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Is there evidence that walking groups have health benefits? A systematic review and meta-analysis

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▸ Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2014-094157).

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Received 22 August 2014
Revised 21 October 2014
Accepted 29 November 2014
Published Online First 19 January 2015

ABSTRACT

Objective To assess the health benefits of outdoor walking groups.

Design Systematic review and meta-analysis of walking group interventions examining differences in commonly used physiological, psychological and well-being outcomes between baseline and intervention end.

Data sources Seven electronic databases, clinical trial registers, grey literature and reference lists in English language up to November 2013.

Eligibility criteria Adults, group walking outdoors with outcomes directly attributable to the walking intervention.

Results Forty-two studies were identified involving 1843 participants. There is evidence that walking groups have wide-ranging health benefits. Meta-analysis showed statistically significant reductions in mean difference for systolic blood pressure −3.72 mm Hg (−5.28 to −2.17) and diastolic blood pressure −3.14 mm Hg (−4.15 to −2.13); resting heart rate −2.88 bpm (−4.13 to −1.64); body fat −1.31% (−2.10 to −0.52), body mass index −0.71 kg/m^2 (−1.19 to −0.23), total cholesterol −0.11 mmol/L (−0.22 to −0.01) and statistically significant mean increases in VO_{2max} of 2.66 mL/kg/min (1.67–3.65), the SF-36 (physical functioning) score 6.02 (0.51 to 11.53) and a 6 min walk time of 79.6 m (53.37–105.84). A standardised mean difference showed a reduction in depression scores with an effect size of −0.67 (−0.97 to −0.38). The evidence was less clear for other outcomes such as waist circumference fasting glucose, SF-36 (mental health) and serum lipids such as high-density lipids. There were no notable adverse side effects reported in any of the studies.

Conclusions Walking groups are effective and safe with good adherence and wide-ranging health benefits. They could be a promising intervention as an adjunct to other healthcare or as a proactive health-promoting activity.

To cite: Hanson S, Jones A. *Br J Sports Med* 2015;**49**:710–715.

INTRODUCTION

Regular physical activity positively impacts health potentially offering similar effects to some drug interventions in terms of mortality benefits. Indeed, it has been suggested as an alternative or adjunct to conventional drug therapy.[1] Walking at a pace of 3–5 m/h (5–8 km/h) expends sufficient energy to be classified as moderate intensity[2] and is an easy and accessible way of meeting physical activity recommendations.[3] Systematic reviews and meta-analyses have shown walking to have various health benefits including positive effects on fitness, fatness and resting blood pressure,[4] blood pressure control,[5] weight loss,[6] depression[7] and cardiovascular disease risk prevention.[8]

Despite evidence and government campaigns such as Change4life[9] to promote physically active lifestyles, few are active enough to be of benefit to general health. In England, for example, 29% of adults do less than 30 min of moderate physical activity per week[10] and about 8% do not even walk continuously for 5 min over 4 weeks.[11] The impact of interventions in primary care to reduce inactivity appears limited; simple advice to be more active has only moderate yet short-term effects and an effective way of increasing physical activity and improving associated health indicators while also making the most efficient use of doctors' resources has yet to be determined.[12–14]

One way to promote and sustain walking behaviours at the population level may be through the provision of outdoor walking groups.[15] Walking groups are typically short walks of under an hour in the natural environment, run by trained lay people. An example of such is 'Walking for Health', a scheme originally set up by an Oxford General Practitioner in 2000. It is England's largest network of lay-led health group walks with 70 000 regular walkers, 10 000 volunteer walk leaders and approximately 3000 short walks offered every week.[16] Group walking is a potentially attractive physical activity intervention that has particular potential to engage those who are interested in the outdoors, whether for leisure or as a health intervention and has been found to be cost-effective in increasing physical activity.[17] Additionally, the dynamics and social cohesion of walking groups may have supportive effects that encourage and sustain adherence and positive attitudes towards physical activity,[18] companionship and a shared experience of wellness.[19] A systematic review in 2007 by Ogilvie *et al*[20] concluded that people could be encouraged to walk more if interventions were tailored to their needs and targeted at the most sedentary or at those most motivated to change and that group-based approaches, such as the social support of walking groups, are one method of delivering this. In a recent review, walking groups were found to be efficacious at increasing physical activity, particularly when targeted at older adults.[21] However, it remains that the benefits to health from increasing physical activity are greater than increasing fitness levels, yet no review to date has attempted to quantify the wider health benefits of walking groups. Hence, this review has been undertaken to understand whether there is evidence that outdoor walking groups show wider health benefits as an intervention and therefore could be recommended by clinicians.

METHODS

This systematic review followed Cochrane systematic review guidelines,[22] requirements of the NHS National Institute of Health Research Centre for

Reviews and Dissemination[23] and the PRISMA statement for reporting studies that evaluate healthcare interventions.[24 25] Methods of the analysis and inclusion criteria were specified in advance and documented in a protocol registered as CRD42013006397[23] available at http://www.crd.york.ac.uk/prospero/

Data sources

We searched using electronic databases; clinical trials registers; by scanning reference lists of articles and from grey literature. For the electronic databases, the search with specific search terms was applied in to AMED, EMBASE, MEDLINE (R) in process and other non-indexed citations and PsycINFO (sourced through OVID); SportDiscus and CINAHL (sourced through EBSCO) and SCOPUS with no date restriction. Databases were selected to best represent source material in health, allied health, physical activity and human science. Clinical trials registers were searched through the UK clinical trials research network study portfolio; clinicaltrials.gov and controlledtrials.com. Grey literature included reports from Natural England, Walking for Health and the National Institute for Health and Care Excellence. Additionally, reference lists from included studies and systematic reviews on exercise and walking were hand searched. The search was completed in November 2013.

Inclusion criteria were studies of outdoor walking groups involving adults with measured physiological, psychological or well-being outcomes. The search was restricted to papers published in English. The inclusion criteria are further detailed in table 1.

Search terms were developed with reference to the previous systematic reviews on walking[20 21] and key words from relevant studies. They were piloted to ensure that known studies were identified. The search syntax for the electronic databases is detailed in online supplementary information appendix (i). For clinical trials registers, the only search term was 'walking' within the title.

Study selection

All studies where the outcome could be directly attributable to the group walking were included. This included studies where walking was the control group. All studies were reviewed by the first reviewer and duplicates or the clearly irrelevant, for example, walk-in centres, using wii-fit, or studies using children or animals that had not been screened out by the database filters were excluded. A particular issue with the assessment of the studies was that the phrase 'walking group' often related to a walking arm of a study, or a group within a trial that could walk, and not a 'walking group' per se. Additionally, there was commonly little information within the abstract about the setting of the intervention, for example, treadmill or indoor circuit-based interventions or home-based solo interventions with physical activity diaries and pedometers. Therefore, most studies were retrieved as full texts and scanned for intervention information to ensure that none were excluded incorrectly. Owing to the generally poor description of the intervention, 40 authors were contacted to confirm whether the study was an outdoor intervention and that they walked as a group. To further ensure that studies had been correctly excluded, 15% of the excluded studies were selected by random number generation and screened by the second author (AJ). All papers were found to have been excluded correctly and therefore no further excluded studies were reviewed.

Data extraction

A data extraction sheet was developed by both authors to summarise the study, the population, walking group characteristics, the intervention (volume and intensity), adherence and outcomes. This was piloted on five manuscripts and refined accordingly. Data were extracted by the first reviewer into a coding frame using Microsoft Excel, synthesised and tabulated.

Risk of bias in individual studies and across studies within meta-analyses

As not all studies were randomised controlled trials, a tool used by Ogilvie *et al*[20] was adapted to assess risk of bias and internal validity[26] with nine items on a binary scale. These were:

1. Randomisation: Was there sufficient description of a randomisation process or statistical test to show that comparability between the two groups has been adjusted for (no explanation scores scored zero)?
2. Exposure: Did the authors show that there was no evidence of a concurrent intervention which could have influenced the results (no explanation scores zero)?

Table 1 Inclusion and exclusion criteria

Inclusion	Exclusion
Adults from the age of 19	Youths and children up to and including 18
Interventions where people walk as part of a defined walking group intervention	Studies that do not involve a walking group intervention, eg, they walk with a physiotherapist
Where the walking is group based, or where the walking is predominantly group based but participants may also walk on their own to supplement this	Participants walking only rarely in groups, or walking on their own, such as home-based or pedometer-based programmes with no group walking
Walking outdoors or walking predominantly outdoors but occasionally indoors (eg, inside tracks or shopping malls for weather reasons)	Walking indoors or predominantly indoors
Studies that compare group walking with group Nordic walking where group walking can be isolated as an intervention and the outcome directly related to group walking	Studies examining Nordic walking only
Studies with physiological, psychological or well-being outcomes such as blood profiles (eg, lipids, HbA1c), cardiovascular measures (eg, BP), psychological (eg, Beck depression inventory), well-being (eg, EQ5D)	Studies where the outcomes are solely physical activity such as step outcomes or logs of physical activity
Studies where the outcome can directly be related to the walking group intervention	Studies with a mixed intervention (eg, walking with calcium supplements or walking combined with a health education intervention) where the outcome cannot be isolated and directly attributed to group walking
Papers and documents written in English	Papers and documents not written in English

3. Representativeness: Were the study samples shown to be representative of the study population?
4. Comparability: Were baseline characteristics of the intervention comparable with the control or were potential confounders at baseline appropriately adjusted for in analysis?
5. Attrition: Were numbers of participants at follow-up identifiable as at least 80% of the baseline?
6. Follow-up tools: Were valid and reliable tools used to assess participant outcomes?
7. Follow-up time scale: Was the time to follow-up assessment of a period no less than 1 month?
8. Precision of the results: Were CIs or p values given?
9. Was there evidence presented that the study was sufficiently powered at follow-up assessment (no evidence or underpowered scores zero)?

Publication bias across studies within the meta-analysis was tested with funnel plots using SE as the measure of study size on the vertical axis[27] and mean difference on the horizontal.

Synthesis of results and statistical analysis

Data for the final studies were synthesised with results for each study recorded as change from baseline to the end of the intervention (↑↓) with p values where available. Non-significant or imprecise p values, such as p>0.05, were used only when this was the only available information. No assumptions were made about walking outside the group provision. To establish the mean difference between baseline and the end of intervention for meta-analysis, baseline data with SD and sample size, and end of intervention data with SD or SE and sample size were utilised. All data were continuous and a difference in means was used except for one analysis; for depression a standardised mean difference was used to account for the different outcome measurements used in the five studies. There was no need for data to be transformed as a reduction in value indicated an improvement in health in all four outcome measures within this analysis. A fixed effects model was used for all analyses representing a more conservative measure than a random effects model.[22] Where data were given for different subgroups, each was input separately and combined in meta-analyses using the RevMan software package.[28] All results are presented with 95% CIs. The I^2 statistic was used to test for heterogeneity. I^2 values of 30–60% and 50–90% were taken to represent moderate and substantial heterogeneity, respectively (ref. 22, Ch 9.5.2).

RESULTS

The initial database search yielded 5145 citations. In addition, the other supplementary sources produced a further 60 studies. Of these 5205 studies, 4627 were removed as duplicates or as clearly irrelevant after reviewing titles. The abstracts of 578 articles were screened and any that did not provide enough information were retrieved for full-text evaluation. A total of 150 papers were read as full texts to be assessed for eligibility. The remaining 46 articles were put forward for second review and independently assessed by the second reviewer (AJ). From this, 10 papers were discussed between the two reviewers. Three studies were excluded due to a lack of information despite repeated attempts to contact authors as the reviewers lacked confidence that the intervention was group based and outdoors. One was excluded on further discussion due to the walking being primarily self-directed. In total, 42 studies met the inclusion criteria and were eligible to be included in the synthesis. Walking groups were used as a control in seven of the studies. The review flow chart is detailed in online supplementary figure S1. The characteristics and synthesised results from all 42 studies are detailed in online supplementary table S1.

All 42 studies were assessed for risk of bias (table 2). No study was excluded due to a low-quality score. Assessments of quality were made by the first reviewer and 20% of the studies were chosen by random number generation and checked by the second reviewer. An inter-rater reliability analysis using the κ statistic was performed to determine consistency among raters and found to be κ 0.66 (p<0.001) representing substantial agreement.

Study characteristics

Although there was no date restriction on the search, 74% of the articles were studies in the past 10 years suggesting the recent interest in walking groups, with no papers prior to 1988 meeting the inclusion criteria. Studies were located in 14 different countries but predominantly in the USA (n=15). A total of 1843 participants walked in outdoor walking groups with at least 1488 h of provision (3 studies did not give enough information from which to calculate dosage) and a total of 74 023 h of participant walking time. Walking groups were used with participants with a broad range of health conditions: arthritis,[29 30] dementia and cognitive impairment,[31–33] diabetes,[34–36] fibromyalgia,[37–39] obesity and overweight,[40–44] mental health issues[45–49] and Parkinson's disease[50] with 64 different tools used to test outcomes.

