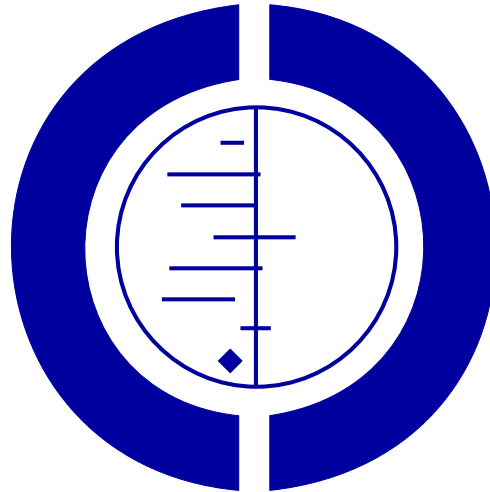


Interventions for promoting physical activity (Review)

Hillsdon M, Foster C, Thorogood M



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ABSTRACT

Background

Little is known about the effectiveness of strategies to enable people to achieve an increase in their physical activity.

Objectives

To assess the effects of interventions for promoting physical activity in adults aged 16 years and older, not living in an institution.

Search strategy

We searched CENTRAL (Issue 4, 2001), MEDLINE, EMBASE, CINAHL, PsychLIT, BIDS ISI, SPORTDISCUS, SIGLE, SCISEARCH (from earliest date available to December 2001) and reference lists of articles.

Selection criteria

Randomised, controlled, trials comparing different interventions to encourage sedentary adults not living in an institution to become physically active. Studies required a minimum of six months follow up from the start of the intervention to the collection of final data and either used an intention to treat analysis or, failing that, had no more than 20% loss to follow up.

Data collection and analysis

At least two reviewers independently assessed each study quality and extracted data. Study authors were contacted for additional information where necessary. Standardised mean differences and 95% confidence intervals were calculated for continuous measures of self reported physical activity and cardio-respiratory fitness. For studies with dichotomous outcomes, odds ratios and 95% confidence intervals were calculated.

Main results

The effect of interventions on self reported physical activity (11 studies; 3940 participants) was positive and moderate, with a pooled standardised mean difference of 0.31 (95% CI 0.12 to 0.50), as was the effect on cardio-respiratory fitness (7 studies; 1406 participants) pooled SMD 0.4 (95% CI 0.09 to 0.70). The effect of interventions in achieving a predetermined threshold of physical activity (6 studies; 2313 participants) was not significant with an odds ratio of 1.30 (95% CI 0.87 to 1.95). There was significant heterogeneity in the reported effects as well as heterogeneity in characteristics of the interventions. The heterogeneity in reported effects was reduced in higher quality studies, when physical activity was self-directed with some professional guidance and when there was on-going professional support.

Authors' conclusions

Our review suggests that physical activity interventions have a moderate effect on self reported physical activity and cardio-respiratory fitness, but not on achieving a predetermined level of physical activity. Due to the clinical and statistical heterogeneity of the studies, only limited conclusions can be drawn about the effectiveness of individual components of the interventions. Future studies should provide greater detail of the components of interventions.

PLAIN LANGUAGE SUMMARY

Interventions designed to increase physical activity can be moderately effective in encouraging people to become physically active and physically fit.

A sedentary lifestyle leads to an increased risk of a number of chronic diseases including heart disease. Regular physical activity can reduce this risk and also provide other physical, and possibly, mental health benefits. The majority of adults are not active at recommended levels. This review found that professional advice and guidance with continued support can encourage people, 16 and older, to be more physically active. The majority of studies included in this review, however, lasted no more than one year. There was no increase in exercise-related cardiac events or injuries among those who had become physically active, compared to those who remained sedentary. More research is needed to establish which methods of exercise promotion work best in the long term to encourage different types of people to be more physically active.

BACKGROUND

Regular physical activity can play an important role in both the prevention and treatment of cardiovascular disease (CVD), hypertension, non-insulin dependent diabetes mellitus, stroke, some cancers, osteoporosis, as well as improve the lipid profile (DOH 2004; FNB 2002; Folsom 1997; Haapanen 1997; US Dept. Health 1996). A meta-analysis of the relationship between physical activity and coronary heart or cardiovascular disease reported a 30% lower risk for the most physically active versus the least physically active (Williams 2001).

Current evidence-based national and international guidelines recommend adults to undertake at least 30 minutes of 'moderate intensity' (5.0-7.5 kcal/min) physical activity on 5 or more days of the week (DOH 1996; Pate 1995). Physical inactivity has been estimated to cause, globally, about 22% of ischaemic heart disease (WHO 2002).

In England the prevalence of physical inactivity is high with 60% of men and 74% of women taking insufficient physical activity to derive significant health benefits. Of the adult population 26% smoke, 76.9% have a raised serum cholesterol concentration and 35.6% are hypertensive (ONS 2004; Petersen 2004).

In England, the government has set a target for 70% of the population to be physically active by 2020 (DCMS/SU 2002). Although a large body of evidence exists about the health benefits of physical activity, evidence on the effectiveness of strategies to achieve this target is lacking.

There are randomised, controlled trials assessing the effects of physical activity in the management of specific diseases, notably hypertension, hyperlipidaemia, overweight and CVD (DOH 2004). These show the effects of exercise on various physiological and biological outcomes and demonstrate the importance of exercise in the management of disease. However, because the main outcome of these trials is not physical activity, they do not help us understand the effectiveness of physical activity promotion strategies. A separate Cochrane review has assessed the effectiveness of exercise-based rehabilitation for coronary heart disease patients

and found that exercise-based cardiac rehabilitation is effective in reducing cardiac deaths (Jolliffe 2004).

Several systematic reviews have considered the effectiveness of physical activity interventions and have been summarised elsewhere but to date there have been no Cochrane reviews of the effectiveness of physical activity interventions on adults (Hillsdon 2004).

OBJECTIVES

To compare the effects, both harms and benefits, of interventions for physical activity promotion in adults aged 16 and above not living in an institution with no intervention, minimal intervention or attention control arms.

If sufficient trials exist, the following secondary objectives were to be explored:

- (1) Are the most intense interventions more effective in changing physical activity than less intense interventions (e.g. a greater frequency and duration of professional contact and support versus single contact)?
- (2) Are specific components of interventions associated with changes in physical activity behaviour (e.g. prescribed v self determined physical activity, supervised v unsupervised physical activity)?
- (3) Are short term changes in physical activity or fitness (e.g. less than 3 months from intervention, less than 6 months from intervention) maintained at 12 months?
- (4) Is the promotion of some types of physical activity more likely to lead to change than other types of physical activity (e.g. walking versus exercise classes)?
- (5) Are home based interventions more successful than facility based interventions?
- (6) Are interventions more successful with particular participant groups (e.g. women, older, minority)?

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

Randomised controlled trials (RCT) comparing different strategies to encourage sedentary, community dwelling adults to become more physically active, with a minimum of six months follow up from the start of the intervention to the final results using either an intention to treat analysis or no more than 20% loss to follow up.

Types of participants

Community dwelling adults, age 16 years to any age, free from pre-existing medical condition or with no more than 10% of subjects with pre-existing medical conditions that may limit participation in physical activity. Interventions on trained athletes or sports students were excluded.

Types of intervention

One only or a combination of:

- one to one counselling/advice or group counselling/advice;
- self directed or prescribed physical activity;
- supervised or unsupervised physical activity;
- home-based or facility-based physical activity;
- ongoing face-to-face support
- telephone support;
- written education/motivation support material;
- self monitoring.

The interventions were conducted by one or a combination of practitioners including a physician, nurse, health educator, counsellor, exercise leader or peer. Mass media interventions and multiple risk factor interventions were excluded.

The interventions were compared with a no intervention control, attention control and/or minimal intervention control group.

Types of outcome measures

The main outcome was change in self reported physical activity between baseline and follow up. Physical activity measures were expressed as an estimate of total energy expenditure (kcal/kg/week, kcal/week), total minutes of physical activity, proportion reporting a pre-determined threshold level of physical activity (e.g., meeting current public health recommendation), frequency of participation in various types of physical activity e.g. walking, moderate intensity physical activity.

Cardio-respiratory fitness was also measured as a primary or secondary outcome measure in some of the studies. It was either estimated from a sub-maximal fitness test or recorded directly from

a maximal fitness test. It was expressed as maximal oxygen consumption ($VO_{2\max}$) either in $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ or $\text{ml}\cdot\text{min}^{-1}$.

Adverse events were also examined. These included job related injuries (Reid 1979), any reported musculoskeletal injury or cardiovascular events (Simons-Morton 2001a; Simons-Morton 2001b) and exercise-related cardiac events and injuries (fractures, sprains) (King 1991)).

A number of secondary outcome measures, which were not the focus of this review, were also measured and included body mass index (King 1991; Kriska 1986; Stewart 2001), health status, smoking status (King 1991; Kriska 1986; Norris 2000), socio-behavioural constructs (e.g. self efficacy, reduction in barriers to physical activity), social support and "stage of change" (Calfas 2000; Goldstein 1999; Norris 2000), time spent in flexibility and strength training (Calfas 2000), weight, height, lean body mass, body fat, plasma lipids (Cunningham 1987; Juneau 1987; Kriska 1986), minute ventilation, maximal heart rate, respiratory exchange ratio, blood cholesterol, flexibility, grip strength, systolic and diastolic blood pressure (Cunningham 1987; King 1991; Kriska 1986), and alcohol consumption (Kriska 1986).

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: Heart Group methods used in reviews.

We searched *The Cochrane Library* and associated trial registers (December 2001), MEDLINE (January 1966 to December 2001), EMBASE (January 1980 to December 2001) (Table 01), CINAHL (January 1982 to December 2001) (Table 02), PsycH-LIT (1887 to December 2001) (Table 03), BIDS ISI (January 1973 to December 2001), SPORTDISCUS (January 1980 to December 2001) (Table 04), SIGLE (January 1980 to December 2001) (Table 05) and SCISEARCH (January 1980 to December 2001) (Table 06), and reference lists of articles. Hand searching was conducted on one journal *Medicine and Science in Sport and Exercise* from 1990 to December 2001. Published systematic reviews of physical activity interventions were used as a source of randomised controlled trials. Reference lists of all relevant articles, books and personal contact with authors were also used. All languages were included. The search strategy below was used to search MEDLINE, with the addition of an RCT filter (Dickersin 1995). This strategy was modified for other databases (also using an appropriate RCT filter for EMBASE (Lefebvre 1996)).

Search Strategy for MEDLINE

- 1 exp Exertion/
- 2 Physical fitness/
- 3 exp "Physical education and training"/
- 4 exp Sports/
- 5 exp Dancing/
- 6 exp Exercise therapy/

- 7 (physical\$ adj5 (fit\$ or train\$ or activ\$ or endur\$)).tw.
- 8 (exercis\$ adj5 (train\$ or physical\$ or activ\$)).tw.
- 9 sport\$.tw.
- 10 walk\$.tw.
- 11 bicycle\$.tw.
- 12 (exercise\$ adj aerobic\$).tw.
- 13 (("lifestyle" or life-style) adj5 activ\$).tw.
- 14 (("lifestyle" or life-style) adj5 physical\$).tw.
- 15 or/1-14
- 16 Health education/
- 17 Patient education/
- 18 Primary prevention/
- 19 Health promotion/
- 20 Behaviour therapy
- 21 Cognitive therapy
- 22 Primary health care
- 23 Workplace/
- 24 promot\$.tw.
- 25 educat\$.tw.
- 26 program\$.tw.
- 27 or/16-26
- 28 15 and 27

METHODS OF THE REVIEW

All abstracts were reviewed independently by two investigators who applied the following criteria to determine if the full paper was needed for further investigation:

- (1) did the study aim to examine the effectiveness of a physical activity promotion strategy to increase physical activity behaviour?
- (2) did the study have a control group (e.g. a no intervention control, attention control and/or minimal intervention control group)?
- (3) did the study allocate participants into intervention or control groups by a method of randomisation?
- (4) did the study include adults of 16 years or older?
- (5) did the study recruit adults not living in institutions and free of chronic disease?
- (6) was the study's main outcome physical activity or physical fitness?
- (7) were the main outcome(s) measured at least 6 months after the start of the intervention?
- (8) did the study analyse the results by intention to treat or, failing that was there less than 20% loss to follow up?

Two reviewers examined a hard copy of every paper that met the inclusion criteria on the basis of the abstract alone (or title and keywords if no abstract was available). When a final group of papers was identified all papers were reviewed again by two reviewers independently. Any disagreement at this stage was discussed between the three reviewers and resolved by consensus.

From the final set of studies that met the inclusion criteria, study details were extracted independently by two reviewers onto a standard form. Any disagreements were discussed between three reviewers and resolved by consensus. Extracted data included date and location of study, study design variables, methodological quality, characteristics of participants (age, gender, ethnicity), intervention strategies, frequency and type of intervention and follow-up contacts, degree of physical activity supervision, study outcome measure, effectiveness of intervention and adverse events.

We wrote to and received clarification from five authors of the studies selected for the review. We were unable to secure information for Halbert 2000 and so this study is not presented in the final results.

Outcomes were analysed both as continuous outcomes and as dichotomous outcomes (active/sedentary) wherever possible. Standard statistical approaches were adopted:

(1) For each study with continuous outcomes; a standardised mean difference (SMD) and 95% confidence intervals were calculated. If the study had more than two arms then the overall effects of the intervention versus control (means and standard deviations) were examined by pooling the individual effect of each intervention arm (means and standard deviations). These pooled groups means and standard deviations were weighted for overall numbers within each arm. Pooled effect sizes were calculated as standardised mean differences with 95% confidence intervals (95% CI) using a random effects model;

(2) For each study with dichotomous outcomes; an odds ratio (OR) and 95% confidence intervals were calculated. Pooled effect sizes were calculated as ORs and with 95% confidence intervals using a random effects model.

DESCRIPTION OF STUDIES

Details of the studies included in this review are provided in Characteristics of Included Studies and Additional Tables - Table 07, Table 08, Table 09, Table 10, Table 11, Table 12, Table 13.

Design of included studies

All seventeen studies were randomised controlled trials. In two papers the results of two studies were reported. (King 1988a; King 1988b; Simons-Morton 2001a; Simons-Morton 2001b). Six studies had a no contact control group. Three studies had attention control groups with participants receiving non-exercise related health advice. The remaining eight studies had comparison control groups, where participants received advice or written information about physical activity. Eleven studies had two arm study designs, the other six having at least three arms, with one study having five arms (Harland 1999).

Participants of included studies

6255 apparently healthy adults participated in the studies. Studies included both genders with three studies recruiting men only (Cunningham 1987; Reid 1979; Simons-Morton 2001a) and two studies recruiting women only (Kriska 1986; Simons-Morton 2001b). The stated age range of participants was from 18 to 95 year (mean 52.5, SD 12.1). Details on ethnic group of participants were reported in eight studies, with proportions of participants in ethnic minorities ranging from 3 to 39.5%. Participants were recruited from four settings, primary health care, workplaces, university and the community [see Additional Table 07].

METHODOLOGICAL QUALITY

Two from three reviewers independently assessed the quality of each study that met the inclusion criteria. We did not rate studies on whether participants were blind to their allocation to intervention or control groups. This would not be appropriate for studies of this type, as it would be impossible to blind participants to a physical activity intervention. Generation of a formal quality score for each study was completed on a four point scale assigning a value of 0 or 1 to each of these factors, (described below).

(1) Was the randomisation method described?

No study provided details on pre-randomisation allocation concealment. All studies reported using randomisation to allocate participants to intervention and control groups, but only eleven described the method of randomisation. Of these, four studies used quasi-randomisation, where the unit of randomisation was participating practices (Norris 2000), matched pairs of participating practices (Goldstein 1999), days of the week (Smith 2000), workplace shifts (Reid 1979);

(2) Was the outcome assessment independent and blind?

Only six studies reported independent and blind outcome assessments (Goldstein 1999; Harland 1999; King 1991; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000);

(3) Was the final outcome measure controlled for baseline physical activity?

Nine studies reported adjusting their final results for baseline values of physical activity (Calfas 2000; King 1988a; King 1988b; King 1991; Norris 2000; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000; Stewart 2001);

(4) Was the analysis intention to treat analysis or was there less than 20% loss to follow up?

Eight studies reported using an intention to treat analysis (Kriska 1986; Lombard 1995; Reid 1979; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000; Stevens 1998; Stewart 2001). Nine studies did not use an intention to treat analysis but had less than 20% loss to follow up (Calfas 2000; Cunningham 1987; Goldstein 1999; Harland 1999; Juneau 1987; King 1988a; King 1988b; King 1991; Norris 2000). The proportion of participants

lost to follow up varied between 4.1%-15.9% [see Additional Table 09].

RESULTS

From 28236 hits, 150 papers were examined against the inclusion criteria (Figure 01). Fifteen papers produced seventeen studies that met the inclusion criteria (Calfas 2000; Cunningham 1987; Goldstein 1999; Harland 1999; Juneau 1987; King 1988a; King 1988b; King 1991; Kriska 1986; Lombard 1995; Norris 2000; Reid 1979; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000; Stevens 1998; Stewart 2001) [Characteristics of included studies]. One study reported long term follow up for the same study subjects (Pereira 1998) [Characteristics of excluded studies].

There was marked clinical heterogeneity in the interventions used in each study. Studies used a single or combination of one to one counselling/advice or group counselling/advice; self directed or prescribed physical activity; supervised or unsupervised physical activity; home-based or facility-based physical activity; ongoing face-to-face support; telephone support; written education/motivation material; self monitoring. The intervention was delivered by one or a number of practitioners with various professional backgrounds including physicians, nurses, health educators, counselors, exercise leaders, peers.

Six studies had more than one intervention arm (Harland 1999; King 1991; Norris 2000; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000). Three of them conducted an analysis of any intervention vs control by combining intervention arms (Harland 1999; Norris 2000; Smith 2000). We calculated pooled results for intervention arms for three further studies (King 1991; Simons-Morton 2001a; Simons-Morton 2001b). We also combined the results of two studies as the final results for control and intervention groups were reported separately by gender, as there was no a priori hypothesis that the effect of the intervention would be different for men and women.(Calfas 2000; Juneau 1987).

Our analysis of effectiveness when combining intervention arms, differed from the original results presented by two studies (King 1991; Simons-Morton 2001b).

Studies with physical activity reported as a continuous measure [see Additional Table 10]

Eleven studies (3940 participants) reported their main outcome as one of several continuous measures of physical activity (Calfas 2000; Cunningham 1987; Goldstein 1999; King 1988a; King 1988b; Kriska 1986; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000; Stevens 1998; Stewart 2001). Measures included kcals/day, kcals/week of moderate physical activity and mean number of occasions of physical activity in past four weeks. The pooled effect of these studies was positive but moderate; the standardised mean difference random effects model was 0.31 (95%

confidence interval 0.12 to 0.51) with significant heterogeneity in observed effects. Five studies reported positive effects. Kriska 1986 found that encouraging walking via an 8 week training programme, followed by a choice of group or independent walking, plus follow up phone calls and incentives resulted in a mean increase of 479 kcal/week (95% confidence interval 249 to 708) of physical activity of all intensities. Cunningham 1987 found that encouragement to attend three group exercise sessions per week and perform an additional weekly exercise session at home resulted in an additional mean 53.7 minutes of vigorous physical activity per day (95% confidence interval 18.09 to 89.31). King 1988a found a mean increase of 3.90 exercise sessions per month (95% confidence interval 0.43 to 7.37), at 6 months, following 30 minutes of baseline instruction (15 minutes of advice and a 15 minute video about exercise training), and daily self monitoring of physical activity using exercise logs returned to staff every month. These additional sessions were approximately equivalent to 101 minutes of moderate intensity physical activity per week. Stevens 1998 saw a net difference between intervention and control groups of 2.31 'sessions' (one session was at least 20 minutes of continuous physical activity) of moderate or vigorous exercise per month (95% confidence interval 1.91 to 2.71). At an initial meeting with a community exercise development officer intervention participants were encouraged to extend a physical activity that they already did rather than start a new activity. A further meeting was offered ten weeks later to support and encourage any changes. Stewart 2001 reported a significant net difference of 82 kcal per day between the intervention and control arms (95% confidence interval 73.9 to 90.1). The intervention group received face to face counselling based on social cognitive theory (Bandura 1986). In addition they were offered further individual follow up appointments, educational materials, phone calls and monthly workshops about physical activity.

No statistically significant effects were observed for the other six studies (Calfas 2000; Goldstein 1999; King 1988b; Simons-Morton 2001a; Simons-Morton 2001b; Smith 2000). No studies had effects that favoured controls.

