)		6	224	24.49 (27.67)	NR (NR)	224	22.72 (27.03)	NR (NR)	31.26 (8.70 to 53.82), 0.007
			Total PA (min/wk)		12	224	24.49 (27.67)	NR (NR)	224	22.72 (27.03)	NR (NR)	39.06 (15.68 to 62.44), 0.001
Lombard, 2016[62] Fair	IG1	HD, PA Medium	Leisure PA (MET-min/wk)		12	259	925 (1760)	-46 (1724.3)	233	863 (1228)	111 (1195.45)	-118.00 (-334.00 to 98.00), NSD
Mailey, 2014[120] Fair	IG1	PA Medium	MVPA (min/wk)	X	6	95	157.15 (93.1)	-8.19 (92.75)	46	146.09 (95.2)	-10.15 (89.3)	1.96 (-30.31 to 34.23), 0.18
			PA score (score)		6	95	19.01 (17.1)	14.74 (20.34)	46	16.92 (19.3)	8.39 (18.82)	6.35 (-0.64 to 13.34), 0.04
			Total PA (counts/day)	X	6†	95	217591 (74418)	5599 (73171.59)	46	222057 (64031)	-4818 (60925.43)	10417.00 (-14031.40 to 34865.40), 0.19
Marcus, 2007[122] Fair	IG1	PA Medium	Meeting PA recs (n, %)		6	80	0 (0)	34 (42.5)	78	0 (0)	14 (17.9)	OR=3.30 (1.66 to 7.22), <0.001
			Total PA (min/wk)		6	80	19.8 (26.6)	103.5 (87.39)	78	19.4 (24.5)	58.3 (92.03)	45.20 (17.22 to 73.18), 0.01
			Meeting PA recs (n, %)		12†	80	0 (0)	17 (21.2)	78	0 (0)	13 (16.7)	OR=1.50 (0.67 to 3.33), NSD
			Total PA (min/wk)		12†	80	19.8 (26.6)	80.8 (108.87)	78	19.4 (24.5)	62.5 (116.79)	18.30 (-16.89 to 53.49), NSD

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
	IG2	PA Medium	Meeting PA recs (n, %)		6	81	0 (0)	32 (39.5)	78	0 (0)	14 (17.9)	OR=2.95 (1.41 to 6.19), <0.001
			Total PA (min/wk)		6	81	20.2 (24.2)	109.3 (145.91)	78	19.4 (24.5)	58.3 (92.03)	51.00 (12.92 to 89.08), <0.01
			Meeting PA recs (n, %)		12	81	0 (0)	40 (49.4)	78	0 (0)	13 (16.7)	OR=5.31 (2.47 to 11.39), <0.001
			Total PA (min/wk)		12	81	20.2 (24.2)	142.2 (154.53)	78	19.4 (24.5)	62.5 (116.79)	79.70 (37.00 to 122.40), <0.001
Marcus, 2013[121] Good	IG1	PA Low	Meeting PA recs (n, %)		6	132	0 (0)	15 (11.4)	134	0 (0)	8 (6)	OR=2.34 (NR), 0.07
			MVPA (min/wk)		6	132	1.87 (6.86)	71.49 (86.5)	134	3.02 (10.3)	29.96 (78.18)	41.36 (25.82 to 56.90), <0.01
			Meeting PA recs (n, %)		12†	132	0 (0)	22 (16.7)	134	0 (0)	8 (6)	OR=3.14 (NR), 0.01
			MVPA (min/wk)		12†	132	1.87 (6.86)	93.91 (112.44)	134	3.02 (10.3)	40.4 (84.89)	51.99 (33.61 to 70.37), <0.01
Marcus, 2016[61] Fair	IG1	PA Low	Meeting PA recs (n, %)		6	104	NR	33 (31.7)	101	NR	13 (12.9)	OR=3.12 (1.46 to 6.66), ≤0.05
			Meeting PA recs (n, %)	X	6	104	NR	14 (13.5)	101	NR	9 (8.9)	OR=1.59 (0.66 to 3.86), NSD
			MVPA (min/wk)		6	104	8.01 (14.95)	104.79 (90.56)	100	10.44 (23.98)	53.06 (79.47)	50.00 (31.38 to 68.62), <0.01
			MVPA (min/wk)	X	6	104	35.77 (69.65)	40.53 (96.52)	101	28.67 (48.22)	15.03 (62.53)	31.00 (10.03 to 51.97), <0.01
			Meeting PA recs (n, %)	X	12†	104	NR	17 (16.3)	101	NR	13 (12.9)	OR=1.31 (0.54 to 3.17), 0.56
			Meeting PA recs (n, %)		12	104	NR	30 (28.8)	101	NR	19 (18.8)	OR=1.72 (0.86 to 3.41), 0.09
			MVPA (min/wk)	X	12†	104	35.77 (69.65)	34.61 (79.37)	101	28.67 (48.22)	26.84 (65.48)	11.47 (5.22 to 17.72), 0.01
			MVPA (min/wk)		12	104	8.01 (14.95)	100.61 (100.55)	101	10.44 (23.98)	65.41 (80.49)	30.68 (8.59 to 52.77), 0.007
Marsaux, 2015[123] Fair	IG1	HD, PA Low	MPA (min/wk)	X	6	187	33 (21)	-2 (99.42)	170	30 (19)	12 (100.78)	-14.00 (-34.78 to 6.78), NSD
			VPA (min/wk)	X	6	339	77 (98)	NR (NR)	303	77 (112)	NR (NR)	NR, NSD

