Prevention of Overweight/Obesity in Adult Populations: A Systematic Review with Meta-analyses

Abstract

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Methods: We searched multiple databases from January 1980 to June 27, 2013, for trials in English or French. Study quality was assessed using the Cochrane Risk of Bias tool and GRADE.

Results: A total of 26 studies were included. Programs were successful in stabilizing weight and producing weight loss by the end of the interventions. Intervention participants lost 0.73 more kg (95% CI -0.93, -0.54, P<0.00001), lowered their BMI by 0.24 kg/m2 more (95% CI -0.34, -0.15, P<0.00001), reduced their waist circumference by an additional 0.95 cm (95% CI -1.27, -0.63, P<0.00001) and lost 1.27% more total body fat (95% CI -1.93, -0.61, P=0.0002) compared to the control group. Small but not clinically meaningful effect sizes were found for secondary outcomes.

Interpretation: Behavioral interventions are associated with reductions in weight and other disease indicators in mixed weight adult populations but it is uncertain if these changes are clinically meaningful and if they are maintained over time.

Funding: Canadian Institutes of Health Research
Prevention of Overweight/Obesity in Adult Populations:  
A Systematic Review with Meta-analyses

Leslea Peirson PhD¹, James Douketis MD²,³, Donna Ciliska PhD¹, Donna Fitzpatrick-Lewis MSc¹, Ali Usman MD, MSc¹, P Raina PhD¹

1. McMaster Evidence Review and Synthesis Centre, DTC 3rd floor, McMaster University  
1280 Main Street West, Hamilton, Ontario Canada L8S 4K1  
2. Department of Medicine, McMaster University  
3. St. Joseph’s HealthCare, Room F 403, 50 Charlton Ave. E. Hamilton Ontario L8N 4A6

Correspondence to: Donna Ciliska  
DTC 3rd floor, McMaster University  
1280 Main Street West, Hamilton, Ontario Canada L8S 4K1  
phone: 1 905-525-9140, ext 22529  
ciliska@mcmaster.ca

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INTRODUCTION

Overweight and obesity, defined by a body mass index (BMI) of 25-29.9 kg/m$^2$, and $\geq 30$ kg/m$^2$, are global problems with increasing prevalence in most countries.$^1$ Excess adiposity is related to considerable increase in morbidity$^2$-$^4$ and premature mortality.$^5$-$^6$

The natural history of weight changes in adults has not been well studied but data were collected on Canadian adults through the National Population Health Survey and analyzed for changes in the time periods of 1996/1997 to 2004/2005. The overall change during eight years was average gain of 4 kg for men and 3.4 kg for women.$^7$ A large cohort study conducted in the United States found that non-obese adults gain, on average, 0.8 pounds (about 0.36 kg) per year.$^8$

Several groups have produced guidelines related to overweight and obesity. The Australian$^9$, New Zealand$^{10}$, Scottish Intercollegiate Guidelines Network (SIGN)$^{11}$, and United States Preventive Services Task Force (USPSTF)$^{12}$ guidelines focused on treatment of overweight and/or obesity. The Obesity Canada Clinical Guidelines Expert Panel made recommendations for interventions for prevention of weight gain, but the underlying studies were graded as B or C (unclear whether benefits outweigh risks).$^{13}$ Similarly, the NICE recommendations about healthy lifestyle for weight gain prevention were based on cohort studies.$^{14}$

Many guideline groups have identified a gap in knowledge of interventions that help people maintain normal weight. While prevention is ideal, is there high quality evidence that interventions in people of normal weight (BMI 18.5 kg/m$^2$ to 24.9 kg/m$^2$) prevent weight gain?

We aimed to identify interventions applicable to primary care settings aimed at preventing weight gain, particularly in normal weight adults. The key question for this review was: Do preventive interventions (behavioral) in normal weight adults lead to short-term or sustained
weight gain prevention, or improved health outcomes? Primary outcomes were weight, BMI, waist circumference, and % body fat; secondary outcomes included total and LDL cholesterol, blood pressure, fasting glucose, and incidence of type 2 diabetes (T2D). Secondary questions explored were: a) differences in efficacy between patient subgroups (e.g., age ≥65 years, sex, baseline cardiovascular risk status); b) adverse effects (e.g., labelling; disordered eating; psychological distress such as anxiety, depression and stigma; nutritional deficits; cost burden); c) differences in adverse effects between adult subgroups (e.g., age ≥65 years, sex, baseline cardiovascular risk status) and d) maintenance weight or health outcome changes.

A concurrent review to this one, studied a similar question but with different inclusion/exclusion criteria. Hutfless and colleagues included 11 trials and 11 observational studies and concluded that there may be effective strategies to prevent weight gain (low fat diets, eating fewer meals out of the home, consuming more fruits and vegetables, monitoring heart rate during exercise and participation in group lifestyle sessions with reminder text messages). 15

METHODS

The protocol was registered with PROSPERO (# CRD42012002753)

(www.crd.york.ac.uk/prospero/).

Search

We searched EMBASE, Medline, Cochrane Central Registry of Controlled Trials, and PsychINFO from January 1980 to June 27, 2013. Reference lists of primary studies included in this review and related systematic reviews were searched for relevant studies not captured by our search. The search strategy example for Medline-Ovid is provided in the online supplemental file (Table 3). In addition, a focused grey literature search of Canadian sources was done for recent
reports on obesity in Canada. All citations were uploaded to a web-based systematic review software program\textsuperscript{16} for screening and data extraction.

**Study Selection, Quality Assessment and Abstraction**

Titles and abstracts of papers were reviewed in duplicate; articles marked for inclusion by either team member went on to full text screening, which was also done independently by two people. One team member completed full data abstraction and a second member verified all extracted data. All data were checked in a third round of verification prior to analysis. RCTs were assessed using Cochrane’s Risk of Bias tool\textsuperscript{17} and overall strength of the evidence was determined using GRADE.\textsuperscript{18,19} The online supplemental file Table 1, summarizes the risk of bias ratings. At all levels, inter-rater conflicts were resolved through discussion.

**Inclusion and Exclusion Criteria**

Studies had to be randomized trials conducted in adults with a normal BMI (18-24.9 kg/m\textsuperscript{2}), reported in English or French. If there was no explicit statement about normal weight status we accepted studies when the baseline mean BMI minus one standard deviation (SD) fell below 25. Trials limited to participants with cardiovascular disease or conditions which are predisposed to weight gain such as the metabolic syndrome, polycystic ovarian disease and pregnancy were excluded; as were studies focused on underweight adults or those with eating disorders.

Behavioural interventions had to centre on weight gain prevention and could include diet, exercise, diet plus exercise, or lifestyle strategies. Lifestyle strategies were typically referred to as such and usually included additional counseling, education or support and environmental changes in addition to diet and/or exercise. Pharmacological and surgical interventions were excluded.
Trials were conducted in settings generalizable to Canadian primary care, feasible for conducting in primary care or feasible for referral from primary care. Studies conducted in hospital or institutional settings, school-based programs, occupational settings, faith-based programs, and other settings deemed not generalizable to primary care, such as those with existing social networks among participants or the ability to offer intervention elements that could not be replicated in a primary care setting were excluded.

Only studies that reported outcome data for at least 12 months post baseline assessment for one or more of the specified weight outcomes (weight, BMI, waist circumference, % body fat) were included. There were no timeframe or weight outcome requirements if a study reported data for any of the adverse effects of interest to this review. Secondary outcomes included total cholesterol (TC), low density lipoprotein (LDL), fasting glucose (FG), incidence of T2D, systolic blood pressure (SBP), and diastolic blood pressure (DBP).

**Data Analysis**

For meta-analyses, immediate post-treatment data (means, standard deviations) were utilized for continuous outcomes while number of events data were utilized for binary outcomes (i.e., incidence of T2D). The DerSimonian and Laird random effects models with inverse variance method were utilized to generate the summary measures of effect in the form of mean difference (MD) for continuous outcomes and risk ratio (RR) for binary outcomes.\(^{20}\)

MDs were calculated using change from baseline data [i.e., mean difference between pre-treatment (baseline) and post-treatment (final/end-point) values along with its standard deviation (SD) for both intervention and control groups]. For studies that did not report SD, we calculated this value from the reported standard error (SE) of the mean, or from the 95% confidence intervals (CI) using equations provided in Chapter 9 of the *Cochrane Handbook for Systematic*
Reviews of Interventions. For studies that provided neither SD nor SE for the follow-up data, we imputed the SD from either the baseline values or other included studies of similar sample size and for the same outcome. The units of measurement for total cholesterol, LDL and fasting glucose, if reported in mg/dL, were converted to Canadian standard units (i.e., mmol/L).

For studies that recruited a single gender or for mixed gender studies that reported results for men and for women, we entered this data separately into the meta-analyses, using alphabetical extensions to identify gender (e.g., Imayama 2011-M, Imayama 2011-F). For studies with more than one intervention arm (e.g., two diet + exercise arms, one using a clinic-based group and one using a correspondence course), we pooled data from the intervention groups to do a pair-wise comparison with the control group. Alternatively, if the interventions were substantively different from each other (e.g., a low calorie diet group and a high intensity aerobic exercise group), we included the data for each intervention arm compared with the control group but split the sample size for the control group in half to avoid a unit-of-analysis error and double counting.

We used Cochrane’s Q (α=0.10) and the $I^2$ statistic to quantify heterogeneity, where $P<0.05$ indicated a high level of statistical heterogeneity between studies. Although there are no strict rules for interpreting $I^2$ a rough guide is that an $I^2 >50\%$ may represent substantial heterogeneity. Sensitivity analyses were performed to evaluate statistical stability and effect on statistical heterogeneity. For the outcome of weight in kg, we did sensitivity analyses based on type of intervention (diet, exercise, diet + exercise, lifestyle), length of intervention ($\leq 12$ months, $>12$ months), gender, participants’ baseline CVD risk status (high risk: identified as having CVD risk factors and/or diagnosed with T2D, hypertension, dyslipidemia; low/no CVD risk or unselected population or not specified), and study risk of bias rating (high, unclear, low). One additional sensitivity analysis was performed based on baseline mean BMI ($<25, \geq 25$) for the
outcome of BMI. Meta-analyses were performed using Review Manager version 5.1 software.\textsuperscript{17}

Publication bias for each outcome was assessed using the Egger’s test.\textsuperscript{22}

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**RESULTS**

**Search Summary**

We conducted four reviews, for obesity prevention in children, obesity treatment in children, obesity prevention in adults, and obesity treatment in adults. We believed some efficiency would be gained in the screening stage if we started with a comprehensive search strategy. Thus, the search and selection process for relevant literature occurred in stages. First, a comprehensive search including both adults and children located 30,196 unique citations of which 3,320 were for consideration for adult prevention (see supplemental file Figure 1a). The literature search was updated in June 2013 and added 1,778 citations for possible inclusion. We conducted hand-searches and reviewed reference lists of recent (published in 2012 and 2013) on topic systematic reviews to ensure that we had not missed relevant studies. Five studies were located in those reference lists that were not found through the database search.