Studies with physical activity reported as a dichotomous measure [see Additional Table 12]

Six studies (2313 participants) reported their main outcome as a dichotomous measure which represented achievement or not of a predetermined level of physical activity (Harland 1999; Lombard 1995; Norris 2000; Reid 1979; Simons-Morton 2001a; Simons-Morton 2001b). Only one study (135 participants) had a significant positive effect (Lombard 1995). Lombard 1995 found that participants who received a high frequency of follow up telephone calls (10 calls over 12 weeks) were more successful at changing their walking behaviour than participants who did not receive telephone calls; the odds ratio was 10.95 (95% confidence interval 1.42 to 84.15).

No effect was found in five studies (Harland 1999; Norris 2000;

Reid 1979; Simons-Morton 2001a; Simons-Morton 2001b). No studies had results that favoured control.

Studies with cardio-respiratory fitness as a main outcome [see Additional Table 11]

In addition to self reported physical activity, seven studies (1406 participants) examined the effect of their intervention on cardio-respiratory fitness (Cunningham 1987; Juneau 1987; King 1988a; King 1988b; King 1991; Simons-Morton 2001a; Simons-Morton 2001b). Two studies presented outcomes for cardio-respiratory fitness only (Juneau 1987; King 1991). The pooled effect of these intervention was again positive and moderate with significant heterogeneity in the observed effects; the standardised mean difference random effects model was 0.4 (95% confidence interval 0.09 to 0.70). Three studies (739 participants) had significant positive effects that favoured treatment (Cunningham 1987; Juneau 1987; Simons-Morton 2001b). Cunningham 1987 reported that recently retired men who were offered supervised exercise sessions increased their fitness by a greater amount than controls who continued with their usual physical activity programmes; the standardised mean difference was 0.44 (95% confidence interval 0.16 to 0.72). Juneau 1987 found a mean increase in fitness; the standardised mean difference was 1.49 (95% confidence interval 1.07 to 1.91) for participants who received a combination of a 30 minute consultation, an educational video, information on using a heart rate monitor and a daily physical activity log, compared to controls. Simons-Morton 2001b found that women who received an intensive mixture of behavioural counselling, support materials and telephone calls (Assistance + Counselling arms) were more likely to increase their fitness; the standardised mean difference was 0.47 (95% confidence interval 0.23 to 0.71) than women who received a less intensive intervention (Advice arm only).

Although King 1991 reported a significant difference in VO_{2max} between intervention and control group at 12 months follow up this difference did not remain when based on the standardised mean difference of the pooled intervention arms; the standardised mean difference 0.17 (95% confidence interval -0.09 to 0.43). In one other study (King 1988b), the author reported a significant difference in the change in fitness between groups, which did not remain significant when based on standardised mean differences at 12 month follow up using their published data.

Adverse events

Four studies reported data on adverse events. One found the rate of job related injuries was four times higher in the control group compared to the intervention group (Reid 1979). Another found no significant difference in rates of musculoskeletal injury and potential cardiovascular events between groups (Simons-Morton 2001a; Simons-Morton 2001b). King 1991 found no exercise-related cardiac events in the study and no significant difference between groups for injuries, including fractures and sprains.

Secondary objectives

(1) Are the most intense interventions more effective in changing physical activity than less intense interventions?

Two studies attempted to investigate the effect of increasing intervention intensity. In Simons-Morton 2001a and Simons-Morton 2001b the three groups received different levels of intervention. The control group (Advice) received physician advice to achieve the recommended level for exercise, then referral to an on-site health educator. At this appointment the health educator provided educational materials and repeated the physician advice to exercise with further follow-up appointments repeating this advice. No other follow up activities were offered. The Assistance group received the same advice from a physician and also received a 30-40 minute counselling session the health educator conducted, including a videotape and action planning. Participants then received follow-up phone calls, interactive mail, an electronic step counter, and monthly monitoring cards, which were returned to the health educator. Follow-up mail and incentives were sent to all participants. The Counselling group received all of the components of the advice and assistance group with additional bi-weekly telephone calls for 6 weeks and then monthly telephone calls up to 12 months. Frequency of telephone calls for the final 12 months of the study was negotiated between the participant and their health educator. Weekly behavioural classes on skills for adopting and maintaining physical activity were also offered to this group. In women, the addition of behavioural counselling, follow up support and materials produced a significant difference in fitness compared to the control groups (Simons-Morton 2001b). In men addition of these components did not lead to greater change. (Simons-Morton 2001a). When we stratified the interventions by the frequency of intervention occasions (an indicator of intervention intensity) there was greater consistency in the effect estimates for the those studies where there was 4 or more contacts between the staff delivering the intervention and participants compared to studies where there was less than 4 contacts.

(2) Are specific components of interventions associated with changes in physical activity behaviour?

We were unable to separate out specific behavioural components of the interventions, but we were able to stratify them according to a number of study characteristics, including degree of physical activity supervision, the extent to which physical activity was prescribed or self-directed and the level of on-going professional support (see Additional Table 08). Although there were insufficient studies to statistically test the difference in observed effects between these various study characteristics, the significant heterogeneity in reported effects was reduced when physical activity was self-directed with some professional guidance and when there was on-going professional support. The heterogeneity in effects was not consistently reduced within the levels of supervision.

(3) Are short term changes in physical activity or fitness maintained at 12 months?

Four studies reported outcomes more than six months after initial intervention. In King 1991 improvements in physical activity and

cardio-respiratory fitness at six months were maintained at 12 months for cardio-respiratory fitness only. Simons-Morton 2001a and Simons-Morton 2001b presented data for cardio-respiratory fitness and self reported physical activity at 6 and 24 months. All three study arms increased their cardio-respiratory fitness and self reported levels of physical activity between baseline and 6 months. However there were no significant differences between groups. At 24 months there was a significant difference in VO_{2max} between participants who received assistance and counselling compared to the advice group for women only (Simons-Morton 2001b). Calfas 2000 reported outcomes at 12 and 24 months with no significant effect observed at either time points.

(4) Is the promotion of some types of physical activity more likely to lead to change than other types of physical activity?

We were unable to determine if any type of physical activity is more likely to be adopted than any other type of physical activity, (e.g. walking, jogging or running) as the studies were not designed to examine this question and as such generally did not report exactly what type of physical activity was performed.

(5) Are home based interventions more successful than facility based interventions?

No study specifically examined this question. However King 1991 compared the difference in adherence to prescribed physical activity sessions between participants who were prescribed home-based versus facility based exercise. A greater number of participants completed at least 75% of prescribed exercise sessions in both home based arms compared to the facility based arms ($p < 0.05$). This improved adherence to the home based exercise sessions was not reflected in greater improvements in fitness.

(6) Are interventions more successful with particular participant groups?

Seven studies examined the differential effects of the interventions within various sub-groups. Six studies looked at the effect of gender (Calfas 2000; Juneau 1987; King 1991; Simons-Morton 2001a; Simons-Morton 2001b; Stewart 2001). Greater effects were reported for improvements in cardio-respiratory fitness for women as compared to men in King 1991 and Simons-Morton 2001a and Simons-Morton 2001b, while Juneau 1987 reported a greater increase in VO_{2max} in men than women.

Two studies found no differential effects between high and low levels of baseline self reported physical activity (Smith 2000; Stewart 2001). No effects were seen for age (above or below 75 years) in Stewart 2001. The same study also found a greater increase in physical activity for overweight participants (BMI more than 27.0), compared with participants who were not overweight (Stewart 2001).

DISCUSSION

Our review suggests that physical activity interventions have a

positive moderate sized effect on increasing self-reported physical activity and measured cardio-respiratory fitness, at least in the short to mid-term.. Any conclusions drawn from this review require some caution given the significant heterogeneity in the observed effects. Despite the clinical heterogeneity between the studies, there is some indication that a mixture of professional guidance and self direction plus on-going professional support leads to more consistent effect estimates. The long term effectiveness of these interventions is not established as the majority of studies stopped after 12 months. The quality of the studies was mainly limited by a lack of intention to treat analysis and failure to examine the interaction baseline levels of physical activity and exposure to the intervention. Only two studies (Simons-Morton 2001a; Simons-Morton 2001b) achieved all of our quality criteria. However, we found that the observed effects were more consistent in studies with higher quality scores [see Additional Table 10; Table 11; Table 12].

Internal validity

Weaknesses in internal validity were found across the studies. These weaknesses were difficulties of allocation concealment to intervention at baseline, not stating randomisation methods, and not using researchers who were independent and blinded to allocation groups at follow up measures. Nine studies controlled their final results for baseline levels of physical activity, taking into account any differences in response to the intervention by baseline physical activity or differential loss to follow up.

Misclassification of physical activity also threatens internal validity of studies. The insensitivity of self reported physical activity measures would lead to less precision in its measurement and increase the variance in measures of behaviour. As intervention and control group participants completed the same self report measure, any misclassification is likely to be non-differential leading to an attenuation of the effect of the intervention. This problem would not apply so much to measures of cardio-respiratory fitness.

External validity

Limitations in the external validity of the studies related to recruitment and screening of participants and the generalisability of the interventions into everyday practice.

The majority of the studies in our review recruited volunteers, for example people replying to newspaper advertisements and the interventions may be less effective in non volunteer populations recruited for example from primary care settings. Often participants had to agree to extensive screening prior to randomisation and as a consequence the people who finally participated in the study were likely to be highly motivated. Participants who were randomised in Project ACT (Simons-Morton 2001a; Simons-Morton 2001b) had already undergone three screening visits. Participants in another study (Stewart 2001) attended pre-study promotional events plus a baseline assessment. By contrast, Stevens 1998 randomised participants at the point of invitation to the study prior to them agreeing to participate [see Additional Table 09].

The physicians in the studies based in a primary health care setting may have been more motivated to deliver the interventions than might be observed in a non-trial setting. We noted that studies described “recruiting” participating practices and physicians and reported using financial incentives to physicians and practice staff during the time of the study.

We also noted a large drop out of participants between the recruitment, eligibility screening and randomisation phases of studies.

Many interventions provided components which would be difficult to deliver in usual practice as they would demand large resources. Most of the interventions offered a choice of physical activities and offered initial support in supervised programmes of physical activity as well as letting participants choose to exercise independently of professional support.

Our conclusions differ from the findings of our own previous systematic review (Hillsdon 1996). In this earlier review we concluded that interventions that encouraged home based activity were more effective than facility based activity interventions. In this current review we have used more rigid inclusion criteria (for example outcome measures with at least 6 months follow up) and subsequently excluded some studies included in the previous review. We also were able to collect unpublished data from study authors which allowed for a quantitative analysis using standardised mean differences for effects as opposed to just narrative descriptions and comparisons.

Only four studies reported data at two years, with one study demonstrating maintenance of improvement in cardio-respiratory fitness (Simons-Morton 2001b). Evidence for the long term effectiveness of interventions is urgently required.

The participants in the studies reviewed were generally white, well educated and middle aged and it is possible that the observed effects may be different in the wider population. There were no studies in this review that examined the effectiveness of interventions in minority groups of any kind.

AUTHORS' CONCLUSIONS

Implications for practice

There is some evidence to suggest that interventions designed to increase physical activity can lead to moderate short and mid-term increases in physical activity, at least in middle age. Due to the clinical and statistical heterogeneity of the studies, only limited conclusions can be drawn about the effectiveness of individual components of the interventions. Nevertheless interventions which provide people with professional guidance about starting an exercise programme and then provide on going support may be more effective in encouraging the uptake of physical activity. There is no evidence that such interventions will reduce physical

activity or cause other harm. There is only very limited evidence of the long-term effectiveness of interventions.

Implications for research

Existing evidence about the effectiveness of physical activity interventions for sedentary adults in the general population is limited by the recruitment of motivated volunteers, and the problems of measuring of physical activity using self report. No studies examined the effect of interventions on participants from varying socioeconomic or ethnic groups. There is also an urgent need for studies with cost-effectiveness data. High quality studies are required with larger numbers, with a greater variety of participants, and with longer follow up periods. In this review we have been able to describe the quantity of the interventions but were unable to describe the quality of the components of the interventions. Future reports of studies should provide greater detail on the nature of the professional who delivered the interventions, the theoretical basis of the intervention and how the theory was translated into practice.

POTENTIAL CONFLICT OF INTEREST

None known

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Stewart 2001 provided clarification regarding the means and stan-

dard deviations for the weekly caloric expenditure in all and moderate intensity physical activity at 12 months follow up.

Smith 2000 provided the mean change and standard deviation of the total minutes of activity for the three arms of the study at 7-8 months follow up.

Norris 2000 was unable to provide the standard deviations for various physical activity outcomes.

Calfas 2000 confirmed the final numbers of participants at the 24 month follow up.

Simons-Morton 2001a and Simons-Morton 2001b provided the standard errors for the physical activity and VO_{2max} values for men and women in all three study arms at 6, 12 and 24 months follow up.

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REFERENCES

References to studies included in this review

Calfas 2000 {published data only}

Calfas KJ, Sallis JF, Nichols JF, Sarkin JA, Johnson MF, Caparosa S, et al. Project GRAD: two-year outcomes of a randomized controlled physical activity intervention among young adults. Graduate Ready for Activity Daily. *American Journal of Preventive Medicine* 2000;**18**(1):28–37. 2910.

Cunningham 1987 {published data only}

Cunningham DA, Rechnitzer PA, Howard JH, Donner AP. Exercise training of men at retirement: a clinical trial. *Journal of Gerontology* 1987;**42**(1):17–23. 28197.

Goldstein 1999 {published data only}

Goldstein MG, Pinto BM, Marcus BH. Physician based physical activity counselling for middle aged and older adults: a randomised trial. *Annals of Behavioral Medicine* 2002;**21**:40–7. 28230.

Halbert 2000 {published data only}

Halbert JA, Silagy CA, Finucane PM, Withers RT, Hamdorf PA. Physical activity and cardiovascular risk factors: effect of advice from

an exercise specialist in Australian general practice. *The Medical Journal of Australia* 2000;**173**(2):84–7. 28231.

Harland 1999 {published data only}

Harland J, White M, Drinkwater C, Chinn D, Farr L, Howel D. The Newcastle exercise project: a randomised controlled trial of methods to promote physical activity in primary care. *BMJ* 1999;**319**(7213): 828–32. 3343.

Juneau 1987 {published data only}

Juneau M, Rogers F, De Santos V, Yee M, Evans A, Bohn A, et al. Effectiveness of self-monitored, home-based, moderate-intensity exercise training in middle-aged men and women. *The American Journal of Cardiology* 1987;**60**:66–70.

King 1988a {published data only}

King AC, Taylor CB, Haskell WL, DeBusk RF. Strategies for increasing early adherence to and long-term maintenance of home-based exercise training in healthy middle-aged men and women. *American Journal of Cardiology* 1988;**61**(8):628–32. 28216.

King 1988b {published data only}

King AC, Taylor CB, Haskell WL, DeBusk RF. Strategies for increas-

ing early adherence to and long-term maintenance of home-based exercise training in healthy middle-aged men and women. *American Journal of Cardiology* 1988;**61**(8):628–32. 28216.

King 1991 {published data only}

King AC, Haskell WL, Taylor CB, Kraemer HC, DeBusk RF. Group- vs home-based exercise training in healthy older men and women. A community-based clinical trial. *JAMA* 1991;**266**(11):1535–42. 28206.

Kriska 1986 {published data only}

Kriska AM, Bayles C, Cauley JA, LaPorte RE, Sandler RB, Pambianco G. A randomized exercise trial in older women: increased activity over two years and the factors associated with compliance. *Medicine and Science in Sports and Exercise* 1986;**18**(5):557–62. 28207.

Lombard 1995 {published data only}

Lombard DN, Lombard TN, Winett RA. Walking to meet health guidelines: the effect of prompting frequency and prompt structure. *Health Psychology* 1995;**14**(2):164–70. 28185.

Norris 2000 {published data only}

Norris SL, Grothaus LC, Buchner DM, Pratt M. Effectiveness of physician-based assessment and counseling for exercise in a staff model HMO. *Preventive Medicine* 2000;**30**(6):513–23. 468.

Reid 1979 {published data only}

Reid EL, Morgan RW. Exercise prescription: a clinical trial. *American Journal of Public Health* 1979;**69**(6):591–5. 516.

Simons-Morton 2001a {published data only}

Simons-Morton DG, Blair SN, King AC, Morgan TM, Applegate WB, O' Toole M, et al. Effects of physical activity counseling in primary care: The Activity Counseling Trial: A randomized controlled trial. *JAMA* 2001;**286**:677–87. 7812.

Simons-Morton 2001b {published data only}

Simons-Morton DG, Blair SN, King AC, Morgan TM, Applegate WB, O' Toole M, et al. Effects of physical activity counseling in primary care: The Activity Counseling Trial: A randomized controlled trial. *JAMA* 2001;**286**:677–87.

Smith 2000 {published data only}

Smith BJ, Bauman AE, Bull FC, Booth ML, Harris MF. Promoting physical activity in general practice: a controlled trial of written advice and information materials. *British Journal of Sports Medicine* 2000;**34**(4):262–7. 427.

Stevens 1998 {published data only}

Stevens W, Hillsdon M, Thorogood M, McArdle D. Cost-effectiveness of a primary care based physical activity intervention in 45-74 year old men and women: a randomised controlled trial. *British Journal of Sports Medicine* 1998;**32**(3):236–41. 3561.

Stewart 2001 {published data only}

Stewart AL, Verboncoeur CJ, McLellan BY, Gillis DE, Rush S, Mills KM, et al. Physical activity outcomes of CHAMPS II: a physical activity promotion program for older adults. *The journals of gerontology. Series A, Biological sciences and medical sciences* 2001;**56**(8):M465–M70. 114.

References to studies excluded from this review

Andersen 1999

Andersen RE, Wadden TA, Bartlett SJ, Zemel B, Verde TJ, Franckowiak SC. Effects of lifestyle activity vs structured aerobic exercise in obese women. *JAMA* 1999;**281**(4):335–40. 26884.

Ballantyne 1978

Ballantyne D, Clark A, Dyker GS, Gillis CR, Hawthorne VM, Henry DA, et al. Prescribing exercise for the healthy assessment of compliance and effects on plasma lipids and lipoproteins. *Health Bulletin, UK* 1978;**36**(4):169–75. 27336.

Baranowski 1990

Baranowski T, Simons-Morton B, Hooks P, Henske J, Tiernan K, Dunn JK, et al. A center-based program for exercise change among black-American families. *Health Education Quarterly* 1990;**17**(2):179–96. 1463.

Bell 2001

Bell AC, Swinburn BA, Aмоса H, Scragg RK. A nutrition and exercise intervention program for controlling weight in Samoan communities in New Zealand. *International Journal of Obesity* 2001;**25**(6):920–7. 26633.

Blair 1986

Blair SN, Piserchia PV, Wilbur CS, Crowder JH. A public health intervention model for work-site health promotion. Impact on exercise and physical fitness in a health promotion plan after 24 months. *JAMA* 1986;**255**(7):921–6. 582.

Blumenthal 2000

Blumenthal JA, Sherwood A, Gullette ECD, Babyak M, Waugh R, Georgiades A, et al. Exercise and weight loss reduce blood pressure in men and women with mild hypertension. *Archives of Internal Medicine* 2000;**160**(13):1947–58. 26732.

Bull 1998

Bull FC, Jamrozik K. Advice on exercise from a family physician can help sedentary patients to become active. *American Journal of Preventive Medicine* 1998;**15**:85–94.

Campbell 1985

Campbell MJ, Browne D, Waters WE. Can general practitioners influence exercise habits? Controlled trial. *BMJ (Clinical Research Edition)* 1985;**290**(6474):1044–6. 671.

Cardinal 1996

Cardinal BJ, Sachs ML. Effects of mail-mediated, stage-matched exercise behavior change strategies on female adults' leisure-time exercise behavior. *The Journal of Sports Medicine and Physical Fitness* 1996;**36**(2):100–7. 2486.

Coleman 1999

Coleman KJ, Raynor HR, Mueller DM, Cerny FJ, Dorn JM, Epstein LH. Providing sedentary adults with choices for meeting their walking goals. *Preventive Medicine* 1999;**28**(5):510–9. 28203.

Donnelly 2000

Donnelly JE, Jacobsen DJ, Heelan KS, Seip R, Smith S. The effects of 18 months of intermittent vs continuous exercise on aerobic capacity, body weight and composition, and metabolic fitness in previously sedentary, moderately obese females. *International Journal of Obesity* 2000;**24**(5):566–72. 26747.

Dunn 1997

Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, Blair SN. Reduction in cardiovascular disease risk factors: 6-month results from Project Active. *Preventive Medicine* 1997;**26**(6):883–92. 2215.

Dunn 1998

Dunn AL, Garcia ME, Marcus BH, Kampert JB, Kohl-HW III, Blair SN. Six-month physical activity and fitness changes in Project Active, a randomized trial. *Medicine and Science in Sports and Exercise* 1998;**30**:1076–83. 6616.