In terms of participants, 76% were women while 43% of the studies were for women only; there were no studies for men only. The grand mean age was 58 years with 15 studies specifically aimed at older participants. There was subanalysis in four studies: ethnicity,[40] intensity[47 51] and gender.[43] Two studies were of people with learning disabilities living in care facilities: one obese adults with Prader-Willi syndrome,[52] and the second the coronary heart disease risk of adults with learning disabilities.[43] Eleven studies described the ethnicity of the participants and 13 studies provided some socioeconomic information. Brandon and Elliott-Lloyd[40] compared the response between African-American women, and the O'Hara *et al*[44] study was specifically for African-American women. Otherwise there was no evaluation of effect for different ethnicities.

Interventions were varied, in volume and intensity, ranging from 168 to 8580 min of walking over a period of 3 weeks to 1 year, with intensity ranging from self-selected and low to brisk walking and high-intensity intervals. Moore-Harrison *et al*[53] specifically targeted those of low socioeconomic profile, and Isaacs *et al*[54] provide subanalysis of uptake of walking group intervention by socioeconomic status. Where supervision was described, it was by professionals, such as physiotherapists, possibly as the interventions were part of clinical trials. Where described, provision was in rural locations in 6 of the studies, and urban for 15. Where additional information from authors has been obtained, this has been added to the results table 2 (see online supplementary information). Adherence and adverse effects are described in 76% of the papers. Mean adherence (where stated) was 75%. One study notes that adherence was lower for those without access to private transport.[54] For adverse effects, one study described one fall with a brief absence from the walking programme,[55] one a calf injury[46] and one, a study with participants with Parkinson's disease, describes one participant experiencing exercise-induced hypotension after intense uphill walking in hot weather and four falls on roots and wet ground.[50] Otherwise, either authors state that there were no injuries, or there is no reference to adverse effects. This is against a back drop of over 74 000 participant hours.

Table 2 Risk of bias for included studies

Author	Study type	Risk of bias items									Total score
		1	2	3	4	5	6	7	8	9	
Armstrong	RCT	1	0	1	1	1	1	1	0	1	7
Bjersing	RCT	1	0	1	1	1	1	1	1	0	7
Brandon	RCT	0	1	1	1	1	1	1	1	1	8
Brosseau	RCT	1	0	1	1	0	1	1	1	0	6
Cox	RCT	1	1	1	1	1	1	1	1	1	9
Duncan	RCT	0	1	1	1	1	1	1	1	0	7
Fisher	RCT	1	0	1	1	0	1	1	1	0	6
Gusi	RCT	1	0	1	1	1	1	1	1	1	8
Hamdorf	RCT	1	1	1	1	0	1	1	1	0	7
Hinkleman	RCT	0	1	1	1	0	1	1	1	0	6
Isaacs	RCT	1	1	1	1	1	1	1	1	1	9
Kamijo	RCT	0	1	1	1	1	1	1	1	0	7
Kayo	RCT	1	0	1	1	0	1	1	1	1	7
Legrand	RCT	0	0	1	1	1	1	1	1	0	6
Mannerkorpi	RCT	1	1	1	1	0	1	1	1	1	8
Moore-Harrison	RCT	0	0	1	1	1	1	1	1	0	6
Morrison	RCT	0	0	1	1	1	1	1	1	0	6
Negri	RCT	1	0	1	1	0	1	1	1	0	6
Palmer	RCT	0	1	1	1	1	1	1	0	0	6
Reuter	RCT	1	1	1	1	1	1	1	1	1	9
Rooks	RCT	1	1	1	1	1	1	1	1	0	8
van Uffelen	RCT	1	0	1	1	1	1	1	1	0	7
Callahan	Pre–post	0	0	1	1	1	1	1	1	0	6
Dallocchio	Pre–post	0	0	1	1	1	1	1	1	0	6
Fantin	Pre–post	0	0	1	1	1	1	1	1	1	7
Figard-Fabre	Pre–post	0	1	1	1	1	1	1	1	0	7
Gelecek	Pre–post	0	1	1	1	1	1	1	0	0	6
Holmberg	Pre–post	0	0	1	1	0	1	1	1	0	5
Moss	Pre–post	0	0	1	1	1	1	1	0	0	5
O'Halloran	Pre–post	0	0	1	1	1	1	1	0	0	5
O'Hara	Pre–post	0	0	1	0	1	1	1	0	0	4
Cavanaugh	CT	0	1	1	1	1	1	1	1	0	7
Fritz	CT	0	0	1	0	1	1	1	1	0	5
Park	CT	0	1	1	1	0	1	1	1	0	6
Roberts	CT	0	1	1	1	1	1	1	0	0	6
Silverthorn	CT	0	1	1	1	1	1	1	0	0	6
Song	CT	1	0	1	1	1	1	1	1	1	8
Takahashi	CT	0	1	0	1	1	1	1	1	0	6
Thomas	CT	0	0	1	1	1	0	1	0	0	4
Cyarto	Quasi-experimental	0	1	1	1	1	1	1	1	0	7
McDevitt	Quasi-experimental	0	0	1	1	1	1	1	1	0	6
Ng	Cohort study	0	0	1	0	1	1	1	0	0	4

(1) Randomisation, (2) exposure, (3) representativeness, (4) comparability, (5) attrition, (6) follow-up tools, (7) follow-up time scale, (8) precision of the results, (9) statistical power.
Grey scale indicates studies included in meta-analysis.
CT, controlled trial; RCT, randomised controlled trial.

Attrition was less clearly described but in one study there was a participant withdrawal as overweight and self-conscious;[45] one author states that travel to the walking club may have affected attrition,[29] and one describes the different attrition rates between African-American and white walkers.[40]

Meta-analysis

Common outcome measures enabled meta-analysis of 17 frequently used outcome measures, summarised in table 3 and presented in full in online supplementary information appendix (iii). Statistically significant improvements from baseline to end of intervention were identified for participants in the intervention groups for systolic and diastolic blood pressure, resting heart rate, body fat, body mass index (BMI), total cholesterol, VO_{2max}, quality of life for physical functioning, 6 min walk time and depression. For depression, a standardised mean difference of −0.67 (−0.97 to −0.38) represents a statistically significant moderate effect.[22] For other outcomes, the effects were not statistically significant.

There was zero heterogeneity in 12 of the analyses with 4 having an I^2 between 28% and 48%. The depression score had an I^2 of 83% suggesting a high level of heterogeneity between the studies. Using funnel plots, all studies were visually symmetrical with a narrow spread at the top of the funnel indicating precision

Table 3 Summary meta-analysis results table: difference between baseline and end of intervention

Outcome measure	n	Effect	95% CIs	Heterogeneity	Test for overall effect
Systolic BP (mm Hg)	440	−3.72	(−5.28 to −2.17)	χ^2=12.02, df=12 (p=0.44); I^2=0%	z=4.70 (p<0.001)
Diastolic BP (mm Hg)	440	−3.14	(−4.15 to −2.13)	χ^2=23.16, df=12 (p=0.03); I^2=48%	z=6.09 (p<0.001)
Resting HR (bpm)	252	−2.88	(−4.13 to −1.64)	χ^2=2.96, df=7 (p=0.89); I^2=0%	z=4.53 (p<0.001)
Body fat (%)	328	−1.31	(−2.10 to −0.52)	χ^2=4.00, df=6 (p=0.68); I^2=0%	z=3.25 (p=0.001)
Body mass index (kg/m^2)	451	−0.71	(−1.19 to −0.23)	χ^2=5.52, df=11 (p=0.90); I^2=0%	z=2.92 (p=0.003)
Total cholesterol (mmol/L)	271	−0.11	(−0.22 to −0.01)	χ^2=12.58, df=9 (p=0.18); I^2=28%	z=2.13 (p=0.03)
VO_{2max} (mL/kg/min)	166	2.66	(1.67 to 3.65)	χ^2=9.67, df=6 (p=0.14); I^2=38%	z=5.28 (p<0.001)
SF-36 score (physical functioning) (points)	68	6.02	(0.51 to 11.53)	χ^2=0.26, df=1 (p=0.61); I^2=0%	z=2.14 (p=0.03)
6 min walk time (m)	65	79.6	(53.37 to 105.84)	χ^2=0.71, df=1 (p=0.40); I^2=0%,	z=5.95 (p≤0.001)
Depression score*(effect size)	101	−0.67	(−0.97 to −0.38)	χ^2=24.14, df=4 (P≤0.001); I^2=83%	z=4.44 (p≤0.001)
Waist circumference (cm)	35	−3.55	(−8.08 to 0.98)	χ^2=0.52, df=1 (p=0.47); I^2=0%	z=1.54 (p=0.12)
HbA1c (%)	66	−0.11	(−0.25 to 0.03)	χ^2=1.17, df=3 (p=0.76); I^2=0%	z=1.53 (p=0.13)
Fasting glucose (mmol/L)	85	−0.09	(−0.28 to 0.11)	χ^2=3.33, df=4 (p=0.50); I^2=0%	z=0.87 (p=0.38)
Low-density lipids (mmol/L)	268	−0.05	(−0.16 to 0.06)	χ^2=8.83, df=9 (p=0.45); I^2=0%,	z=0.93 (p=0.35)
High-density lipids (mmol/L)	251	0.01	(−0.04 to 0.07)	χ^2=8.04, df=8 (p=0.43); I^2=0%	z=0.45 (p=0.65)
Triglycerides (mmol/L)	271	−0.05	(−0.12 to 0.03)	χ^2=13.39, df=9 (p=0.15); I^2=33%	z=1.25 (p=0.21)
SF-36 score (mental health index) (points)	68	2.70	(−2.09 to 7.48)	χ^2=0.18, df=1 (p=0.67); I^2=0%	z=1.10 (p=0.27)

*All analyses fixed effects model and mean difference except depression score (effect is standardised mean difference).
BP, blood pressure; HbA1c, glycated haemoglobin; HR, heart rate.

with results close to the pooled estimate and without bias towards smaller studies (see online supplementary appendix ii).

In order to test if the impact of the group walking was greater in those with clearly defined morbidity, a sub analysis was completed for the conditions of overweight or obese (BMI≥25), Type II diabetes (as defined by authors) and depression (as defined by authors). For depression and BMI this strengthened the results. By only including those defined as depressed[17 45 47] the effect size became large −0.76 (−1.12 to −0.41). By only including those with a BMI ≥25[17 34 35 40 41 43 54 56 57] the mean difference increased to −0.75 (−1.26 to −0.24). For glycated haemoglobin (HbA1c) and fasting glucose, only including those with type II diabetes[34 35] the mean differences remained statistically not significant −0.16 (−0.40 to 0.08) and −0.57 (−1.58 to 0.43) respectively.

DISCUSSION

Principal findings

This systematic review and meta-analysis provides evidence that outdoor walking groups have health benefits over and above making people more physically active. Statistically significant improvements were found in a range of widely used measures of health; systolic and diastolic blood pressure, resting heart rate, body fat, BMI, total cholesterol, VO_{2max}, depression, 6-min walk time, and quality of life for physical functioning. This is despite the fact that the majority of the interventions (75%) were below international moderate activity guidelines which may account for some of the effect sizes being small. Walking groups appear an acceptable intervention to participants with high levels of adherence and a low risk of serious adverse effects.

Strengths and limitations

The strength of this review is that it has comprehensively sought out walking group studies. It has extensively analysed 42 different studies with 1843 participants involved in over 74 000 participant hours of group walking. It has also extracted information for 17 meta-analyses to provide evidence of health benefits and within these was generally zero or low heterogeneity. Limitations of the study are that only manuscripts published in English were sought. Additionally, the populations in the included studies are very different with many small studies. The lack of information on walking dose in many of the studies mean it was not possible to undertake an analysis of dose–responses.

Results in context of other published reviews

Kassavou *et al*[21] found that walking groups increase physical activity. The results from this study extend these findings by providing evidence of the wide-ranging health benefits of group walking.

Clinicians and therapists may however be asked whether walking in groups has similar health benefits than walking per se or the use of a pedometer, a widely used method of increasing walking. To explore this, the results of the meta-analysis within this study were compared first with meta-analyses of walking and then with pedometers.