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj[*]	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
	IG2	HD, PA Low	MPA (min/wk)	X	6	174	35 (20)	-3 (99.27)	170	30 (19)	12 (100.78)	-15.00 (-36.14 to 6.14), NSD
			VPA (min/wk)	X	6	324	98 (140)	NR (NR)	303	77 (112)	NR (NR)	NR, NSD
	IG3	HD, PA Low	MPA (min/wk)	X	6	195	34 (22)	14 (99.39)	170	30 (19)	12 (100.78)	2.00 (-18.57 to 22.57), NSD
			VPA (min/wk)	X	6	321	70 (98)	NR (NR)	303	77 (112)	NR (NR)	NR, NSD
Marshall, 2003[124] Fair	IG1	PA Low	Meeting PA recs (n, %)		6[†]	227	59 (26)	91 (40.1)	235	66 (28.1)	73 (31.1)	OR=1.46 (0.98 to 2.18), NSD
			Total PA (min/wk)		6	227	180 (204)	18 (NR)	235	198 (246)	-12 (NR)	NR, 0.03
Martinson, 2008[125] Good	IG1	PA High	Meeting MPA recs (n, %)		6[†]	495	112 (21.4)	166 (33.5)	491	146 (27.8)	140 (28.5)	OR=1.27 (0.97 to 1.66), <0.004
			Meeting VPA recs (n, %)		6	495	192 (36.7)	234 (47.3)	491	184 (35)	209 (42.6)	OR=1.21 (0.94 to 1.56), 0.52
			MVPA (kcal/wk)		6	493	1907 (1415.18)	101 (1515.27)	490	2141 (1810.12)	-377 (1759.67)	241.00 (35.00 to 447.00), 0.03
			Total PA (kcal/wk)		6	492	3822 (1940.16)	26 (2041.36)	491	3998 (2176.72)	-440 (2219.62)	321.00[§§§] (50.00 to 593.00), 0.03
			MVPA (kcal/wk)		12	494	1907 (1415.18)	239 (1556.42)	487	2141 (1810.12)	-207 (1719.22)	224.00[§§§] (18.00 to 430.00), 0.04
			Total PA (kcal/wk)		12[†]	494	3822 (1940.16)	341 (2082.5)	487	3998 (2176.72)	-57 (2127.41)	243.00[§§§] (-28.00 to 515.00), 0.08
			MVPA (kcal/wk)		24	487	1907 (1415.18)	273 (1604.65)	475	2141 (1810.12)	-238 (1757.63)	273.00[§§§] (66.00 to 481.00), 0.01
			Total PA (kcal/wk)		24	490	3822 (1940.16)	487 (2258.47)	475	3998 (2176.72)	-94 (2200.25)	415.00[§§§] (142.00 to 688.00), 0.01
Maselli, 2017[53] Fair	IG1	PA Medium	MVPA (min/wk)	X	6[†]	10	255.8 (122.2)	-31.3 (107.31)	11	204.3 (110.2)	-14.7 (112.89)	-16.60 (-111.04 to 77.84), NSD
			Total PA (MET-min/wk)		6	10	1235.6 (957.82)	3310.7 (2291.39)	11	1949.09 (1111.5)	-338.79 (1415.67)	3649.49 (2037.81 to 5261.17), ≤0.05
	IG2	PA Low	MVPA (min/wk)	X	6	11	245.6 (184.9)	-60 (173.03)	11	204.3 (110.2)	-14.7 (112.89)	-45.30 (-167.39 to 76.79), NSD
			Total PA (MET-min/wk)		6	11	1172 (917.6)	273.5 (1121.46)	11	1949.09 (1111.5)	-338.79 (1415.67)	612.29 (-454.99 to 1679.57), NSD