Eakin 2000

Eakin EG, Glasgow RE, Riley KM. Review of primary care-based physical activity intervention studies: effectiveness and implications for practice and future research. *Journal of Family Practice* 2000;**49**(2):158–68. 2890.

Eaton 1998

Eaton CB, Menard LM. A systematic review of physical activity promotion in primary care office settings. *British Journal of Sports Medicine* 1998;**32**(1):11–6. 3428.

Ebrahim 1997

Ebrahim S, Thompson PW, Baskaran V, Evans K. Randomized placebo-controlled trial of brisk walking in the prevention of postmenopausal osteoporosis. *Age and Ageing* 1997;**26**(4):253–60. 28208.

Ebrahim 1998

Ebrahim S, Smith GD. Lowering blood pressure: a systematic review of sustained effects of non-pharmacological interventions. *Journal of Public Health Medicine* 1998;**20**(4):441–8. 26889.

Emmons 1999

Emmons KM, Linnan LA, Shadel WG, Marcus B, Abrams DB. The Working Healthy Project: a worksite health-promotion trial targeting physical activity, diet, and smoking. *Journal of Occupational and Environmental Medicine* 1999;**41**(7):545–55. 3177.

Fiatarone 1994

Fiatarone MA, O'Neill EF, Ryan ND, Clements KM, Solares GR, Nelson ME, et al. Exercise training and nutritional supplementation for physical frailty in very elderly people. *New England Journal of Medicine* 1994;**330**(25):1769–75. 28201.

Fody-Urias 2001

Fody-Urias BM, Fillit H, Hill J. The effect of a fitness program on health status and health care consumption in Medicare MCOs. *Managed Care Interface* 2001;**14**(9):58–64. 38.

Godin 1987

Godin G, Desharnais R, Jobin J, Cook J. The impact of physical fitness and health-age appraisal upon exercise intentions and behavior. *Journal of Behavioral Medicine* 1987;**10**(3):241–50. 28221.

Goldwater 1985

Goldwater BC, Collis ML. Psychologic effects of cardiovascular conditioning: a controlled experiment. *Psychosomatic Medicine* 1985;**47**(2):174–81. 28200.

Gossard 1986

Gossard D, Haskell WL, Taylor CB, Mueller JK, Rogers F, Chandler M, et al. Effects of low- and high-intensity home-based exercise training on functional capacity in healthy middle-aged men. *American Journal of Cardiology* 1986;**57**(6):446–9. 28217.

Graham-Clarke 1994

Graham-Clarke P, Oldenburg B. The effectiveness of a general-practice-based physical activity intervention on patient physical activity status. *Behaviour Change* 1994;**11**(3):132–44. 28227.

Halbert 1999

Halbert JA, Silagy CA, Finucane P, Withers RT, Hamdorf PA. Recruitment of older adults for a randomized, controlled trial of exercise advice in a general practice setting. *Journal of the American Geriatrics Society* 1999;**47**(4):477–81. 3066.

Halbert 2001

Halbert J, Crotty M, Weller D, Ahern M, Silagy C. Primary care-based physical activity programs: Effectiveness in sedentary older patients with osteoarthritis symptoms. *Arthritis & Rheumatism-Arthritis Care & Research* 2001;**45**(3):228–34. 28087.

Hamdorf 1999

Hamdorf PA, Penhall RK. Walking with its training effects on the fitness and activity patterns of 79-91 year old females. *Australian and New Zealand journal of medicine* 1999;**29**:22–8.

Harrell 1996

Harrell JS, Johnston LF, Griggs TR, Schaefer P, Carr-EG J, McMurray RG, et al. An occupation based physical activity intervention program: improving fitness and decreasing obesity. *Official Journal of the American Association of Occupational Health Nurses* 1996;**44**:377–84. 4736.

Heinonen 1999

Heinonen A, Kannus P, Sievanen H, Pasanen M, Oja P, Vuori I. Good maintenance of high-impact activity-induced bone gain by voluntary, unsupervised exercises: An 8-month follow-up of a randomized controlled trial. *Journal of Bone and Mineral research* 1999;**14**(1):125–8. 3047.

Hellenius 1995

Hellenius ML, Brismar KE, Berglund BH, de Faire UH. Effects on glucose tolerance, insulin secretion, insulin-like growth factor 1 and its binding protein, IGFBP-1, in a randomized controlled diet and exercise study in healthy, middle-aged men. *Journal of Internal Medicine* 1995;**238**(2):121–30. 2681.

Hellenius 1997

Hellenius ML, Krakau I, Faire Ud. Favourable long-term effects from advice on diet and exercise given to healthy men with raised cardiovascular risk factors. *Nutrition Metabolism & Cardiovascular Diseases* 1997;**7**(4):293–300. 26966.

Jakicic 1995

Jakicic JM, Wing RR, Butler BA, Robertson RJ. Prescribing exercise in multiple short bouts versus one continuous bout: effects on adherence, cardiorespiratory fitness, and weight loss in overweight women. *International Journal of Obesity and Related Metabolic Disorders* 1995;**19**(12):893–901. 28211.

Jakicic 1999

Jakicic JM, Winters C, Lang W, Wing RR. Effects of intermittent exercise and use of home exercise equipment on adherence, weight loss, and fitness in overweight women: a randomized trial. *JAMA* 1999;**282**(16):1554–60. 26796.

Jette 1996

Jette AM, Harris BA, Sleeper L, Lachman ME, Heislein D, Giorgetti M, et al. A home-based exercise program for nondisabled older adults. *Journal of the American Geriatrics Society* 1996;**44**(6):644–9. 28186.

Kahn 2002

Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, et al. The effectiveness of interventions to increase physical activity. A systematic review. *American Journal of Preventive Medicine* 2002;**22**(suppl 4):73–107. 28228.

Kerr 2000

Kerr J, McKenna J. *A randomized control trial of new tailored walking campaigns in an employee sample*. US: Taylor and Francis, 2000. [MedLine: 7929].

King 1984

King AC, Frederiksen LW. Low-cost strategies for increasing exercise behaviour. *Behavior Modification* 1984;**8**(1):3–21. 28224.

King 1995

King AC, Haskell WL, Young DR, Oka RK, Stefanick ML. Long-term effects of varying intensities and formats of physical activity on participation rates, fitness, and lipoproteins in men and women aged 50 to 65 years. *Circulation* 1995;**91**:2596–604.

King 1997

King AC, Oman RF, Brassington GS, Bliwise DL, Haskell WL. Moderate-intensity exercise and self-rated quality of sleep in older adults. A randomized controlled trial. *JAMA* 1997;**277**(1):32–7. 28199.

King 2000

King AC, Pruitt LA, Phillips W, Oka R, Rodenburg A, Haskell WL. Comparative effects of two physical activity programs on measured and perceived physical functioning and other health-related quality of life outcomes in older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* 2000;**55**:M74–83.

Kinion 1993

Kinion ES, Christie N, Vilella AM. Promoting activity in the elderly through interdisciplinary linkages. *Nursing Connections* 1993;**6**(3):19–26. 1897.

Kukkonen-H 1998

Kukkonen-Harjula K, Laukkanen R, Vuori I, Oja P, Pasanen M, Nenonen A, et al. Effects of walking training on health-related fitness in healthy middle-aged adults: a randomized controlled study. *Scandinavian Journal of Medicine & Science in Sports* 1998;**8**(4):236–42. 3563.

Lawlor 2001a

Lawlor DA, Hopker SW. The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials. *BMJ* 2001;**322**(7289):763–7. 341.

Leon 1996

Leon AS, Casal D, Jacobs D, Jr. Effects of 2,000 kcal per week of walking and stair climbing on physical fitness and risk factors for coronary heart disease. *Journal of Cardiopulmonary Rehabilitation* 1996;**16**(3):183–92. 28219.

Lewis 1993

Lewis CE, Raczynski JM, Heath GW, Levinson R, Hilyer JC, Cutter GR. Promoting physical activity in low-income African-American communities: the PARR project. *Ethnicity & Disease* 1993;**3**(2):106–18. 1852.

Lewis 1993a

Lewis BS, Lynch WD. The effect of physician advice on exercise behavior. *Preventive Medicine* 1993;**22**(1):110–21. 1950.

Li 2001

Li F, Harmer P, McAuley E, Duncan TE, Duncan SC, Chaumeton N, et al. An evaluation of the effects of Tai Chi exercise on physical function among older persons: a randomized controlled trial. *Annals of Behavioral Medicine* 2001;**23**(2):139–46. 31.

Lord 1995

Lord JC, Green F. Exercise on prescription: does it work?. *Health Education Journal* 1995;**54**:453–64. 4685.

MacKeen 1985

MacKeen PC, Rosenberger G, Slater JS, Nicholas WC, Buskirk ER. A 13-year follow-up of a coronary heart disease risk factor screening and exercise program for 40- to 59-year-old men: exercise habit maintenance and physiologic status. *Journal of Cardiopulmonary Rehabilitation* 1985;**5**:510–23.

Manson 1999

Manson JE, Hu FB, Rich-Edwards JW, Colditz GA, Stampfer MJ, Willett WC, et al. A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. *New England Journal of Medicine* 1999;**341**(9):650–8. 28223.

Marcus 1992

Marcus BH, Banspach SW, Lefebvre RC, Rossi JS, Carleton RA, Abrams DB. Using the stages of change model to increase the adoption of physical activity among community participants. *American Journal of Health Promotion* 1992;**6**(6):424–9. 1286.

Marcus 1993

Marcus BH, Stanton AL. Evaluation of relapse prevention and reinforcement interventions to promote exercise adherence in sedentary females. *Research Quarterly for Exercise and Sport* 1993;**64**(4):447–52. 28218.

Marcus 1995

Marcus BH, Albrecht AE, Niaura RS, Taylor ER, Simkin LR, Feder SI, et al. Exercise enhances the maintenance of smoking cessation in women. *Addictive Behaviors* 1995;**20**(1):87–92. 28198.

Marcus 1998 (a)

Marcus BH, Emmons KM, Simkin-Silverman LR, Linnan LA, Taylor ER, Bock BC, et al. Evaluation of motivationally tailored vs. standard self-help physical activity interventions at the workplace. *American Journal of Health Promotion* 1998;**12**(4):246–53. 3694.

Marcus 1998 (b)

Marcus BH, Bock BC, Pinto BM, Forsyth LH, Roberts MB, Traficante RM. Efficacy of an individualized, motivationally-tailored physical activity intervention. *Annals of Behavioral Medicine* 1998;**20**:174–80.

McAuley 1994

McAuley E, Courneya KS, Rudolph DL, Lox CL. *Enhancing exercise adherence in middle-aged males and females*. United Kingdom: Academic Press Inc, 1994. [MedLine: 7484].

McMurdo 1992

McMurdo ME, Burnett L. Randomised controlled trial of exercise in the elderly. *Gerontology* 1992;**38**(5):292–8. 1237.

McMurdo 1995

McMurdo ME, Johnstone R. A randomized controlled trial of a home exercise programme for elderly people with poor mobility. *Age and Ageing* 1995;**24**(5):425–8. 2774.

Messier 2000

Messier SP, Royer TD, Craven TE, O'Toole ML, Burns R, Ettinger WH. Long-term exercise and its effect on balance in older, osteoarthritic adults: results from the Fitness, Arthritis, and Seniors Trial (FAST). *Journal of the American Geriatrics Society* 2000;**48**(2): 131–8. 2870.

Mills 1996

Mills KM, Stewart AL, King AC, Roitz K, Sepsis PG, Ritter PL, et al. Factors associated with enrollment of older adults into a physical activity promotion program. *Journal of Aging and Health* 1996;**8**(1): 96–113. 2591.

Mulder 1981

Mulder JA, Griffin R. Prescription of home exercise therapy for cardiovascular fitness. *Journal of Family Practice* 1981;**13**(3):345–8. 28196.

Naylor 1999

Naylor PJ, Simmonds G, Riddoch C, Velleman G, Turton P. Comparison of stage-matched and unmatched interventions to promote exercise behaviour in the primary care setting. *Health Education Research* 1999;**14**(5):653–66. 3368.

Nisbeth 2000

Nisbeth O, Klausen K, Andersen LB. Effectiveness of counselling over 1 year on changes in lifestyle and coronary heart disease risk factors. *Patient Education and Counseling* 2000;**40**(2):121–31. 264.

Noland 1989

Noland MP. The effects of self-monitoring and reinforcement on exercise adherence. *Research Quarterly for Exercise and Sport* 1989;**60**(3):216–24. 28220.

Oman 2000

Oman RE, King AC. The effect of life events and exercise program format on the adoption and maintenance of exercise behavior. *Health Psychology* 2000;**19**(6):605–12. 277.

Ostwald 1989

Ostwald SK. Changing employees' dietary and exercise practices: an experimental study in a small company. *Journal of Occupational Medicine* 1989;**31**(2):90–7. 27197.

Parks 1997

Parks PSM, Read MH. *Adolescent male athletes: Body image, diet, and exercise*. Switzerland: Editions Medicine et Hygiene, 1997. [MedLine: 7692.

Partonen 1998

Partonen T, Leppamaki S, Hurme J, Lonnqvist J. Randomized trial of physical exercise alone or combined with bright light on mood and health-related quality of life. *Psychological Medicine* 1998;**28**(6): 1359–64. 26897.

Pereira 1998

Pereira MA, Kriska AM, Day RD, Cauley JA, LaPorte RE, Kuller LH. A randomized walking trial in postmenopausal women: effects on physical activity and health 10 years later. A randomized walking trial in postmenopausal women: effects on physical activity and health 10 years later. A randomized walking trial in postmenopausal women: effects on physical activity and health 10 years later. *Archives of Internal Medicine* 1998;**158**:1695–701.

Peterson 1999

Peterson TR, Aldana SG. *Improving exercise behavior: An application of the stages of change model in a worksite setting*. US: American Journal of Health Promotion Inc, 1999. [MedLine: 7968.

Petrella 2000

Petrella RJ, Wight D. An office-based instrument for exercise counseling and prescription in primary care. The Step Test Exercise Prescription (STEP). *Archives of Family Medicine* 2000;**9**(4):339–44. 2911.

Petrella 2001

Petrella RJ, Koval JJ, Cunningham DA, Paterson DH. A self-paced step test to predict aerobic fitness in older adults in the primary care clinic. *Journal of the American Geriatrics Society* 2001;**49**(5):632–8. 186.

Pinto 2001

Pinto BM, Lynn H, Marcus BH, DePue J, Goldstein MG. Physician-based activity counseling: intervention effects on mediators of motivational readiness for physical activity. *Annals of Behavioral Medicine* 2001;**23**(1):2–10. 195.

Robison 1992

Robison JI, Rogers MA, Carlson JJ, Mavis BE. *Effects of a 6-month incentive-based exercise program on adherence and work capacity*. US: Lippincott Williams and Wilkins, 1992. [MedLine: 7589.

Ruby 1993

Ruby KL, Blainey CA, Haas LB, Patrick M. The knowledge and practices of registered nurse, certified diabetes educators: teaching elderly clients about exercise. *The Diabetes Educator* 1993;**19**(4):299–306. 1982.

Samaras 1997

Samaras K, Ashwell S, Mackintosh AM, Fleury AC, Campbell LV, Chisholm DJ. Will older sedentary people with non-insulin-dependent diabetes mellitus start exercising? A health promotion model. *Diabetes Research and Clinical Practice* 1997;**37**(2):121–8. 2242.

Schoenfelder 2000

Schoenfelder DP. A fall prevention program for elderly individuals. Exercise in long-term care settings. *Journal of Gerontological Nursing* 2000;**26**(3):43–51. 348.

Sevick 2000

Sevick MA, Dunn AL, Morrow MS, Marcus BH, Chen GJ, Blair SN. *Cost-effectiveness of lifestyle and structured exercise interventions in sedentary adults: Results of Project ACTIVE*. US: Elsevier Science Inc, 2000. [MedLine: 7942.

Singh 1997

Singh S. Why are GP exercise schemes so successful (for those who attend)? Results from a pilot study. *Journal of Management in Medicine* 1997;**11**(4):233–7. 2339.

Singh 1997a

Singh NA, Clements KM, Fiatarone MA. *A randomized controlled trial of progressive resistance training in depressed elders*. US: Gerontological Society of America, 1997. [MedLine: 7698.

Smolander 2000

Smolander J, Blair SN, Kohl HW. Work ability, physical activity, and cardiorespiratory fitness: 2-year results from Project Active. *Journal of Occupational and Environmental Medicine* 2000;**42**(9):906–10. 403.

Sorensen 1999

Sorensen M, Anderssen S, Hjermand I, Holme I, Ursin H. The effect of exercise and diet on mental health and quality of life in middle-aged individuals with elevated risk factors for cardiovascular disease. *Journal of Sports Sciences* 1999;**17**(5):369–77. 26829.

Stephens 1999

Stephens 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 heart disease: randomized trial. *BMJ* 1999;**319**(7215):943–7. 26805.

Stephens 2000

Stephens A, Rink E, Kerry S. Psychosocial predictors of changes in physical activity in overweight sedentary adults following counseling in primary care. *Preventive Medicine* 2000;**31**(2 Pt 1):183–194. 3001.

Stevens 1999

Stevens M, Bult P, de Greef MH, Lemmink KA, Rispens P. Groningen Active Living Model (GALM): stimulating physical activity in sedentary older adults. *Preventive Medicine* 1999;**29**(4):267–76. 3243.

Taylor 1998

Taylor AH, Doust J, Webborn N. Randomised controlled trial to examine the effects of a GP exercise referral programme in Hailsham, East Sussex, on modifiable coronary heart disease risk factors. *Journal of Epidemiology and Community Health* 1998;**52**:595–601.

Tsuji 2000

Tsuji I, Tamagawa A, Nagatomi R, Irie N, Ohkubo T, Saito M, et al. Randomized controlled trial of exercise training for older people (Sendai Silver Center Trial; SSCT): study design and primary outcome. *Journal of Epidemiology* 2000;**10**(1):55–64. 2867.

Votruba 1968

Votruba SB, Horvitz MA, Schoeller DA. The role of exercise in the treatment of obesity. *Nutrition* 1968;**2000**(16):3–188. 26749.

Vuori 1994

Vuori IM, Oja P, Paronen O. Physically active commuting to work—testing its potential for exercise promotion. *Medicine and Science in Sports and Exercise* 1994;**26**(7):844–50. 1719.

Wankel 1985

Wankel LM, Yardley JK, Graham J. The effects of motivational interventions upon the exercise adherence of high and low self-motivated adults. *Canadian Journal of Applied Sport Sciences* 1985;**10**(3):147–56. 695.

Wood 1983

Wood PD, Haskell WL, Blair SN, Williams PT, Krauss RM, Lindgren FT, et al. Increased exercise level and plasma lipoprotein concentrations: a one-year, randomized, controlled study in sedentary, middle-aged men. *Metabolism* 1983;**32**(1):31–9. 28189.

Young 1999

Young DR, Appel LJ, Jee S, Miller ER, III. The effects of aerobic exercise and Tai Chi on blood pressure in older people: results of a randomized trial. *Journal of the American Geriatrics Society* 1999;**47**(3):277–84. 28222.

References to studies awaiting assessment**Elley 2003**

Elley CR, Kerse N, Arroll B, Robinson E. Effectiveness of counselling patients on physical activity in general practice: cluster randomised controlled trial. *BMJ* 2003;**326**:793.

Green 2002

Green BB, McAfee T, Hindmarsh M, Madsen L, Caplow M, Buist D. Effectiveness of telephone support in increasing physical activity levels in primary care patients. *American Journal of Preventive Medicine* 2002;**22**:177–83.

Hillsdon 2002

Hillsdon M, Thorogood M, White I, Foster C. Advising people to take more exercise is ineffective: a randomized controlled trial of physical activity promotion in primary care. *International Journal of Epidemiology* 2002;**31**:808–15.

Lamb 2002

Lamb SE, Bartlett HR, Ashley A, Bird W. Can lay-led walking programmes increase physical activity in middle aged adults? A randomised controlled trial. *Journal of Epidemiology and Community Health* 2002;**56**:246–52.

Lowther 2002

Lowther M, Mutrie N, Scott EM. Promoting physical activity in a socially and economically deprived community: a 12 month randomized control trial of fitness assessment and exercise consultation. *Journal of Sports Science* 2002;**7**:577–88.

Mutrie 2002

Mutrie N, Carney C, Blamey A, Crawford F, Aitchison T, Whitelaw A. “Walk in to Work Out”: a randomised controlled trial of a self help intervention to promote active commuting. *Journal of Epidemiology and Community Health* 2002;**56**:407–12.

Woods 2002

Woods C, Mutrie N, Scott M. Physical activity intervention: a transtheoretical model-based intervention designed to help sedentary young adults become active. *Health Education Research* 2002;**17**:451–60.