At the end of the search and selection process, 26 studies with 48 papers met the inclusion criteria for the adult prevention review (see supplemental file Figure 1b). All studies reported weight outcome data. Most (81\%) of the studies were rated as having unclear or high risk of bias for the weight outcomes, primarily due to lack of information about or lack of procedures to ensure random sequence generation, allocation concealment and/or blinding of outcome assessment (see supplement file, Table 1). Due to the nature of behavioral interventions, there
was also high risk of bias for blinding of participants and personnel across all studies. The adults who volunteered or agreed to participate in these studies may have been more weight conscious than the general population and some may have been better motivated to lose weight.

Although this review focuses on the prevention of overweight and obesity, the population was not restricted to normal weight adults. A single study\(^\text{23}\) was found that included only normal weight adults (BMI $>$ 18 and $<$ 24.9). The criteria were, therefore, expanded to allow studies that included at least some normal weight adults, with the conditions that at least one study arm had a baseline mean BMI $<$ 25 or baseline mean BMI $>$ 25 but minus one SD $<$ 25, or the number or percentage of normal weight participants was specified. Four studies were found that reported a baseline mean BMI for at least one study group that fell within the normal range;\(^\text{24-27}\) 16 studies reported baseline mean BMIs that fell in the overweight range (25 to 29.9) and in five studies at least one intervention arm had a baseline mean BMI just over the obesity threshold of 30 kg/m\(^2\).\(^\text{28-32}\)

None of the included studies specifically targeted or recruited seniors (\(\geq 65\) years). Most studies (n=18) included mixed gender samples; seven targeted only women\(^\text{31,33-38}\) and the analysis in one study was limited to male participants.\(^\text{39}\) Few studies (n=4) were directed at participants at high risk for cardiovascular disease (i.e., screened/identified as high CVD risk and/or diagnosed with T2D, hypertension and/or dyslipidemia).\(^\text{30,40-42}\) The intervention duration was $\leq$ 1 year in over two-thirds of the studies (n=18); in the remaining 8 studies the duration ranged from two years to up to 12 years, with half of these interventions (n=4) running for two years. Just over one-third of the studies (n=10) were done in European countries, with the remainder in the US (n=7), Australia and/or New Zealand (n=4) and Japan (n=2). Less than half of the studies (n=11) were
published in the last five years (2009-2012). The characteristics of the 26 included studies are reported in the online supplement file, Table 2.

**Weight**

We were unable to conclusively determine whether primary care-relevant interventions prevent weight gain or lead to improved health outcomes in normal weight adults. As noted above, the search found one study that included only normal weight adults that met the inclusion criteria. The “Pound of Prevention” pilot study examined the effects of a 12 month, education and incentive-based lifestyle intervention in the US over 25 years ago with approximately 200 normal weight adults (defined as <115% of ideal weight as indicated by the Metropolitan Life Insurance Company tables for 1983). More intervention participants (82%) maintained their baseline weight or lost weight over the 12 month intervention compared with control group participants (56%). On average, intervention group participants lost 0.95 kg whereas control group participants lost 0.14 kg (P=0.0.3). Aside from weight, this study did not report any outcomes of interest to this review.

Given scant direct evidence to answer the key question of this prevention focused review, the criteria were expanded to allow studies that included some normal weight adults, as explained above. Twenty-five studies were found that met the expanded inclusion criteria. Therefore, the following analyses, based on subgroups of the 26 included RCTs, provide indirect evidence to address the review questions.

Nineteen RCTs of very low GRADE quality with a total of 48,460 participants provided data on weight that could be pooled. Across the 19 studies, baseline BMI ranged from 22.4 to 30.1; in three of the studies the baseline mean BMI of at least one study arm was <25; in 16 studies the
baseline mean BMIs were in the overweight/obese range. There was a statistically significant reduction in weight in the intervention group as compared with the control group [MD (95% CI) -0.73 kg (-0.93, -0.54)] (see Figure 1). Subanalysis by type of intervention found a reduction in weight in the intervention group as compared with the control group for diet [MD (95% CI) -0.51 kg (-0.65, -0.36)]; exercise [MD (95% CI) -0.88 kg (-1.44, -0.33)]; diet and exercise [MD (95% CI) -0.99 kg (-1.90, -0.08)]; and lifestyle interventions [MD (95% CI) -0.89 kg (-1.44, -0.34)] (see Table 1).

The test for subgroup differences found no significant results for duration of the intervention (> or <12 months) [Chi²=3.07, df=1 (P=0.08), I²=67%] or gender [Chi²=1.34, df=1 (P=0.25), I²=25%]. Weight loss interventions were effective for both those considered at high CVD risk [MD (95% CI) -0.88 kg (-1.45, -0.32)] and no or low CVD risk [MD (95% CI) -0.72 kg (-0.93, -0.52)]; and for those studies at unclear [MD (95% CI) -0.53 kg (-0.67, -0.40)] and low risk of bias [MD (95% CI) -1.22 kg (-2.16, -0.28)], but not for studies rated as high risk of bias [MD (95% CI) -1.20 kg (-3.04, 0.64)] (see Table 1).

**BMI**

Twenty RCTs of low GRADE quality with a total of 52,243 participants, whose baseline BMIs ranged from 22.4 to 33.2, were included. Most studies (n=14) included mixed gender samples.

There was a statistically significant reduction in BMI in the intervention group as compared with the control group [MD (95% CI) -0.24 kg/m² (-0.34, -0.15)]. The test for subgroup differences was not significant [Chi²=0.06, df=1 (P=0.81), I²=0%] and, therefore, baseline mean BMI did not explain the variation across these studies (see Table 2).

When restricted to studies with a mean baseline BMI <25, the analysis included four RCTs of low GRADE quality. Baseline BMI ranged from 22.4 to 24.8 but all studies included some
overweight/obese adults. BMI was reduced more in the intervention group than the control [MD (95% CI) -0.27 kg/m\(^2\) (-0.50, -0.05)]. This benefit was also observed in intervention groups in 16 RCTs with a baseline BMI ≥25 [MD (95% CI) -0.24 kg/m\(^2\) (-0.36, -0.12)] (see Table 2).

**Waist Circumference**

Fifteen RCTs of very low GRADE quality with a total of 20,796 participants found a benefit of the intervention over the control group on waist circumference [MD (95% CI) -0.95 cm (-1.27, -0.63)] (see Table 2).

**Percent Body Fat**

Considering total % body fat, six RCTs of low GRADE quality that included 1,663 participants found that the intervention group had less body fat than the controls at the end of the interventions [MD (95% CI) -1.27 % (-1.93, -0.61)] (see Table 2).

**Secondary Outcomes**

Pooled effect estimates for some secondary health outcomes were significant in favour of the interventions. At the post-intervention point, compared to the control group, intervention participants had reduced their total cholesterol by an additional 0.06 mmol/L (95% CI -0.11, -0.01), lowered their LDL level by an additional 0.06 mmol/L (95% CI -0.09, -0.03), and reduced their fasting glucose level by 0.04 mmol/L more (95% CI -0.08, -0.0016). These effect sizes are not clinically meaningful. No statistically significant results were found for the effect of the interventions on systolic or diastolic blood pressure or on the likelihood of being diagnosed with T2D (see Tables 3 and 4).
Harms

No harms of interest to this review were reported. Only six studies mentioned adverse effects, half of which\(^\text{27,30,32,36,38,43}\) reported no adverse events associated with participation, two showed no significant differences between exercisers and those in the control groups in terms of injuries, falls or serious adverse events, and only one study found significantly more falls and injuries were sustained by those taking part in the exercise program compared to control group participants.

Maintenance of weight or health outcomes

Only one study of a 9-month exercise intervention was available to address the question about the long-term benefits of weight gain prevention programs. There was a statistically significant increase (P<0.00001) in weight in the intervention group as compared to the control group from the point of intervention completion to 15 months later [MD (95% CI) 0.20 kg (0.17, 0.23)]. For the same comparison and the same time period, there was no statistically significant difference (P=1.00) in waist circumference; instead, both groups increased on this measure by 1.4 cm. None of the benefits in terms of reduced total cholesterol, fasting glucose and systolic blood pressure levels that were observed in intervention participants at the end of the program were maintained over the next 15 months. The intervention group showed significantly greater increases in all three outcomes compared to the control group at the follow-up assessment point.
Interpretation

To our knowledge, this is the first meta-analysis of prevention of obesity in adults. Gaining <0.5 kg over one year may not appear clinically meaningful but this should be considered with regard to expected weight gain that typically occurs in adults (3-4 kg in 8 years) and the associated obesity-related health problems.

Weight gain prevention programs targeting normal weight adults would expect to demonstrate weight maintenance in the intervention participants compared to a hypothesized increase in weight in control group participants. In this review we considered four measures of weight gain prevention: weight; BMI; waist circumference; and total % body fat. Across studies, interventions were successful in stabilizing weight and, in some cases, conferred weight loss by the end of the interventions. In many studies, those in the control groups also lost weight but a smaller amount than intervention participants. These results are consistent with the review by Hutfless et al., although their inclusion/exclusion criteria and some outcomes differed.

For adults in an overweight or obese category, these changes do not represent clinically meaningful reductions in weight. However, this was not the goal of these interventions, which was to prevent weight gain. With that goal, the benefits of these interventions could become apparent over time but long-term follow-up data are not available to draw such conclusions.

Sensitivity analyses performed on studies providing weight in kg and BMI data found no significant differences between any sub-groups. None of the specified categorizations (i.e., type of behavioral intervention, duration of intervention, gender, baseline CVD risk status, baseline mean BMI, and study risk of bias rating) explain the variation across this evidence. The
moderate to high statistical heterogeneity across studies in most sub-analyses is most likely due to small versus large treatment effects observed across studies.

Most of the studies were assessed as having unclear or high risk of bias, primarily due to the lack of information about or lack of procedures to ensure random sequence generation, allocation concealment and/or blinding of outcome assessment as well as other sources of bias (i.e., industry funding, imbalance in baseline characteristics and/or selection bias). Due to the nature of behavioral interventions, there is a high risk of bias for blinding of participants and personnel across all studies.