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Metzgar, 2016[65] Fair	IG1	HD High	Energy expenditure (kcal/day)		6	26	1202 (642.48)	-95 (632.53)	21	1103 (746.96)	60 (735.77)	-155.00 (-546.23 to 236.23), NSD
	IG2	HD High	Energy expenditure (kcal/day)		6	27	1168 (441.67)	-161 (434.09)	21	1103 (746.96)	60 (735.77)	-221.00 (-554.44 to 112.44), NSD
Mosca, 2008[126] Good	IG1	HD, PA Medium	MVPA (days/wk)		12†	232	1.9 (2.02)	0.59 (2.29)	232	1.6 (2.02)	0.35 (1.98)	0.24 (-0.15 to 0.63), 0.20
Napolitano, 2006[127] Fair	IG1	PA Low	MVPA (min/wk)		12†	95	48.6 (141.2)	100.3 (168.27)	92	33.6 (51.2)	105.9 (168.34)	-5.60 (-53.85 to 42.65), NSD
	IG1+IG2	PA Low	MVPA (min/wk)		12	188	49.6 (114.6)	102.1 (163.08)	92	33.6 (51.2)	105.9 (168.34)	-3.80 (-44.90 to 37.30), NSD
	IG2	PA Low	MVPA (min/wk)		12	93	50.7 (79.4)	103.8 (163.56)	92	33.6 (51.2)	105.9 (168.34)	-2.10 (-49.93 to 45.73), NSD
Norris, 2000[128] Fair	IG1	PA Medium	Total PA (kcal/wk)		6	362	1571.9 (2422.1)	536.2 (NR)	460	1681.2 (2470.3)	366.4 (NR)	NR, 0.77
			Total PA (min/wk)		6†	362	240 (336.4)	91.1 (336.4)	460	272.2 (352.4)	58.5 (352.4)	32.60 (-31.07 to 96.27), 0.99
			Walking (min/wk)		6	362	148.1 (206.5)	38.8 (NR)	460	163.1 (232.2)	38.7 (NR)	NR, 0.41
Parekh, 2014[129] Fair	IG1	HD, PA Low	Meeting PA recs (n, %)		12	667	333 (49.9)	325 (48.7)	1406	725 (51.6)	661 (47)	OR=1.07 (0.89 to 1.29), NSD
	IG2	HD, PA Low	Meeting PA recs (n, %)		12	800	419 (52.4)	415 (51.9)	1406	725 (51.6)	661 (47)	OR=1.21 (1.02 to 1.45), ≤0.05
Patel, 2017[51] Good	IG1	PA Medium	Total PA (steps/day)	X	6†	94	7244 (3368)	1385 (3116.95)	100	7662 (3776)	978 (3518.3)	494.00 (170.00 to 818.00), 0.003
Patel, 2019[153] Good	IG1	PA Low	Total PA (steps/day)	X	6	150	6313 (2812)	924 (2874.94)	151	6086 (2631)	76 (2423.78)	936.00 (516.00 to 1356.00), <0.001
			Total PA (steps/day)	X	9	150	6313 (2812)	279 (2750.7)	151	6086 (2631)	-187 (2419.04)	553.00 (116.00 to 990.00), 0.01
	IG2	PA Low	Total PA (steps/day)	X	6	150	6120 (2583)	694 (2413.26)	151	6086 (2631)	76 (2423.78)	645.00 (262.00 to 1027.00), 0.001
			Total PA (steps/day)	X	9†	150	6120 (2583)	-82 (2263.93)	151	6086 (2631)	-187 (2419.04)	110.00 (-248.00 to 468.00), 0.55
	IG3	PA Low	Total PA (steps/day)	X	6	151	6297 (2571)	678 (2491.25)	151	6086 (2631)	76 (2423.78)	710.00 (316.00 to 1104.00), <0.001

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Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
			Total PA (steps/day)	X	9	151	6297 (2571)	135 (2455.14)	151	6086 (2631)	-187 (2419.04)	482.00 (71.00 to 893.00), 0.02
Pekmezi, 2009[130] Fair	IG1	PA Low	MVPA (min/wk)		6†	45	16.56 (25.76)	130.71 (229.76)	48	11.88 (21.99)	84.91 (109.17)	45.80 (-26.59 to 118.19), 0.25
Pinto, 2002[131] Fair	IG1	PA Medium	Meeting PA recs (n, %)		6†	112	12 (10.5)	29 (25.9)	131	24 (16.2)	35 (26.7)	OR=1.11 (0.60 to 2.06), 0.73
			MPA (kcal/kg/day)		6	112	1.5 (2.5)	0.5 (3.27)	131	2 (3.4)	-0.2 (3.08)	0.70 (-0.10 to 1.50), 0.80
			Total PA (kcal/kg/day)		6†	112	33.2 (1.9)	0.6 (2.4)	126	33.5 (2)	0.1 (2.05)	0.50 (-0.07 to 1.07), 0.34
			VPA (kcal/kg/day)		6	112	0.1 (0.7)	0.4 (1.21)	126	0.2 (0.6)	0.2 (1.22)	0.20 (-0.11 to 0.51), 0.59
Pinto, 2005[132] Fair	IG1	PA Medium	MPA (kcal/kg/wk)		6	49	2.54 (4.32)	4.19 (5.67)	44	3.02 (4.97)	1.11 (5.64)	3.08 (0.78 to 5.38), <0.05
			MPA (min/wk)		6	49	38.08 (64.84)	62.84 (84.7)	44	45.31 (74.55)	16.6 (84.9)	46.24 (11.72 to 80.76), 0.01
			Total PA (kcal/kg/day)		6†	49	32.17 (0.92)	-0.84 (4.97)	44	32.09 (1.06)	-0.08 (4.97)	-0.76 (-2.78 to 1.26), NSD
			VPA (kcal/kg/wk)		6	49	0.78 (3.51)	-0.45 (0.14)	44	0.03 (0.22)	-0.42 (0.13)	-0.03 (-0.09 to 0.03), NSD
			VPA (min/wk)		6	49	7.79 (35.08)	-4.46 (1.53)	44	0.31 (2.17)	-4.24 (1.68)	-0.22 (-0.87 to 0.43), NSD
Ruffin, 2011[134] Fair	IG1	HD, PA Low	Meeting PA recs (n, %)		6	2033	620 (26.2)	630 (31)	1236	397 (27.9)	339 (27.4)	OR=1.47 (1.08 to 1.98), ≤0.05
Samdal, 2019[67] Fair	IG1	PA Medium	MVPA (hrs/day)	X	6†	38	0.9 (0.62)	0.02 (0.65)	43	1.11 (0.87)	0.03 (0.8)	-0.01 (-0.33 to 0.31), 0.735
Simkin-Silverman, 1995[136] Good	IG1	HD, PA High	Total PA (counts/hr)	X	6†	236	18.3 (6.66)	3.2 (8.62)	253	19.9 (8.93)	0.08 (8.24)	3.12 (1.63 to 4.61), <0.001
			Total PA (kcal/wk)		6	236	1216.6 (1026)	402.1 (1041.27)	253	1389.1 (1352.2)	-48 (1367.45)	450.10 (233.53 to 666.67), <0.05
			Total PA (kcal/wk)		18	236	1216.6 (1026)	431.7 (1251.97)	253	1389.1 (1352.2)	43.4 (1369.05)	388.30 (155.26 to 621.34), ≤0.05
			Total PA (counts/hr)	X	54	246	18.3 (6.66)	2.3 (9.1)	263	19.9 (8.93)	-0.26 (7.8)	2.56 (1.09 to 4.03), ≤0.05
			Total PA (kcal/wk)		54	246	1216.6 (1026)	274.9 (1172.9)	263	1389.1 (1352.2)	-113.3 (1261)	388.20 (176.24 to 600.16), ≤0.05