Additional references**Bandura 1986**

Bandura A. *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice Hall, 1986.

DCMS/SU 2002

Department of Culture Media, Sport, Strategy Unit. *Game Plan: a strategy for delivering Government's sport and physical activity agenda*. London: Strategy Unit, 2002.

Dickersin 1995

Dickersin K, Scherer, Lefebvre C. Identifying relevant studies from systematic reviews. In: London, editor(s). In: *Chalmers I, Altman DG. Systematic Reviews*. BMJ Publishing Group, 1995:64–74.

DOH 1996

Department of Health. *Strategy Statement on Physical Activity*. London: Department of Health, 1996.

DOH 2004

Department of Health. *At least five a week: evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer*. London: Department of Health, 2004.

FNB 2002

. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients). Food and Nutrition Board (FNB), Institute of Medicine (IOM) 2002: 697–736.

Folsom 1997

Folsom AR, Arnett DK, Hutchinson RG, Liao F, Clegg LX, Cooper LS. Physical activity and incidence of coronary heart disease in middle-aged women and men. *Medicine and Science in Sports and Exercise* 1997;**29**:901–9.

Haapanen 1997

Haapanen N, Miilunpalo S, Vuori I, Oja P, Pasanen M. Association of leisure time physical activity with the risk of coronary heart disease, hypertension and diabetes in middle-aged men and women. *International Journal of Epidemiology* 1997;**26**:739–47.

Hillsdon 1996

Hillsdon M, Thorogood M. A systematic review of physical activity promotion strategies. *British Journal of Sports Medicine* 1996;**30**:84–9.

Hillsdon 2004

Hillsdon M, Foster C, Naidoo B, Crombie H. *The effectiveness of public health interventions for increasing physical activity among adults: a review of reviews*. London: Health Development Agency, 2004.

Jolliffe 2004

Jolliffe JA, Rees K, Taylor RS, Thompson D, Oldridge N, Ebrahim S. Exercise-based rehabilitation for coronary heart disease (Cochrane Review). In: *The Cochrane Library*, 1, 2004. Chichester, UK: John Wiley & Sons, Ltd.

Lefebvre 1996

Lefebvre C, McDonald S. Development of a sensitive search strategy for reports of randomised controlled trials in EMBASE. Paper

presented at the Fourth International Cochrane Colloquium, 20–24 Oct ; Adelaide, Australia. 1996.

ONS 2004

. Living in Britain. Results from the 2002 General Household Survey. The Stationery Office 2004.

Pate 1995

Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, et al. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association* 1995;**273**:402–7.

Petersen 2004

Petersen S, Peto V, Rayner M. *Coronary Heart Disease Statistics*. British Heart Foundation, 2004.

US Dept. Health 1996

US Department of Health, Human Services. *Physical activity and health: a report of the surgeon general*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

WHO 2002

World Health Organisation. *World Health Report 2002*. Geneva: World Health Organisation, 2002.

Williams 2001

Williams PT. Physical fitness and activity as separate heart disease risk factors: a meta-analysis. *Medicine and Science in Sports and Exercise* 2001;**33**:754–62.

*Indicates the major publication for the study

T A B L E S**Characteristics of included studies**

Study	Calfas 2000
Methods	Randomised controlled trial
Participants	University students
Interventions	Intervention group received a 15 week cognitive behavioural education course, 15x50 minutes lectures followed by 15x110 minutes lab experience, led by peer health facilitators, plus homework including practice of behavioural management strategies. Participants received 2 course credits and could attend supervised x2 per week exercise sessions. All participants received 15 monthly follow up phone calls and monthly written materials.
Outcomes	Self reported physical activity
Notes	No significant differences in physical activity between groups Participants volunteered to participate in a health course and attend a baseline assessment Participants in both study arms had very high baseline levels of physical activity - mean 2+ hours of vigorous physical activity per week. Students also received academic credits for attending intervention sessions.

Characteristics of included studies (Continued)

Allocation concealment B

Study	Cunningham 1987
Methods	Randomised controlled trial
Participants	Retirees from community centre
Interventions	Participants received 3 group exercise sessions per week and were encouraged to do one additional home based session.
Outcomes	Self reported physical activity Cardio-respiratory fitness
Notes	Intervention group improved their fitness and vigorous physical activity levels versus control group. All exercise sessions were conducted on an indoor or outdoor running track

Allocation concealment B

Study	Goldstein 1999
Methods	Randomised controlled trial
Participants	Primary care patients
Interventions	Participants received 5 minutes of stage of change matched counselling, plus a written prescription, materials plus the chance of a follow up appointment. Participants also received 5 monthly mailed written materials.
Outcomes	Self reported physical activity
Notes	No difference in stage of change or in physical activity in elderly score Active adults were excluded from the study

Allocation concealment B

Study	Halbert 2000
Methods	Randomised controlled trial
Participants	Primary care patients
Interventions	Participants received a baseline assessment and a 20 minutes session with an exercise specialist. They received individualised advice to exercise and a written plan for PA over 3 months focusing on increasing usual activities and increasing self-efficacy, plus written materials, and a follow up interview at 6 months.
Outcomes	Self reported physical activity
Notes	Frequency of walking increased as did frequency and duration of vigorous activity Effect seen in control group who received 20 minutes of nutrition advice walking was stressed during intervention but there was no difference in self reported walking occasions between groups

Allocation concealment B

Study	Harland 1999
Methods	Randomised controlled trial
Participants	Primary care patients
Interventions	All participants completed a baseline assessment of self reported physical activity, physical measures and cycle ergometer fitness test. They received feedback of their results, brief advice about their present level of physical activity and comparison to recommended levels, plus written health information, 19 leaflets about local physical activity facilities and activities. In addition there were four intervention group, (i) one motivational interview, (ii) one motivational interview plus vouchers for free use of local facilities, (iii) 6 motivational interviews over 12 weeks and (iv) 6 motivational interviews over 12 weeks plus vouchers.

Characteristics of included studies (Continued)

Outcomes	Self reported physical activity
Notes	All intervention groups more active than control at 12 weeks, no differences at 12 months. Two approaches to recruitment used opportunistic and all potential participants who attended the health centre Self reported vigorously active excluded from study Moderate take up of motivational interviews amongst participants offered up to six - median 3
Allocation concealment	B

Study Juneau 1987

Methods	Randomised controlled trial
Participants	Workplace employees
Interventions	Participants received a 30 minute consultation including watching a video, information on using a heart rate monitor and daily physical activity log. Participants were given a portable heart monitor, which warned the user if heart rate not in prescribed range. Participants were instructed to exercise at 65-77% peak baseline treadmill heart rate.
Outcomes	Cardio-respiratory fitness
Notes	Increase in VO ₂ in intervention group improved over control group (approx 14% in males, 10% in female) Participants attended a screening session and a VO ₂ max test prior to randomisation
Allocation concealment	B

Study King 1988a

Methods	Randomised controlled trial
Participants	Workplace employees
Interventions	Maintenance study participants received 30 minutes of baseline instruction (15 mins advice + 15 mins video), daily self monitoring of physical activity using exercise logs returned to staff every month.
Outcomes	Self reported physical activity
Notes	Significant difference in number of exercise sessions/month between groups Participants had previously taken part in an exercise RCT
Allocation concealment	B

Study King 1988b

Methods	Randomised controlled trial
Participants	Workplace employees
Interventions	Adoption study participants received 30 minutes of baseline instruction (15 mins advice + 15 mins video) plus 10 staff initiated phone calls and self-monitoring materials including pulse monitor.
Outcomes	Self reported physical activity
Notes	No significant difference in number of exercise sessions/month between groups but both groups increased physical activity over baseline. Participants had previously taken part in an exercise RCT
Allocation concealment	B

Study King 1991

Methods	Randomised controlled trial
Participants	Community older volunteers

Characteristics of included studies (Continued)

Interventions	Participants received baseline physiological assessments and then were prescribed either home or group based training at high or low intensity plus written information, physical activity logs and phone calls.
Outcomes	Cardio-respiratory fitness
Notes	Increase in VO2 max (approx 5%) and treadmill duration (approx 14%). Adherence greater in home based arms Participants agreed to attend an extensive medical and physical assessment if they wished to participate in study
Allocation concealment	B

Study Kriska 1986

Methods	Randomised controlled trial
Participants	Older women
Interventions	Participants received a baseline physical assessment, 8 week walking training programme with organised walks, then choice of group or independent walking. Participants monitored their walking with monthly logs and also were offered social meetings. Participants also received follow up phone calls, cards, and incentives to maintain compliance.
Outcomes	Self reported physical activity
Notes	Significant different between intervention and control groups on walking blocks per day. Frequency of follow up measures, meetings, mall walks and incentives not stated.
Allocation concealment	B

Study Lombard 1995

Methods	Randomised controlled trial
Participants	University staff & students
Interventions	Participants were encouraged to walk in groups or with a friend and also received different frequencies and intensities of follow up telephone calls plus written materials including walking maps
Outcomes	Self reported physical activity
Notes	Survival analysis showed that participants who received a high frequency of phone calls rather than a highly structured call were more successful in sustaining walking over control and other groups. Only 3 men in study (2.2%)
Allocation concealment	B

Study Norris 2000

Methods	Randomised controlled trial
Participants	Health maintenance organisation members
Interventions	Stage matched strategies and written materials given to patient prior to counselling with physician. Physician delivered behavioural counselling appropriate to stages of change model, with goal setting, identifying barriers, problem solving and contracting techniques, plus a written prescription for exercise. Patients also received single follow up phone call.
Outcomes	Self reported physical activity
Notes	No significant differences between groups at 6 months High baseline physical activity levels - 1500+ kcals/week
Allocation concealment	B

Study Reid 1979

Methods	Randomised controlled trial
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Characteristics of included studies (Continued)

Participants	Male fire fighters
Interventions	Pre randomisation fitness assessment, feedback by physician of fitness results compared population levels, prescription for exercise appropriate for age. Group one received additional one hour of health education, film, written & verbal advice. Group two received self-monitoring materials and a weekly record, which were returned to research staff bi-weekly. All participants reported monthly on exercise programme.
Outcomes	Compliance index score
Notes	Short term significant improvement in compliance index (VO ₂ +exercise freq.) not maintained at 6 months. Participants agreed to attend a screening session prior to randomisation Active fire fighters were excluded from study
Allocation concealment	B

Study Simons-Morton 2001a

Methods	Randomised controlled trial
Participants	Primary care patients
Interventions	Participants were randomised to one of three groups, advice, assistance or counselling. The assistance group received the same advice as the advice for a physician but the health educator conducted a 30-40 minute counselling session, including a videotape and action planning. Participants then received follow up phone calls, interactive mail, an electronic step counter, and monthly monitoring cards, which were returned to the health educator. Follow up mail was returned plus incentive to all participants. The counselling group received all of components of the advice and assistance group with in addition telephone-counselling calls. Weekly behavioural classes were also offered to this group.
Outcomes	Self reported physical activity Cardio-respiratory fitness
Notes	No differences in physical activity. No differences for either fitness or physical activity in any male group. Participants undertook three sessions of pre-screening before randomisation.
Allocation concealment	B

Study Simons-Morton 2001b

Methods	Randomised controlled trial
Participants	Primary care patients
Interventions	Participants were randomised to one of three groups, advice, assistance or counselling. The assistance group received the same advice as the advice for a physician but the health educator conducted a 30-40 minute counselling session, including a videotape and action planning. Participants then received follow up phone calls, interactive mail, an electronic step counter, and monthly monitoring cards, which were returned to the health educator. Follow up mail was returned plus incentive to all participants. The counselling group received all of components of the advice and assistance group with in addition telephone-counselling calls. Weekly behavioural classes were also offered to this group.
Outcomes	Self reported physical activity Cardio-respiratory fitness
Notes	Women's VO ₂ increased in assistance group and counselling group compared to the advice group. No differences in physical activity. Participants undertook three sessions of pre-screening before randomisation.
Allocation concealment	B

Study Smith 2000

Methods	Randomised controlled trial
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Interventions for promoting physical activity (Review)

Characteristics of included studies (Continued)

Participants	Primary care patients
Interventions	Participants received GP advice, or GP advice plus stage matched booklets via post
Outcomes	Self reported physical activity
Notes	Short-term (6-10 weeks) increase in physical activity for advice plus booklet group versus controls only for participants inactive at baseline . Potential participants with poor English were excluded. Active subjects included in study but final results adjusted for baseline physical activity status
Allocation concealment	D

Study **Stevens 1998**

Methods	Randomised controlled trial
Participants	Primary care patients
Interventions	Participants were invited by their GP to attend a consultation with an exercise development officer. At this meeting they discussed their present physical activity and were encouraged to increase on their current physical activity choices rather than start any new. A follow up appointment was made ten weeks later.
Outcomes	Self reported physical activity
Notes	Significant increase in occasions of exercise in past 4 weeks in intervention v control groups Active participants at baseline were not randomised MH & MT were study authors
Allocation concealment	B

Study **Stewart 2001**

Methods	Randomised controlled trial
Participants	Community dwelling older adults
Interventions	Social Cognitive Theory (SCT) based face to face counseling, behavioural, cognitive techniques to use local exercise opportunities or develop own programs. Participants also attended informational meetings, individual planning sessions, monthly group workshops, received physical activity diaries, telephone calls, newsletters, and functional fitness assessments. Participants were strongly encouraged to attend first two of ten workshops where a walking clinic was offered.
Outcomes	Self reported physical activity
Notes	Greater increase in moderate physical activity in intervention group versus control at 12 months High baseline levels of physical activity - 1052 kcals/week moderate LTPA, 1935 kcals/week for all physical activities
Allocation concealment	B

Characteristics of excluded studies

Andersen 1999	Study aim irrelevant
Ballantyne 1978	Study aim irrelevant
Baranowski 1990	Less than 6 months follow up
Bell 2001	Study aim irrelevant
Blair 1986	Non-randomised study
Blumenthal 2000	Study aim irrelevant
Bull 1998	Loss to follow up > 20%

Characteristics of excluded studies (Continued)

Campbell 1985	Non-randomised study
Cardinal 1996	Less than 6 months follow up
Coleman 1999	No appropriate control group
Donnelly 2000	Study aim irrelevant
Dunn 1997	No appropriate control group
Dunn 1998	No appropriate control group
Eakin 2000	Review paper
Eaton 1998	Review paper
Ebrahim 1997	Study aim irrelevant
Ebrahim 1998	Review paper
Emmons 1999	Multiple risk factor intervention
Fiatarone 1994	Study aim irrelevant
Fody-Urias 2001	Study aim irrelevant
Godin 1987	Less than 6 months follow up
Goldwater 1985	Less than 6 months follow up
Gossard 1986	Less than 6 months follow up
Graham-Clarke 1994	Multiple risk factor intervention
Halbert 1999	Study aim irrelevant
Halbert 2001	Study aim irrelevant
Hamdorf 1999	Loss to follow up > 20%
Harrell 1996	No appropriate control group
Heinonen 1999	Study aim irrelevant
Hellenius 1995	Study aim irrelevant
Hellenius 1997	Study aim irrelevant
Jakicic 1995	No appropriate control group
Jakicic 1999	No appropriate control group
Jette 1996	Less than 6 months follow up
Kahn 2002	Review paper
Kerr 2000	No appropriate control group
King 1984	Less than 6 months follow up
King 1995	Study aim irrelevant
King 1997	Study aim irrelevant
King 2000	Study aim irrelevant
Kinion 1993	Study aim irrelevant
Kukkonen-H 1998	Study aim irrelevant
Lawlor 2001a	Review paper
Leon 1996	Study aim irrelevant
Lewis 1993	Under 1st included
Lewis 1993a	Less than 6 months follow up
Li 2001	Study aim irrelevant
Lord 1995	Non-randomised study

Characteristics of excluded studies (Continued)

MacKeen 1985	Loss to follow up > 20%
Manson 1999	Study aim irrelevant
Marcus 1992	Non-randomised study
Marcus 1993	Less than 6 months follow up
Marcus 1995	Study aim irrelevant
Marcus 1998 (a)	Less than 6 months follow up
Marcus 1998 (b)	Loss to follow up > 20%
McAuley 1994	Less than 6 months follow up
McMurdo 1992	Study aim irrelevant
McMurdo 1995	Study aim irrelevant
Messier 2000	Study aim irrelevant
Mills 1996	Study aim irrelevant
Mulder 1981	Study aim irrelevant
Naylor 1999	Non-randomised study
Nisbeth 2000	Study aim irrelevant
Noland 1989	Less than 6 months follow up
Oman 2000	Study aim irrelevant
Ostwald 1989	Study aim irrelevant
Parks 1997	Non-randomised study
Partonen 1998	Study aim irrelevant
Pereira 1998	Study aim irrelevant
Peterson 1999	Less than 6 months follow up
Petrella 2000	Study aim irrelevant
Petrella 2001	Study aim irrelevant
Pinto 2001	Study aim irrelevant
Robison 1992	Under 16s included
Ruby 1993	Less than 6 months follow up
Samaras 1997	Subjects with chronic disease
Schoenfelder 2000	Study aim irrelevant
Sevick 2000	No appropriate control group
Singh 1997	Study aim irrelevant
Singh 1997a	Less than 6 months follow up
Smolander 2000	No appropriate control group
Sorensen 1999	Study aim irrelevant
Step toe 1999	Multiple risk factor intervention
Step toe 2000	Study aim irrelevant
Stevens 1999	Non-randomised study
Taylor 1998	Loss to follow up > 20%
Tsuji 2000	Study aim irrelevant
Votruba 1968	Review paper
Vuori 1994	Less than 6 months follow up

Characteristics of excluded studies (Continued)

Wankel 1985	Less than 6 months follow up
Wood 1983	Study aim irrelevant
Young 1999	Study aim irrelevant

ADDITIONAL TABLES

Table 01. Search Strategy for EMBASE

Dates 1980 to 2001

- 1.(((health-education) or (health-education-research)) or ((patient-education) or (patient-education-and-counseling)) or ((health-promotion) or (health-promotion-international)) or (primary-health-care) or ((workplace) or (workplace-)) or (promot*) or ((promot*) or ((educat*) or ((program*) and (((exertion) or (fitness) or (fitness-) or ((fitness) or (fitness-)) or (exercise) or ((exercise) or (sport) or (walk*))))))
- 2.((research) or (((random-controlled) or (random-sample) or (randomisation) or (randomised) or (randomised-controlled) or (randomization) or (randomization-) or (randomizd) or (randomize) or (randomized) or (randomized-block) or (randomized-controlled) or (randomized-controlled-trial) or (randomized-control)) or ((double-blind) or (double-blind-procedure)) or ((single-blind) or (single-blind-procedure))) and (la=english)) and (la=english) and (ec=human)) or (clinical) or (clin*) or (trial*) or (((clin* near trial*) in ti) and (la=english) and (ec=human)) or (clin*) or (trial*) or (((clin* near trial*) in ab) and (la=english) and (ec=human)) or (sing*) or (doubl*) or (trebl*) or (tripl*) or (blind*) or (mask*) or (((sing* or doubl* or trebl* or tripl*) near (blind* or mask*)) and (la=english) and (ec=human)) or ((placebos) or (placebo-controlled)) or ((placebo* in ti) and (ec=human)) or ((placebo* in ab) and (ec=human)) or ((random* in ti) and (ec=human)) or ((random in ab) and (ec=human)) or (research)) ec=human
- 3.(((studies) or (prospective-study) or (follow-up) or (comparative) or (evaluation)) and (ec=human))

Table 02. Search Strategy for CINAHL

Date 1982 to 2001

- 1.exact{controlled}
- 2.exact{randomized}
- 3.exact{random-assignment}
- 4.exact{double-blind}
- 5.exact{single-blind}
- 6.#1 or #2 or #3 or #4 or #5
- 7.exact{animal}
- 8.exact{human}
- 9.#6 not #7
- 10.exact{clinical}
- 11.(clin* near trial*) in ti
- 12.(clin* near trial*) in ab
- 13.(singl* or doubl* or trebl* or tripl*) near (blind* or mask*)
- 14.(#13 in ti) or (#13 in ab)
- 15.placebos
- 16.placebo* in ti
- 17.placebo* in ab
- 18.random* in ti
- 19.random* in ab
- 20.exact{research-methodology}
- 21.#10 or #11 or #12 or #13 or #14 or #15 or #16 or #17

Table 02. Search Strategy for CINAHL (Continued)