In terms of depression, Robertson *et al*[7] in their meta-analysis of walking using a fixed effects model, found a standardised mean effect size of −0.86 (−1.12 to −0.61), comparable to the effect size of −0.67 (−0.97 to −0.38) in this review of group walking. In terms of cardiovascular health, a systematic review by Murphy *et al*[4] of walking using a random effects model found statistically significant reductions in body fat, BMI and diastolic blood pressure and increases in VO_{2max}. The effects were however of a smaller magnitude than those found in this study; a reduction of diastolic blood pressure of 1.54 mm Hg from walking compared with 3.14 mm Hg in group walking; a reduction in BMI of 0.2 kg/m^2 compared with 0.7 kg/m^2; and a reduction of body fat of 0.63% from walking compared with a reduction of 1.31% in group walking. In addition, Murphy *et al* did not find a statistically significant reduction in systolic blood pressure (−1.06 mm Hg, p=0.316) from walking in contrast to the significant reduction in systolic blood pressure (−3.72 mm Hg, p<0.001) found from group walking in this review. Murphy *et al*[4] stated a relative reduction of 0.8% in systolic and 2% in diastolic blood pressure. This is comparable to a previous meta-analysis of walking and resting blood pressure[58]

which found a 2% reduction in systolic and diastolic from walking. In comparison, this review of group walking found reductions of 3% in systolic 5% in diastolic blood pressure, representing a greater reduction than those from walking alone. The importance of this difference becomes significant when viewed against findings that a 2 mm Hg in diastolic blood pressure can reduce coronary heart disease risk by 6% and stroke and trans-ischaemic attacks by 15%.[59] Further evidence of the importance of this reduction comes from a meta-analysis of prospective studies which suggested that a persistent reduction in average blood pressure by widely practicable methods could avoid large absolute numbers of premature deaths and disabling strokes and a reduction of only 2 mm Hg in systolic blood pressure could reduce stroke mortality by 10% and mortality from vascular causes in a middle-aged population by 7%.[60] Outdoor walking groups could be an example of such a practicable method. The second part of this further analysis compared the results from this systematic review of group walking to a systematic review and meta-analysis of pedometers to increase physical activity and improve health outcomes.[61] Again walking groups were found to have comparable and greater results to those from pedometers in reductions in BMI, systolic and diastolic blood pressure and total cholesterol. This was particularly significant for diastolic blood pressure with the use of pedometers showing a reduction of −0.3 mm Hg (−0.02 to −0.46) compared with walking groups −3.14 mm Hg (−4.15 to −2.13). It should be noted that the two comparator systematic reviews included outdoor group walking as well as other methods (indoors and solo) in their meta-analysis; within the systematic review of pedometers some of the participants may have walked within a workplace group and additionally people who walk in groups invariably walk by themselves too. Therefore, this further analysis is not a straightforward comparison of non-group versus group methods but this comparison has provided some evidence that group walking may have benefits to health at least equal to walking with pedometers and walking per se.

Conclusions and meaning of the study for clinicians

This systematic review with meta-analysis has found that outdoor walking groups have wide-ranging health benefits. With low levels of attrition, high levels of adherence and virtually no adverse effects this study suggests that walking groups could be a practicable intervention, acceptable to patients as a line of treatment with a potential for both physiological and psychological health benefits. It may provide clinicians with evidence of a further effective option to recommend to those patients who would benefit from increasing moderate physical activity.

Unanswered questions and further research

One study evaluated the results based on three different walk speeds.[51] Otherwise, there were insufficient studies meeting moderate activity guidelines from which to conduct a subanalysis and suggest any tentative conclusions about effectiveness of walking groups and time or intensity. It may be that effect sizes could be improved by increasing volume and intensity and this important question remains unanswered. A lack of socioeconomic information prevented analysis of the distribution and effects between different social groups confirming concerns raised by Ogilvie *et al*[20] that such targeted interventions may be preferentially utilised by better-off groups[62] and may thereby increase health inequalities.[63] The issue of equity could be addressed in future research. Additionally, the majority of the studies in this analysis were with people with diagnosed health conditions or cardiovascular disease risk factors; therefore, the potential benefit of walking groups in maintaining good health in healthy populations is not known. Nevertheless, this review has shown that there are wide-ranging health benefits from outdoor walking groups and these appear not to be counterbalanced by an increase in injuries or other adverse side effects.

What are the new findings?

- Outdoor walking groups have wide-ranging health benefits including reducing blood pressure, body fat, total cholesterol and risk of depression.
- Outdoor walking groups appear to be an acceptable intervention to participants, with high levels of adherence and virtually no adverse effects.

How might it impact on clinical practice in the near future?

Provides clinicians with evidence of a further effective option to recommend to those patients who would benefit from increasing moderate physical activity.

Acknowledgements This work was partially supported by the Centre for Diet and Activity Research (CEDAR), a UKCRC Public Health Research Centre of Excellence. Funding from the British Heart Foundation, Economic and Social Research Council, Medical Research Council, National Institute for Health Research and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged. The authors thank William Jones, faculty librarian for his help in the search strategy and Dr Toby Smith for helpful advice and comments.

Contributors SH and AJ designed the protocol and the search strategy which was executed by SH. SH screened the initial results and extracted data from the primary studies. SH drafted the original manuscript which was critically revised by AJ.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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BRITISH JOURNAL OF SPORTS MEDICINE

Walking groups come out trumps for boosting overall health without side effects

Benefits include reductions in blood pressure, body fat, total cholesterol and depression risk

[Is there evidence that walking groups have health benefits? A systematic review and meta-analysis Online First doi 10.1136/bjsports-2014-094157]

Joining a walking group is one of the best and easiest ways to boost overall health, with virtually no side effects, suggests an analysis of the available evidence, published online in the **British Journal of Sports Medicine**.

The benefits are wide ranging, and what's more, members find it relatively easy to stick with this type of exercise regime.

The findings prompt the researchers to suggest that doctors and other healthcare professionals should recommend joining a walking group as a way of boosting health.

They assessed the available evidence from a wide range of sources on the physical and mental health consequences of joining an outdoor walking group for adults, and published up to the end of 2013.

They found 42 studies, involving almost 2000 people, which met all their criteria. Three-quarters of their haul had been published within the past decade, suggesting growing interest in the potential health benefits of walking groups.

The studies involved participants from 14 different countries, with a wide range of long term conditions, including arthritis, dementia, diabetes, fibromyalgia, obesity/overweight, mental health issues, and Parkinson's disease.

Analysis of the pooled data showed that walking groups have wide ranging benefits, above and beyond making people more physically active.

People who joined these groups registered statistically significant falls in average blood pressure, resting heart rate, body fat, weight, and total cholesterol.

The evidence was less clear-cut for reductions in other risk factors for ill health, such as waist circumference, fasting blood glucose, and blood fats.

But walkers also experienced improvements in lung power, overall physical functioning, and general fitness, and they were less depressed than before they started walking regularly.

Three quarters of all the participants stuck with the group, and there were few side effects to speak of, apart from a handful of falls on roots or wet ground.

The researchers point out that in England, at least, 29% of adults do less than 30 minutes of moderate physical activity every week, and almost one in 10 don't even manage to walk for more than five minutes at a time over a month.

Efforts by doctors to bump up total physical activity levels often fall on stony ground, they explain.

"Walking groups are effective and safe with good adherence and wide ranging health benefits," they write. "They could be a promising intervention as an adjunct to other healthcare, or as a proactive health-promoting activity."

And the social aspect of walking groups may help to foster positive attitudes towards physical activity, they suggest.

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Embargoed link to research: http://press.psprings.co.uk/bjsm/january/bjsm094157.pdf
Public link to research: http://bjsm.bmj.com/lookup/doi/10.1136/bjsports-2014-094157

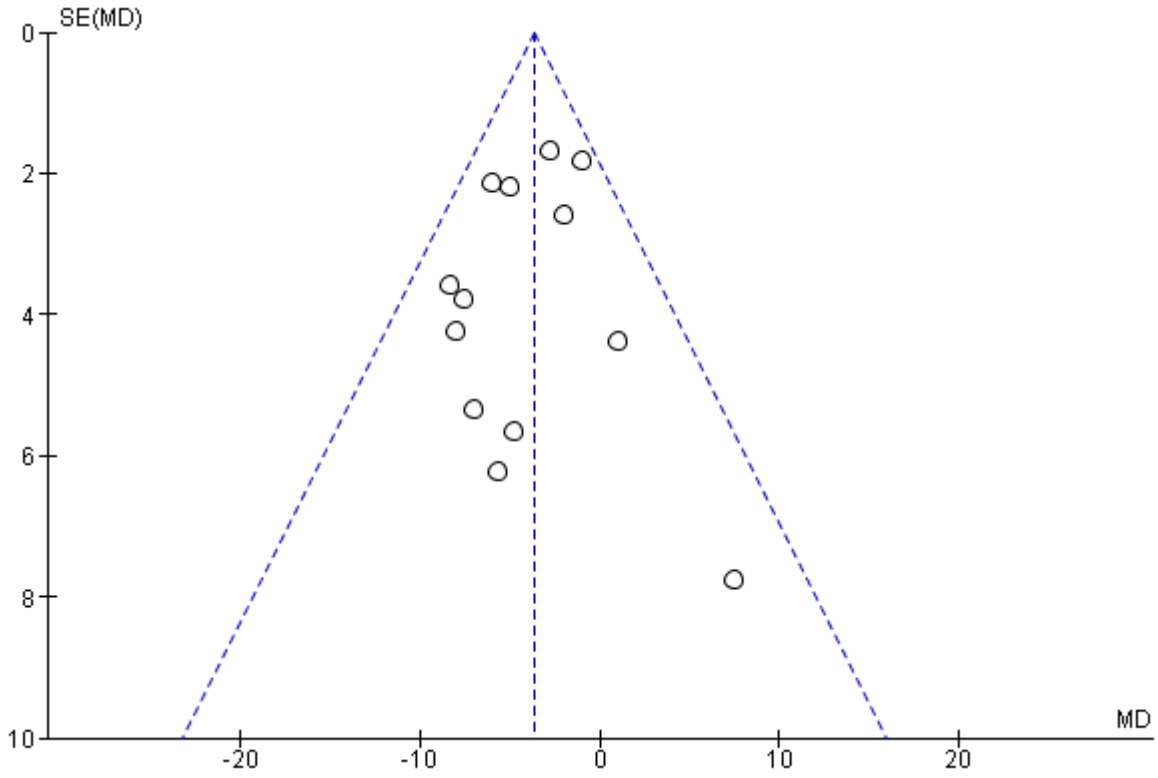
SUPPLEMENTARY INFORMATION

Appendix (i) Search syntax for electronic databases

1. "walk* program*".af.
2. "walk* intervention".af.
3. "health walk*".af.
4. "nordic walk*".af.
5. "walk* group*".af.
6. "walk* club*".af.
7. "lay led walk*".af.
8. "community based walk*".af.
9. "community walk*".af.
10. "walk* scheme*".af.
11. "walk* for health".af.
12. "group physical activity". af.
13. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
14. remove duplicates from 13
15. limit 14 to "all adult (19 plus years)"
16. limit 15 to English language

af represents all fields
* or $ sign used as truncation wildcard as appropriate to each database

Appendix (ii) Example funnel plot (systolic blood pressure)

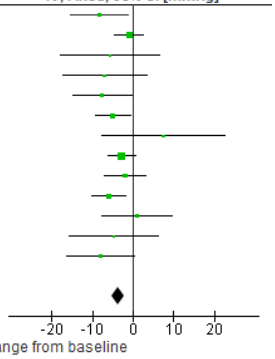


Appendix (iii) Results from Meta-analysis

Systolic blood pressure

Study or Subgroup	WG end of intervention Mean [mmHg]	SD [mmHg]	Total	WG Baseline Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Fixed, 95% CI [mmHg]
Brandon 2006	102.4571	13.733	28	110.7571	13.1328	28	4.9%	-8.30 [-15.34, -1.26]
Duncan 1991	106.3953	9.7117	43	107.3721	6.9813	43	18.9%	-0.98 [-4.55, 2.60]
Fantin 2012	140.27	15.41	21	145.95	23.93	21	1.6%	-5.68 [-17.85, 6.49]
Figard-Fabre 2010	129	12	11	136	13	11	2.2%	-7.00 [-17.45, 3.45]
Fritz 2006	138.6	9.6693	17	146.2	12.2	17	4.4%	-7.60 [-15.00, -0.20]
Gelecek 2006	105	8.5	29	110	8.3	29	12.9%	-5.00 [-9.32, -0.68]
Hamdorf 1999	152.1	25.4558	18	144.6	20.7889	18	1.0%	7.50 [-7.68, 22.68]
Isaacs 2007	133.3	11.7683	103	136.1	21.5149	311	22.2%	-2.80 [-6.10, 0.50]
Morrison 2009	120	8	19	122	8	19	9.3%	-2.00 [-7.09, 3.09]
Moss 2009	111.47	14.4743	100	117.53	15.5923	100	13.9%	-6.06 [-10.23, -1.89]
Negri 2010	134	13.9	21	133	14.5	21	3.3%	1.00 [-7.59, 9.59]
Palmer 1995	112.3	17.7	16	117.1	14	16	2.0%	-4.80 [-15.86, 6.26]
Takahashi 2013	123	11.225	14	131	11.225	14	3.5%	-8.00 [-16.32, 0.32]
Total (95% CI)			**440**			**648**	**100.0%**	**-3.72 [-5.28, -2.17]**

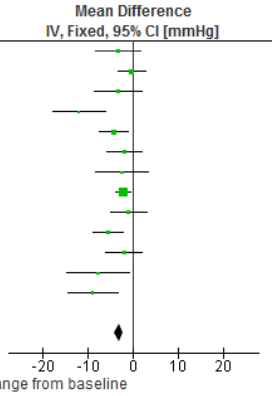
Heterogeneity: Chi² = 12.02, df = 12 (P = 0.44); I² = 0%
Test for overall effect: Z = 4.70 (P < 0.00001)