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Smith, 2014[137] Fair	IG1	HD, PA Medium	MVPA (min/wk)	X	6	29	133 (98)	0 (91.8)	30	112 (91)	7 (94.69)	-0.70 (-32.90 to 31.50), 0.97
			Total PA (steps/day)	X	6†	29	7170 (2973)	-153 (2737.34)	30	7152 (2171)	-111 (2154.2)	-38.00 (-732.00 to 657.00), 0.91
Spring, 2018[60] Fair	IG1	HD, PA, SB High	MVPA (min/wk)	X	6	84	68.6 (38.49)	204.4 (145.03)	44	64.4 (13.93)	58.8 (91.34)	145.60 (98.46 to 192.74), ≤0.05
			MVPA (min/wk)	X	9†	84	68.6 (38.49)	172.2 (114.05)	44	64.4 (13.93)	86.8 (142.13)	85.40 (40.05 to 130.75), ≤0.05
	IG1+IG2		MVPA (min/wk)	X	9	133	NR (NR)	172.9 (195.64)	44	64.4 (13.93)	86.8 (142.13)	84.70 (37.80 to 132.30), ≤0.05
	IG2	HD, PA, SB High	MVPA (min/wk)	X	6	84	63 (25.66)	177.1 (123.91)	44	64.4 (13.93)	58.8 (91.34)	118.30 (76.78 to 159.82), ≤0.05
			MVPA (min/wk)	X	9	84	63 (25.66)	168.7 (142.88)	44	64.4 (13.93)	86.8 (142.13)	81.90 (29.88 to 133.92), ≤0.05
Stewart, 2001[139] Fair	IG1	PA High	MVPA (kcal/wk)		12	81	1052 (NR)	487 (NR)	83	1185 (NR)	5 (NR)	NR, 0.003
			Total PA (kcal/wk)		12	81	1935 (NR)	687 (NR)	83	2057 (NR)	-10 (NR)	NR, 0.003
Sun, 2017[56] Fair	IG1	HD, PA, SB Medium	Total PA (steps/day)	X	6†	16	7942.53 (4654.29)	1011.1 (4824.65)	16	9366 (5316.39)	375.04 (4604.26)	Cohen's d=0.13, NR
Thompson, 2008[140] Fair	IG1	HD, PA High	Leisure PA (min/wk)		6	100	303.6 (289.8)	9.6 (282.05)	100	367.8 (384)	-27.6 (389.51)	37.20 (-57.06 to 131.46), NSD
			Leisure PA (min/wk)		12	100	303.6 (289.8)	1.2 (299.53)	100	367.8 (384)	-50.4 (348.38)	51.60 (-38.45 to 141.65), NSD
			Leisure PA (min/wk)		18	100	303.6 (289.8)	-7.2 (291.62)	100	367.8 (384)	-54.6 (348.38)	47.40 (-41.65 to 136.45), 0.48
Thompson, 2014[141] Good	IG1	PA High	Total PA (Activity units/day)	X	6†	24	4255 (1480)	-217.8 (1032.3)	24	4668 (2121)	-583.6 (940.3)	365.80 (-192.85 to 924.45), 0.21
Tokunaga-Nakawatase, 2014[143] Fair	IG1	HD, PA Low	Total PA (kcal/day)		6	52	243 (296.6)	-15.77 (NR)	50	379.8 (816.6)	-28.79 (NR)	NR, 0.2947
			Total PA (kcal/day)		12	47	243 (296.6)	-4.73 (NR)	50	379.8 (816.6)	-70.34 (NR)	NR, 0.4302