Date 1982 to 2001

- 22.#18 or #19 or #20
- 23.#21 or #22
- 24.animal
- 25.human
- 26.#23 not #24
- 27.#26 or #9 or #8 or #25
- 28.exact{comparative}
- 29.study
- 30.#28 and #29
- 31.exact{evaluation}
- 32.studies
- 33.#31 and #32
- 34.exact{follow-up}
- 35.exact{prosecutive}
- 36.#35 and #32
- 37.control* or prosectiv* or volunteer*
- 38.(#37 in ti) or (#37 in ab)
- 39.#38 or #36 or #33 or #30
- 40.#39 not #24
- 41.#39 or #27 or #9
- 42.explode "exertion"/ all subheadings
- 43."physical fitness"
- 44.explode "physical education and training"/ all subheadings
- 45.explode "sports"/ all subheadings
- 46.explode "dancing"/ all subheadings
- 47.explode "exercise therapy"/ all subheadings
- 48.(physical\$ adj5 (fit\$ or train\$ or activ\$ or endur\$)).tw.
- 49.(exercis\$ adj5 (train\$ or physical\$ or activ\$)).tw.
- 50.sport\$.tw.
- 51.walk\$.tw.
- 52.bicycle\$.tw
- 53.(exercise\$ adj aerobic\$).tw.
- 54.(("lifestyle" or life-style) adj5 activ\$).tw.
- 55.(("lifestyle" or life-style) adj5 physical\$).tw.
- 56.#42 or #43 or #44 or #45 or #46 or #47 or #48 or #49 or (exercise\$) or (aerobic\$) or ("lifestyle") or (activ\$) or ("lifestyle") or (life-style) or (physical\$)
- 57.health education
- 58.patient education
- 59.primary prevention
- 60.health promotion
- 61.behaviour therapy
- 62.cognitive therapy
- 63.primary health care
- 64.workplace
- 65.promot\$.tw.
- 66.educat\$.tw.
- 67.program\$.tw.
- 68.#57 or #58 or #59 or #60 or #61 or #62 or #63 or #64 or #65 or #66 or #67
- 69.#68 and #56

Table 02. Search Strategy for CINAHL (Continued)

Date 1982 to 2001

70.#69 and #41

Table 03. Search Strategy for PSYCHLIT

Dates 1887 to 2001

- 1.exertion
- 2.physical-fitness
- 3.exercise
- 4.explode exercise
- 5.sport
- 6.walk*
- 7.cycle
- 8.#1 or #2 or #3 or #4 or #5 or #6 or #7
- 9.health education
- 10.patient education
- 11.primary prevention
- 12.health promotion
- 13.behaviour therapy
- 14.cognitive therapy
- 15.primary health care
- 16.workplace
- 17.promot\$.tw.
- 18.educat\$.tw.
- 19.program\$.tw.
- 20.#9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
- 21.#8 and #20
- 22.controlle
- 23.randomized
- 24.random-assignment
- 25.double-blind
- 26.single-blind
- 27.#22 or #23 or #24 or #25 or #26
- 28.animal
- 29.human
- 30.#27 not #28
- 31.clinical
- 32.(clin* near trial*) in ti
- 33.clin* near trial*) in ab
- 34.(singl* or doubl* or trebl* or tripl*) near (blind* or mask*)
- 35.(#34 in ti) or (#34 in ab)
- 36.placebos
- 37.placebo* in ti
- 38.placebo* in ab
- 39.random* in ti
- 40.random* in ab
- 41.research-methodology}

Table 03. Search Strategy for PSYCHLIT (Continued)

Dates 1887 to 2001

42.#31 or #32 or #33 or #34 or #35 or #36 or #37 or #38
43.#39 or #40 or #41
44.#42 or #43
45.animal
46.human
47.#44 not #45
48.#47 or #30 or #29 or #46
49.comparative
50.study
51.#49 and #50
52.evaluation
53.studies
54.#52 and #53
55.follow-up
56.propective
57.#56 and #53
58.control* or prospective* or volunteer*
59.(#58 in ti) or (#58 in ab)
60.#59 or #57 or #54 or #51
61.#60 not #45
62.#60 or #48 or #30
63.#62 and #21

Table 04. Search Strategy SPORTSDISCUS

Dates 1980 to 2001

1.'physical activity'
2.exercise
3.fitness
4.sedentary
5.housebound
6.aerobics or circuits or swimming or aqua or jogging or running or cycling or fitness or yoga or walking or sport
7.patient education
8.primary prevention
9.health promotion
10.behaviour therapy
11.cognitive therapy
12.primary health care
13.workplace
14.controlled
15.randomized
16.random-assignment
17.double-blind
18.single-blind
19.clinical
20.placebos

Table 04. Search Strategy SPORTSDISCUS (Continued)

Dates 1980 to 2001

- 21.comparative
- 22.evaluation
- 23.study

Table 05. Search Strategy SIGLE

Dates 1980 to 2001

- 1.explode "Exertion"/ all subheadings
- 2."Physical fitness"
- 3.explode "Physical education and training"/ all subheadings
- 4.explode "Sports"/ all subheadings
- 5.explode "Dancing"/ all subheadings
- 6.explode "Exercise therapy"/ all subheadings
- 7.(physical\$ adj5 (fit\$ or train\$ or activ\$ or endur\$)).tw.
- 8.(exercis\$ adj5 (train\$ or physical\$ or activ\$)).tw.
- 9.sport\$.tw.
- 10.walk\$.tw.
- 11.bicycle\$.tw
- 12.(exercise\$ adj aerobic\$).tw.
- 13.(("lifestyle" or life-style) adj5 activ\$).tw.
- 14.(("lifestyle" or life-style) adj5 physical\$).tw.
- 15.#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or (exercise\$) or (aerobic\$) or ("lifestyle") or (activ\$) or ("lifestyle") or (life-style) or (physical\$)
- 16.Health Education
- 17.Patient education
- 18.Primary prevention
- 19.Health promotion
- 20.Behaviour therapy
- 21.Cognitive therapy
- 22.Primary health care
- 23.Workplace
- 24.promot\$.tw.
- 25.educat\$.tw.
- 26.program\$.tw.
- 27.#16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26
- 28.#15 and #27

Table 06. Search Strategy SCISEARCH

Dates 1980 to 2001

- 1.((promot\$ or uptake or encourag\$ or increas\$ or start) near (physical adj activity))
- 2.(promot\$ or uptake or encourag\$ or increas\$ or start) near exercise
- 3.(promot\$ or uptake or encourag\$ or increas\$ or start) near (aerobics or circuits or swimming or aqua\$)
- 4.(promot\$ or uptake or encourag\$ or increas\$ or start) near (jogging or running or cycling)

Table 06. Search Strategy SCISEARCH (Continued)**Dates 1980 to 2001**

5.(promot\$ or uptake or encourag\$ or increas\$ or start) near ((keep adj fit) or (fitness adj class\$) or yoga)

6.(promot\$ or uptake or encourag\$ or increas\$ or start) near walking

7.(promot\$ or uptake or encourag\$ or increas\$ or start) near sport\$

Table 07. Descriptive data for review studies

Author	Publication year	Setting	No. randomised	% Male	Age range	Authors' description
Reid 1979	1979	Workplace	124	100	24 to 56	Endurance activities
Kriska 1986	1986	Community	229	0	50 to 65	Walking
Cunningham 1987	1987	Workplace / community	224	100	54 to 68	Walking, jogging or running
Juneau 1987	1987	Workplace	120	50	40 to 60	Walking or slow jogging
King 1988a	1988	Workplace	52	50	40 to 60	Walking and jogging
King 1988 b	1988	Workplace	51	51	40 to 60	Walking and jogging
King 1991	1991	Community	357	55	50 to 65	Group or home based walking/ jogging activities
Lombard 1995	1995	University	135	2.2	21 to 63	Walking
Stevens1998	1998	Primary Health Care	714	42	45 to 74	Build on present physical activities
Goldstein 1999	1999	Primary Health Care	355	35	50+	Choice of moderate or vigorous physical activity
Harland 1999	1999	Primary Health Care	520	41.5	40 to 64	Choice of safe and effective physical activity
Calfas 2000	2000	University	338	45.8	18 to 29	Moderate or vigorous physical activity plus strength and flexibility activities
Norris 2000	2000	Primary Health Care	847	47.9	30+	Moderate physical activity
Smith 2000	2000	Primary Health Care	1142	39.5	25 to 65	Physical activity prescribed by medical practitioner

Table 07. Descriptive data for review studies (Continued)

Author	Publication year	Setting	No. randomised	% Male	Age range	Authors' description
Simons-Morton 2001a	2001	Primary Health Care	479	100	35 to 75	Choice of moderate or vigorous physical activity
Simons-Morton 2001b	2001	Primary Health Care	395	0	35 to 75	Choice of moderate or vigorous physical activity
Stewart 2001	2001	Primary Health Care	173	34	65 to 95	Moderate physical activity

Table 08. Characteristics of study type and intensity of intervention and follow up

Study ID & Author	Programme direction	Supervision	Rate of intervention	Rate of Follow Up	Contact at Follow up
Reid 1979	P - prescribed by professional only	US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	Low - 0-4 occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Kriska 1986	P - prescribed by professional only	S - physical activity programme was structured and supervised by professional & US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	Low - 0-4 occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Cunningham 1987	P - prescribed by professional only	S - physical activity programme was structured and supervised by professional & US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	High - 5+ occasions between week five and outcome measure.	None
Juneau 1987	P - prescribed by professional only	US - physical activity programme was unstructured and performed	Low - 0-3 occasions	Low - 0-4 occasions between week five and outcome measure.	None

Table 08. Characteristics of study type and intensity of intervention and follow up (Continued)

Study ID & Author	Programme direction	Supervision	Rate of intervention	Rate of Follow Up	Contact at Follow up
		independently by the participant			
King 1988 a	SD self directed only	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	Low - 0-4 occasions between week five and outcome measure.	None
King 1988 b	SD self directed only	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	High - 5+ occasions between week five and outcome measure.	Telephone only
King 1991	P - prescribed by professional only	S - physical activity programme was structured and supervised by professional & US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Lombard 1995	P - prescribed by professional only	US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	High - 5+ occasions between week five and outcome measure.	Telephone only
Stevens 1998	SD self directed only	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	Low - 0-4 occasions between week five and outcome measure.	Face-to-face
Goldstein 1999	SD+ self directed plus professional guidance	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Harland 1999	SD+ self directed plus professional	US - physical activity programme	High - 4+ occasions	Low - 0-4 occasions between week	Face-to-face

Table 08. Characteristics of study type and intensity of intervention and follow up (Continued)

Study ID & Author	Programme direction	Supervision	Rate of intervention	Rate of Follow Up	Contact at Follow up
	guidance	was unstructured and performed independently by the participant		five and outcome measure.	
Calfas 2000	SD+ self directed plus professional guidance	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Norris 2000	SD+ self directed plus professional guidance	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Smith 2000	P - prescribed by professional only	US - physical activity programme was unstructured and performed independently by the participant	Low - 0-3 occasions	Low - 0-4 occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Simons-Morton 2001a	SD+ self directed plus professional guidance	US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Simons-Morton 2001b	SD+ self directed plus professional guidance	US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
Stewart 2001	SD+ self directed plus professional guidance	US - physical activity programme was unstructured and performed independently by the participant	High - 4+ occasions	High - 5+ occasions between week five and outcome measure.	Mixture of postal, telephone or face-to-face
	(a) Nature of direction of the intervention	(b) Degree of programme supervision - S - physical activity programme was	(c) Frequency of intervention occasions in first four weeks post baseline.	(d) Frequency of follow up contacts.	

Table 08. Characteristics of study type and intensity of intervention and follow up (Continued)

Study ID & Author	Programme direction	Supervision	Rate of intervention	Rate of Follow Up	Contact at Follow up
		structured and supervised by professional, US - physical activity programme was unstructured and performed independently by the participant			

Table 09. Participation numbers in study recruitment, randomisation and follow up

Study ID	Potentially eligible	Eligible (b)	Randomised (c)	Complete (d)	% complete/ eligible	% lost to follow up	Use ITT analysis (f)
Reid 1979	Not stated	146	124	34	23.2	72.5	Yes
Kriska 1986	Not stated	229	229	209	0	8.7	Yes
Cunningham 1987	Not stated	224	224	200	89.2	10.7	No
Juneau 1987	Not stated	126	120	131	89.6	5.8	No
King 1988a	Not stated	Not stated	52	47	Not available	9.6	No
King 1988b	Not stated	Not stated	51	48	Not available	5.8	No
King 1991	3117	1755	357	300	17.1	15.9	No
Lombard 1995	Approximately 5000	135	135	135	0	0	Yes
Stevens 1998	2253	827	714	415	50.1	41.8	Yes
Goldstein 1999	2145	444	355	312	70.2	12.1	No
Harland 1999	2974	734	520	442	60.2	15.0	No
Calfas 2000	Not stated	Not stated	338	315 (data provided by study authors)	Not available	6.8	No
Norris 2000	1920	985	847	812	82.4	4.1	No
Smith 2000	2097	1214	1142	1101	90.6	17.1	Yes
Simons-Morton 2001a	3910	NS	479	451 - Self-reported physical activity, 396 - Cardio-vascular	Not available	5.8 - Self-reported physical activity, 17.3 - Cardio-vascular	Yes

Table 09. Participation numbers in study recruitment, randomisation and follow up (Continued)

Study ID	Potentially eligible	Eligible (b)	Randomised (c)	Complete (d) fitness (data provided by study authors)	% complete/ eligible	% lost to follow up fitness	Use ITT analysis (f)
Simons-Morton2001b	3910	NS	395	349 - Self-reported physical activity, 302 - Cardio-vascular fitness (data provided by study authors)	Not available	11.6 - Self-reported physical activity, 23.5 - Cardio-vascular fitness	Yes
Stewart 2001	1381 (a) Number of people contacted to determine potential eligibility	1053 (b) Number identified as eligible for study - the number of participants who were assessed as eligible for randomisation into study	173 (c) Number of people randomised - Number eligible minus refusals, excluded on medical grounds or failed to attend for randomisation	164 (d) Number with complete data set at final outcome measure	15.5 (e) % Number of participants with final outcome measure / Numbers identified as eligible for study	5.0	Yes (f) ITT - Intention to treat

Table 10. Outcome measure, SMD, 95% CI and outcome for studies with continuous SRPA

Study ID	Outcome measure	SMD	95% CI	Outcome direction	Study quality score
Kriska 1986	Kcal/week	0.54	0.28 to 0.80	+ favours intervention	1
Cunningham 1987	Mins/day vigorous physical activity (>4.9 METS)	0.40	0.13 to 0.67	+ favours intervention	0
King 1998a	Exercise occasions per month (30 Mins. per session)	0.64	0.05 to 1.23	+ favours intervention	2
King 1988b	Exercise occasions per month (30 Mins. per session)	0.37	-0.21 to 0.94	0 no effect	2
Stevens 1998	Exercise occasions per month (greater than 20 Mins per session)	0.84	0.68 to 0.99	+ favours intervention	2

Table 10. Outcome measure, SMD, 95% CI and outcome for studies with continuous SRPA (Continued)

Study ID	Outcome measure	SMD	95% CI	Outcome direction	Study quality score
Goldstein 1999	Physical Activity Scale for Elderly (PASE Scale)	0.02	-0.20 to 0.24	0 no effect	0
Calfas 2000	Kcal/kg/week	0.12	-0.10 to 0.34	0 no effect	1
Smith 2000	Mins/week	0.08	-0.04 to 0.21	0 no effect	3
Simons-Morton 2001a	Kcal/kg/day	0.18	-0.02 to 0.38	0 no effect	4
Simons-Morton 2001a	Kcal/kg/day	0.08	-0.14 to 0.30	0 no effect	4
Stewart 2001	Kcal/day	0.32	0.02 to 0.63	+ favours intervention	3

METS = Energy cost of physical activity measured at cost of basal metabolic rate.

Table 11. Outcome measure, SMD, 95% CI and outcome for studies with continuous CV Fitness

Study ID	Outcome measure	SMD	95% CI	Outcome direction	Study quality score
Cunningham 1987	VO2	0.44	0.16 to 0.72	+ favours treatment	0
Juneau 1987	VO2	1.49	1.07 to 1.91	+ favours treatment	0
King 1988a	VO2	-0.16	-0.74 to 0.42	0 no effect	2
King 1988b	VO2	0.15	-0.42 to 0.72	0 no effect	2
King 1991	VO2	0.17	-0.09 to 0.43	0 no effect	3
Simons-Morton 2001a	ml/min	0.14	-0.07 to 0.35	0 no effect	4
Simons-Morton 2001b	ml/min	0.47	0.23 to 0.71	+ favours treatment	4

Table 12. Outcome measure, OR, 95% CI and outcome measure for studies with dichotomous PA

Study ID	Outcome measure	OR	95% CI	Outcome direction	Study quality score
Reid 1979	Improving physical activity compliance and fitness increase (OR for a participant achieving "prescribed compliance" if they reported exercising at least twice a week and increased their VO2 by +9.5% over baseline level)	1.68	0.72 to 3.92	0 no effect	1
Lombard 1995	Achieving at least 3 occasions of walking	10.95	1.42 to 84.15	+ favours treatment	1

Table 12. Outcome measure, OR, 95% CI and outcome measure for studies with dichotomous PA (Continued)

Study ID	Outcome measure	OR	95% CI	Outcome direction	Study quality score
	for at least 20 minutes per week (OR for a participant walking on least 3 occasions per week for at least 20 minutes per occasion)				
Harland 1999	Improving physical activity index score by at least one level (OR for a participant increasing their number of sessions of moderate and vigorous physical activity lasting a minimum of 20 minutes in the previous four weeks, used in a physical activity index score)	1.18	0.69 to 2.04	0 no effect	2
Norris 2000	Increasing physical activity by at least 30 minutes per week (OR for a participant increasing their level of any type of physical activity by at least 30 minutes per week compared to their baseline level)	0.79	0.60 to 1.04	0 no effect	2
Simons-Morton 2001a	Meeting CDC recommendation for physical activity (Odds ratio for a participant meeting 30 minutes of moderate to vigorous intensity physical activity (at least 3 METS) at least 5 days a week, 30 minutes of vigorous physical activity (at least 5 METS) at least 3 days a week, or at least 2 kcal·kg ⁻¹ ·day ⁻¹ in moderate to vigorous physical activity)	1.63	0.98 to 2.71	0 no effect	4
Simons-Morton 2001b	Meeting CDC recommendation for physical activity (Odds ratio for a participant	1.26	0.68 to 2.34	0 no effect	4

Table 12. Outcome measure, OR, 95% CI and outcome measure for studies with dichotomous PA (Continued)

Study ID	Outcome measure	OR	95% CI	Outcome direction	Study quality score
	meeting 30 minutes of moderate to vigorous intensity physical activity (at least 3 METS) at least 5 days a week, 30 minutes of vigorous physical activity (at least 5 METS) at least 3 days a week, or at least 2 kcal·kg ⁻¹ ·day ⁻¹ in moderate to vigorous physical activity)				
	CDC = Centre for disease control				

Table 13. Characteristics of study control groups and number of study arms

Study ID	No. study arms (a)	Control -description	Type of control
Reid 1979	2	Written advice	Comparison control
Kriska 1986	2	Baseline assessment only	No contact
Cunningham 1987	2	Continue usual physical activity	No contact
Juneau 1987	2	Daily physical activity logs	Comparison control
King 1988a	2	Weekly exercise monitoring	Comparison control
King 1988b	2	Self monitoring materials and pulse monitor	Comparison control
King 1991	4	Asked not to change physical activity	No contact
Lombard 1995	2	Written information	Comparison control
Stevens 1998	2	Written information	Comparison control
Goldstein 1999	2	Usual care	Attention control
Harland 1999	5	Health check	Attention control
Calfas 2000	2	General health lectures	Attention control
Norris 2000	3	Usual care	No contact
Smith 2000	3	Usual care	No contact
Simons-Morton 2001a	3	Advice to exercise from physician & health educator	Comparison control
Simons-Morton 2001b	3	Advice to exercise from physician & health educator	Comparison control

Table 13. Characteristics of study control groups and number of study arms (*Continued*)

Study ID	No. study arms (a)	Control -description	Type of control
Stewart 2001	2	Wait list	No contact
	(a) Number of study arms - This figure is a sum of the number of intervention arms plus control	(b) Description of control group	(c) Type of control group - No contact - Wait list, baseline assessment only, Attention control - Usual care, health check, health advice not physical activity specific, Comparison control - Written information, advice about physical activity, self monitoring materials

ANALYSES

Comparison 01. Sub group analysis

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Degree of Supervision - Cardiovascular Fitness	7	1406	Standardised Mean Difference (Random) 95% CI	0.42 [0.14, 0.71]
02 Degree of Supervision - Self Reported Physical Activity	11	3940	Standardised Mean Difference (Random) 95% CI	0.31 [0.12, 0.51]
03 Nature of Direction - Self Reported Physical Activity	11	3940	Standardised Mean Difference (Random) 95% CI	0.31 [0.12, 0.51]
04 Nature of Direction - Cardiovascular Fitness	7	1406	Standardised Mean Difference (Random) 95% CI	0.42 [0.14, 0.71]
05 Frequency of intervention occasions - Self reported physical activity	11	3940	Standardised Mean Difference (Random) 95% CI	0.31 [0.12, 0.51]
06 Frequency of intervention occasions - Cardiovascular Fitness	7	1406	Standardised Mean Difference (Random) 95% CI	0.42 [0.14, 0.71]
07 Frequency of intervention occasions - Dichotomous data	6	2313	Odds Ratio (Random) 95% CI	1.30 [0.87, 1.95]
08 Frequency of Follow Up - Self reported physical activity	11	3940	Standardised Mean Difference (Random) 95% CI	0.31 [0.12, 0.51]
09 Frequency of Follow Up - Cardiovascular Fitness	7	1406	Standardised Mean Difference (Random) 95% CI	0.42 [0.14, 0.71]
10 Frequency of Follow Up - Dichotomous data	6	2313	Odds Ratio (Random) 95% CI	1.30 [0.87, 1.95]
11 Study Quality Score - Self reported physical activity	11	3940	Standardised Mean Difference (Random) 95% CI	0.31 [0.12, 0.51]
12 Study Quality - Cardiovascular Fitness	7	1406	Standardised Mean Difference (Random) 95% CI	0.42 [0.14, 0.71]
13 Study Quality - Dichotomous data	6	2313	Odds Ratio (Random) 95% CI	1.30 [0.87, 1.95]

Comparison 02. Pooled effects

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Studies with dichotomous outcome data for self-reported physical activity	6	2313	Odds Ratio (Random) 95% CI	1.30 [0.87, 1.95]
02 Studies with continuous outcome data for cardio-respiratory fitness	7	1406	Standardised Mean Difference (Random) 95% CI	0.40 [0.09, 0.70]
03 Studies with continuous outcome data for self-reported physical activity in order of publication date	11	3940	Standardised Mean Difference (Random) 95% CI	0.31 [0.12, 0.51]

INDEX TERMS

Medical Subject Headings (MeSH)

*Exercise; Health Promotion [*methods]; Physical Fitness; Randomized Controlled Trials

MeSH check words

Humans

COVER SHEET

Title

Interventions for promoting physical activity

Authors

Hillsdon M, Foster C, Thorogood M

Contribution of author(s)

Dr Hillson was involved in:

Conceiving the review, Designing the review, Coordinating the review, Screening search results, Screening retrieved papers against inclusion criteria, Appraising quality of papers, Abstracting data from papers, Data management for the review, Entering data into RevMan, Analysis of data,

Interpretation of data, Providing a methodological perspective, Providing a clinical perspective, Providing a policy perspective, Writing the review, Providing general advice on the review, Securing funding for the review, Performing previous work that was the foundation of current study.