As noted, only one pilot study addressed a normal weight population. All other data in this review is taken from studies with mixed weight populations, and thus constitutes only indirect evidence for primary prevention of adult overweight and obesity.

Results presented for the secondary health outcomes (total cholesterol, LDL, fasting glucose, blood pressure, incidence of T2D) should be considered with caution as we did not conduct a full systematic review for these components. To be included in this review studies had to report data for the primary outcome of weight; therefore any investigations of relevant interventions that examined the secondary outcomes but did not provide weight data were excluded. Finally, we restricted our search to papers in English or French, thus we may have missed the papers written in other languages.

Interpreting these results is challenging. People who were motivated to join a weight gain prevention program not only did not gain weight, but actually lost a small amount of weight. These benefits were also achieved without experiencing serious adverse effects. For participants who were of normal weight to begin with, we cannot know if this small weight loss was clinically meaningful, except to note that they are not increasing health risks associated with
weight gain. It is difficult to know how primary care practitioners might motivate normal weight people to consider participating in such interventions.

In summary, this review was unable to conclusively determine if behaviorally-based primary care relevant prevention interventions lead to short-term or sustained weight gain prevention and improved health outcomes in normal weight adults. Intervention research involving normal weight samples with long term follow-up is required to effectively answer this question.
Reference List


45. Mensink M, Blaak EE, Corpeleijn E, Saris WH, de Bruin TW, and Feskens EJ. Lifestyle intervention according to general recommendations improves glucose tolerance. Obes Res. 2003; 11(12): 1588-96.


Figure 1: Meta-analysis of Weight Gain Prevention Interventions on Weight (kg)

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<td>Mensink 2003</td>
<td>-2.4</td>
<td>4.43</td>
<td>40</td>
<td>-0.1</td>
<td>3.46</td>
<td>48</td>
<td>1.2%</td>
<td>-2.3000 [-3.9981, -0.6139]</td>
</tr>
<tr>
<td>Roderick 1997 F</td>
<td>0.09</td>
<td>5.2</td>
<td>246</td>
<td>0.82</td>
<td>5.2</td>
<td>231</td>
<td>3.6%</td>
<td>-0.7300 [-1.6638, 0.2038]</td>
</tr>
<tr>
<td>Roderick 1997 M</td>
<td>-0.29</td>
<td>5.2</td>
<td>227</td>
<td>0.28</td>
<td>5.2</td>
<td>251</td>
<td>3.6%</td>
<td>-0.5700 [-1.5038, 0.3635]</td>
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<tr>
<td>Simkin-Silverman</td>
<td>-0.1</td>
<td>5.2</td>
<td>246</td>
<td>2.4</td>
<td>4.9</td>
<td>201</td>
<td>4.0%</td>
<td>-2.5000 [-3.3807, -1.6193]</td>
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<td>Steptoe 1999</td>
<td>-0.6</td>
<td>6.61</td>
<td>168</td>
<td>-0.2</td>
<td>5.73</td>
<td>350</td>
<td>2.5%</td>
<td>-0.4000 [-1.5659, 0.7659]</td>
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<tr>
<td>Velhuis 2009 F</td>
<td>0.66</td>
<td>3.67</td>
<td>96</td>
<td>0.34</td>
<td>4.63</td>
<td>99</td>
<td>2.2%</td>
<td>0.0300 [1.6702, 0.0300]</td>
</tr>
<tr>
<td>Vermunt 2012</td>
<td>-0.8</td>
<td>5.1</td>
<td>305</td>
<td>-0.4</td>
<td>4.7</td>
<td>259</td>
<td>4.6%</td>
<td>-0.4000 [-1.2095, 0.4095]</td>
</tr>
<tr>
<td>Werkman 2010 M</td>
<td>-1.86</td>
<td>3.08</td>
<td>186</td>
<td>-1.62</td>
<td>3.03</td>
<td>169</td>
<td>6.3%</td>
<td>-0.2400 [-0.8944, 0.4144]</td>
</tr>
</tbody>
</table>

Total (95% CI) - Heterogeneity: Tau² = 0.04, Chi² = 40.95, df = 21 (P = 0.000); I² = 49%
Test for overall effect Z = 7.42 (P < 0.00001)
## Table 1: Change in Weight (KG)

<table>
<thead>
<tr>
<th>Group or Sub-group</th>
<th>Meta-analysis, Mean difference, weight in kg (95% CI)</th>
<th>Sub-group Differences</th>
<th>No. Participants</th>
<th>No. Studies</th>
<th>GRADE Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>-0.73 (-0.93 to -0.54)</td>
<td></td>
<td>48,460</td>
<td>19</td>
<td>Very Low</td>
</tr>
<tr>
<td>Type – Diet</td>
<td>-0.51 (-0.65 to -0.36)</td>
<td></td>
<td>42,308</td>
<td>2</td>
<td>Low</td>
</tr>
<tr>
<td>Type – Exercise</td>
<td>-0.88 (-1.44 to -0.33)</td>
<td>P=0.25</td>
<td>2,024</td>
<td>5</td>
<td>Low</td>
</tr>
<tr>
<td>Type – Diet + Exercise</td>
<td>-0.99 (-1.90 to -0.08)</td>
<td></td>
<td>748</td>
<td>4</td>
<td>Low</td>
</tr>
<tr>
<td>Type – Lifestyle</td>
<td>-0.89 (-1.44 to -0.34)</td>
<td></td>
<td>3,380</td>
<td>8</td>
<td>Low</td>
</tr>
<tr>
<td>Duration &lt;= 12 Months</td>
<td>-0.61 (-0.70 to -0.51)</td>
<td>P=0.08</td>
<td>4,908</td>
<td>12</td>
<td>Low</td>
</tr>
<tr>
<td>Duration &gt; 12 Months</td>
<td>-1.21 (-1.88 to -0.54)</td>
<td></td>
<td>43,552</td>
<td>7</td>
<td>Low</td>
</tr>
<tr>
<td>Gender – Male</td>
<td>-0.48 (-0.99 to 0.03)</td>
<td>P=0.25</td>
<td>975</td>
<td>4</td>
<td>Very Low</td>
</tr>
<tr>
<td>Gender – Female</td>
<td>-0.82 (-1.09 to -0.55)</td>
<td></td>
<td>44,390</td>
<td>9</td>
<td>Low</td>
</tr>
<tr>
<td>High CVD Risk</td>
<td>-0.88 (-1.45 to -0.32)</td>
<td>P=0.60</td>
<td>1,356</td>
<td>3</td>
<td>Low</td>
</tr>
<tr>
<td>No/Low CVD Risk</td>
<td>-0.72 (-0.93 to -0.52)</td>
<td>P=0.60</td>
<td>47,104</td>
<td>16</td>
<td>Very Low</td>
</tr>
<tr>
<td>High Risk Of Bias</td>
<td>-1.20 (-3.04 to 0.64)</td>
<td></td>
<td>652</td>
<td>2</td>
<td>Very Low</td>
</tr>
<tr>
<td>Unclear Risk of Bias</td>
<td>-0.53 (-0.67 to -0.40)</td>
<td></td>
<td>45,237</td>
<td>13</td>
<td>Very Low</td>
</tr>
<tr>
<td>Low Risk of Bias</td>
<td>-1.22 (-2.16 to -0.28)</td>
<td></td>
<td>2,571</td>
<td>4</td>
<td>Low</td>
</tr>
</tbody>
</table>

*Low=downgraded for risk of bias and indirectness
Very Low=downgraded for risk of bias, indirectness and reporting bias
Table 2: Changes in BMI, Waist Circumference, % Body Fat

<table>
<thead>
<tr>
<th>Group or Sub-group</th>
<th>Meta-analyses: mean difference (95% CI)</th>
<th>Sub-group Differences</th>
<th>No. Participants</th>
<th>No. Studies</th>
<th>GRADE Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>-0.24 (-0.34 to -0.15)</td>
<td></td>
<td>52,243</td>
<td>20</td>
<td>Low</td>
</tr>
<tr>
<td>Baseline Mean BMI – Normal Weight (≤25 kg/m²)</td>
<td>-0.27 (-0.50 to -0.05)</td>
<td>P=0.81</td>
<td>5,152</td>
<td>4</td>
<td>Low</td>
</tr>
<tr>
<td>Baseline Mean BMI – Overweight/Obese (≥25 kg/m²)</td>
<td>-0.24 (-0.36 to -0.12)</td>
<td></td>
<td>47,091</td>
<td>16</td>
<td>Low</td>
</tr>
</tbody>
</table>

Outcome: Waist Circumference (cm)

| Overall | -0.95 (-1.27 to -0.63) |                       | 20,796           | 15          | Very Low     |

Outcome: Total % Body Fat

| Overall | -1.27 (-1.93 to -0.61) |                       | 1,663            | 6           | Low          |

*Low=downgraded for risk of bias and indirectness
Very Low=downgraded for risk of bias, indirectness and reporting bias
Table 3: Changes in Total Cholesterol, LDL, Fasting Glucose and Blood Pressure

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Meta-analyses: mean difference (95% CI)</th>
<th>No. Participants</th>
<th>No. Studies</th>
<th>GRADE Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cholesterol (mmol/L)</td>
<td>-0.06 (-0.11 to -0.01)</td>
<td>10,660</td>
<td>15</td>
<td>Low</td>
</tr>
<tr>
<td>LDL (mmol/L)</td>
<td>-0.06 (-0.09 to -0.03)</td>
<td>5,635</td>
<td>11</td>
<td>Low</td>
</tr>
<tr>
<td>Fasting Glucose (mmol/L)</td>
<td>-0.04 (-0.08 to -0.0016)</td>
<td>7,189</td>
<td>10</td>
<td>Low</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>-0.31 (-0.84 to 0.22)</td>
<td>48,493</td>
<td>17</td>
<td>Very Low</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>-0.18 (-0.44 to 0.07)</td>
<td>47,945</td>
<td>15</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

*Low=downgraded for risk of bias and indirectness
Very Low=downgraded for risk of bias, indirectness and imprecision
Table 4: Change in Type 2 Diabetes Incidence

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Relative Effect (95% CI)</th>
<th>Absolute Number per thousand (Range)</th>
<th>ARR</th>
<th>NNT</th>
<th>No. Participants</th>
<th>No. Studies</th>
<th>GRADE Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2D Incidence</td>
<td>RR 0.95 (0.89 to 1.02)</td>
<td>3 fewer (from 8 fewer to 2 more)</td>
<td>0.34%</td>
<td>293</td>
<td>46,537</td>
<td>2</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