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Van Hoecke, 2014[145] Fair	IG1	PA Medium	PA score (Study defined)		12	124	12.1 (11.76)	20.02 (16.48)	114	14.88 (11.6)	13.62 (16.12)	6.40 (2.05 to 10.76), <0.01
			Total PA (steps/day)	X	12†	124	5734.33 (2565.35)	460.61 (2374.76)	114	5877.54 (2542.03)	39.77 (2282.87)	420.41 (-166.39 to 1007.21), NSD
	IG2	PA Low	PA score (Study defined)		12	110	14.2 (11.6)	18.61 (16.26)	114	14.88 (11.6)	13.62 (16.12)	4.99 (0.54 to 9.44), <0.05
			Total PA (steps/day)	X	12	110	5923.21 (2578.04)	538.86 (2259.55)	114	5877.54 (2542.03)	39.77 (2282.87)	499.10 (-92.89 to 1091.08), NSD
Van Keulen, 2011[158] Fair	IG1	HD, PA Medium	Total PA (min/wk)		11†	285	258.6 (223.8)	109.2 (246.4)	331	276.6 (217.8)	42.6 (249.2)	Cohen's d=16.20 (7.20 to 25.80), NSD††††
			Total PA (min/wk)		17	285	258.6 (223.8)	96 (252.0)	307	276.6 (217.8)	45.6 (249.2)	Cohen's d=13.80 (4.20 to 22.80), NSD††††
			Meeting PA recs (n, %)		11	290	0 (0)	84 (29.0)	332	0 (0)	61 (18.4)	OR=2.46 (1.50 to 4.05), <0.001††††
			Meeting PA recs (n, %)		17	285	0 (0)	83 (29.1)	327	0 (0)	74 (22.6)	OR=1.77 (1.09 to 2.87), <0.05††††
	IG2	HD, PA Medium	Total PA (min/wk)		11	307	290.4 (237.6)	49.8 (252.9)	331	276.6 (217.8)	42.6 (249.2)	Cohen's d=7.20 (-1.80 to 16.80), NSD††††
			Total PA (min/wk)		17	302	290.4 (237.6)	44.4 (255.0)	327	276.6 (217.8)	45.6 (249.2)	Cohen's d=6.60 (-2.40 to 16.20), NSD††††
			Meeting PA recs (n, %)		11	310	0 (0)	82 (26.5)	332	0 (0)	61 (18.4)	OR=1.74 (1.05 to 2.88), <0.05††††
			Meeting PA recs (n, %)		17	302	0 (0)	71 (23.5)	327	0 (0)	74 (22.6)	OR=1.19 (0.73 to 1.96), NSD††††
	IG3	HD, PA Low	Total PA (min/wk)		11	266	291.6 (238.8)	119.4 (283.4)	331	276.6 (217.8)	42.6 (249.2)	Cohen's d=19.20 (9.60 to 28.80), NSD††††
			Total PA (min/wk)		17	272	291.6 (238.8)	52.2 (263.1)	327	276.6 (217.8)	45.6 (249.2)	Cohen's d=6.00 (-3.60 to 15.60), NSD††††
			Meeting PA recs (n, %)		11	266	0 (0)	91 (34.2)	332	0 (0)	61 (18.4)	OR=2.98 (1.80 to 4.92), <0.001††††
			Meeting PA recs (n, %)		17	272	0 (0)	73 (26.8)	327	0 (0)	74 (22.6)	OR=1.37 (0.83 to 2.25), NSD††††

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Van Stralen, 2010[146] Fair	IG1	PA Low	Total PA (days/wk)		6	481	4.2 (2.2)	0.7 (2.11)	486	4 (2.2)	0.2 (2.11)	0.54 (0.28 to 0.80), <0.001
			Leisure walking (min/wk)		12	450	162.2 (186.5)	20.9 (195.72)	458	149.9 (181.8)	-2.5 (175.31)	21.90 (1.00 to 42.90), <0.05
			Total PA (days/wk)		12	450	4.2 (2.2)	0.5 (2.11)	458	4 (2.2)	0.3 (2.11)	0.28 (0.04 to 0.52), <0.01
			Total PA (min/wk)		12†	450	629.8 (440.9)	73.4 (442.1)	458	610.4 (438.2)	9.6 (443.18)	62.00 (7.40 to 116.60), <0.05
	IG2	PA Low	Total PA (days/wk)		6	444	4.2 (2.2)	0.6 (2.11)	486	4 (2.2)	0.2 (2.11)	0.59 (0.32 to 0.85), <0.001
			Leisure walking (min/wk)		12	418	178.6 (206.6)	-5.3 (197.57)	458	149.9 (181.8)	-2.5 (175.31)	5.90 (-15.60 to 27.40), NSD
			Total PA (days/wk)		12	418	4.2 (2.2)	0.5 (2.15)	458	4 (2.2)	0.3 (2.11)	0.39 (0.15 to 0.63), <0.01
			Total PA (min/wk)		12	418	662.8 (474.6)	7.9 (456.48)	458	610.4 (438.2)	9.6 (443.18)	13.50 (-42.40 to 69.40), NSD
Vandelanotte, 2005[147] Fair	IG1	HD, PA Medium	MVPA (min/wk)		6	189	325 (312)	61 (320.84)	204	392 (340)	45 (344.07)	16.00 (-49.91 to 81.91), NSD
			Total PA (min/wk)		6†	189	532 (519)	173 (519)	204	720 (485)	14 (501.22)	159.00 (58.11 to 259.89), <0.001
	IG2	HD, PA Medium	MVPA (min/wk)		6	180	295 (249)	93 (281.86)	204	392 (340)	45 (344.07)	48.00 (-15.42 to 111.42), NSD
			Total PA (min/wk)		6	180	514 (367)	213 (442.93)	204	720 (485)	14 (501.22)	199.00 (103.84 to 294.16), <0.001
Vidoni, 2019[152] Fair	IG1	HD, PA Medium	Meeting PA recs (n, %)		6	242	81 (33.5)	NR	247	82 (33.2)	NR	OR=2.02 (1.25 to 3.26), 0.0041
			Meeting PA recs (n, %)		12	242	81 (33.5)	NR	247	82 (33.2)	NR	OR=1.53 (0.92 to 2.54), 0.1010
Vrdoljak, 2014[148] Fair	IG1	HD, PA Medium	Meeting PA recs (n, %)		18	371	158 (42.6)	94 (25.3)	367	147 (40.1)	108 (29.4)	OR=0.82 (0.56 to 1.19), NSD
Wadsworth, 2010[149] Fair	IG1	PA Medium	MPA (sessions/wk)		6†	34	2.31 (2.03)	0.75 (2.13)	37	1.5 (1.42)	0.53 (1.66)	0.22 (-0.67 to 1.11), 0.132
Walthouwer, 2015[154] Fair	IG1	HD, PA Medium	MVPA (min/wk)		6†	465	521.01 (80)	201.18 (106.4)	463	584.64 (103.93)	197.75 (120.81)	-10.15 (-169.96 to 149.66), 0.900****