Charles Foster was involved in:

Conceiving the review, Designing the review, Coordinating the review, Data collection for the review, Developing search strategy, Undertaking searches, Screening search results, Organising retrieval of papers, Screening retrieved papers against inclusion criteria, Appraising quality of papers, Abstracting data from papers, Writing to authors of papers for additional information, Providing additional data about papers, Obtaining and screening data on unpublished studies, Data management for the review, Entering data into RevMan, Analysis of data, Interpretation of data, Providing a methodological perspective, Providing a clinical perspective, Providing a policy perspective, Writing the review, Providing general advice on the review, Securing funding for the review, Performing previous work that was the foundation of current study

Professor Thorogood was involved with:

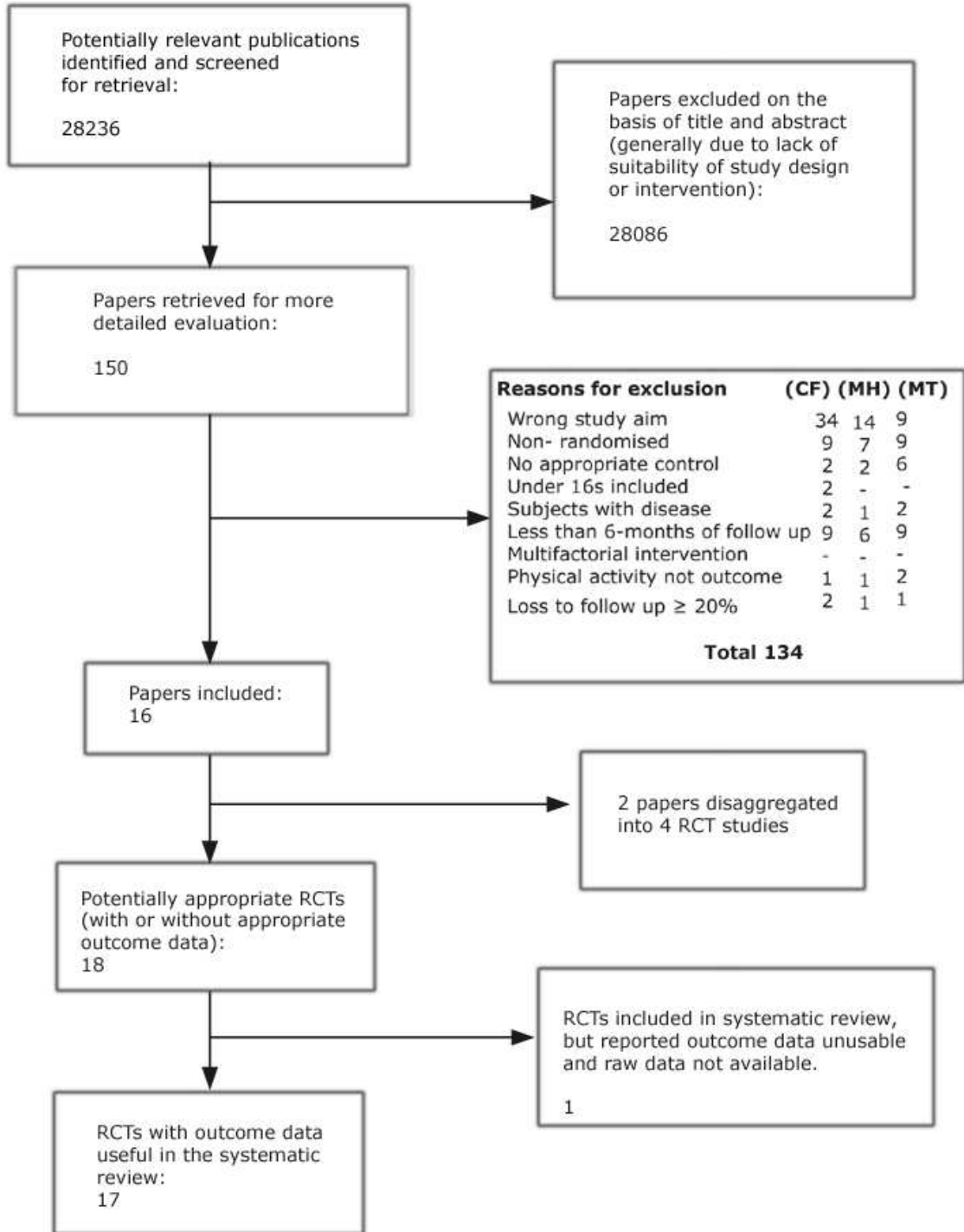
Conceiving the review, Designing the review, Coordinating the review, Screening search results, Screening retrieved papers against inclusion criteria, Appraising quality of papers,

Abstracting data from papers, Data management for the review, Entering data into RevMan, Analysis of data, Interpretation of data, Providing a methodological perspective, Providing a clinical perspective, Providing a policy perspective, Writing the review, Providing general advice on the review, Securing funding for the review, Performing previous work that was the foundation of current study

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What's New	Information not supplied by author
Date new studies sought but none found	Information not supplied by author
Date new studies found but not yet included/excluded	Information not supplied by author
Date new studies found and included/excluded	Information not supplied by author
Date authors' conclusions section amended	Information not supplied by author
Contact address	Dr Melvyn Hillsdon Department of Exercise and Health Sciences University of Bristol Tyndall Avenue Bristol BS8 1TP UK E-mail: m.hillsdon@bristol.ac.uk Tel: +44 0117 33 11216
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GRAPHS AND OTHER TABLES

Figure 01. Quorum statement flow diagram

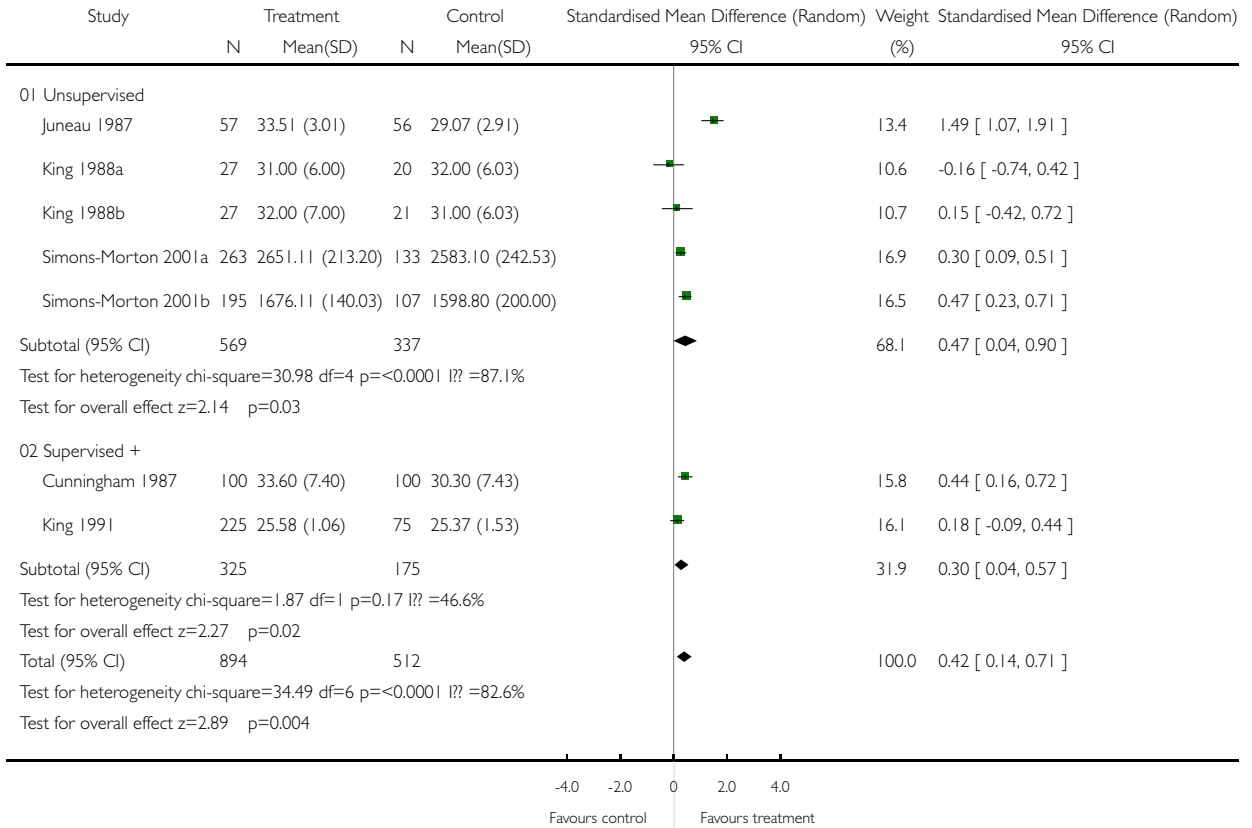


Analysis 01.01. Comparison 01 Sub group analysis, Outcome 01 Degree of Supervision - Cardiovascular Fitness

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 01 Degree of Supervision - Cardiovascular Fitness

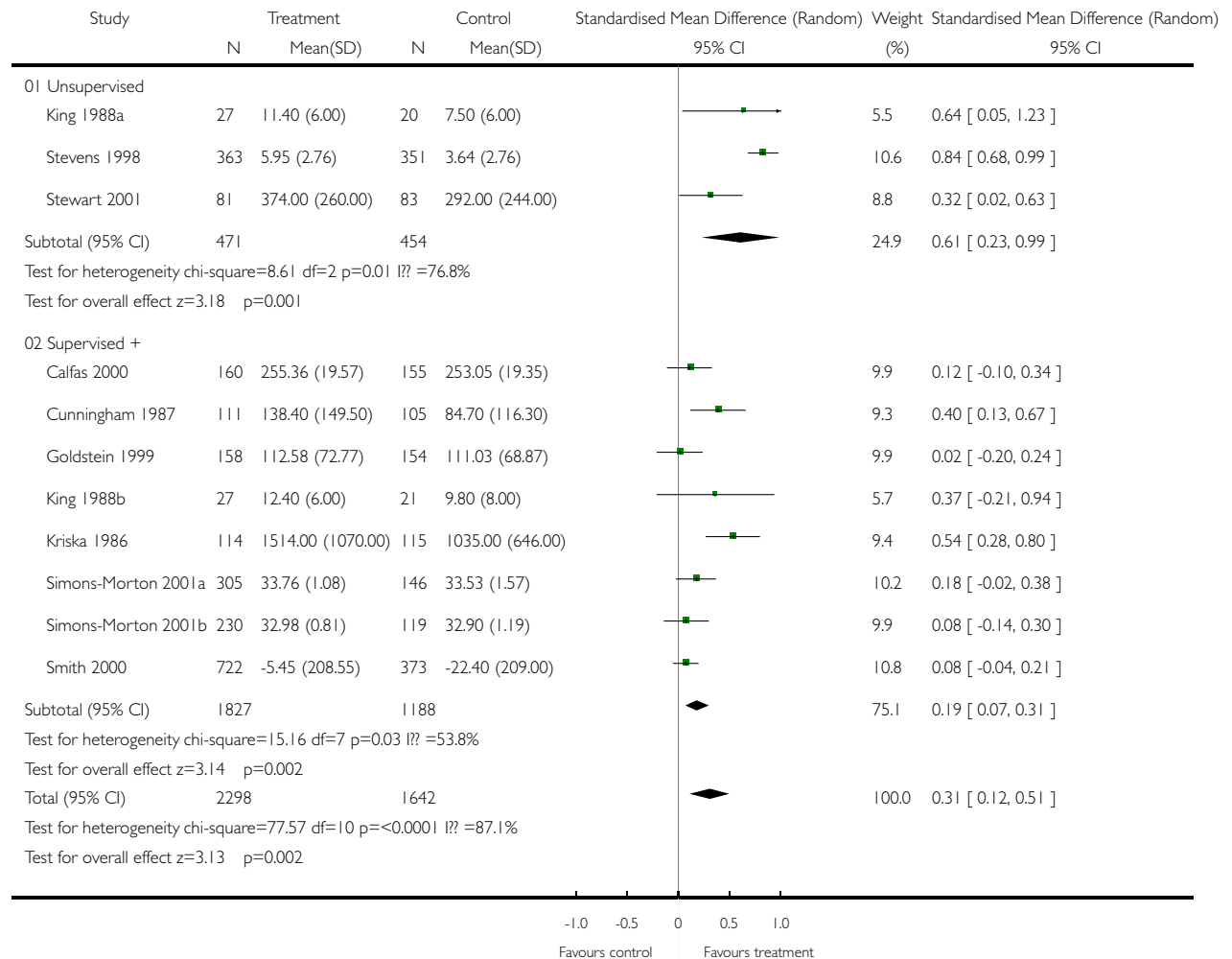


Analysis 01.02. Comparison 01 Sub group analysis, Outcome 02 Degree of Supervision - Self Reported Physical Activity

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 02 Degree of Supervision - Self Reported Physical Activity

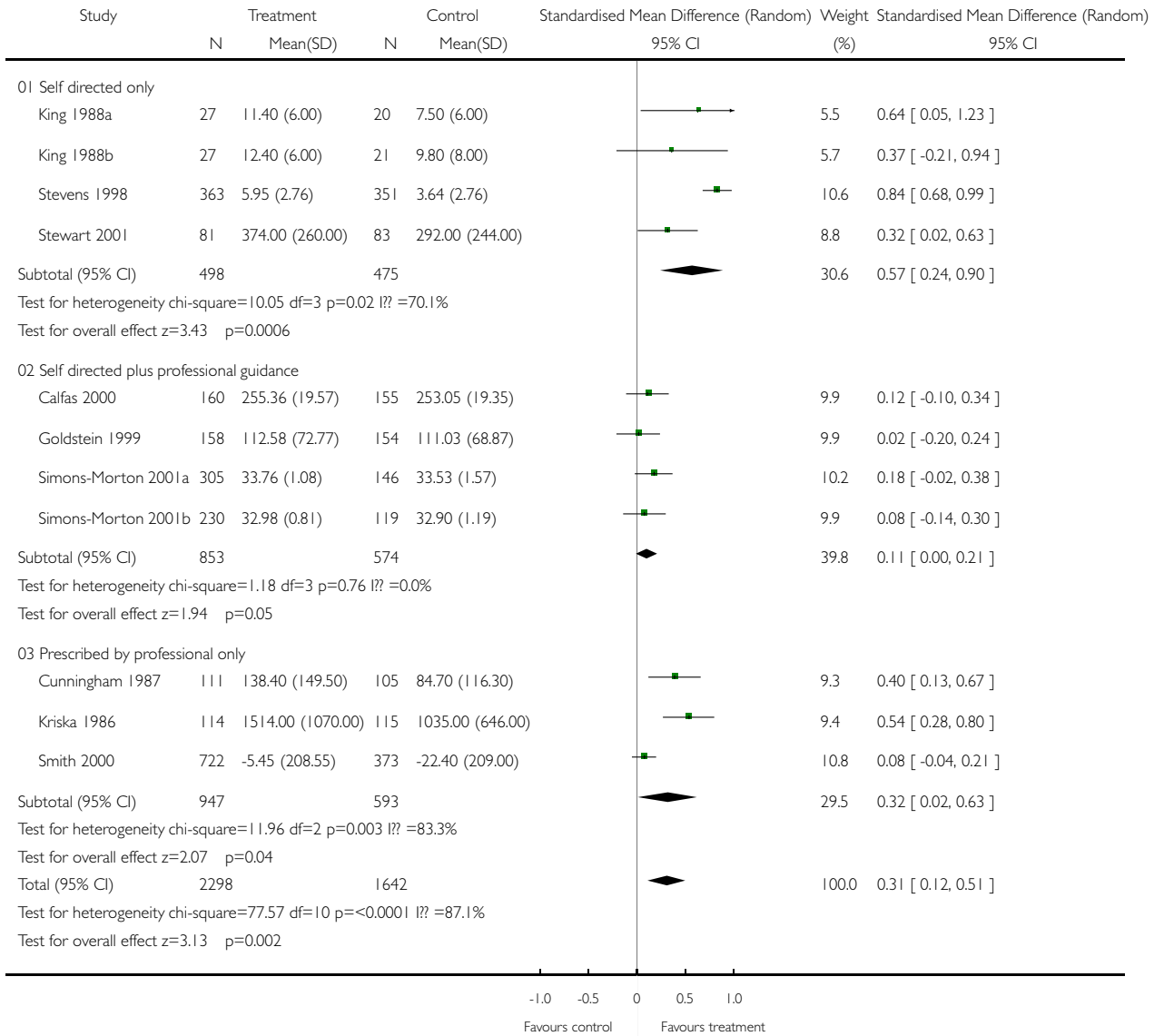


Analysis 01.03. Comparison 01 Sub group analysis, Outcome 03 Nature of Direction - Self Reported Physical Activity

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 03 Nature of Direction - Self Reported Physical Activity