* Very Low=downgraded for risk of bias, indirectness and imprecision
Adult Obesity Prevention - Supplemental File

Figure 1: Study Flow Diagram

Table 1: Summary of Risk of Bias Assessment

Table 2: Characteristics of Included Studies

Table 3: Search Strategy - Medline
Figure 1 a: Initial Comprehensive Search Results

Main Search
Adult and Child Obesity Prevention and Treatment
30,196

Excluded at Level 1
Title and Abstract
10,914

Adult Obesity
Prevention and Treatment
11,183

Child Obesity
Prevention and Treatment
8,099

Excluded at Level 2
Title and Abstract
6,711

Adult Obesity
Treatment
1,152

Adult Obesity
Prevention
3,320

Adult Obesity
Prevention Update Search
1,778

Title and Abstract Screening
Adult Obesity Prevention
5,098

Continued in
Figure 1b
Figure 1b: Adult Overweight/Obesity Prevention Search Results

Title and Abstract Screening
5,098

Excluded at Title and Abstract Screening
3,922

Eligible for Full Text Screening
1,176

USPSTF Full Text Screening
2

Hand-searched and Companion Papers
13

Excluded due to:
- No outcomes for population of interest: 645 + 1 USPSTF
- No intervention of interest: 119
- No True Control
- <30 participants per arm: 90
- <12 month outcomes: 82
- No control: 23
- Study design: 21

Full Text Screening
1,191

Excluded at Full Text
981
(980 from our search, 1 from USPSTF)

Systematic Reviews
162

Included Studies
26
(48 Papers)
Table 1: Summary of Risk of Bias Assessment of Included RCTs Using Cochrane’s Risk of Bias Tool

<table>
<thead>
<tr>
<th>Study</th>
<th>Sequence Generation</th>
<th>Allocation Concealment</th>
<th>Blinding of Outcome Assessors</th>
<th>Incomplete Reporting</th>
<th>Selective Reporting</th>
<th>Other Bias</th>
<th>Overall Risk of Bias</th>
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<tr>
<td></td>
<td>O</td>
<td>BJ</td>
<td>SU</td>
<td>B</td>
<td>S-</td>
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<td>Eriksson 2009</td>
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<td>H</td>
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<td>E</td>
</tr>
</tbody>
</table>

L (green) = Low Risk; U (yellow) = Unclear Risk; H (red) = High Risk; OBJ = Objective Outcome; SUB = Subjective Outcome; S-R = Self-Reported Outcome

For Peer Review Only
### Table 2: Characteristics of Included Studies

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Babazano 2007&lt;sup&gt;2&lt;/sup&gt; Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>To determine whether patient-motivated lifestyle changes would better enhance healthcare outcomes compared with usual care</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>Design: RCT</td>
</tr>
<tr>
<td></td>
<td>Selection: participants were members of the National Health Insurance in Umi Town, Fukuoka, Japan. Patients meeting inclusion criteria were sent invitation letters</td>
</tr>
<tr>
<td></td>
<td>Inclusion criteria: SBP 130-150mmHg; DBP 85-99mmHg or HbA1c ≥5.6%</td>
</tr>
<tr>
<td></td>
<td>Exclusion criteria: Persons with critical need for medical treatment</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>Sample n = 99</td>
</tr>
<tr>
<td></td>
<td>Intervention group n = 50; Control group n = 49</td>
</tr>
<tr>
<td></td>
<td>Age: Mean age Intervention (SD): 64.3 (7.1); Mean age Control (SD): 64.5 (7.9)</td>
</tr>
<tr>
<td></td>
<td>Gender [Female n(%)]: Intervention 29 (58%); Control 28 (51.1%)</td>
</tr>
<tr>
<td></td>
<td>Loss to follow-up: Intervention n = 4; Control n = 8</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Intervention: group had a support team of dietitians, health exercise instructors, and public health nurses who encouraged patients to set goals and to select their own lifestyle improvements. Follow-up support was performed twice during the first year</td>
</tr>
<tr>
<td></td>
<td>Control: usual care</td>
</tr>
<tr>
<td></td>
<td>Duration of intervention: 12 months</td>
</tr>
<tr>
<td></td>
<td>Length of follow-up: immediate post</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Broekhuizen 2012&lt;sup&gt;3&lt;/sup&gt; The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>This project evaluated the efficacy of an individualized tailored lifestyle intervention on lipids, systolic blood pressure, glucose, body mass index (BMI) and waist circumference in people with familial hypercholesterolemia (FH)</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>Design: RCT</td>
</tr>
<tr>
<td></td>
<td>Selection: recruitment was by invitation brochures</td>
</tr>
<tr>
<td></td>
<td>Inclusion criteria: participants diagnosed with FH from Jan 1 2007 to Apr 15 2009; aged 18 to 70 years and with a LDL-C level &gt;75&lt;sup&gt;th&lt;/sup&gt; percentile (age and gender specific) also access to internet; fluency in Dutch and residency &lt;150KM from Amsterdam</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>Sample: n = 340</td>
</tr>
<tr>
<td></td>
<td>Intervention group n = 181; Control group n = 159</td>
</tr>
<tr>
<td></td>
<td>Age: Mean age Intervention (SD): 44.7 (12.9); Mean age Control (SD): 45.9 (13.0)</td>
</tr>
<tr>
<td>Study/Location</td>
<td>Burke 2003 Australia</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Companion papers:</td>
<td>Dzator, Burke</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objective</th>
<th>The objective of this study was to compare two methods of delivery of a diet and physical activity program for couples with a 1 year follow up</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Methods</th>
<th>Design: RCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection: couples recruited by advertisement in the press and through publicity on radio and television programs (did not include couples who took part in the pilot study)</td>
<td></td>
</tr>
<tr>
<td>Inclusion criteria: couples in Perth, Australia, cohabiting for the first time and for &lt; 2 years, intending to reside in Perth for the length of the study, and not planning a pregnancy during the time of the intervention</td>
<td></td>
</tr>
<tr>
<td>Exclusion criteria: illnesses such as heart disease, diabetes, or severe asthma</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th>Sample: 137 couples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention 1 n= 47 couples; Intervention 2 n=47 couples; Control n=43 couples</td>
<td></td>
</tr>
<tr>
<td>Age: Mean age Overall (SD): 29.6 years in women (range 18-62); 31.4 years in men (range 20-61)</td>
<td></td>
</tr>
<tr>
<td>Gender [Female n(%)]: 50% female</td>
<td></td>
</tr>
<tr>
<td>Loss to follow-up: 59 couples</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Interventions: 16-week program consisting of 6 printed modules focused on nutrition (encouraging consumption of foods low in fat, high in fiber, low in salt) and physical activity (encouraging at least 30 minutes of moderate activity most days and incidental activity); information about the benefits of stopping smoking and drinking alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention 1 (high-level): modules every 2 weeks, alternating mail-outs with contact sessions at which the facilitators explained the aim of the modules, demonstrated exercise techniques, answered to questions, and reviewed progress</td>
<td></td>
</tr>
<tr>
<td>Intervention 2 (low-level): after a single contact session at which the first module was delivered, all other modules were mailed every second week</td>
<td></td>
</tr>
<tr>
<td>Control: no intervention</td>
<td></td>
</tr>
</tbody>
</table>

Gender [Female n (%)]: Intervention: 181(57.1%); Control: 159(56.3%)
Loss to follow-up: Intervention n = 11; Control n = 14

Intervention: personalised health counseling intervention; computer-generated tailored web-based advice and face-to-face counseling with telephone booster session
Control: usual care
Duration of intervention: 12 months
Length of follow-up: immediate post
### Study/Location

Carty 2011<sup>3</sup> US  
*Companion papers*: Howard,<sup>31,32</sup> Tinker,<sup>33</sup> Women’s Health Initiative Study Group,<sup>34</sup> Hays<sup>35</sup>

### Objective
To characterize long-term body composition changes associated with a (low-fat) dietary modification trial

### Methods
**Design**: RCT  
**Selection**: women aged 50-79 years were enrolled between 1993 and 1998 at 40 clinical centers throughout the United States  
**Exclusion criteria**: history of breast, colorectal, and other cancers except nonmelanoma skin cancer in previous 10 years; medical conditions predictive of a survival time of <3 years; type I diabetes; high risk of lack of retention or intervention nonadherence; consumption of <600 kcal/day or >5000 kcal/day; consumption of a diet with <32% of total energy from fat; consuming ≥10 main meals/week prepared outside of the home

### Participants
**Sample**: 48,835  
**Intervention n=19,541** ; **Control n=29,294**  
**Age**: Mean age Overall (SD): 62.3 (6.9)  
**Gender [Female n(%)]:** 100%  
**SES**: college degree or higher  
**Intervention**: n=7,445 (38.3%); **Control n=11,042 (37.9%)**  
**Loss to follow-up**: Overall n=2027; Intervention n=727; Control n=1300

### Intervention
**Intervention**: designed to promote dietary change with the goals of reducing total fat intake to 20% of total energy, increasing vegetable and fruit intake to 5 servings/day and increasing grain intake to 6 servings/day; women received individual fat gram goals and participated in an intensive behavioral modification program consisting of 18 group sessions in the first year and quarterly maintenance sessions until the trial ended in 2005  
**Control**: asked to maintain usual diet and eating patterns, given copy of "Nutrition and Your Health: Dietary Guidelines for Americans" but no contact with study dieticians  
**Duration of intervention**: not specified (8-12 years)  
**Length of follow-up**: 7.5 years post baseline

### Study/Location
Elley 2003<sup>6</sup> New Zealand

### Objective
To assess the long term effectiveness of the "green prescription" program, a clinician based initiative in general practice that provides counseling on physical activity
## Methods

**Design:** RCT

Selection: all urban and rural general practitioners in the central and eastern Waikato region of New Zealand were invited to participate; all patients aged 40-79 years who attended the participating practices during a five day period received a screening form, based on currently recommended levels of physical activity, to establish eligibility.

Exclusion criteria: patients considered by practice personnel considered as too unwell to participate; patients with debilitating medical condition or unstable cardiac condition; patients who did not understand English, or if they were expecting to leave the region.