Appendix H Table 2. Physical Activity Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
	IG2	HD, PA Medium	MVPA (min/wk)		6	491	537.88 (88.41)	220.85 (110.65)	463	584.64 (103.93)	197.75 (120.81)	13.16 (-138.25 to 164.50), 0.863****
Warner, 2016[150] Fair	IG1	PA Medium	Total PA (MET-min/wk)		10†	86	219.09 (31.83)	-10.83 (28.09)	80	222.57 (27.16)	-9.16 (27.87)	-1.67 (-10.19 to 6.85), NSD
			Total PA (MET-min/wk)		14	84	219.09 (31.83)	-5.18 (29.99)	69	222.57 (27.16)	-3.67 (25.81)	-1.51 (-10.48 to 7.46), NSD
	IG2	PA Medium	Total PA (MET-min/wk)		10	27	214.82 (28.81)	-1.21 (29.58)	80	222.57 (27.16)	-9.16 (27.87)	7.95 (-4.40 to 20.30), NSD
			Total PA (MET-min/wk)		14	25	214.82 (28.81)	14.22 (31.45)	69	222.57 (27.16)	-3.67 (25.81)	17.89 (5.36 to 30.42), ≤0.05
Wieland, 2018[55] Fair	IG1	HD, PA, SB High	MVPA (min/wk)	X	6	36	NR (NR)	105.7 (568.4)	34	NR (NR)	60.9 (133.7)	44.80 (-151.26 to 240.86), 0.65
			MVPA (min/wk)	X	12†	36	NR (NR)	-25.9 (245.7)	34	NR (NR)	-56 (110.6)	30.10 (-60.07 to 120.27), 0.12

Abbreviations: BL=baseline; CG=control group; FU=followup; HD=healthy diet; IG=intervention group; Intv=intervention; IQR=interquartile range; Kcal=kilocalories; Kg=kilograms; MET=metabolic equivalent of task; Min=minutes; Mos=months; MPA=moderate physical activity; MVPA=moderate to vigorous physical activity; N=n analyzed; NR=not reported; NSD=non-significant difference; Obj=objective measurement; OR=odds ratio; PA=physical activity; RD=risk difference; Recs=recommendations; REE=resting energy expenditure; RR=risk ratio; SB=sedentary behavior; SD=standard deviation; VPA=vigorous physical activity; Wk=week(s).

* Based on objective measurement (e.g., accelerometer). If blank, measurement was based on self-report
† Included in meta-analysis
‡ Median (range)
§ Median change (range)
‖ Median difference (95% confidence interval)
** Median (IQR)
†† Median
‡‡ Increased total sessions
§§ % difference
*** Increased by one or more levels
††† MVPA in ≥10 min bouts
‡‡‡ % change
§§§ Least squares mean difference
**** Regression coefficient
†††† Adjusted

Appendix H Table 3. Sedentary Behavior Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Aadahl, 2014[71] Good	IG1	SB Medium	Sitting time (hrs/day)	X	6†	79	9.3 (1.8)	-0.27 (1.7)	66	9.8 (1.8)	0.06 (1.7)	-0.32 (-0.87 to 0.24), 0.31
Burke, 2013[83] Fair	IG1	HD, PA Medium	Sitting time (min/wk)		6†	176	2063 (1050)	-355 (1004.59)	199	1691 (925)	43 (956.96)	-398.00 (-596.67 to -199.33), 0.794
Gill, 2019[151] Fair	IG1	HD, PA, SB Medium	Sitting time (min/wk)		6†	59	2520 (2205)	-0.63 (1.48)	59	2520 (1680)	-0.07 (1.48)	-0.56 (-1.12 to -0.04), 0.03
Guagliano, 2020[157] Fair	IG1	PA High	Sedentary time (min/wk)	X	12†	15	4531.1 (648.2)	-344.4 (321.3)	18	4536.7 (387.8)	-276.5 (478.8)	52.50 (-120.40 to 226.10), NSD‡
	IG2	PA Low	Sedentary time (min/wk)	X	12	13	4230.1 (496.3)	139.3 (385.7)	18	4536.7 (387.8)	-276.5 (478.8)	96.60 (-98.70 to 291.90), NSD‡
Harris, 2015[103] Good	IG1	PA Medium	Sedentary time (min/wk)	X	12†	137	4207 (455)	-56 (493.74)	136	4165 (462)	-49 (480.46)	-7.00 (-122.58 to 108.58), NSD
				X	48	108	4207 (455)	-21 (455)	117	4165 (462)	-56 (480.46)	49.00 (-63.00 to 161.00), 0.37
Harris, 2018[50] Good	IG1	PA Medium	Sedentary time (min/wk)	X	12†	321	4333 (546)	7 (549.53)	323	4291 (476)	21 (490.6)	-1.40 (-63.00 to 63.00), 0.96
				X	36	231	4333 (546)	7 (517.38)	214	4291 (476)	14 (486.84)	-14.00 (-98.00 to 63.00), 0.69
	IG2	PA Low	Sedentary time (min/wk)	X	12	312	4298 (497)	21 (497)	323	4291 (476)	21 (490.6)	7.00 (-56.00 to 70.00), 0.83
				X	36	236	4298 (497)	21 (511.58)	214	4291 (476)	14 (486.84)	-7.00 (-84.00 to 77.00), 0.90
Herghelegiu, 2017[54] Good	IG1	HD, PA, SB Medium	Sedentary time (%)		6	90	NR	61 (67.8)	88	NR	73 (83)	OR=0.40 (0.20 to 0.90), 0.02
Katz, 2008[110] Fair	IG1	PA High	Sitting time (score)		6	185	2.21 (1.12)	-0.02 (0.82)	117	2.14 (1.1)	0 (0.97)	-0.02 (-0.22 to 0.18), NSD
					12†	185	2.21 (1.12)	-0.09 (0.95)	117	2.14 (1.1)	-0.01 (1.08)	-0.08 (-0.31 to 0.15), NSD
Lombard, 2016[62] Fair	IG1	HD, PA Medium	Sitting time (hrs/day)		12†	259	3.91 (2.24)	-0.06 (2.3)	233	3.66 (2.31)	0.03 (2.1)	-0.01 (-0.33 to 0.31), NSD
Marcus, 2016 Fair[61, 220]	IG1	PA Low	Sedentary time (min/wk)	X	6	101	3852 (990)	270.6 (1020.67)	101	3588 (1176)	388.8 (1123.35)	146.78 (-17.62 to 311.18), 0.02‡§
					12†	101	3852 (990)	283.2 (1025.25)	101	3588 (1176)	231.6 (1071.88)	254.35 (79.24 to 429.46), 0.02‡§
	IG1	HD, PA Low	Sedentary time (min/wk)	X	6†	187	747 (78)	-176 (272.1)	170	746 (76)	-190 (252.79)	14.00 (-40.64 to 68.64), NSD