Diastolic blood pressure

Study or Subgroup	WG end of intervention Mean [mmHg]	SD [mmHg]	Total	WG Baseline Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Fixed, 95% CI [mmHg]
Brandon 2006	65.2143	9.5435	28	68.4929	9.4851	28	4.1%	-3.28 [-8.26, 1.71]
Duncan 1991	72.093	6.6505	43	72.3721	8.1373	43	10.4%	-0.28 [-3.42, 2.86]
Fantin 2012	79.18	7.12	21	82.43	10.12	21	3.7%	-3.25 [-8.54, 2.04]
Figard-Fabre 2010	73	7	11	85	7	11	3.0%	-12.00 [-17.85, -6.15]
Fritz 2006	80.9	3.3419	17	85.2	5.6	17	10.7%	-4.30 [-7.40, -1.20]
Gelecek 2006	72	8.7	29	74	6.4	29	6.6%	-2.00 [-5.93, 1.93]
Hamdorf 1999	76.1	8.4853	18	78.6	9.3338	18	3.0%	-2.50 [-8.33, 3.33]
Isaacs 2007	82.1	7.1633	103	84.3	10.0521	311	32.4%	-2.20 [-3.98, -0.42]
Morrison 2009	78	6	19	79	7	19	6.0%	-1.00 [-5.15, 3.15]
Moss 2009	70.94	12.0829	100	76.53	12.9439	100	8.5%	-5.59 [-9.06, -2.12]
Negri 2010	78	7.1	21	80	6.2	21	6.3%	-2.00 [-6.03, 2.03]
Palmer 1995	73.2	9.5	16	80.9	10.6	16	2.1%	-7.70 [-14.67, -0.73]
Takahashi 2013	70	7.4833	14	79	7.4833	14	3.3%	-9.00 [-14.54, -3.46]
Total (95% CI)			**440**			**648**	**100.0%**	**-3.14 [-4.15, -2.13]**

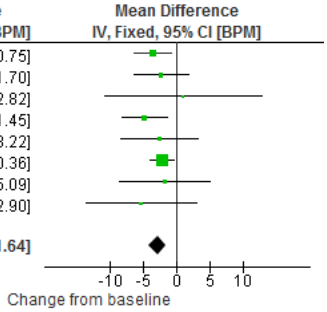
Heterogeneity: Chi² = 23.16, df = 12 (P = 0.03); I² = 48%
Test for overall effect: Z = 6.09 (P < 0.00001)



Resting heart rate

Study or Subgroup	WG end of intervention Mean [BPM]	SD [BPM]	Total	WG Baseline Mean [BPM]	SD [BPM]	Total	Weight	Mean Difference IV, Fixed, 95% CI [BPM]
Cox 2006	65.1867	7.54	49	68.7867	7.5433	60	19.2%	-3.60 [-6.45, -0.75]
Fantin 2012	76.5	5.93	21	78.82	7.3	21	9.6%	-2.32 [-6.34, 1.70]
Figard-Fabre 2010	81	16	11	80	12	11	1.1%	1.00 [-10.82, 12.82]
Gelecek 2006	73.8	6.2	29	78.6	6.8	29	13.9%	-4.80 [-8.15, -1.45]
Hamdorf 1999	71.8	8.9095	18	74.4	8.9095	18	4.6%	-2.60 [-8.42, 3.22]
Isaacs 2007	63	4.3359	102	65.2	10.5811	160	45.9%	-2.20 [-4.04, -0.36]
Palmer 1995	72.2	9	16	74	10.8	16	3.3%	-1.80 [-8.69, 5.09]
Silverthorn 1993	56	7.1	6	61.33	7.45	6	2.3%	-5.33 [-13.56, 2.90]
Total (95% CI)			**252**			**321**	**100.0%**	**-2.88 [-4.13, -1.64]**

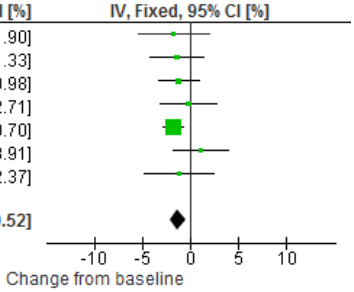
Heterogeneity: Chi² = 2.96, df = 7 (P = 0.89); I² = 0%
Test for overall effect: Z = 4.53 (P < 0.00001)



Body fat

Study or Subgroup	WG end of intervention Mean [%]	SD [%]	Total	WG Baseline Mean [%]	SD [%]	Total	Weight	Mean Difference IV, Fixed, 95% CI [%]
Brandon 2006	43.2964	7.0012	28	45.0643	6.9943	28	4.7%	-1.77 [-5.43, 1.90]
Duncan 1991	25.9043	6.7869	46	27.3174	6.6319	46	8.3%	-1.41 [-4.16, 1.33]
Figard-Fabre 2010	39.9	2.4	11	41.1	2.8	11	13.2%	-1.20 [-3.38, 0.98]
Hinkleman1993	36.3	4.2426	18	36.5	4.6669	18	7.4%	-0.20 [-3.11, 2.71]
Isaacs 2007	36.22	2.3139	104	38	8.8176	311	54.0%	-1.78 [-2.86, -0.70]
Moss 2009	26.2545	11.0559	100	25.2	9.4945	100	7.7%	1.05 [-1.80, 3.91]
Song 2013	30.7	5.6	21	31.9	6.2	21	4.9%	-1.20 [-4.77, 2.37]
Total (95% CI)			**328**			**535**	**100.0%**	**-1.31 [-2.10, -0.52]**

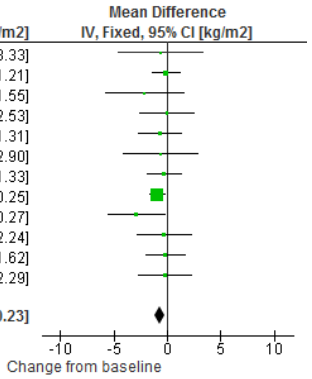
Heterogeneity: Chi² = 4.00, df = 6 (P = 0.68); I² = 0%
Test for overall effect: Z = 3.25 (P = 0.001)



BMI

Study or Subgroup	WG at end of intervention Mean [kg/m2]	SD [kg/m2]	Total	WG Baseline Mean [kg/m2]	SD [kg/m2]	Total	Weight	Mean Difference IV, Fixed, 95% CI [kg/m2]
Brandon 2006	31.4607	7.7792	28	32.125	7.4497	28	1.4%	-0.66 [-4.65, 3.33]
Cox 2006	26.3182	3.5272	49	26.4382	3.5272	60	12.9%	-0.12 [-1.45, 1.21]
Dallachio 2010	21.92	4.9	14	24.07	5.1	14	1.7%	-2.15 [-5.85, 1.55]
Fantin 2012	28.58	3.8	21	28.63	4.69	21	3.4%	-0.05 [-2.63, 2.53]
Figard-Fabre 2010	31.6	2.2	11	32.3	2.6	11	5.7%	-0.70 [-2.71, 1.31]
Fritz 2006	31.2	5.2	17	31.8	5.2	17	1.9%	-0.60 [-4.10, 2.90]
Gusi 2008	29.4	4.2	51	29.7	4.2	51	8.6%	-0.30 [-1.93, 1.33]
Isaacs 2007	29.65	1.0798	104	30.6	6	311	46.9%	-0.95 [-1.65, -0.25]
Moss 2009	26.2545	11.0559	100	29.159	7.608	100	3.3%	-2.90 [-5.53, -0.27]
Negri 2010	28.9	4.2	21	29.2	4.2	21	3.5%	-0.30 [-2.84, 2.24]
Song 2013	23	3.1	21	23.2	2.9	21	6.9%	-0.20 [-2.02, 1.62]
Takahashi 2013	22.1	3.3675	14	22.3	3.3675	14	3.7%	-0.20 [-2.69, 2.29]
Total (95% CI)			**451**			**669**	**100.0%**	**-0.71 [-1.19, -0.23]**

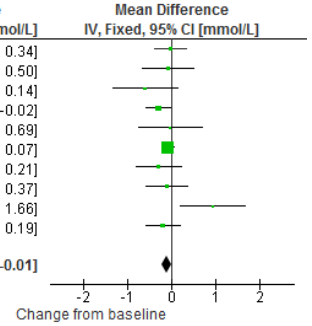
Heterogeneity: Chi² = 5.52, df = 11 (P = 0.90); I² = 0%
Test for overall effect: Z = 2.92 (P = 0.003)



Total cholesterol

Study or Subgroup	WG end of intervention Mean [mmol/L]	SD [mmol/L]	Total	WG Baseline Mean [mmol/L]	SD [mmol/L]	Total	Weight	Mean Difference IV, Fixed, 95% CI [mmol/L]
Duncan 1991	4.7719	0.843	43	4.7902	0.8623	43	8.5%	-0.02 [-0.38, 0.34]
Fantin 2012	5.79	0.91	21	5.87	1.02	21	3.2%	-0.08 [-0.66, 0.50]
Fritz 2006	5.1	1.1	17	5.7	1.1	17	2.0%	-0.60 [-1.34, 0.14]
Gelecek 2006	3.43	0.6	29	3.73	0.46	29	14.7%	-0.30 [-0.58, -0.02]
Hinkleman1993	5.04	1.1455	18	5.07	1.0607	18	2.1%	-0.03 [-0.75, 0.69]
Isaacs 2007	5.68	0.6519	75	5.76	0.07	258	50.8%	-0.08 [-0.23, 0.07]
Morrison 2009	5.1	0.8	19	5.4	0.8	19	4.3%	-0.30 [-0.81, 0.21]
Negri 2010	4.53	0.72	21	4.63	0.83	21	5.0%	-0.10 [-0.57, 0.37]
Park 2013	6.08	0.7249	7	5.15	0.6614	7	2.1%	0.93 [0.20, 1.66]
Song 2013	5	0.6	21	5.2	0.7	21	7.1%	-0.20 [-0.59, 0.19]
Total (95% CI)			**271**			**454**	**100.0%**	**-0.11 [-0.22, -0.01]**

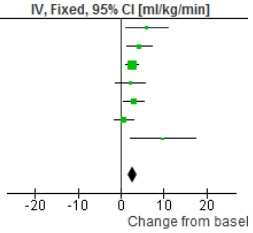
Heterogeneity: Chi² = 12.58, df = 9 (P = 0.18); I² = 28%
Test for overall effect: Z = 2.13 (P = 0.03)



VO2 max.

Study or Subgroup	WG end of intervention Mean [ml/kg/min]	SD [ml/kg/min]	Total	WG Baseline Mean [ml/kg/min]	SD [ml/kg/min]	Total	Weight	Mean Difference IV, Fixed, 95% CI [ml/kg/min]
Armstrong 2004	31.53	5.3	9	25.55	5.5	9	3.9%	5.98 [0.99, 10.97]
Brandon 2006	36.4393	5.3991	28	32.1429	5.5874	28	11.8%	4.30 [1.42, 7.17]
Cox 2006	30.09	4.165	49	27.551	4.165	60	39.5%	2.54 [0.97, 4.11]
Dallachio 2010	33.28	4.7	14	31.14	4.8	14	7.9%	2.14 [-1.38, 5.66]
Duncan 1991	34.5714	5.8685	42	31.6	5.791	42	15.7%	2.97 [0.48, 5.46]
Hinkleman1993	26.3	2.9698	18	25.7	3.8184	18	19.5%	0.60 [-1.63, 2.83]
Silverthorn 1993	45.85	5.95	6	36.16	7.38	6	1.7%	9.69 [2.10, 17.28]
Total (95% CI)			**166**			**177**	**100.0%**	**2.66 [1.67, 3.65]**

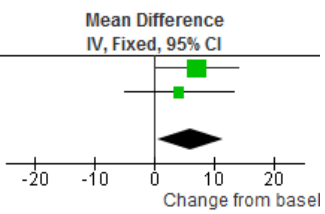
Heterogeneity: Chi² = 9.67, df = 6 (P = 0.14); I² = 38%
Test for overall effect: Z = 5.28 (P < 0.00001)



Quality of life SF36 (physical functioning)

Study or Subgroup	WG end of intervention Mean	SD	Total	WG baseline Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Brousseau 2012	70.088	18.819	44	63.003	18.332	79	64.3%	7.08 [0.21, 13.96]
Moore-Harrison 2008	85.8	13.6	24	81.7	18.6	24	35.7%	4.10 [-5.12, 13.32]
Total (95% CI)			**68**			**103**	**100.0%**	**6.02 [0.51, 11.53]**

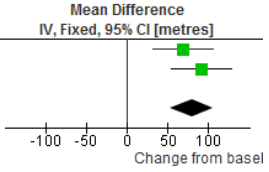
Heterogeneity: Chi² = 0.26, df = 1 (P = 0.61); I² = 0%
Test for overall effect: Z = 2.14 (P = 0.03)



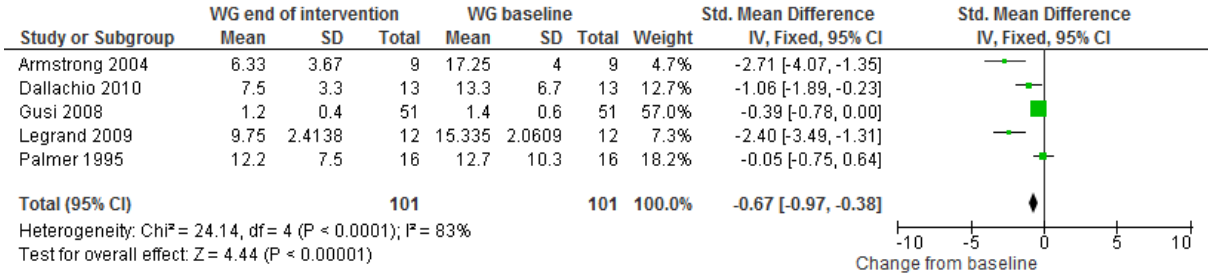
6 minute walk test

Study or Subgroup	WG end of intervention Mean [metres]	SD [metres]	Total	WG Baseline Mean [metres]	SD [metres]	Total	Weight	Mean Difference IV, Fixed, 95% CI [metres]
Brousseau 2012	524.86	106.52	44	456.45	87.62	79	50.5%	68.41 [31.48, 105.34]
Negri 2010	612	78.8	21	521	37.2	21	49.5%	91.00 [53.73, 128.27]
Total (95% CI)			**65**			**100**	**100.0%**	**79.60 [53.37, 105.84]**