## Participants

Sample n = 878

- Intervention group n = 451; Control group n = 427
- Age: Mean age Intervention (SD): 57.2 (10.8); Mean age Control (SD): 58.6 (11.5)
- Gender [Female n(%)]: Intervention n = 301 (67%); Control n = 281 (66%)
- Race/Ethnicity: Intervention: NR
- SES [lower SES]: Intervention: n = 205 (45%); Control: n = 211 (49%)
- Loss to follow-up: Intervention n = 68; Control n = 64

## Intervention

- Intervention: goals for increasing physical activity discussed and set with primary care professional, written on a green prescription and given to patient as well as faxed to local sports foundation; exercise specialists make at least three calls (10-20 minutes each) to patients over three months to encourage and support them using motivational interviewing techniques and give specific advice about exercise or community groups; quarterly newsletters from sports foundation about exercise initiatives in the community and motivational material; other materials sent to interested participants; general practice staff encouraged to provide feedback to participants on subsequent visits.
- Control: usual care

- Duration of intervention: 12 months
- Length of follow-up: immediate post

## Study/Location

<table>
<thead>
<tr>
<th>Eriksson 2009</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>To test whether intensive lifestyle modification, shown previously in tightly-controlled clinical trials to be efficacious for diabetes risk-reduction among high-risk individuals, can reduce cardiovascular risk factor levels in the primary care setting.</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>Design: RCT</td>
</tr>
<tr>
<td>Selection:</td>
<td>selected from the catchment area of a primary health care center in the town of Boden in northern Sweden; invited by letter</td>
</tr>
<tr>
<td>Inclusion criteria:</td>
<td>individuals from the clinic aged 18–65 years with a clinically documented diagnosis of hypertension, dyslipidemia, type 2 diabetes, and/or obesity</td>
</tr>
<tr>
<td>Study/Location</td>
<td>Forster 1988 US</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Objective</th>
<th>The objective of this study was to evaluate the feasibility and effectiveness of a program for weight gain prevention in normal-weight adults</th>
</tr>
</thead>
</table>

| Methods       | Design: RCT  
Selection: recruited from a list of individuals screened for cardiovascular risk factors as part of the Minnesota Heart Health Program; individuals of normal weight at the time of their visit (before Jan 1986) were sent a letter in Feb 1986 describing the program and requesting that they return a prepaid postcard if they wanted further information  
Inclusion criteria: there was no lower weight limit for eligibility for the study |
|---------------|----------------------------------------------------------------------------------------------------------------------------------|

| Participants  | Sample: 219  
Intervention n= NR ;Control n= NR  
Age: Mean age Overall (SD): 45.9  
Gender [Female n(%)]: 71.0% overall  
Loss to follow-up: NR |
|---------------|----------------------------------------------------------------------------------------------------------------------------------|

| Intervention  | Intervention: monthly newsletter for 1 year including information relevant to weight control; financial incentive for weight maintenance; offered an optional educational course of four sessions offered midway through the year  
Control: not contacted between the baseline visit and a follow-up scheduled 1 year later  
Duration of intervention: 12 months |
|---------------|----------------------------------------------------------------------------------------------------------------------------------|
### Study/Location

| Friedenreich 2011<sup>9</sup> Canada  
| Companion papers: Friedenreich<sup>37-39</sup> |

### Objective
To examine the effects of an aerobic exercise intervention on adiposity outcomes that may be involved in the association between physical activity and breast cancer risk

### Methods
**Design:** RCT  
**Selection:** women recruited through targeted mailings to participants in the Alberta Breast Screening Program, posters and brochures distributed to family physicians and media campaigns between May 2003 and June 2006  
**Inclusion criteria:** age 50-74 years; postmenopausal; no previous cancer diagnosis; no major comorbidities; acceptable baseline fitness test; sedentary (<90 min of weekly exercise or, if between 90 and 120 min, having a VO2max level <34 kg-1min-1); able to do unrestricted physical activity; normal blood lipid and hormone levels, BMI between 22 and 40 kg/m²; nonsmoker; <14 drinks per week of alcohol; no medications or exogenous hormones that might influence estrogen metabolism and not currently or planning to undertake a weight loss program

### Participants
**Sample:** 320  
**Intervention n=160 ; Control n=160**  
**Age:** Mean age Intervention (SD): 61.2 (5.4); Mean age Control: 60.6 (5.7)  
**Gender [Female n(%)]:** 100%  
**SES:** educated beyond high school  
**Intervention: 112 (70%); Control: 102 (64%)**  
**Loss to follow-up: Overall n=9; Intervention n=5; Control n=4**

### Intervention
**Intervention:** exercise prescription was moderate-to-vigorous intensity aerobic exercise for at least 45 min on 5 days per week for 1 year; at least three sessions per week were facility based with on-site exercise trainers and remaining sessions were home based; prescription ramped up over the first 3 months starting with three weekly sessions of 15-20 min at 50-60% of the heart rate reserve; program individualized to the age and fitness level of each participant; women were instructed not to change their usual diet  
**Control:** asked to maintain their regular lifestyle  
**Duration of intervention:** 12 months  
**Length of follow-up:** immediate post

### Study/Location

| Harris 2012<sup>10</sup> Australia |

### Objective
To evaluate the impact of a lifestyle intervention in Australian general practice to reduce the risk of vascular disease
### Methods

**Design:** RCT  
**Selection:** recruited from within 30 eligible practices  
**Inclusion criteria:** participants who had attended the practice in the previous 12 months and were either aged 40-55 years with a recorded diagnosis of hypertension and/or hyperlipidaemia or were aged 56-64 with or without recorded risk factors

### Participants

**Sample:** n= 699  
**Intervention group n = 384; Control group n = 315**  
**Ages:** 40-55 years Intervention group: 96 (25.0%); Control: 78 (24.8%);  
Ages: 56-64 Intervention group: 288 (75.0%); Control: 237 (75.2%);  
**Gender [Female n(%)]:** Intervention: 232 (60.4); Control: 169 (53.7)  
**Race/Ethnicity:** Intervention: NR  
**SES [post-secondary education]:** Intervention: 18.8; Control: 30.2  
**Loss to follow-up:** Intervention n = 29; Control n = 15

### Intervention

**Intervention:** brief intervention, which included an initial visit with a dietician or exercise physiologist for an assessment and individual goal setting, followed by attendance at a group education program "CHANGE for HIPS" which comprised 4 1.5 hours sessions over the first 3 months and a further two follow-up sessions at 6 and 9 months focused on education, physical activity (20-30 minutes of walking or resistance exercise) and self-management strategies aimed at promoting positive dietary and physical activity changes and weight loss.  
**Control:** patients attending practices allocated to control group received usual general practice care for their risk factors, including routine pharmacological management  
**Duration of intervention:** 9 months  
**Length of follow-up:** 3 months

### Study/Location

| Study/Location | Hivert 2007\(^1\) Canada |

### Objective

**To explore the efficacy of a seminar based educational and behavioural program aimed at improving lifestyle in newly admitted undergraduate students**
| Participants | Sample: 115  
Intervention n=58; Control n=57  
Age: Mean age Intervention (SD): 19.9 (0.2); Mean age Control (SD): 19.5 (0.2)  
Gender [Female n(%)]: Intervention n=47 (81.0%); Control n=47 (82.4%)  
Loss to follow-up: Overall 19; Intervention 10; Control 9 |
| Intervention | Intervention: small group interactive educational/behavioural seminars of approximately 45 minutes offered every 2 weeks for the first 2 months of the academic calendar and every month thereafter for the remaining 2 years (23 seminars in 2 years)  
Control: no intervention  
Duration of intervention: 24 months  
Length of follow-up: immediate post |
| Study/Location | Imayama 2011\(^{12}\) US  
*Companion paper:* McTiernan\(^{40}\) |
| Objective | The purpose of this study was to assess, in a randomized, controlled clinical trial, the effect of a 12-month moderate-to-vigorous intensity exercise program on weight, anthropometrics, and body composition and abdominal fat in women and men |
| Methods | Design: RCT  
Selection: recruited to a trial that examined the effects of exercise on colon cancer biomarkers [not to a trial specifically focused on obesity prevention]; recruited between 2001 and 2004 through gastroenterology practices, media placements, flyers, a study website and referrals  
Inclusion criteria: 40 to 75 years old; colonoscopy within the previous 3 years; engaged in < 90 minutes/week of moderate-to-vigorous intensity exercise during the previous 3 months [or low-fitness on VO2max testing]; < two servings of alcohol/day; no history of invasive cancer or high risk for colon cancer (e.g., familial polyposis, ulcerative colitis) or other serious medical conditions; normal response to a maximal exercise tolerance test; normal complete blood count and blood chemistries; and no contraindications for colon biopsy. |
| Participants | Sample: 202  
Intervention n=100; Control n=102  
Age: Mean age Intervention (SD): women 54.4 (7.1) range 43-73; men 56.2 (6.7) range 40-69; Mean age Control (SD): women 53.7 (5.6) range 42-65; men 56.6 (7.6) range 40-74  
Gender [Female n(%)]: Intervention n=49 (49.0%); Control n=51 (50.0%)  
SES [college degree]: Intervention n=61 (61.0%); Control n=62 (60.8%)  
Loss to follow-up: Intervention 6; Control 2 |
| **Intervention** | Intervention: goal of 60 minutes/day, 6 days/week of moderate-to vigorous intensity aerobic exercise performed at facilities and at home, with gradual increase over first 12 weeks; participants required to exercise 3 times/week at one of four facilities under supervision of exercise specialists, provided with Polar (Polar Electro Inc., Lake Success, NY) heart rate monitors and advised to exercise at 60%-85% of their maximal heart rate on their baseline VO2max test; participants also asked to exercise at home or at exercise facilities 3 days/week with same instructions for exercise duration and intensity.

Control: asked not to change their exercise or diet habits during the trial.

Duration of intervention: 12 months

Length of follow-up: immediate post |

| **Study/Location** | Kanaya 2012 USA |

| **Objective** | A community-based, translational lifestyle program to reduce diabetes risk in lower-socioeconomic status (SES) and ethnic minority adults. |

| **Methods** | Design: RCT

Selection: recruitment began with community-based, educational outreach to identify individuals at risk for diabetes in 4 distinct low-income neighborhoods.

Inclusion criteria: capillary blood glucose value between 106 and 160 milligrams per deciliter who had a moderate to high diabetes risk appraisal score; aged 25 years or older.

Exclusion criteria: diabetes (physician diagnosis, use of insulin or other diabetes medications); diagnosis (<6 months) of myocardial infarction, congestive heart failure, or stroke; heart procedure or heart surgery (<6 months); implanted defibrillator; hip or knee replacement (<3 months); insufficient cognitive functioning; pregnancy; not conversant in English or Spanish; plans to move out of area in 1 year; spouse or partner already enrolled. |

| **Participants** | Sample: n = 238

Intervention group n = 119; control group n = 119

Age: Mean age Intervention (SD): 58 (16); Mean age Control (SD): 55 (17)

Gender [Female n(%)]: Intervention: 73%; Control: 74%

Race/Ethnicity: African American 23%, Non-Hispanic White 22.5%, Hispanic 37%

SES [education]: <High school 23%, High school 15.5%

Loss to follow-up: Intervention n = 14; Control n = 12 |

| **Intervention** | Intervention: a 6-month active intervention phase and a 6-month maintenance phase; trained health department counselors provided education and skills training to modify diet and physical activity through primarily telephone-based counseling (12 calls) with 2 in person sessions and 5 optional group workshops.