Appendix H Table 3. Sedentary Behavior Outcomes (Key Question 3)

Author, year Quality	Intv arm	Intv focus Intensity	Outcome (Unit)	Obj*	FU (mos)	IG N	IG BL mean (SD)	IG mean change (SD)	CG N	CG BL mean (SD)	CG mean change (SD)	Mean difference in change, p-value
Marsaux, 2015[123] Fair	IG2	HD, PA Low	Sedentary time (min/wk)	X	6	174	738 (75)	-151 (272.57)	170	746 (76)	-190 (252.79)	39.00 (-16.58 to 94.58), NSD
	IG3	HD, PA Low	Sedentary time (min/wk)	X	6	195	749 (77)	-138 (270.74)	170	746 (76)	-190 (252.79)	52.00 (-1.99 to 105.99), NSD
Samdal, 2019[67] Fair	IG1	PA Medium	Sedentary time (hrs/day)	X	6†	38	19.52 (1.91)	-0.09 (1.87)	43	19.47 (1.83)	0.01 (1.62)	-0.10 (-0.86 to 0.66), 0.276
Smith, 2014[137] Fair	IG1	HD, PA Medium	Sedentary time (min/wk)		6†	29	3605 (777)	-112 (698)	30	3619 (616)	-49 (687.71)	-63.00 (-322.00 to 189.00), 0.61
Spring, 2018[60] Fair	IG1	HD, PA, SB High	Screen time (min/wk)		6	84	1872.5 (526.08)	-1456.7 (3691.53)	44	1754.2 (338.96)	18.2 (728.11)	-1474.90 (-2578.68 to -371.12), ≤0.05
					9†	84	1872.5 (526.08)	-1390.2 (458.48)	44	1754.2 (338.96)	-340.9 (753.69)	-1049.30 (-1259.57 to -839.03), ≤0.05
	IG1+IG2		Screen time (min/wk)		9	133	NR (NR)	-1193.5 (535.44)	44	1754.2 (338.96)	-340.9 (753.69)	-963.90 (-1091.30 to -836.50), ≤0.05
	IG2	HD, PA, SB High	Screen time (min/wk)		6	84	1758.4 (622.31)	-1322.3 (556.31)	44	1754.2 (338.96)	18.2 (728.11)	-1340.50 (-1566.75 to -1114.25), ≤0.05
					9	84	1758.4 (622.31)	-1344 (539.71)	44	1754.2 (338.96)	-340.9 (753.69)	-1003.10 (-1229.63 to -776.57), ≤0.05
Thompson, 2008[140] Fair	IG1	HD, PA High	TV time (hrs/day)		6	100	2.42 (1.8)	-0.4 (1.66)	100	2.54 (1.99)	-0.46 (1.81)	0.06 (-0.42 to 0.54), NSD
					12†	100	2.42 (1.8)	-0.46 (1.69)	100	2.54 (1.99)	-0.56 (1.79)	0.10 (-0.38 to 0.58), NSD
					18	100	2.42 (1.8)	-0.39 (1.69)	100	2.54 (1.99)	-0.54 (1.89)	0.15 (-0.35 to 0.65), 0.89
Wieland, 2018[55] Fair	IG1	HD, PA, SB High	Sedentary time (min/wk)	X	6	36	NR (NR)	-304.5 (1481.2)	34	NR (NR)	-266 (1050.7)	-38.50 (-643.30 to 566.30), 0.81
				X	12	36	NR (NR)	-342.3 (1285.2)	34	NR (NR)	138.6 (880.6)	-480.90 (-999.98 to 38.18), 0.19

Abbreviations: CG=control group; FU=followup; HD=healthy diet; Hrs=hours; IG=intervention group; Intv=intervention; Min=minutes; Mos=months; NR=not reported; NSD=non-significant difference; PA=physical activity; SB=sedentary behavior; SD=standard deviation; Wk=week.