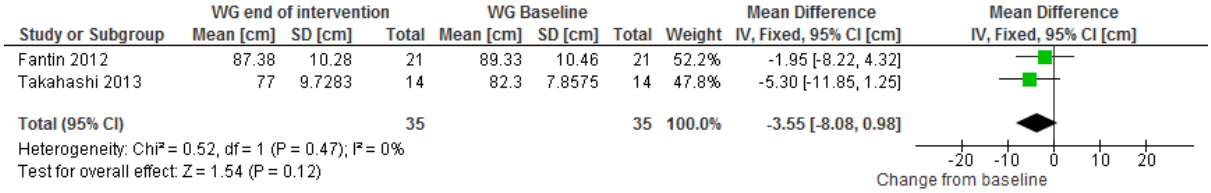
Heterogeneity: Chi² = 0.71, df = 1 (P = 0.40); I² = 0%
Test for overall effect: Z = 5.95 (P < 0.00001)



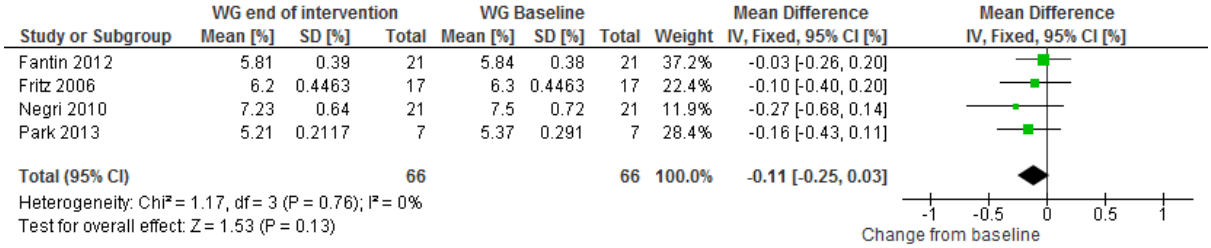
Depression



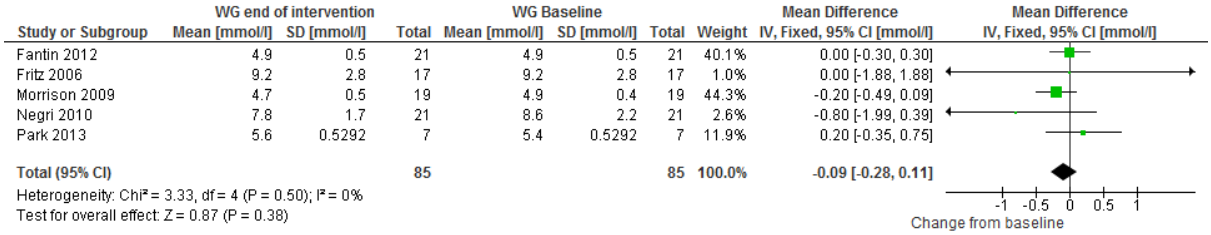
Waist circumference



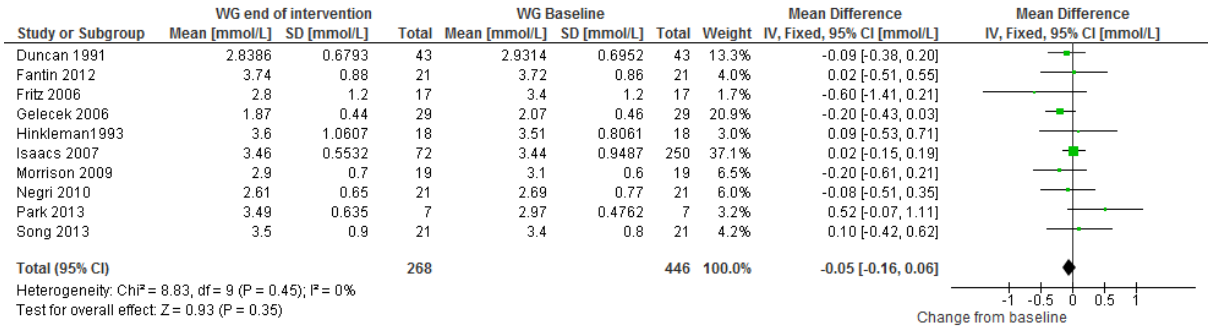
HbA1C



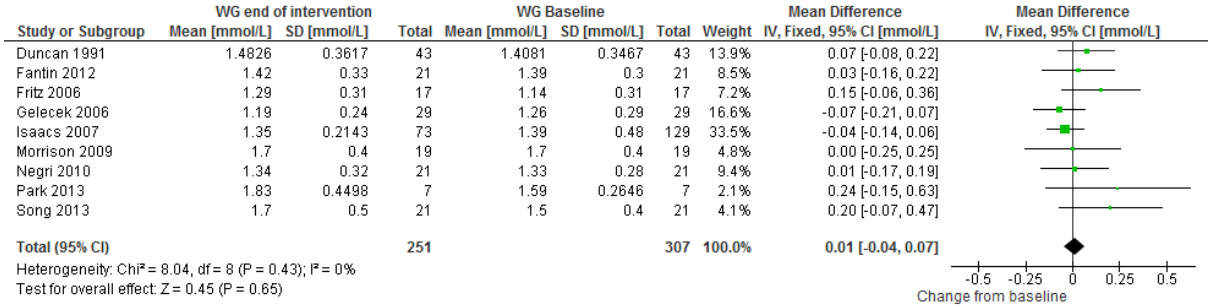
Glucose



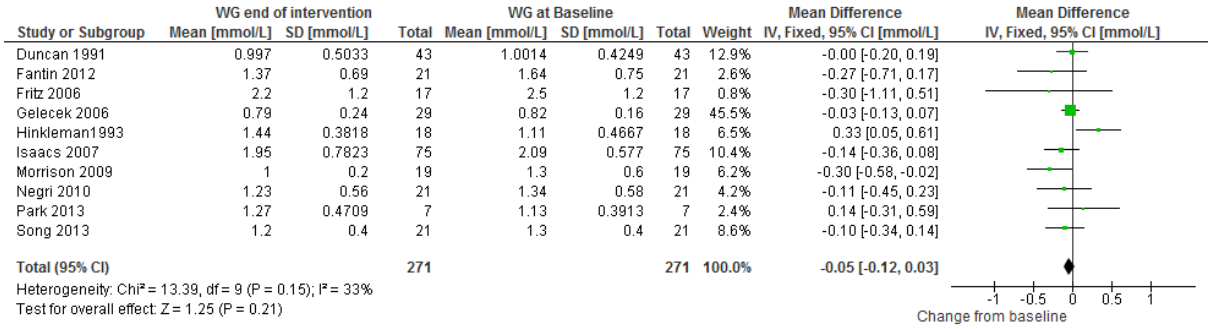
Low density lipids



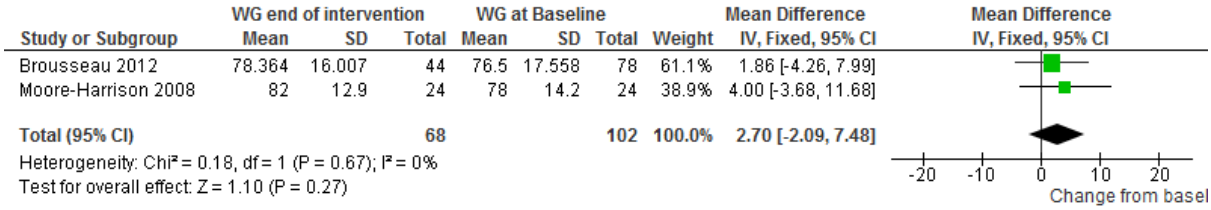
High density lipids



Triglycerides



Quality of life SF36 (mental health index)



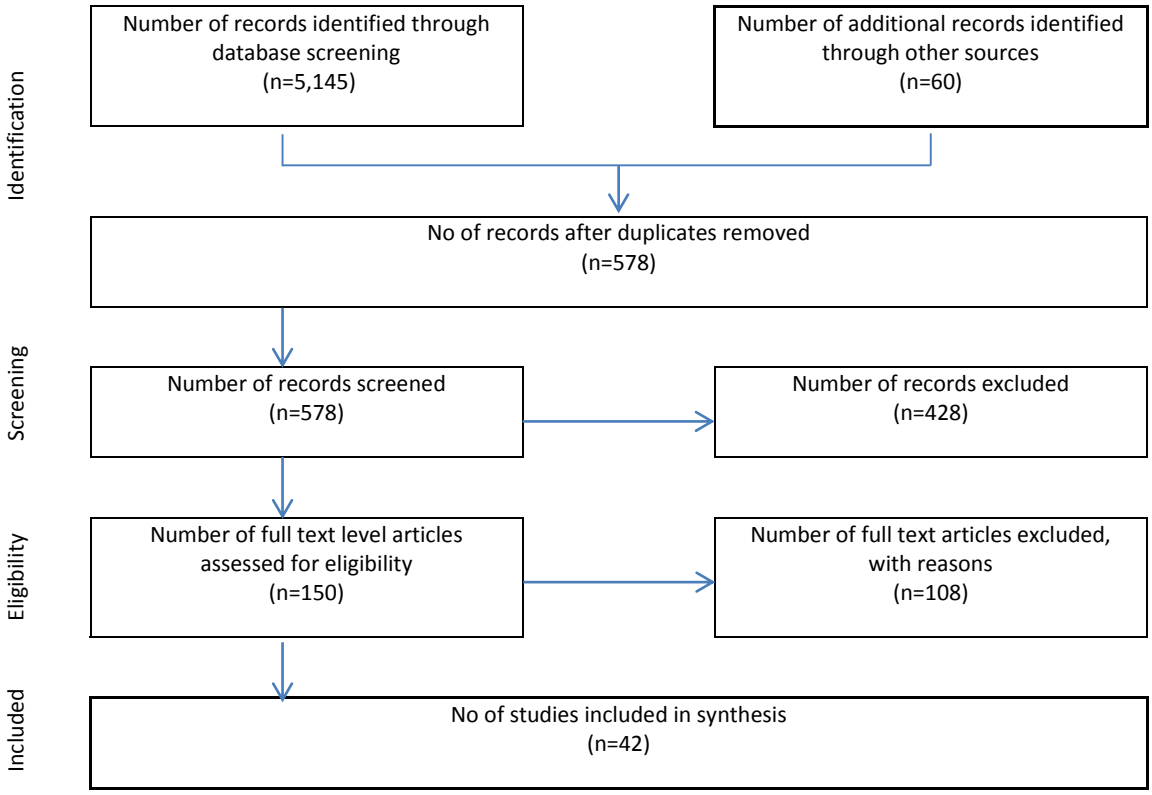


Figure 1: Review flowchart

PROSPERO International prospective register of systematic reviews

Review title and timescale

1 Review title

Give the working title of the review. This must be in English. Ideally it should state succinctly the interventions or exposures being reviewed and the associated health or social problem being addressed in the review.

Is there evidence that outdoor walking groups have benefits other than increasing physical activity?

2 Original language title

For reviews in languages other than English, this field should be used to enter the title in the language of the review. This will be displayed together with the English language title.

3 Anticipated or actual start date

Give the date when the systematic review commenced, or is expected to commence.

07/05/2013

4 Anticipated completion date

Give the date by which the review is expected to be completed.

31/01/2014

5 Stage of review at time of this submission

Indicate the stage of progress of the review by ticking the relevant boxes. Reviews that have progressed beyond the point of completing data extraction at the time of initial registration are not eligible for inclusion in PROSPERO. This field should be updated when any amendments are made to a published record.

The review has not yet started ×

Review stage	Started	Completed
Preliminary searches	No	Yes
Piloting of the study selection process	No	Yes
Formal screening of search results against eligibility criteria	No	Yes
Data extraction	Yes	No
Risk of bias (quality) assessment	Yes	No
Data analysis	Yes	No

Provide any other relevant information about the stage of the review here.

This review is part of studentship for a PhD programme.

Review team details

6 Named contact

The named contact acts as the guarantor for the accuracy of the information presented in the register record.

Sarah Hanson

7 Named contact email

Enter the electronic mail address of the named contact.

s.hanson@uea.ac.uk

8 Named contact address

Enter the full postal address for the named contact.

Norwich Medical School Room 1.23 Queens Building University of East Anglia Norwich NR4 7TJ

9 Named contact phone number

Enter the telephone number for the named contact, including international dialing code.