Control: wait list |
Duration of intervention: 6 months  
Length of follow-up: 6 months  

| Study/Location | Kastarinen 2002 Finland  
|----------------|-------------------------  
| Objective      | To assess whether lifestyle counseling is effective in non-pharmacological treatment of hypertension in primary health care  
| Methods        | Design: RCT  
Selection: The Lifestyle Intervention against Hypertension in Eastern Finland (LIHEF) study was conducted in 10 municipal primary health care centres in eastern Finland, mainly in North Karelia; participants enrolled between Feb 1996 and June 1997  
Inclusion: Eligible subjects were men and women aged 25–74 years with SBP 140–179 mmHg and/or DBP 90–109 mmHg or on antihypertensive drug therapy.  
Exclusion criteria: secondary hypertension, mental or physical illness serious enough to potentially influence compliance with study procedures, alcoholism, type 1 diabetes, current or planned pregnancy, recent myocardial infarction or stroke  
| Participants   | Sample n= 715  
Intervention group n = 360; Control group n = 355  
Age: Mean age Intervention (SD): 54.4 (10.1); Mean age Control (SD): 54.2 (9.9)  
Gender [Female n(%)]: Intervention: n = 187 (52%); Control: n = 192 (54%)  
Loss to follow-up: Intervention n = 58; Control n = 71  
| Intervention   | Intervention: the core of the actual intervention consisted of four visits by participants to local public health nurses during the first year of the follow-up (1, 3, 6 and 9 months after randomization), and of three visits during the second year (15, 18 and 21 months after the randomization); participants systematically instructed to change their health behaviour primarily on the basis of their individual situation; a 2-h group session concentrates mainly on advice targeting reduction of salt intake and overweight was organized for the intervention group in every health care centre at 6 and 18 months  
Control: instructed to visit their own physicians and public health nurses according to usual practices  
Duration of intervention: 24 months  
Length of follow-up: immediate post  
| Study/Location | Khare 2012 USA  
|----------------|-------------------------  
| Objective      | Aimed at reducing CVD risk factors among uninsured and underinsured women who are participants in the Illinois Breast and Cervical Cancer Program (IBCCP), an early detection and screening program for low-income women.
<table>
<thead>
<tr>
<th>Methods</th>
<th>Design: RCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Selection: recruited from Illinois Breast and Cervical Cancer Program (IBCCP) using family info sessions, personal phone calls, fliers and advertisements</td>
</tr>
<tr>
<td></td>
<td>Inclusion: underinsured and uninsured women aged 40 to 64 years who were enrolled in the Illinois Breast and Cervical Cancer Program (IBCCP)</td>
</tr>
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<table>
<thead>
<tr>
<th>Participants</th>
<th>Sample n= 833</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Intervention group n = 418; Control group n = 415</td>
</tr>
<tr>
<td></td>
<td>Age: Mean age Overall (SD): 52.5 (7.0); Mean age Intervention (SD): 52.4 (7.0); Mean age Control (SD): 52.5 (6.9)</td>
</tr>
<tr>
<td></td>
<td>Gender [Female n(%)]: 100%</td>
</tr>
<tr>
<td></td>
<td>Race/Ethnicity: Intervention: Non-Hispanic White 84.1%; Control: Non-Hispanic White 84.2%</td>
</tr>
<tr>
<td></td>
<td>SES [Education grades 9-12]: Intervention: 60%; Control: 58.9%</td>
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<tr>
<td></td>
<td>Loss to follow-up: Intervention n = 193; Control n = 135</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Intervention</th>
<th>Intervention: received CVD risk factor screening, CVD-related educational materials, referrals to physician care as needed, a 12-week lifestyle intervention, and follow-up contacts for 24 months from the baseline screening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control: received CVD risk factor screening and CVD-related educational materials</td>
</tr>
<tr>
<td></td>
<td>Duration of intervention: 12 weeks</td>
</tr>
<tr>
<td></td>
<td>Length of follow-up: 40 weeks</td>
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<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Lawton 200816 New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>To assess the effectiveness of a primary care based program of exercise on prescription among relatively inactive women over a two year period</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Methods</th>
<th>Design: RCT</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Selection: recruited from an existing cohort of 50-74 year old women recruited by invitation letter from their general practitioner to a previous observational study of postmenopausal women between 1999 and 2002 from 10 primary care practices in Wellington; the remainder of the participants were recruited from 13 primary care practices in 2004-5, including two Maori health clinics; general practitioners at participating practices were asked to identify women in the age group from their practice register, excluding patients deemed inappropriate for participation in a physical activity trial and then sent letters to those identified as suitable, inviting them to participate in a lifestyle study.</td>
</tr>
<tr>
<td></td>
<td>Inclusion criteria: women between 40-74; physically inactive, as determined by a one question screening tool</td>
</tr>
</tbody>
</table>
Exclusion criteria: women with a medical condition that might be adversely affected by increasing their physical activity, as determined by the physical activity readiness questionnaire (PAR-Q) and subsequent assessment by their own general practitioner.

| Participants | Sample: 1089  
| | Intervention n=544 ; Control n=545  
| | Age: Mean age Intervention (SD): 59.1 (6.8) ; Mean age Control: 58.7 (6.9)  
| | Gender [Female n(%)]: 100%  
| | SES [lower socioeconomic status]: Intervention: 87 (16%), Control: 75 (14%)  
| | Loss to follow-up: 7% at 12 months and 11% at 24 months  

| Intervention | Intervention: primary care nurse briefly counsels (7-13 minutes) patients using motivational interviewing techniques to increase physical activity among those who are physically inactive (recommended goal was moderate intensity physical activity such as brisk walking, with a goal of achieving 30 minutes five days a week; follow-up was extended to include telephone calls over a nine month period (average of five calls, each lasting 15 minutes) with an added 30 minute visit with the primary care nurse at six months  
| | Control: usual care from primary care practice  
| | Duration of intervention: 9 months  
| | Length of follow-up: 3 months and 15 months  

| Study/Location | Levine 2007\[17\] US  
| Objective | To evaluate the efficacy of two interventions relative to a control group in preventing weight gain among normal or overweight women and to identify demographic, behavioral, and psychosocial factors related to weight gain prevention  
| Methods | Design: RCT  
| | Selection: recruited through local television, radio, and newspaper advertisements, direct-market mailings, and announcements to employees of a local medical center  
| | Inclusion criteria: 25 and 44 years of age; good health according to a self-report questionnaire; BMI between 21 and 30  
| | Exclusion criteria: pregnant; had been pregnant or participated in a weight loss program in the past year; were receiving treatment for a psychiatric disorder; had taken a medication affecting body weight during the past 3 months; or were planning to relocate within the next 36 months. In addition, women who were unable to engage in moderate physical activity or make modest changes in dietary intake were excluded  

| Participants | Sample: 284  
| | Intervention 1 (clinic) n=97; Intervention 2 (correspondence) n=94; Control n=93
| Age: Mean age Intervention 1 (SD): 36.4 (5.7); Mean age Intervention 2 (SD): 35.0 (6.1); Mean age Control: 35.4 (5.3) |
| Gender [Female n(%)]: 100% |
| SES: % college graduate |
| Intervention 1: 52.6%; Intervention 2: 74.5%; Control: 66.3% |
| Loss to follow-up: Year 1: n= 62; Year 2: n=74; Year 3: n=79 |

**Intervention**

- Intervention 1 (clinic-based): 15 group meetings over 24-month period. Sessions led by trained nutritionists and behavioral interventionists and held biweekly for first 2 months and bimonthly for next 22 months
- Intervention 2 (correspondence): 15 lessons by mail over 24-month period. The lessons were identical in content to the Clinic group and contained a brief homework assignment to be completed by the participant and returned by mail; participants asked to weigh themselves and report their weight on their returned assignment
- Control: received a booklet containing information about the benefits of weight maintenance, low-fat eating, and regular physical activity
- Duration of intervention: 24 months
- Length of follow-up: immediate post and 12 months