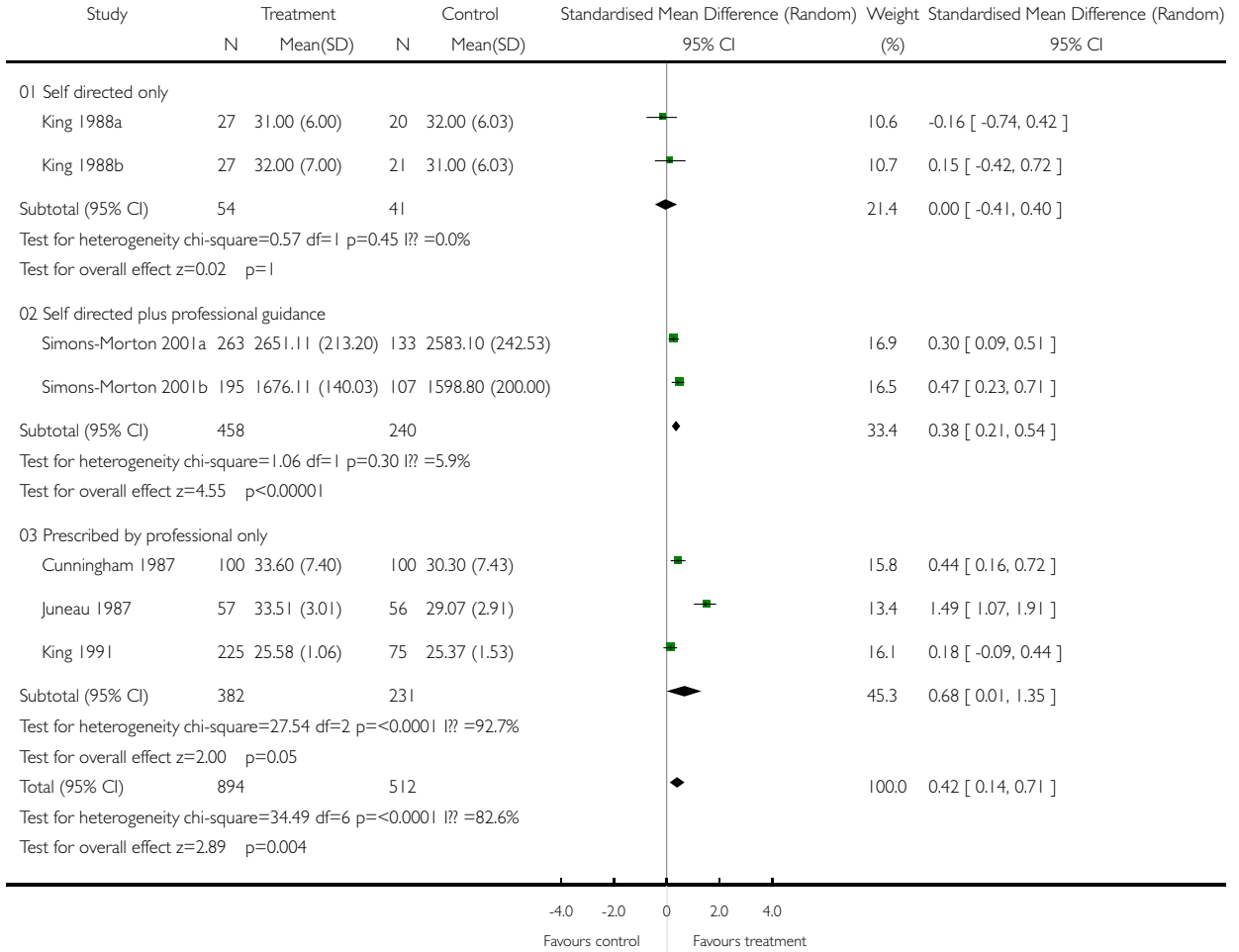


Analysis 01.04. Comparison 01 Sub group analysis, Outcome 04 Nature of Direction - Cardiovascular Fitness

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 04 Nature of Direction - Cardiovascular Fitness

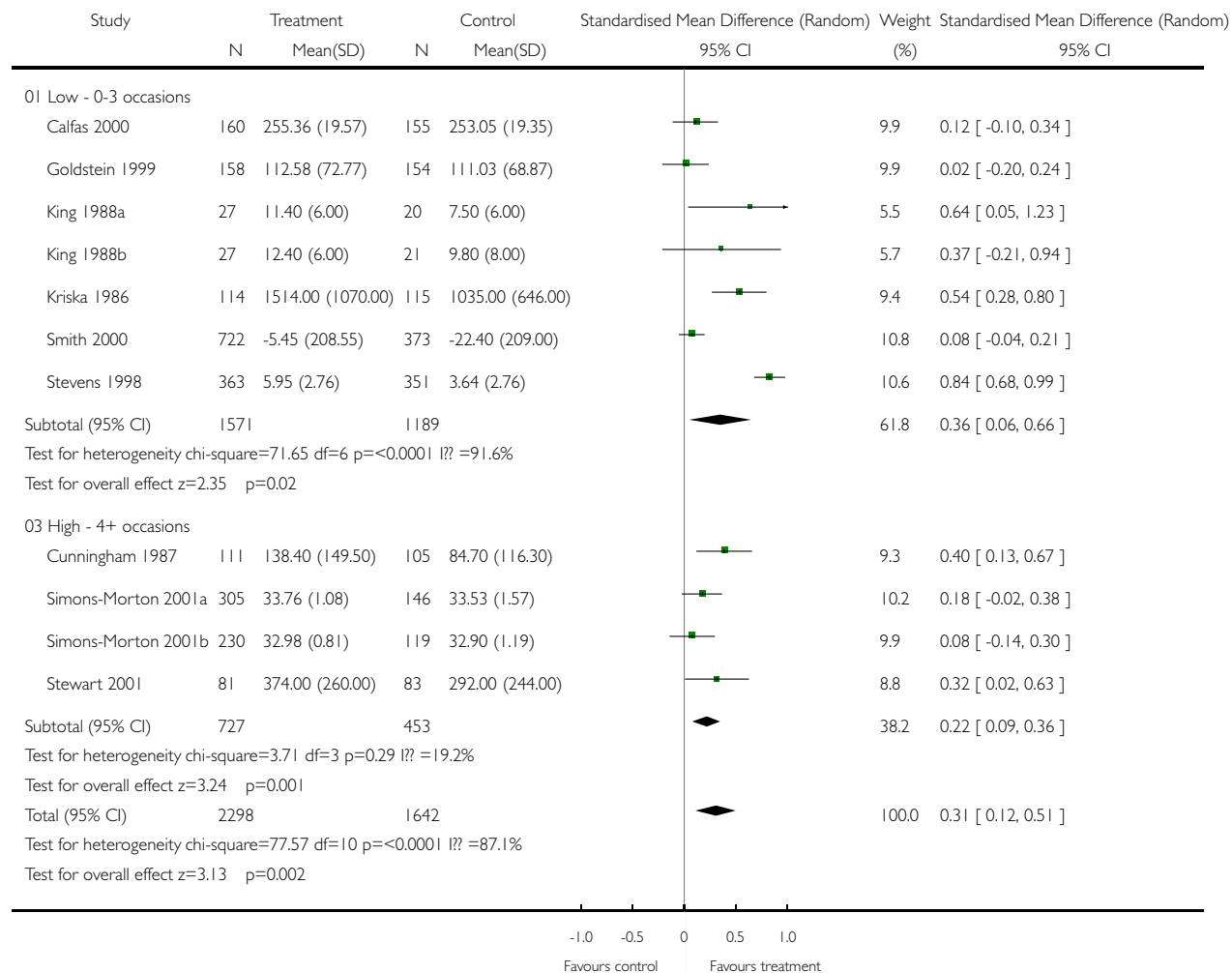


Analysis 01.05. Comparison 01 Sub group analysis, Outcome 05 Frequency of intervention occasions - Self reported physical activity

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 05 Frequency of intervention occasions - Self reported physical activity

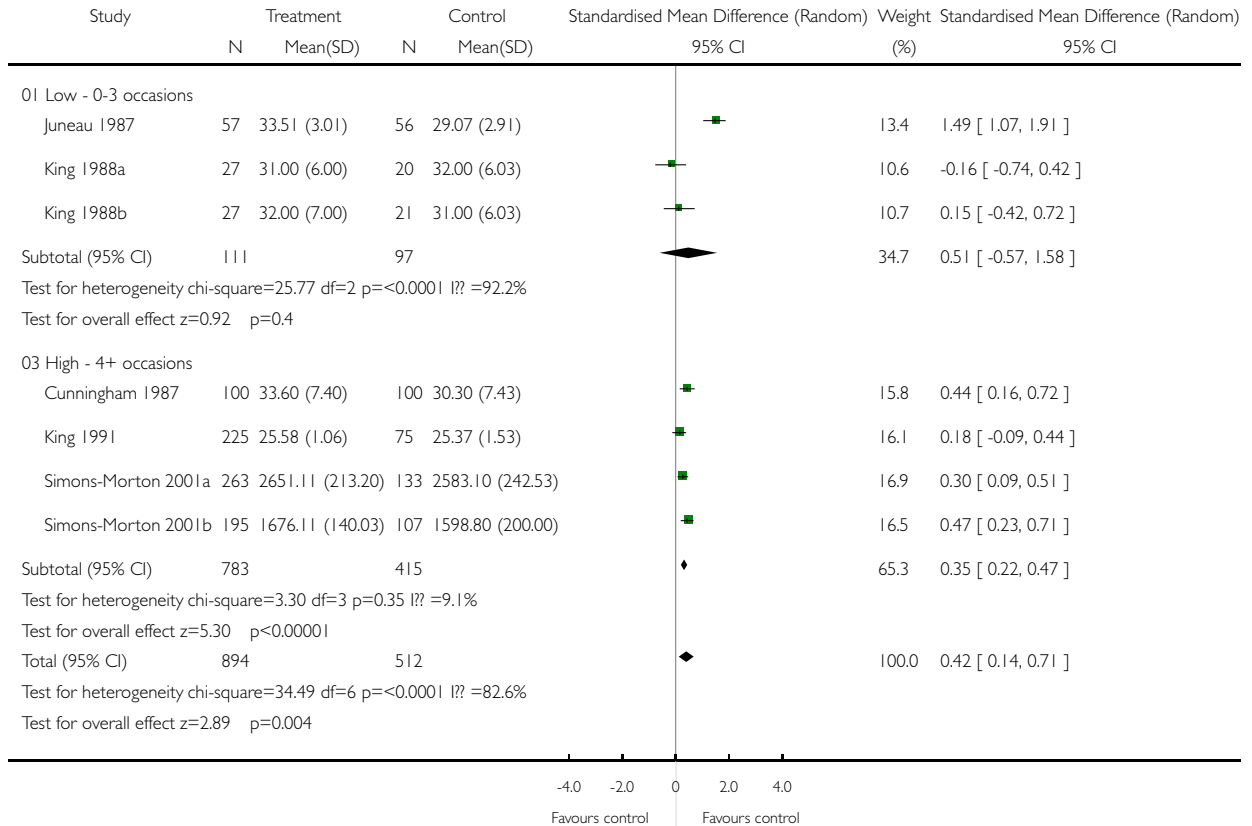


Analysis 01.06. Comparison 01 Sub group analysis, Outcome 06 Frequency of intervention occasions - Cardiovascular Fitness

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 06 Frequency of intervention occasions - Cardiovascular Fitness

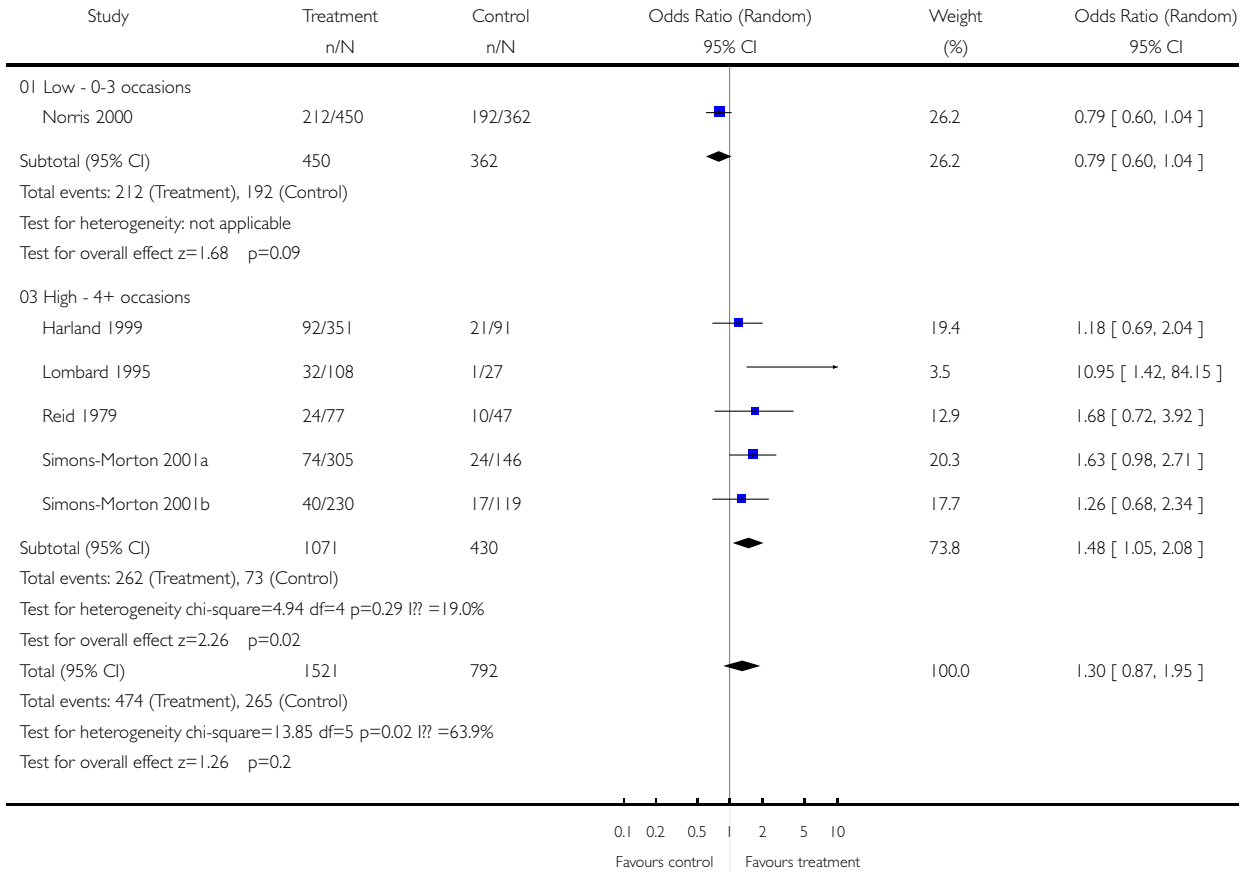


Analysis 01.07. Comparison 01 Sub group analysis, Outcome 07 Frequency of intervention occasions - Dichotomous data

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 07 Frequency of intervention occasions - Dichotomous data

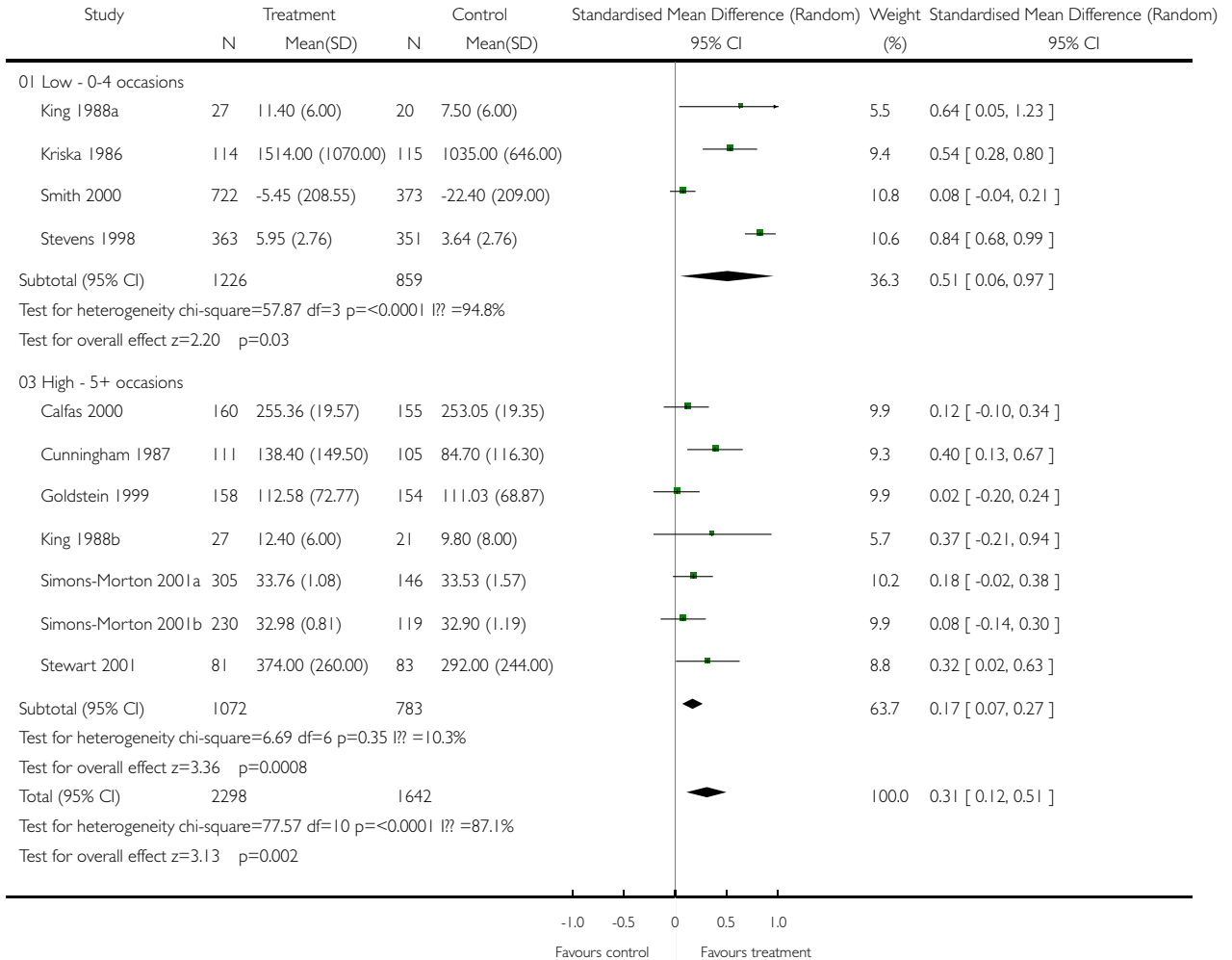


Analysis 01.08. Comparison 01 Sub group analysis, Outcome 08 Frequency of Follow Up - Self reported physical activity

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 08 Frequency of Follow Up - Self reported physical activity

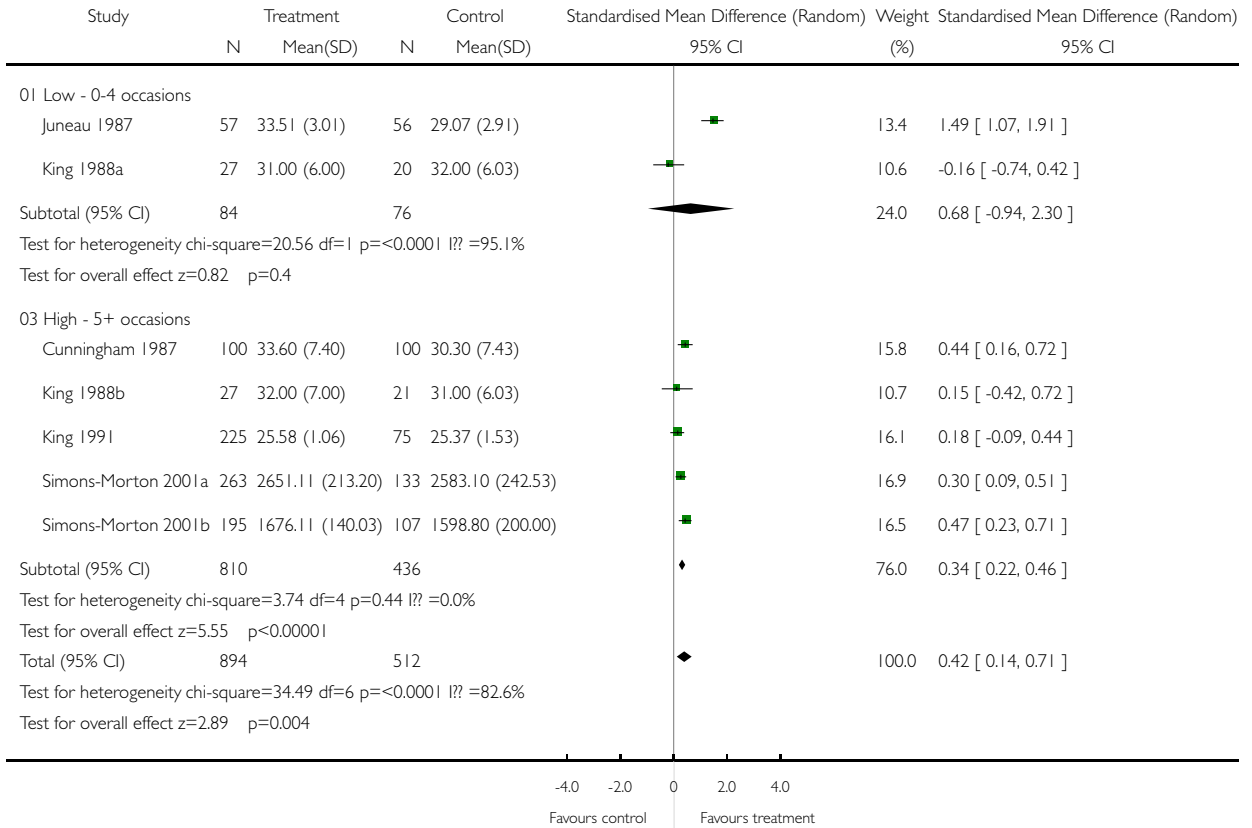


Analysis 01.09. Comparison 01 Sub group analysis, Outcome 09 Frequency of Follow Up - Cardiovascular Fitness