+44 (0)1603 - 593093

10 Organisational affiliation of the review

Full title of the organisational affiliations for this review, and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

Norwich Medical school. University of East Anglia

Website address:

www.uea.ac.uk

11 Review team members and their organisational affiliations

Give the title, first name and last name of all members of the team working directly on the review. Give the organisational affiliations of each member of the review team.

Title	First name	Last name	Affiliation
Mrs	Sarah	Hanson	Norwich Medical School. University of East Anglia
Professor	Andy	Jones	Norwich Medical School. University of East Anglia

12 Funding sources/sponsors

Give details of the individuals, organizations, groups or other legal entities who take responsibility for initiating, managing, sponsoring and/or financing the review. Any unique identification numbers assigned to the review by the individuals or bodies listed should be included.

Not applicable

13 Conflicts of interest

List any conditions that could lead to actual or perceived undue influence on judgements concerning the main topic

investigated in the review.
Are there any actual or potential conflicts of interest?
None known

14 Collaborators

Give the name, affiliation and role of any individuals or organisations who are working on the review but who are not listed as review team members.

Title	First name	Last name	Organisation details

Review methods

15 Review question(s)

State the question(s) to be addressed / review objectives. Please complete a separate box for each question.
Is there evidence that outdoor walking schemes have benefits other than increasing physical activity levels?
What are the characteristics of outdoor walking schemes that show clinical benefits?

16 Searches

Give details of the sources to be searched, and any restrictions (e.g. language or publication period). The full search strategy is not required, but may be supplied as a link or attachment.
A range of health, allied health, physical activity and science databases: AMED EMBASE MEDLINE PsycINFO SportDiscus CINAHL SCOPUS Clinical trials registers Reference lists from included articles will be hand searched Restricted to English language No date restriction Adults only

17 URL to search strategy

If you have one, give the link to your search strategy here. Alternatively you can e-mail this to PROSPERO and we will store and link to it.

I give permission for this file to be made publicly available
Yes

18 Condition or domain being studied

Give a short description of the disease, condition or healthcare domain being studied. This could include health and wellbeing outcomes.
All health and wellbeing outcomes used by the study authors.

19 Participants/population

Give summary criteria for the participants or populations being studied by the review. The preferred format includes details of both inclusion and exclusion criteria.
Inclusion: Adults from the age of 18 Exclusion: Youths and children

20 Intervention(s), exposure(s)

Give full and clear descriptions of the nature of the interventions or the exposures to be reviewed
Inclusion: Interventions where people walk as part of a defined walking intervention Exclusion: Studies that do not involve a walking intervention Inclusion: Where the walking is group based, or where the walking is predominantly group based but participants may also walk on their own to supplement this Exclusion: Participants walking only rarely in groups, or walking on their own e.g. home-based or pedometer based programmes with no group walking Inclusion: Studies that compare group walking with group Nordic walking i.e. group walking can be isolated as an intervention and the outcome directly related to group walking Exclusion: Studies examining Nordic walking only Inclusion: Studies where the outcomes are measures of health status or well-being of participants Exclusion: Studies where the outcomes are solely physical activity e.g. step outcomes / logs of physical activity Inclusion: Studies where the outcome can directly be related to the walking intervention Exclusion: Studies with a mixed intervention (e.g. walking with calcium supplements/walking combined with a health education intervention) where the outcome cannot be isolated and directly attributed to walking

21 Comparator(s)/control

Where relevant, give details of the alternatives against which the main subject/topic of the review will be compared (e.g. another intervention or a non-exposed control group).
There is no comparator.

22 Types of study to be included initially

Give details of the study designs to be included in the review. If there are no restrictions on the types of study design eligible for inclusion, this should be stated.
There is no restriction on study design.

23 Context

Give summary details of the setting and other relevant characteristics which help define the inclusion or exclusion criteria.
Inclusion: Walking outdoors or walking predominantly outdoors but occasionally indoors (e.g. inside tracks or shopping malls for weather reasons). Exclusion: Indoors.

24 Primary outcome(s)

Give the most important outcomes.
All clinical outcomes will be included in the review. This will include physiological outcomes such as blood pressure or lipid profiles. Also included will be psychological, such as quality of life outcomes
Give information on timing and effect measures, as appropriate.
Information will be extracted at the end of the intervention (this may be as little as one month or as long as one year) where this is available.

25 Secondary outcomes

List any additional outcomes that will be addressed. If there are no secondary outcomes enter None.

The characteristics of effective walking groups. This may include whether a walking group, as an intervention, has particularly addressed different socio-economic groups, genders or ethnic minorities.

Give information on timing and effect measures, as appropriate.
This will be a qualitative narrative.

26 Data extraction, (selection and coding)

Give the procedure for selecting studies for the review and extracting data, including the number of researchers involved and how discrepancies will be resolved. List the data to be extracted.
Study selection: All abstracts will be read by the first reviewer and any that do not meet the inclusion will be excluded at this stage. Where adequate information is not provided at abstract level full texts will be evaluated. Where the author has not specified whether the walking group is in fact a walking group or a walking arm of the study, the primary reviewer will contact the author for further information. The second reviewer will review 10% of the papers as a sample to verify that papers have been excluded as per the protocol. Data to be extracted: Author name and date Clinical question addressed Description of the walking group Description of the participants Description of the environment and the provision The number of participants in the study The number of participants in the walking group part of the study The gender of the participants in the walking group Mean age of the walking group Location of the study Description of any socio-economic information Description of ethnicity of the participants The type of walking e.g. self selected, brisk Time in the intervention per week (events x time per week) Dosage of walking group activity in the research (weekly activity x length of time in the study) Results e.g BMI (p 0.257)

27 Risk of bias (quality) assessment

State whether and how risk of bias will be assessed, how the quality of individual studies will be assessed, and whether and how this will influence the planned synthesis.
An eight point tool has been used with 1 point allocated to each element. Randomisation Exposure (no evidence of concurrent intervention) Representativeness Comparability Attrition (over 20% would give a zero score) Follow up tools Precision of the results. This tool will be used by the primary reviewer and the second reviewer will review 10% of the studies. Papers will be presented with their score and also a definition of high quality, medium quality and low quality. No papers will be excluded from the synthesis on quality grounds

28 Strategy for data synthesis

Give the planned general approach to be used, for example whether the data to be used will be aggregate or at the level of individual participants, and whether a quantitative or narrative (descriptive) synthesis is planned. Where appropriate a brief outline of analytic approach should be given.
The results will be given per study on an aggregate level. A table of results will display the extracted information. There will also be a descriptive narrative of the characteristics of walking groups where this information has been available.

29 Analysis of subgroups or subsets

Give any planned exploration of subgroups or subsets within the review. ‘None planned’ is a valid response if no subgroup analyses are planned.
None planned.

Review general information

30 Type of review

Select the type of review from the drop down list.
Intervention

31 Language

Select the language(s) in which the review is being written and will be made available, from the drop down list. Use the control key to select more than one language.
English
Will a summary/abstract be made available in English?
Yes

32 Country

Select the country in which the review is being carried out from the drop down list. For multi-national collaborations select all the countries involved. Use the control key to select more than one country.
England

33 Other registration details

List places where the systematic review title or protocol is registered (such as with he Campbell Collaboration, or The Joanna Briggs Institute). The name of the organisation and any unique identification number assigned to the review by that organization should be included.
None

34 Reference and/or URL for published protocol

Give the citation for the published protocol, if there is one.
Give the link to the published protocol, if there is one. This may be to an external site or to a protocol deposited with CRD in pdf format.

I give permission for this file to be made publicly available
Yes

35 Dissemination plans

Give brief details of plans for communicating essential messages from the review to the appropriate audiences.
Essential messages will be disseminated through journal publication and conference proceedings/presentations

Do you intend to publish the review on completion?
Yes

36 Keywords

Give words or phrases that best describe the review. (One word per box, create a new box for each term)
Systematic review
Walking groups
Clinical outcomes

37 Details of any existing review of the same topic by the same authors

Give details of earlier versions of the systematic review if an update of an existing review is being registered, including full bibliographic reference if possible.

38 Current review status

Review status should be updated when the review is completed and when it is published.
Ongoing

39 Any additional information

Provide any further information the review team consider relevant to the registration of the review.

40 Details of final report/publication(s)

This field should be left empty until details of the completed review are available.
Give the full citation for the final report or publication of the systematic review.
Give the URL where available.

Table 2: Summary results for all 42 studies

Lead author	Study aim	Description of the participants Mean age (SD)	Socio-economic (SE) and Ethnicity (E) information Country	Description of the environment, provision and group size	n = study (walking arm of the study)	Type of walking	Intervention (as stated or based on average session time)	Minutes in the study per person Adherence (where stated)	Results. i) Given at the end of the intervention. Difference from baseline. ii) p-values given as stated
Armstrong (2004) [1]	A 12 week RCT to investigate the effects of a pram walking versus a social support group	Had given birth in the past 12 months. Edinburgh postnatal depression scale of ≥ 12 30	SE: Education and family income information E: not stated Australia	Flat walking path (NB prams) at an area on the Gold Coast. Group size 9. Also encouraged to walk once a week independently	19 (9)	Moderate intensity (60-75% of predicted HR).	40 mins. 2 times a week for 12 weeks	960 75%	EPDS↓ (time p <0 .001) VO_2max ↑(time p > 0 .05)
Bjersing (2012) [2]	Effects of 15-week moderate- to high-intensity aerobic exercise (Nordic walking) on the level of serum bioactive IGF-1 in women with fibromyalgia. Low-intensity aerobic exercise (walking) was the control group.	Women with FM aged 20-60 with an interest in exercising outdoors for 15 weeks 52	Not stated Sweden	Outdoors walking together under the leadership of a physiotherapist. Group size 23	49 (23)	Low intensity walking	43 mins. 2 times a week for 15 weeks	1290	Pain threshold ↓ (p 0.031) Pain ↓ (p 0.067) 6MWT ↑ (p 0.183) IGF-1 ↓ (p 0.148) IGFBP3 ↓ (p 0.881) Please see text for sub-group analysis of cerebrospinal markers (N.B. walking was the control group)

Brandon (2006) [3]	Evaluate body composition and blood pressure responses to a 16-week dose of brisk walking in sedentary and obese African American and White women	Sedentary women 35	SE: not stated E: African American and white USA	Faculty of an urban university and from local government agencies. Outside on courses measured for distance before the study. On rainy days subjects walked on an indoor track or treadmill. Groups of various sizes.	52 (28)	16 weeks has been shown to be of sufficient length to provide for significant weight loss. Encouraged to walk briskly at 3.5mph	50 mins. 3 times a week for 16 weeks to achieve 3 miles.	2400 AA 86% White 90%	African American (AA) and White: Weight: AA ↓(p 0 .543) White ↓(p 0 .001) Body fat: AA↓(p 0 .164) White ↓(p 0 .001) Trunk fat: AA↓(p 0 .024) White ↓(p 0 .001) Leg fat: AA ↓(p 0 .807) White ↓(p 0 .010) BMI: AA↓(p 0 .214) White ↓(p 0 .001) Waist to height ratio AA↓(p 0 .138) White ↓(p 0 .000) SBP: AA ↓(p 0 .001) White↓(p 0 .000) DBP: AA↓(p 0 .001) White↓(p 0 .000) VO_2max : AA↑(p 0 .000) W ↑(p 0 .000) (results for AA and white combined in meta-analysis)

Brosseau (2012) [4]	Effect of a proven effective walking programme based on the Ottawa Panel clinical practice guidelines implemented through a knowledge translation intervention	Participants with a confirmed diagnosis of mild to moderate unilateral or bilateral osteoarthritis 63.9 (± 10.3)	SE: Level of education given E: White 87.3%, black 1.3%, Hispanic 2.5%, Asian 6.3%, Canada	Two walking sites in Ottawa, Ontario and one in Gatineau, Quebec. 71 participants who walked in supervised walking programme but the number in the group not described	222 (71)	Ottowa panel evidence based clinical practice guidelines for individuals with osteo-arthritis	55 mins. 3 times a week for 52 weeks	8580 58%	The author gives p-values for walking group versus control. The control group was self-directed using a guidance pamphlet and pedometer and self-recorded <u>SF-36</u>: Physical Functioning ↑ (p 0.250) Role physical ↑ (p 0.909) Pain index ↑ (p 0.581) General health perception↓(p 0.223) Vitality ↑ (0.856) Social functioning ↓ (0.266) Role emotional↑ (0.949) Mental Health Index↑ (0.735) Health transition item ↓ (0.821) Standardised physical component ↑(p0.804) Standardized mental component ↑ (p 0.595) <u>AIMS 2</u>: Health perception ↓(0.420) Arthritis impact ↓(0.431) Physical component ↓(0.554) Affect component ↓(0.937) Symptoms component ↓(0.523) Social interaction component ↓(0.081) Role component ↓(0.536) <u>WOMAC</u> : Pain ↓(0.572) Stiffness ↓(0.125) Physical function ↓(0.672) Total WOMAC score ↓(0.612) 6 minute walk test ↑ (0.063) Gait speed ↓(0.535) Timed up and go ↓(0.770) There are also 18 month results given in the paper (all of which have non-significant p values of walking group v control)