| Study/Location | Mensink 2003\(^{18}\) The Netherlands |
| Objective | To evaluate the impact of a 2-year combined diet and physical activity intervention program on glucose tolerance in Dutch subjects at increased risk for developing diabetes. |
| Methods | Design: RCT |
| Selection: patients selected from existing cohort |
| Inclusion criteria: subjects with high risk of glucose intolerance, i.e., those of age > 40 years and a family history of diabetes or a BMI ≥25 kg/m\(^2\) selected from an existing cohort and invited to undergo a first oral glucose-tolerance test (OGTT) |
| Exclusion criteria: overt or previously diagnosed diabetes (not gestational diabetes); medication use known to interfere with glucose tolerance; participation in regular vigorous exercise or an intensive weight reduction program during the previous year; presence of any (chronic) disease that hampered participation in a lifestyle intervention program; improbability of 5-year survival |
| Participants | Sample: 114 |
| Intervention: n= 55; Control n = 59 |
| Age: Mean age Intervention (SD): 55.6 (0.9); Mean age Control (SD): 57.8 (1.0) |
| Gender [Female n(%)]: 50 (44%) |
| Loss to follow-up: Intervention n= 14; Control n= 11 |
| Intervention | Intervention: consisted of a dietary and physical activity component, with visits scheduled at regular intervals throughout the study  
Control: received oral and written information about the beneficial effects of a healthy diet, weight loss, and increased physical activity; however, no individual advice or programs were provided and visits were only for the annual measurements  
Duration of intervention: 2 years  
Length of follow-up: immediate post |
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<tbody>
<tr>
<td>Study/Location</td>
</tr>
<tr>
<td>Objective</td>
</tr>
</tbody>
</table>
| Methods | Design: RCT  
Selection: eight practices from the Medical Research Centre's (MRC's) general practice research framework (GPRF) were selected in pairs with one pair from each of four geographical areas - Yorkshire, Midlands, south-east England and South Wales  
Inclusion: ages 35-59 attending surgery who did not have contra-indications, i.e known causes of secondary hyperlipidaemia, sever psychiatric illness, pregnancy, terminal illness or those already attending a coronary heart disease health promotion clinic |
| Participants | Sample n = 956  
Intervention group n = 473; Control group n = 483  
Age: Mean age Intervention (SD): 47.2 years; Mean age Control (SD): 47.4 years  
Gender [Female n(%)]: Intervention n = 246 (52%); Control n = 232(48%)  
Loss to follow-up: Intervention n = 66; Control n = 126 |
| Intervention | Intervention: standard health education from the leaflets Guides to Healthy Eating, Giving up smoking, Look After Your Heart, Heart Disease, and Exercise, Why Bother?; dietary advice, based on negotiated changed, which aimed for food substitution (i.e nurse and patient negotiated and agreed up to 5 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'; 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  
Control: standard health education from the leaflets Guides to Healthy Eating, Giving up smoking, Look After Your Heart, Heart Disease, and Exercise, Why Bother?  
Duration of intervention: 12 months  
Length of follow-up: immediate post |
<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Sacerdote 2006&lt;sup&gt;30&lt;/sup&gt; Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>To investigate the effectiveness of a non-structured 15-min educational intervention by general practitioners (GPs) on modifications of daily diet among healthy adults</td>
</tr>
<tr>
<td>Methods</td>
<td>Design: RCT</td>
</tr>
<tr>
<td></td>
<td>Selection: GPs were selected through their professional organizations as those most motivated in the trial. All patients aged 18–65 years attending the wards of 33 selected GPs (in the cities of Torino and Asti, Italy)</td>
</tr>
<tr>
<td></td>
<td>Inclusion: patients aged 18–65 years attending the wards of 33 selected GPs (in the cities of Torino and Asti, Italy) were eligible if they were not obese [body mass index, (BMI), 30] or affected by chronic or severe diseases. Only patients who visited their GP for reasons unrelated to gastrointestinal problems, and without dietary restrictions, were enrolled</td>
</tr>
<tr>
<td>Participants</td>
<td>Sample n= 3179</td>
</tr>
<tr>
<td></td>
<td>Intervention group n = 1592; Control group n = 1587</td>
</tr>
<tr>
<td></td>
<td>Age: Mean age Intervention (SD): 44.7 (12.6); Mean age Control (SD): 44.2 (12.1)</td>
</tr>
<tr>
<td></td>
<td>Gender [Female n(%)]: Intervention: n = 797 (50.1%); Control: n = 794 (50.0%)</td>
</tr>
<tr>
<td></td>
<td>Loss to follow-up: Intervention n = 104; Control n = 98</td>
</tr>
<tr>
<td>Intervention</td>
<td>Intervention: at first visit to the intervention group the GP administered a 15-min personalized nutritional intervention, based on a brochure about diet and health that summarized the Italian Guidelines for a Correct Nutrition 1998.</td>
</tr>
<tr>
<td></td>
<td>Control: ‘sham’ intervention, i.e. a simpler and non-personalized conversation without the use of a brochure.</td>
</tr>
<tr>
<td></td>
<td>Duration of intervention: 15 minutes</td>
</tr>
<tr>
<td></td>
<td>Length of follow-up: 12 months</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Simkin-Silverman 1998&lt;sup&gt;31&lt;/sup&gt; US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>To report the 54-month results of a lifestyle dietary and physical activity program on weight, body composition, physical activity, diet, and other CVD risk factors.</td>
</tr>
<tr>
<td>Methods</td>
<td>Design: RCT</td>
</tr>
<tr>
<td></td>
<td>Selection: mailings targeted at registered voters in Allegheny, Pennsylvania</td>
</tr>
<tr>
<td></td>
<td>Inclusion criteria: women ages 44-50 years; premenopausal by self-report; not taking hormone replacement therapy; BMI 20-34 kg/m², fasting total cholesterol 140-260 mg/dl, fasting LDL-c 80-160 mg/dl, fasting glucose levels &lt; 140 mg/dl and diastolic blood pressure &lt; 95 mm Hg</td>
</tr>
<tr>
<td></td>
<td>Exclusion criteria: Women taking lipid-lowering medication, antihypertensive</td>
</tr>
</tbody>
</table>

Companion papers: Simkin-Silverman<sup>42</sup>, Salamone<sup>43</sup>, Klem<sup>44</sup>, Kuller<sup>45</sup>, Park<sup>46</sup>
medication, insulin, thyroid medication, or psychotropic medications

| Participants | Sample: 535  
|             | Intervention n= 260; Control n= 275  
|             | Age: Mean age Overall (SD): ages 44 to 50  
|             | Gender [Female n(%)]: 100%  
|             | Loss to follow-up: Overall ; Intervention n=14 ; Control n= 12  
| Intervention | Intervention: 5-year behavioral dietary and physical activity program conducted in 2 phases during the 5 years trial  
|             | Phase 1 (weeks 1-20): 15 group meetings, presentation, handouts, homework assignments, low-fat/reduced-calorie meal plan, suggested increase in physical activity expenditure (activity prescription) for moderate-intensity aerobic activity and purposeful lifestyle activities, with ongoing consultation, monitoring and written feedback  
|             | Phase 2 (months 6-54): additional behavioural skills, support, motivation, group meetings, refresher programs, mail and telephone follow-up, incentives and group competitions  
|             | Control: assessment-only control group  
|             | Duration of intervention: 54 months  
|             | Length of follow-up: immediate post  

| Study/Location | Sone 2002 Japan  
| Objective | To determine whether long-term lifestyle intervention can improve glycemic control and prevent complications in patients with type 2 diabetes.  
| Methods | Design: RCT  
| Selection: patients previously diagnosed with type 2 diabetes with HbA1c levels >6.5% from all over Japan were recruited from 59 institutes specializing in diabetes care  

| Participants | Sample: 2205  
|             | Intervention n=1105 ;Control n=1100  
|             | Age: Mean age Intervention (SD): 59.4 (7.5); Mean age Control (SD): 59.4 (7.4)  
|             | Gender [Female n(%)]: Intervention n=495; Control n=505  
|             | SES [college degree or higher]: Intervention: 240; Control: 238  
|             | Unemployed: Intervention 681; Control 353  
|             | Co-morbidities: Diabetes  
|             | Loss to follow-up: Overall loss 232; Intervention 115; Control 117  
| Intervention | Intervention: lifestyle modification program with intensive lifestyle management at each outpatient visit and telephone counseling sessions by trained nurse educators at
least once every 2 weeks
Control: regular conventional care
Duration of intervention: not specified
Length of follow-up: 36 months post initiation

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Steptoe 1999&lt;sup&gt;23&lt;/sup&gt; UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>To measure the effect of behaviourally oriented counseling in general practice on healthy behaviour and biological risk factors in patients at increased risk of coronary heart disease.</td>
</tr>
<tr>
<td>Methods</td>
<td>Design: RCT</td>
</tr>
<tr>
<td></td>
<td>Selection: 42 training practices linked with the Department of General Practice at St. George's Hospital Medical School and within the South Thames region were invited to participate by means of letters outlining the study aims</td>
</tr>
<tr>
<td></td>
<td>Inclusion criteria: ≥1 modifiable cardiovascular risk factors: regular cigarette smoking (&gt;1 cigarette/day), high serum cholesterol concentration (6.59.0 mmol/l), combined high BMI (2535) and low physical activity (&lt;12 episodes of vigorous or moderate exercise for at least 20 minutes in the past 4 weeks)</td>
</tr>
<tr>
<td></td>
<td>Exclusion criteria: active follow up or drugs for coronary heart disease, CVD or peripheral vascular disease, serious chronic illness, prescribed special diet, lipid lowering drugs</td>
</tr>
<tr>
<td>Participants</td>
<td>Sample n= 883</td>
</tr>
<tr>
<td></td>
<td>Intervention group n =316; Control group n = 567</td>
</tr>
<tr>
<td></td>
<td>Age: Mean age Overall (SD): 46.7 (0.4 SE)</td>
</tr>
<tr>
<td></td>
<td>Gender [Female n(%)]: n=477 (54.0%)</td>
</tr>
<tr>
<td></td>
<td>Loss to follow-up: Overall n = 365; Intervention n = 148; Control n = 217</td>
</tr>
<tr>
<td>Intervention</td>
<td>Intervention: invited for three counseling sessions if they had two risk factors and for two counseling sessions if only one risk factor; counseling sessions scheduled to last ≤20 minutes, and between sessions the nurse contacted the patient by telephone one or two times to consolidate the counselling and to encourage behaviour change</td>
</tr>
<tr>
<td></td>
<td>Control: usual care</td>
</tr>
<tr>
<td></td>
<td>Duration of intervention: 12 months</td>
</tr>
<tr>
<td></td>
<td>Length of follow-up: immediate post</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Velthuis 2009&lt;sup&gt;24&lt;/sup&gt; The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companion paper:</td>
<td>Monnikhof&lt;sup&gt;47&lt;/sup&gt;</td>
</tr>
<tr>
<td>Objective</td>
<td>To investigate the effect of a 12-month moderate-to-vigorous exercise program combining aerobic and muscle strength training on body composition among sedentary,</td>
</tr>
</tbody>
</table>
postmenopausal women

| Methods | Design: RCT  
| Selection: random selection out of municipality registries in Utrecht and surroundings in the Netherlands  
| Inclusion criteria: post-menopausal women; 50-69 years old; sedentary (<2 hours/week in moderate sport recreational activities and not adherent to the International Physical Activity Recommendation); non-smokers for ≥12 months; not abusing alcohol or drugs; not planning a strict diet; not experiencing diabetes mellitus or other endocrine related diseases or any disease/disorder (locomotor, optical, neurological, mental) that might impede participation in exercise program; BMI 22-40 kg/m2; fluent in Dutch language; had last menses ≥12 months ago; not used hormone replacement or oral contraceptives in the past 6 months; not diagnosed with breast cancer; not diagnosed with other cancers in the past 5 years; not currently using cortico steroids or beta-blockers |

| Participants | Sample: 189  
| Intervention n=96 ; Control n=93  
| Age: Mean age Intervention (SD): 58.9 (4.6); Mean age Control: 58.4 (4.2)  
| Gender [Female n(%)]: 100%  
| Loss to follow-up: Overall n=6; Intervention n=1; Control n=5 |

| Intervention | Intervention: one-year moderate to vigorous exercise program, which included 2 supervised group sessions of 1 hour/week and an additional home-based individual session of 30 min/week  
| Control: requested to retain habitual exercise patterns  
| Duration of intervention: 12 months  
| Length of follow-up: immediate post |

| Study/Location | Vermunt 2012 The Netherlands  
| Companion paper: Vermunt |

| Objective | To determine the effectiveness of a 2.5-year lifestyle intervention for Type 2 diabetes prevention in Dutch general practice compared with usual care |

| Methods | Design: RCT  
| Selection: recruited by 48 general practitioners from 14 general practices in Eindhoven and surroundings  
| Inclusion criteria: Age between ≥40 and ≤70 and a score of ≥13 point on a Dutch translation of the Finnish FINDRISC |

| Participants | Sample: n= 1065  
| Intervention n = 479 and Control n = 446 |
### Intervention

**Intervention**

11 consultations of 20 min were scheduled over 2.5 years alternately with
the nurse practitioner and the general practitioner; five group meetings were organized
by to provide more detailed information on diet and exercise; also included a 1-h
consultation with a dietician, in which a 3-day food record was discussed.