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 09 Frequency of Follow Up - Cardiovascular Fitness

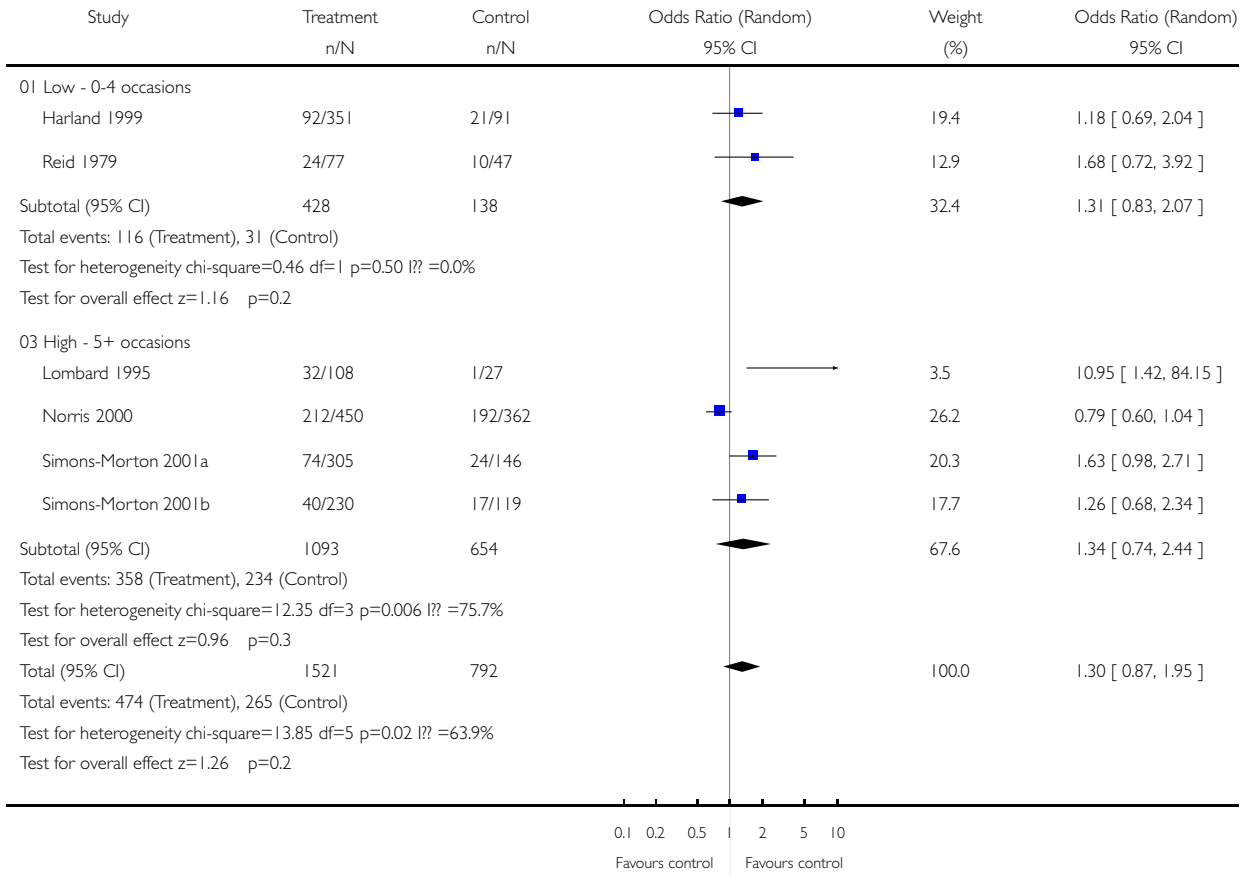


Analysis 01.10. Comparison 01 Sub group analysis, Outcome 10 Frequency of Follow Up - Dichotomous data

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 10 Frequency of Follow Up - Dichotomous data

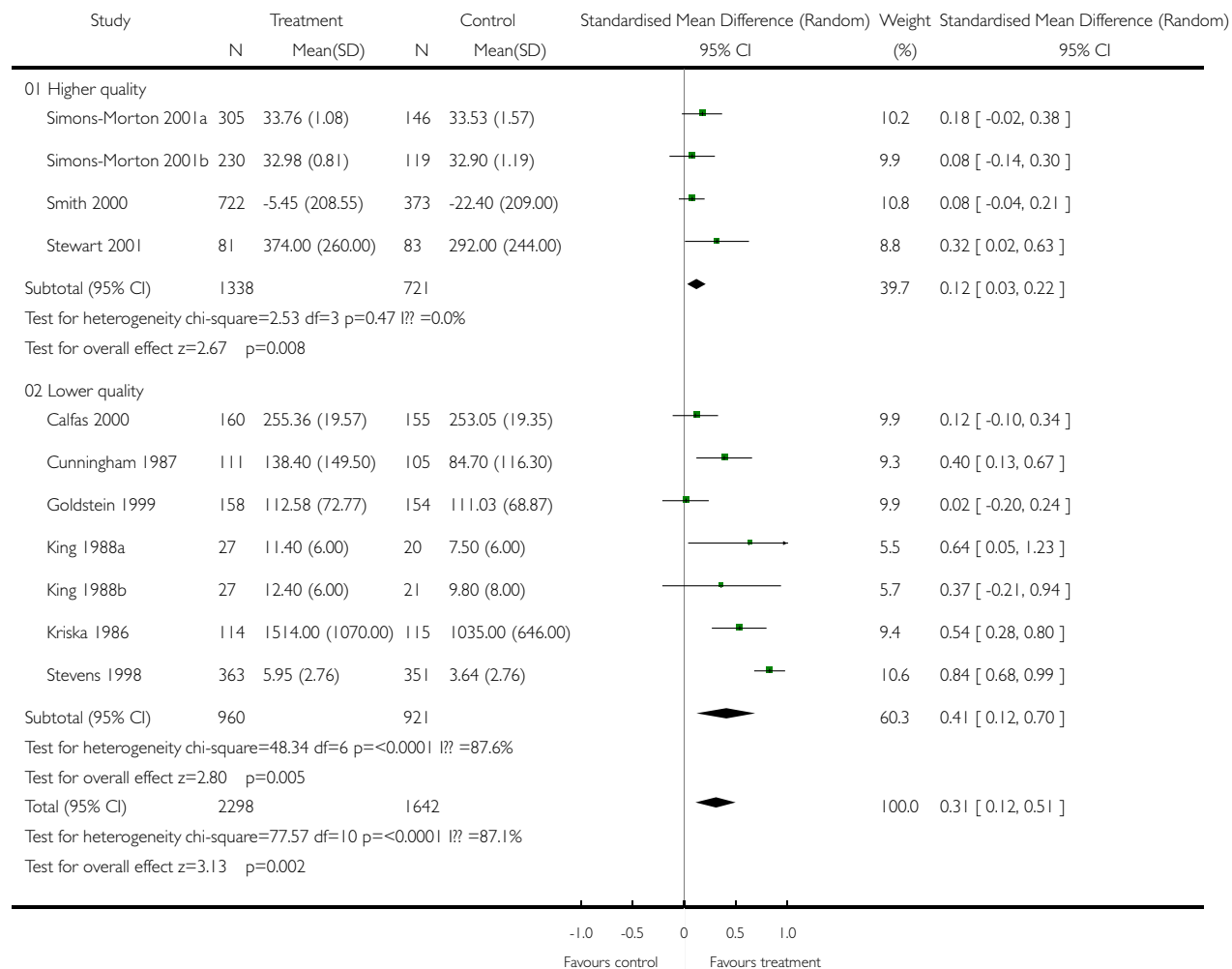


Analysis 01.11. Comparison 01 Sub group analysis, Outcome 11 Study Quality Score - Self reported physical activity

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 11 Study Quality Score - Self reported physical activity

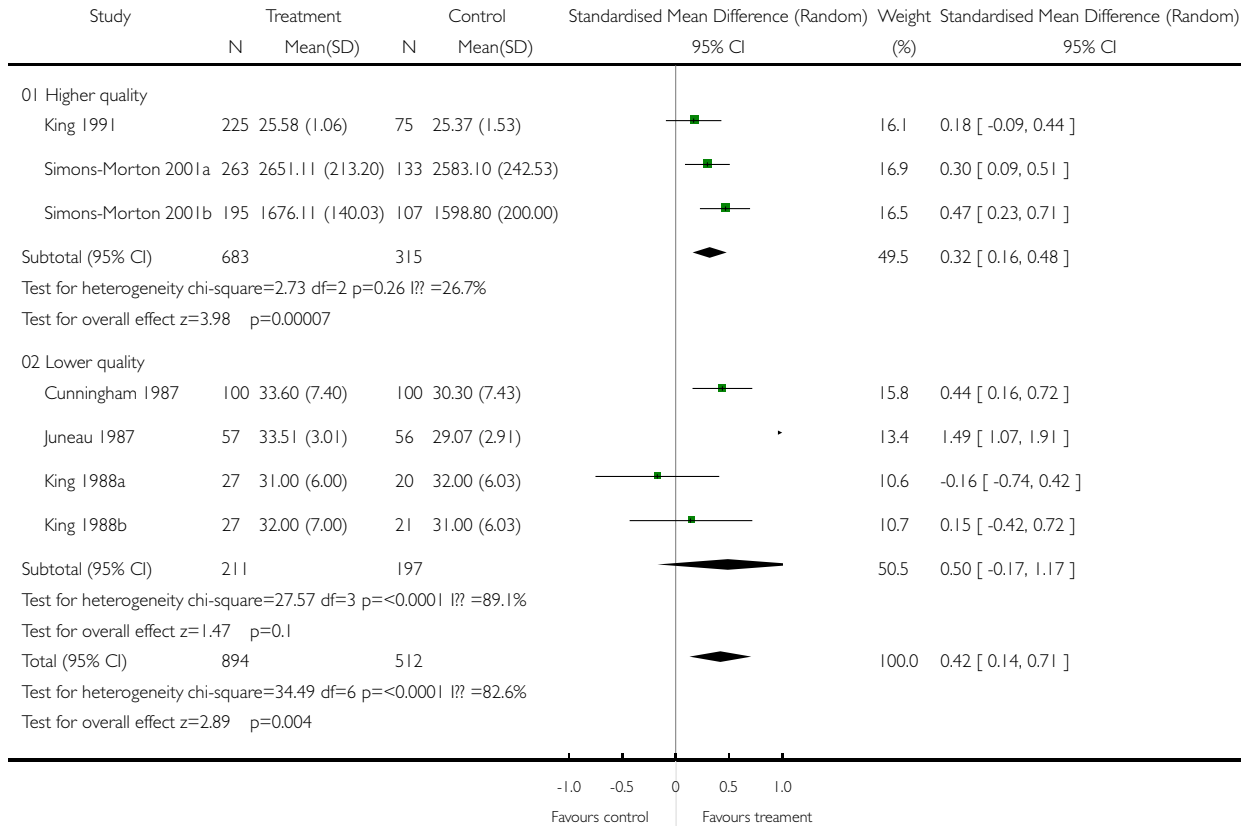


Analysis 01.12. Comparison 01 Sub group analysis, Outcome 12 Study Quality - Cardiovascular Fitness

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 12 Study Quality - Cardiovascular Fitness

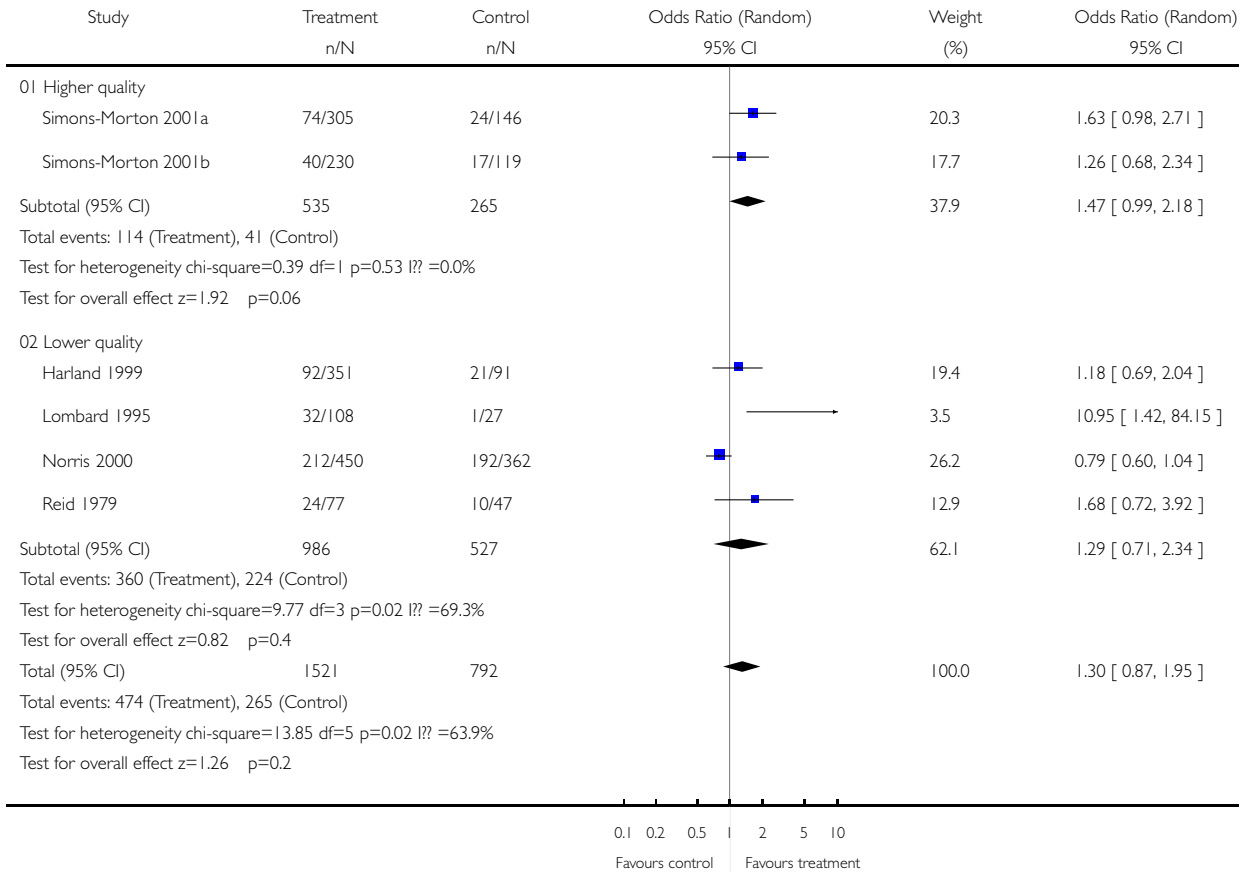


Analysis 01.13. Comparison 01 Sub group analysis, Outcome 13 Study Quality - Dichotomous data

Review: Interventions for promoting physical activity

Comparison: 01 Sub group analysis

Outcome: 13 Study Quality - Dichotomous data

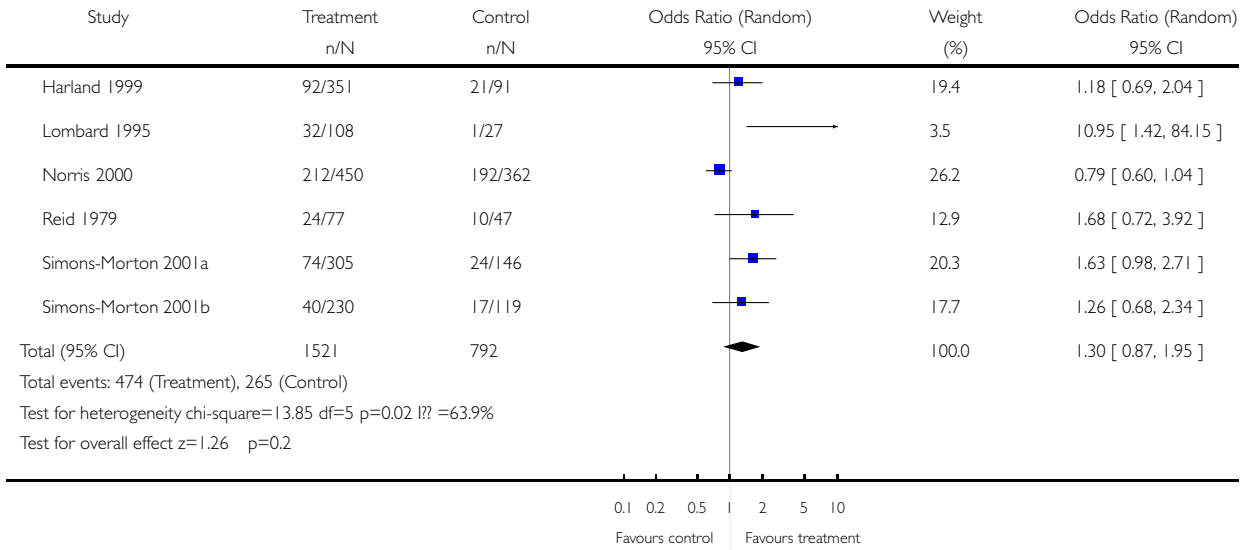


Analysis 02.01. Comparison 02 Pooled effects, Outcome 01 Studies with dichotomous outcome data for self-reported physical activity

Review: Interventions for promoting physical activity

Comparison: 02 Pooled effects

Outcome: 01 Studies with dichotomous outcome data for self-reported physical activity

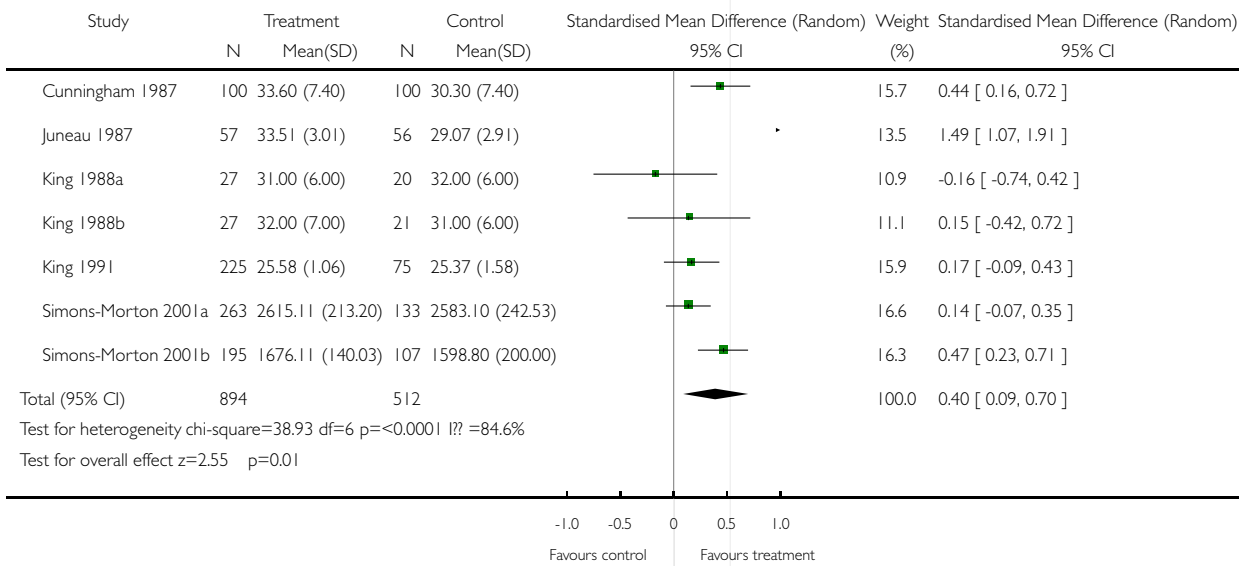


Analysis 02.02. Comparison 02 Pooled effects, Outcome 02 Studies with continuous outcome data for cardio-respiratory fitness

Review: Interventions for promoting physical activity

Comparison: 02 Pooled effects

Outcome: 02 Studies with continuous outcome data for cardio-respiratory fitness



Analysis 02.03. Comparison 02 Pooled effects, Outcome 03 Studies with continuous outcome data for self-reported physical activity in order of publication date

Review: Interventions for promoting physical activity

Comparison: 02 Pooled effects

Outcome: 03 Studies with continuous outcome data for self-reported physical activity in order of publication date