Callahan (2011) [5]	Effects of a 6-week walking program for adults with arthritis, Walk With Ease (WWE), delivered in 2 formats, instructor-led group or self-directed	Self-reported joint pain, stiffness, or any type of doctor-diagnosed arthritis. Recruited from urban and rural settings 70.7 (±9.8)	SE: Education information E: 26% African American 71% white USA - North Carolina	Instructor led group ranged in size from 2 or 3 to 19 participants with most in the range of 5-12 people. Adherence 92.7% versus 83.3% for the self-directed. Participants self-selected the intervention group	462 (192)	Walk with ease (WWE), 6 week community based walking group programme for adults with arthritis	60 mins. 3 times a week for 6 weeks	1080 92.7% versus 83.3% for self - directed	Performance based physical measures: Lower extremity strength, (1 chair and 3 chair stands) in seconds ↓ (improved) ($p < 0.01$) Standing balance/turning ability) in seconds ↓ (improved) ($p < 0.01$) Balance) in seconds ↓ (improved) ($p < 0.01$) Functional mobility: Normal walking speed ↑ ($p < 0.01$), fast walking speed ↑ ($p < .01$) Endurance, 2 minute step test↓ ns Self-reported: HAQ ↓ (improved) ($p < 0.01$) VAS (pain, fatigue, stiffness) ↓ (improved) ($p < 0.01$) Pain arthritis self-efficacy ↑ ($p < 0.01$) Symptom arthritis self-efficacy ↑ ($p <0.05$) Rheumatology attitudes index ↓ (improved) ($p < 0.05$) Self-efficacy for physical activity↑ ns
Cavanaugh (1988) [6]	Evaluate whether brisk walking stops bone loss in post-menopausal women	Recruited via a letter sent to employees at a local university. Post-menopausal 5.6 ± 1.6 years 55.4 (±1.7)	SE: employment info. given E: not stated USA	Grassy outdoor soccer field. As protocol time increased was also done on city sidewalks. During inclement weather or periods of extreme heat walking was done in building hallways. All of the group (8) met as a group every Monday Wednesday and Friday at noon for 52 weeks	17 (8)	Moderate exercise regime. 60% of target heart rate. Increased time progressively	Average 26 mins. 3 times a week for 52 weeks	4056 73%	Pre exercise heart rate: ↓($p<0.01$) Body fat index ↓ Post exercise heart rate: no change Bone loss over 1 year was no different to control. Absolute values (and SD) not given within published study therefore unable to include heart rate data in meta-analysis

Cox (2006) [7]	Evaluate 6 months of supervised moderate swimming or walking on blood pressure in previously sedentary, normotensive older women.	Women aged 50-70 recruited from media advertising. Sedentary, non-smokers 55.45 (±4.93)	Not stated Australia	Continuous walk around ovals and parks with a research assistant with a degree in sports science. Usually 4-6 (varied from 2-10)	116 (60)	50% of HRreserve and progressed to 60-70% of HRreserve at 8 weeks.	45 mins. 3 times a week for 24 weeks	3240 74.3%	Weight ↓ ns BMI ↓ns Triceps skinfold ↑ns Arm muscle girth ↓ns Urinary sodium excretion ↑ns Urinary calcium excretion ↑ns Systolic BP ↓ns Diastolic BP ↓ns Heart rate ↓($p < 0.001$) VO_2max ↑($p < 0.001$) Final values not given within published study for BP and therefore unable to include results within meta-analysis (N.B. walking is the control)
Cyarto (2008) [8]	Evaluate and compare resistance training programmes and a group walking programme (control) in improving the functional performance of older adults	Older adults living in retirement villages aged 65-96 years 78.8 (±6.4)	SE: Level of education stated E: 98% Caucasian Australia	Some hills on the route. Had a leader. Group size 48	167 (48)	Walking at a self-selected pace	30 mins 2 times a week for 20 weeks	1200 53%	Chair stand ↑ns Arm curl ↑ns 2 minute step test ↑ns Sit and reach↓ ($p < .05$) Back scratch ↑ns Up and go ↓ns (N.B. walking is the control)
Dallocchio (2010) [9]	A pilot study to evaluate the effects of regular low-medium intensity exercise on sedentary patients with psychogenic movement disorders	Patients with psychogenic movement disorders. Women 33 (±8.79)	Not stated Italy	As a group at a country track. Supervised by the lead investigator. Individually if unable to attend group session. Group size 13	13 (13)	Low-moderate intensity walking	Average of 20 mins. 3 times a week for 12 weeks	720	PMDRS ↓ (p 0.014) PMDRS function ↓ (p 0.043) BAI ↓ (p 0.034) HDS ↓ (p 0.028) BMI ↓ (p 0.026) VO_2max ↑(p 0 .023) Life gratification ↑
Duncan (1991) [10]	Whether the quantity and quality of walking necessary to decrease the risk of CVD among women differed substantially from that required to	Women through advertising. Sedentary, randomly selected. 20-40 years of age	SE: Not stated E: 81% white, 17% black and 2% Hispanic USA	Tartan-surfaced 1.6km track. Supervision of an exercise physiologist. Group size 12-18	102 (43)	Aerobic walkers (8.0km/hr), Brisk walkers (6.4km/hr) and Strollers (4.8km/hr).	60 mins. 5 times a week for 24 weeks	7200 85% +	BP: Strollers ↓ns / Brisk no change / Aerobic walkers no change Total cholesterol: Strollers ↓ns / Brisk ↓ns / Aerobic walkers ↑ns LDL: Strollers ↓ns / Brisk ↓($p<0.05$) / Aerobic walkers ↑ns HDL: Strollers ↑($p<0.05$)/ Brisk ↑ns/ Aerobic walkers↑ ($p<0.05$)

	improve cardiorespiratory fitness.								Triglycerides: Strollers ↓ns / Brisk No change/ Aerobic walkers↑ ns Cholesterol and HDL ratio: Strollers ↓(p<0.05) / Brisk ↓ns / Aerobic walkers ↓ns Body fat: all groups ↓ns VO_2max ↑ all groups Strollers (p <0 .05) /Brisk walkers (p <0 .001) Aerobic walkers (p <0 .001) (Results combined in the REVMAN programme for meta-analysis)
Fantin (2012) [11]	The effect of a moderate (60-min exercise sessions of walking twice per week—approximately 7–8METs per week), 6-month aerobic exercise program on cardiovascular risk factors and pulse wave velocity in a group of apparently healthy elderly women with and without hypertension.	Women living in the community, aged 60-80. 68.19 (±5.72)	Not stated Italy	Outside and supervised by a qualified physical education instructor. Group size not stated.	21 (21)	Brisk walking i.e. moderate physical activity. 7-8 METs/week Increased intensity over time to 75% max heart frequency.	60 mins. 2 times a week for 24 weeks	2880	Weight ↑ (p 0.33) BMI ↓ (p 0.81) Waist (circumference) ↓ (p 0.01) SAD ↓ (p 0.04) FM ↓ (p 0.32) FFM ↓ (p 0.33) Glucose ↑ (p 0.30) HbA1C↓ (p 0.15) Total chol ↓ (p 0.64) HDL chol. ↑ (p 0.20) LDL chol ↑ (p 0.92) TG↓ (p 0.02) HR ↓ (p 0.09) SBP ↓ (p 0.31) DBP ↓ (p 0.33) MAP ↓ (p 0.6) PWVcr ↓ (p 0.75) PWVcf ↓ (p 0.02) All participants, normotensive and hypertensive. (see text for sub-analysis of normo- and hypertensive)
Figard-Fabre (2010) [12]	The effects of a 12 week Nordic interval training programme to those of a walking programme.	Obese middle aged women Age not stated	Not stated Italy	Outside and supervised in groups of 12-15 (confirmed by email).	23 (11)	Comfortable walking pace and intervals of higher intensity at maximal walking speed	Average 44 minutes. 3 times a week for 12 weeks	1584 81%	Body Mass ↓(p 0.045) BMI ↓(p 0.060) Skinfold thickness ↓(p 0.020) Body fat ↓(p 0.011) HR↑(p 0.048) SBP ↓(p 0.085) DBP↓(p <0.001)

Fisher (2004) [13]	The effects of a neighbourhood walking programme on quality of life of older adults.	Aged over 65, sedentary. 74.03 (± 6.3)	SE: Education and income information E:Black or other. 85% white USA	Leader led walking group in their neighbourhood (28 neighbourhoods for walking). Walking included winter and fall for some groups. Walk leaders recruited locally and paid. Groups of approx. 10 per neighbourhood with 2 walk leaders.	582 (280)	Leisurely but purposeful walk	Average 45 mins 3 times a week for 6 months	3510 74%	SF12: mental and physical scores ↑ ($p < 0.001$) Life satisfaction scores ↑ ($p< 0 .001$) Absolute values (and SD) not given within published study and therefore unable to include results within QoL meta-analysis
Fritz (2006) [14]	The effects on metabolic control and cardiovascular risk factors in type 2 diabetes after a period of a low intensity exercise walking programme (walking) feasible to most patients and to the resources of a primary health centre.	Patients with type 2 diabetes from primary care practices suburban communities outside Stockholm. 60 (±7.3)	Not stated Sweden	Walking groups were provided 4 times a week, short distances from the patients' homes. At other times, self-recorded. Typical group size was 10-12. Walks were taken in a rural area, along a "path of health" with no steep elevations. An assistant nurse joined the group during each walk.	52 (26)	Low intensity exercise. Brisk walking. To increase their exercise by 45 min of brisk walking, three times weekly, during 4 months.	45 mins. 3 times a week for 16 weeks	2160 65% achieved 80%	Results based on n=17 that achieved 80% of prescribed increased activity SBP ↓($p<0.05$) DBP ↓($p<0.05$) BMI ↓($p<0.05$) HbA1c ↓ ns Fasting glucose no change Fasting insulin ↓ns HOMA2-IR no change ns Total chol ↓($p< 0.05$) HDL cholesterol ↑($p<0.05$) LDL cholesterol ↓($p<0.05$) Triglycerides ↓ns $VO_{2\ max}$ no change (in L/min) (See text for analysis of those who did not alter activity levels)
Gelecek (2006) [15]	To examine the effects of a 6-week brisk walking training on plasma homocysteine levels and lipid profiles in sedentary young subjects.	Healthy physio-therapy students. 20 (±2.1)	SE: University students E: Not stated Turkey	Walked in large garden on their campus in 3 groups of: 10, 10 and 9 according to their aerobic capacity determined by sub-maximal cycling test.	29 (29)	Brisk walking programme with a speed of 6.4 km/hr	40 mins. 3 times a week for 6 weeks	720	Body mass↓($p > 0.05$) SBP↓($p > 0.05$) DBP↓($p > 0.05$) Resting HR↓($p <0 .05$) Homocysteine ↑($p > 0.05$) TG ↓($p > 0.05$) Total –cholesterol↓($p <0 .05$) HDL-c↓($p > 0.05$) LDL-c↓($p <0 .05$)

				Supervised by a physiotherapist.					
Gusi (2008) [16]	To assess the cost utility of adding a supervised walking programme to the standard "best primary care" for overweight, moderately obese, or moderately depressed elderly women.	Aged 60 and over, moderately depressed or overweight. 74 (±6)	SE: Education and income E:Not stated Spain	Public park or forest tracks with qualified exercise leaders. Socialising encouraged.	107 (51)	A pragmatic intervention that could be replicated in a large population	50 mins. 3 times a week for 24 weeks	3,600 86%	BMI ↓ (p 0.003) Geriatric depression scale ↓ (p 0.001) Anxiety (state trait anxiety inventory ↓ (p< 0.001) Anxiety/depression EQ5D ↓ (p 0.009)
Hamdorf (1999) [17]	The effect of progressive walking programme on healthy women in their 9th decade for evidence of the benefits of exercise.	Recruited through local advertising. 82.4	Not stated Australia	Outdoors Group size 18. Experienced fitness instructors	38 (18)	Low frequency, moderate-intensity, progressive training programme. Target 40-60% of HRR (100bpm)	20 mins. 2 times a week for 26 weeks	1040 89.5%	Resting heart rate ↓(p 0 .029) Exercise heart rate↓(p 0 .002) SBP ↑ ns DBP ↓ns Habitual activity profile and morale: (p values compared to control) MCA and NII↑(improved) (p>0.001) PGMS↑(improved) (p 0.002)
Hinkleman (1993) [18]	The effects of a walking program on body composition and serum lipids and lipoproteins in overweight women	Recruited from the local community, female aged 24-45 and 10-40% overweight. 36 (±1.6)	Not stated USA	On a measured course near the research testing facility. Supervised. Sessions offered morning and evening. Supervised by an exercise instructor. 2 groups provided for 18 people	36 (18)	Brisk walking at 62± 2% VO_2max. 10 second pulse rates or heart monitors used.	45 mins. 5 times a week for 15 weeks	3375 100%	Body fat ↓ns Fat weight ↓ns Lean weight ↑ns Triglycerides ↑ns Cholesterol↓ns LDL –C ↑ns TC/HDL ↓ns
Holmberg (1997) [19]	Evaluation of a clinical intervention designed to decrease unsafe wandering and reduce	From a specialised dementia unit with quite significant	Not stated USA	Following the evening meal (6pm) participants walked away from the unit, through public areas of	11 (11)	Dementia based rather than physical activity rationale.	90 mins. (including rest stops) Number of times in a week not stated. The intervention	Unable to state from the data given	Measured counts of aggression in a one year period of those who had been involved in the walking group versus no intervention. ↓30%