**Control**

Oral and written information on T2M and healthy lifestyle provided.

**Duration of intervention**

2.5 years

**Length of follow-up**

Immediate post

---

### Study/Location

**Werkman 2010**

The Netherlands

### Objective

To investigate the effect of a one year low-intensity computer-tailored energy balance
program among recent retirees on waist circumference, body weight and body
composition, blood pressure, physical activity and dietary intake.

### Methods

**Design:** RCT

Selection: recruited from pre-retirement workshops as offered by employers to
approximately 10% of the Dutch retiring population; approximately 1,100 workshop
attendees were invited to participate in the WAAG-Study from September 2003 to
mid March 2004.

**Inclusion criteria:** recent retirees (date of retirement <= 6 months before or after
baseline); 55-65 years; not undergoing medical treatments that might affect body
composition.

### Participants

**Sample:** 415

**Intervention n=174 ; Control n=178**

**Characteristics:**

- Age: Mean age Intervention (SD): 59.5 (2.5); Mean age Control 59.4 (2.3)
- Gender [Female n(%)]: 0%
- SES [% low education level]: Intervention: 25%; Control: 23%
- Loss to follow-up: Intervention n=27; Control n=24

### Intervention

**Intervention**

Five program modules during the one year intervention period; newsletters every 2-3 months that contained study information, information about diet and physical activity and encouragements to use the modules.

**Control**

Provided with newsletters with general information about the study, such as study progress, and information about art exhibitions and city trips; they could not login to the website and had access to the general information about the study design only.
Duration of intervention: 12 months
Length of follow-up: immediate post and 12 months

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>Wister 2007 (^2) Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>The objective of this study was to test the efficacy of a low intensity lifestyle intervention aimed at reducing the risk of cardiovascular disease among mid-life individuals</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>Design: RCT</td>
</tr>
<tr>
<td></td>
<td>Selection: population based recruitment 2002-2004 via ads in local newspapers, interviews on radio, posters for workplaces</td>
</tr>
<tr>
<td></td>
<td>Inclusion criteria: The 3 eligibility criteria were age 45–64 years, residence in the Fraser Health region and cardiovascular risk profile according to the literature for primary and secondary prevention</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>Sample: 611</td>
</tr>
<tr>
<td></td>
<td>Intervention 1 (Primary Prevention group) n= 157; Control 1 (Primary Prevention group) n= 158; Intervention 2 (Secondary Prevention group) n= 153; Control 2 (Secondary Prevention group) n= 143</td>
</tr>
<tr>
<td></td>
<td>Age: Mean age Intervention 1 (SD): 55.8 (5.5); Mean age Control 1 (SD): 55.1 (5.2); Mean age Intervention 2 (SD): 56.6 (5.1); Mean age Control 2 (SD): 57.2 (5.0)</td>
</tr>
<tr>
<td></td>
<td>Gender [Female n(%)]: Intervention 1: n= 86 (54.8%); Control 1: n= 98 (62.0%); Intervention 2: n= 52 (34.0%); Control 2: n= 40 (28.0%)</td>
</tr>
<tr>
<td></td>
<td>Loss to follow-up: Overall n= 79; Intervention 1 n= 20; Control 1 n= 17; Intervention 2 n= 15; Control 2 n= 27</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>Intervention: The intervention consisted of a report card (sent to the participant and his or her family doctor) showing the person’s CVD risk profile, coupled with a Telehealth-guided self-care management system; Telehealth counseling occurred within 10 days of the patient receiving the annual report card and every 6 months thereafter for approximately 30 minutes per session, up to 60 minutes per year</td>
</tr>
<tr>
<td></td>
<td>Control: usual care</td>
</tr>
<tr>
<td></td>
<td>Duration of intervention: 12 months</td>
</tr>
<tr>
<td></td>
<td>Length of follow-up: immediate post</td>
</tr>
</tbody>
</table>
Reference List


(23) Steptoe A, Doherty S, Rink E, Kerry S, Kendrick T, Hilton S. Behavioural counselling in general practice for the promotion of healthy behaviour among adults at increased risk of coronary


Table 3 - Search Strategy  Medline-OVID

Most Recent Search: June 27 2013
1. (suicide adj prevent*).tw.
2. Weight Reduction Programs/
3. exp obesity/pc
4. Overweight/pc
5. weight maintenance.tw.
6. weight management.tw.
7. Diet, Reducing/
8. Diet, Fat-Restricted/
9. Caloric Restriction/
10. Diet Therapy/
11. (diet* adj counsel*).ti,ab.
12. (diet* adj education*).ti,ab.
13. (nutrition* adj (counsel* or education* or intervention)).ti,ab.
14. (diet$ adj (modi*$ or therapy or intervention* or strateg* or healthy)).ti,ab.
15. ((diet or dieting or slim$) adj (club$ or organi?ation$)).ti,ab.
16. ((healthy living or healthy lifestyle) adj (program* or intervention* or group or club or strategy)).tw.
17. (weightwatcher* or weight watcher* or commerical weightloss or commerical weight loss or Jenny Craig).tw.
18. exp *Exercise/
19. Exercise Therapy/
20. Motor Activity/
21. Physical Fitness/
22. physical activity.ti,ab.
23. (exercise adj3 (program* or intervention* or strategy or club?)).ti,ab.
24. Fitness Centers/
25. health promotion/ or preventive health services/
26. Primary Prevention/
27. 25 or 26
28. exp *obesity/
29. *overweight/
30. *Weight Gain/
31. 28 or 29 or 30
32. 27 and 31
33. 2 or 3 or 4 or 5 or 6
34. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
35. 27 and 34
36. exp obesity/
37. overweight/
38. weight gain/
39. Weight Loss/
40. (weight or bmi or body mass index or waist circumference or obese or obesity).ti.
41. 36 or 37 or 38 or 39 or 40
42. 35 and 41
43. 32 or 33 or 42
44. animals/ not humans/
45. limit 44 to "all child (0 to 18 years)"
46. limit 45 to "all adult (19 plus years)"
47. 46 not 47
48. 45 not 48
49. limit 49 to (english or french)
50. limit 50 to (case reports or comment or editorial or in vitro or letter or news or newspaper article or webcasts)
51. 50 not 51
52. limit 52 to ed=20120426-20130527
53. limit 53 to ed=20120426-20130527
54. meta-analysis/
55. exp meta-analysis as topic/
56. (meta analy* or metaanaly* or met analy* or metanaly*).tw.
57. review literature as topic/
58. (collaborative research or collaborative review* or collaborative overview*).tw.
59. (integrative research or integrative review* or integrative overview*).tw.
60. (quantitative adj3 (research or review* or overview*)).tw.
61. (research integration or research overview*).tw.
62. (systematic* adj3 (review* or overview*)).tw.
63. (methodologic* adj3 (review* or overview*)).tw.
64. exp technology assessment biomedical/
65. (hta or thas or technology assessment*).tw.
66. ((hand adj2 search*) or (manual* adj search*)).tw.
67. ((electronic adj database*) or (bibliographic* adj database*)).tw.
68. ((data adj2 abstract*) or (data adj2 extract*)).tw.
69. (analys* adj3 (pool or pooled or pooling)).tw.
70. mantel haenszel.tw.
71. (cochrane or pubmed or pub med or medline or embase or psycinfo or psyclit or psychinfo or psychlit or cinahl or science citation index).ab.
72. or/54-71
73. limit 53 to "review"
74. 53 and 72
75. 73 not 74
76. 53 not 75
77. (weight or BMI or waist circumference or waist to hip ratio).mp.
78. Lifestyle.ti.
79. *Life Style/
80. 78 or 79
81. 77 and 80
82. 27 and 81
83. (prevent or prevention or primary care).tw.
84. 81 and 83
85. 82 or 84
86. limit 85 to (english or french)
87. limit 86 to (case reports or comment or editorial or in vitro or letter or news or newspaper article or webcasts)
88. 86 not 87
89. animals/ not humans/
90. 88 not 89
91. limit 90 to "all child (0 to 18 years)"
92. limit 90 to "all adult (19 plus years)"
93. 91 not 92
94. 90 not 93
95. limit 94 to "review"
96. 72 and 94
97. 95 not 96
98. 94 not 97
99. 98 not 76
100. limit 99 to yr="1980 -Current"
101. 76 or 100
<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
<td>title page (pg1)</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
<td>Abstract (pg 2)</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
<td>3-4</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
<td>4</td>
</tr>
<tr>
<td>METHODS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
<td>4</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
<td>5-6</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
<td>5</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
<td>Table 3, Supplemental file</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
<td>5-6</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>5</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
<td>5-6</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td>5</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
<td>7-8</td>
</tr>
</tbody>
</table>
## PRISMA 2009 Checklist

### Synthesis of results
14. Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.

### Risk of bias across studies
15. Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).

### Additional analyses
16. Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.

## RESULTS

### Study selection
17. Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.

### Study characteristics
18. For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.

### Risk of bias within studies
19. Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).

### Results of individual studies
20. For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.

### Synthesis of results
21. Present results of each meta-analysis done, including confidence intervals and measures of consistency.

### Risk of bias across studies
22. Present results of any assessment of risk of bias across studies (see Item 15).

## DISCUSSION

### Additional analysis
23. Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).
### PRISMA 2009 Checklist

<table>
<thead>
<tr>
<th>Component</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary of evidence</td>
<td>24</td>
</tr>
<tr>
<td>Limitations</td>
<td>25</td>
</tr>
<tr>
<td>Conclusions</td>
<td>26</td>
</tr>
<tr>
<td>FUNDING</td>
<td>27</td>
</tr>
</tbody>
</table>

#### Summary of evidence 24
Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).

#### Limitations 25
Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).

#### Conclusions 26
Provide a general interpretation of the results in the context of other evidence, and implications for future research.

#### FUNDING 27
Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.

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For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org).