† Included in meta-analysis
* Based on objective measurement (e.g., accelerometer)
‡ Adjusted
§ Study reported adjusted mean difference (IG, FU minus CG, FU)

Appendix I Table 1. Ongoing Studies

Trial Identifier	Study Name	Country	Est. N	Description	Estimated Completion Date*
NCT03720327	The Effects of a Mobile Health Intervention and Health Coach Text Messaging on Cardiovascular Risk of Older Adults (GET FIT)	US	50	This study will test a mobile-health based intervention which includes use of a Fitbit activity tracker for 3 months, a smartphone application that tracks daily food intake, and one 45-minute counseling session to create personal goals and provide patient education by a health coach; versus Get FIT+ (the same items) plus personalized text messages focusing on participant's activity and nutrition progress as monitored in the app, from the health coach for 3 months. The investigators will measure the impact on participant's diet, physical activity, clinical outcomes, psychosocial well-being, and engagement.	March 2021
NCT04425304	Effects of Efficient Lifestyle Counseling Method on the Risks of Cardiovascular Disease in Health Care Center Patients	Finland	200	The aim of the trial is to study the effect of a lifestyle change program in patients with obesity and risk of cardiovascular diseases. The main focus is to motivate and support lifestyle changes	December 2022
NCT03886064	Scaling-up Packages of Interventions for Cardiovascular Disease Prevention in Selected Sites in Europe and Sub-Saharan Africa. SPICES Study Implementation Phase	France	10,000	SPICES project builds on progress in HIV / AIDS treatment in sub-Saharan Africa (SSA) and chronic disease management through the Innovative Care for Chronic Conditions (ICCC Framework), WHO plan to apply these intervention frameworks to CVD prevention efforts.	October 2022
NCT03854461	The Efficacy of Individualized Dietary Advice in Improving Diet Quality and Cardiovascular Health	Ireland	134	This study is a randomized controlled parallel group dietary intervention conducted over six months in participants at high risk of cardiovascular disease living in Ireland (North and South) to evaluate the efficacy of individualized dietary advice incorporating biomarker profiles in improving diet quality and cardiometabolic outcomes.	June 2024
NCT03312439	Effects of Primary Prevention in Elderly People-The Healthy Aging Initiative (HAI)	Sweden	10,000	The proposed project is a intervention study where the overarching aim is to evaluate whether a primary prevention with the focus of decreasing obesity and increasing objective measures of physical activity will decrease the future risk of the endpoints cardiovascular disease, stroke, diabetes, falls, fractures, dementia and death, in a population based cohort of 70-year-old women and men	December 2022
NCT02223793	Vascular Lifestyle-Intervention and Screening in Pharmacy (VISA)	Norway	582	The overall goal of the present project is to contribute to new knowledge about the effect of a low threshold population screening system for cardiovascular risk factors in Norway. Further, this project aims to study if identifying high cardiovascular risk itself may lead to beneficial changes in health behaviors such as physical activity, diet, tobacco and alcohol behavior together with reduced risk score of cardiovascular disease, across socioeconomic status.	February 2022
NCT04113213	Primary Care - Prescribing Lifestyle Adjustments for Cardiovascular Health (P-PLAC 2)	Wales	240	P-PLAC2 (Primary Care - Prescribing Lifestyle Adjustments for Cardiovascular Health) is a Phase II interventional study to determine the efficacy of a Lifestyle Prescription (LRx), from the viewpoint of patients and healthcare practitioners. The study uses a mixed methods design, and full study training and support will be provided to staff involved in the recruitment of patients, through to the behaviour change consultation, and end of study.	July 2020

Appendix I Table 1. Ongoing Studies

Trial Identifier	Study Name	Country	Est. N	Description	Estimated Completion Date*
NCT04118673	Secondary Care - Prescribing Lifestyle Adjustments for Cardiovascular Health (S-PLAC 2)	Wales	120	Prescribing lifestyle changes to patients who have cardiovascular disease (CVD) may be an extremely cost-effective mechanism of improving health individually and for the NHS. Positive lifestyle changes such as improved diet, increased physical activity, quitting smoking and reducing alcohol consumption have been proven to reform the health status of individuals with CVD. S-PLAC 2 is a phase II study to determine the efficacy of a lifestyle prescription (L℞) in patients and healthcare practitioners in a secondary care setting (i.e., hospital clinics/wards).	July 2020
NCT04518943	Multiphase Optimization Trial of Incentives for Veterans to Encourage Walking	US	200	The investigators propose to fill the research gaps through a Multiphase Optimization Strategy (MOST) trial of incentives for walking. A MOST trial is ideally suited for situations in which a proposed intervention has many potential intervention components. A MOST trial consists of three phases. A screening phase trial is used to efficiently identify-through a factorial designed randomized trial-the effective components of a complex intervention like incentives. A refining phase trial tests the optimal dose (size or duration) of the incentives. A confirmatory phase trial tests the optimal components and dose against a usual care control. The goal of the proposed study is to conduct the screening phase trial in 128 Veterans to identify the optimal components of incentives for increasing walking among physically inactive Veterans. All Veterans in this phase will be given various components of incentives for increasing average steps per day to 7,000 steps over a 12-week habit-building period, and then maintaining the increase through a 12-week habit maintenance period.	October 2022

Abbreviations: CVD=cardiovascular disease; Est.=estimated; US=United States; WHO=World Health Organization.

* Current as of January 2021