	interpersonal tension on a dementia unit.	cognitive impairment. 84.6		the facility (or outside, weather permitting). Walk leaders were lay community volunteers (2 or 3 per group). Groups size average of 10.			lasted for 52 weeks		
Isaacs (2007) [20]	The effectiveness and cost-effectiveness of a leisure centre-based exercise programme, a community walking programme and advice on physical activity and local exercise facilities in patients referred for exercise by their GPs	GP referred. 40-74, not physically active and with at least one cardio-vascular risk factor. 56.9 (±8.5)	SE: Education level, employment status and socio-economic classification given. E: 76% white and 14.3% Asian England	12 different locations (parks and open spaces), 7 days a week with 20 classes to choose from. Started at 9.30 and ran throughout the day until 7.30pm During the winter the evening classes took place under floodlights. Walking classes graded but were free to choose. Trained instructors. 40-50 in each 10 week cohort which facilitated social support and exercise partners.	949 (311) (161 randomised to assess-ment)	60-80% of max. – slightly breathless	60 mins. 2 times a week for 10 weeks	1200 62% attended less than 50% 38% attended more than 50% Adherence much higher in those with access to private transport	Changes at 10 weeks: ITT Weight↓ ns BMI ↓ ns % body fat↓ (p < .001) Waist-hip ratio no change Resting pulse ↓ ns SBP ↓ (p < .001) DBP ↓ (p 0 .06) IKES ↑ ns LEP↑(p <0 .05) LEP power to weight↑(p <0 .01) Shoulder abduction↑(p <0 .05) Cholesterol↓ (p 0.057) HDL↓ ns Cholesterol/HDL↓ ns LDL↓ ns Triglycerides↓ ns Please see text for sub-set analysis – 50% randomised to assessment at end of intervention, other time periods and for those on medication. Meta-analysis used absolute data from those participants re-randomised (50%) to assessment at 10 weeks. HADS score not included as completed at 6 months rather than end of intervention.

Kamijo (2007) [21]	Effects of a 12-week Walking Program on Cognitive Function in Older Adults	Older adults, right handed, sedentary. 71.1 (±1.3)	Not stated Japan	They walked together on the sidewalk that faces the general road with trained exercise personnel. Group size 14.	26 (14)	Pace: fairly light to somewhat hard	40 mins. 2 times a week for 12 weeks	960 85%	Reaction time no change Error rate no change Neuro electric measures: P3 amplitude (congruent and incongruent condition): Fz ↑ns C3↑ns Cz↑ns C4↑ns Pz↓ns P3 Latency(congruent and incongruent condition): Fz ↓ns C3↓ns Cz↓ns C4↓ns Pz↓ns
Kayo (2012) [22]	To compare the effectiveness of muscle-strengthening exercises and a walking programme in reducing pain and self-reported physical function in patients with fibromyalgia.	Women with fibromyalgia aged between 30-55. 47.7 (±5.3)	SE: schooling E: not stated Brazil	Outdoors or indoors in a gymnasium, depending on the weather. Supervised by a physical therapist. Walking duration and intensity increased over the 16 weeks. Group size not stated but attended the exercise program in small groups, enabling proper supervision.	90 (30)	ACSM principles for developing cardio-vascular and muscular fitness and flexibility.	60 mins. 3 times a week for 16 weeks	2880	Pain (VAS) ↓ns FIQ ↓($p < 0.001$) between baseline and week 8. Otherwise ns. SF-36: (NB. Higher score indicates better health outcome) bodily pain score ↑ ($p < 0.01$); general health and vitality ↑ ($p < 0.05$); physical functioning and mental health ↑ ($p < 0.05$) Use of medication: 46.7% restarted medication (80% in the control group) SF-36 values not given for end of intervention therefore unable to include in QoL meta-analysis

Legrand (2009) [23]	The antidepressant effects of two group-based walking programmes (which differed in frequency but not weekly volume) among French older women with subsyndromal depression.	Women, with mild depressive, symptoms, inactive and between 60-74yrs. 66.8 (±2.5)	Not stated France	Outdoors on a fitness loop of 2/3 of a mile, located in a 1000 acre natural area park. Driven to the site and supervised by the study investigator. 6 in each group.	12 (12)	Participants identified their own walk pace (slow, medium, brisk)	60 mins a week (either as one session or 3-5 sessions equating to 60 minutes) for 4 weeks	240 Above 75%	Geriatric depression scale: Once a week ↓($p < .05$) 3-5 times a week ↓($p < .03$) (Please see text for qualitative statements and themes from participants)
Mannerkorpi (2010) [24]	The effects of moderate-to-high intensity Nordic walking (NW) on functional capacity and pain in fibromyalgia (FM). Low intensity walking is the control	Women aged 20-60 years with fibromyalgia, recruited through advertising. 50 (±7.6)	SE: Education and work status E: Not stated Sweden	Parks and forests with flat areas and small hills under the supervision of a physiotherapist. Group size 33	67 (33)	Low-intensity walking ranging from 9 (very light) to 11 (fairly light) on the Borg scale.	20 mins. Once a week for 15 weeks	300 50%	6 minute walk test ↑ (p 0 .105) Exercise HR ↓ (p 0.079) FIQ pain ↓ (p 0.065) Exercise heart rate ↓ (p 0.079) FIQ physical ↑ (p 0 .929) FIQ total ↑ (p 0 .374) MFI: General fatigue ↓ (p 0.972) Physical fatigue ↓ (p 0.280) Reduced activity ↓ (p 0.194) Reduced motivation ↑ (p 0 .287) Mental fatigue ↓ (p 0.461) (NB. walking is control)
McDevitt (2004) [25]	To evaluate a 12 week moderate intensity walking programme for sedentary adult outpatients with serious and persistent mental illness.	Adults with serious and persistent mental illness who were enrolled in a psychosocial rehabilitation programme. Volunteers.	SE: not stated E: 60% African American, 27% white, 13% Hispanic USA	Group size 15. No other information. 41.1 (±12.1)	15 (15)	60-79% of HRmax	Average 25 mins. 2 or 3 times a week for 12 weeks	750 76%	SF12 – no change Vigor-activity ↑ (p 0 .05) Mood ↓(improved) (p 0.027) Psychosocial functioning ↑ (p 0 .028)

Moore-Harrison (2008) [26]	To describe the population in terms of risk for disability and compare the effects of a walking programme and nutritional education (control) on risk modification and functional performance in lower socioeconomic older adults	26 community dwelling adults aged over 60. 68.6 (±7.6)	SE: mainly low socio-economic (38% below poverty level). Income (2008) given. Education stated. E: 41.7% African American USA	A cityscape walking path in Athens, Georgia USA. Group size 12	26 (12)	60-75% of HRmax and Borg scale of 12-14	30 mins. 3 times a week for 16 weeks	1440 88.5%	(p value relates to walking v control at 16 weeks) CS – PFP scores: CS-PFP10 total score ↑(p <0 .05) Upper body strength ↑(p <0 .05) Upper body flexibility ↑(p <0 .05) Lower body strength ↑(p <0 .05) Balance & co-ordination ↑(p <0 .05) Endurance ↑(p <0 .05) SF-36: Physical Functioning ↑(p 0 .14) Role physical ↑ ns Pain index ↑ ns General health ↑ ns Vitality ↑ ns Social functioning no change ns Role emotional↑ ns Mental Health ↑ ns
Morrison (2009) [27]	The effect of an 8-week program of either soft-sand or firm-surface walking on lower limb muscle strength, submaximal fitness, and blood lipid profile in women 60–75 years of age.	Women aged 60-75 and relatively inactive. Randomly assigned. 65.5 (± 3.7)	Not stated Australia	Participants in the sand-walking group walked on the soft sand at a local beach, well away from the water's edge. The firm-surface-walking group walked on footpaths at the same (beach) locations. Supervised for the 8 weeks by the same person. 19 in each group.	38 (19)	Self- selected speed. Exercise intensity was 74%	Average 33 mins. 3 times a week for 8 weeks	792 83% achieved 64% attendance	Firm surface only. Weight ↑ns SBP ↓ns DBP↓ns Total chol ↓(p < .05) Triglycerides ↓(p < .05) HDL ns LDL ↓ (p < .05) Coronary risk ratio ↓ (p < .05) Glucose ↓ns Strength (kg of force): Knee flexion ↑ns Knee extension ↑ns Knee total ↑ns Hip flexion ↑(p < .05) Hip extension ↑(p < .05) Hip abduction ↑(p < .05) Hip total ↑(p < .05) Total strength ↑(p < .05) (Please see text for sand walking results). Results given are for the 38 who attended 64% or more of the sessions. Meta-analysis used firm surface only results

Moss (2009) [28]	To determine the coronary heart disease (CHD) risk profile of adults with intellectual disabilities residing in a care facility and to determine the effect of a physical activity intervention on the CHD risk profile of the residents.	Men and women with intellectual disabilities residing in a care facility and to determine the effect of a PA intervention on the CHD risk profile of the residents. BMI 29. 39.2 (± 8.9)	Not stated – NB living in a care facility South Africa	400m circular route on the residing grounds with a level walking surface. All 100 walked together with 10 supervisors (post graduate students). 100 walked together	100 (100)	Not stated	Average 25 mins. 3 times a week for 12 weeks	900 47%	Body Mass Men↓ns / women ↑ns BMI Men↓ns / women ↓ns WHR Men ↑ns / women ↓ns Body fat ↓ ($p < .05$) (men and women) SBP Men↓ns / women ↓ns DBP Men↓ns / women ↓ns PWC Men ↑($p < .05$) / women ↑ns
Negri (2010) [29]	The feasibility and effectiveness of an intervention based on the organisation of supervised walking groups	Type II diabetic for 2 years, physically inactive, aged 50-75, A1C 6.5-9.9% Gender not stated. 65.7 (±4.9)	Not stated Italy	A city park supervised by an exercise specialist who encouraged each participant. Walking groups were composed according to walking speed. Max. 20 participants in the group.	60 (39)	Low to moderate physical activity intended to achieve an energy expenditure of 10 MET h/week. Groups organised according to walking speed.	45 mins. 3 times a week for 16 weeks	2160 47%	Participants who attended at least 60% of the supervised walking sessions (n= 21): HbA1C ↓ ($p < .05$) Total cholesterol ↓ ($p < .05$) 6 min walk time ↑ ($p < .001$) Body weight ↓ns BMI ↓ns HbA1C ↓ ($p < .001$) Total cholesterol ↓ns Glucose ↓ ($p < .05$ compared to control) HDL cholesterol ↑ns LDL cholesterol ↓ns Triglyceride ↓ns SBP ↑ns DBP ↓ns Changes to anti-diabetic medication: (compared to control) Dose decreased or discontinued 33% v 5% (p 0.05) Dose increased /No change to regimen ns

Ng (2007) 30 31	A pilot study investigating the effectiveness of an adjunctive walking programme in the acute treatment of bipolar disease (2007) _____ Effects of a walking program in the psychiatric in-patient treatment setting: a cohort study (2007)	Private inpatient psychiatric unit. 45.6 (±16.1)	Not stated Australia	Walks provided on weekday mornings. Even terrain in the vicinity of the hospital which consisted of suburban streets on flat grounds. Group size 6-8.	49 (35)	Not stated	Walks offered for 40 mins. 5 times a week. Length of stay in days 19.3 ± 14.	Cannot assess dosage from data given.	Results are for those that reliably attended. Walking is adjunct to treatment. Illness severity at discharge in the walking intervention: CGI-S ↓ ns CGI-I ↓ns Total DASS↓ (p 0 .005) DASS depression↓ (p 0 .048) DASS anxiety↓ (p 0 .002) DASS stress↓ (p 0 .01) (retrospective and no data for depression scale meta-analysis)
O'Halloran (2007) 32	Effects of group walking on mood change in sedentary people with type 2 diabetes.	Sedentary people with type II diabetes. 54 (±4.7)	Not stated Australia	Three groups available at different locations in metropolitan Melbourne. Group size varied from 6-11.	24 (24)	Moderate level of exertion. Borg scale 10-12	Average 28 mins. Once a week for 6 weeks	168	SEES Positive well-being ↑(p> 0.001) Psychological distress↓(p 0.355) Fatigue ↑ (p 0.061)
O'Hara (2000) 33	Effects of a walking programme on reducing blood pressure and on increasing health promoting behaviours.	Church based – mid-western African-American. Volunteered. Average BMI 34.2(±5.2) 41.8 (±7)	SE: Not stated E: African American USA	Group size 14.	14 (14)	Progressive aerobic walking programme (aim 40-75% age adjusted HRmax). Borg scale 12-15	Average 45 mins. 3 times a week for 10 weeks	1350 80%	SBP ↓ DBP ↓ (No baseline values or p values given. Insufficient data within published study to include in meta-analysis)
Palmer (1995) 34	Effects of a walking program on attributional style, depression, and self-esteem in women.	Non-exercising, premenopausal female volunteers aged 29-50 recruited	Not stated USA	Met in a university coliseum. Supervised. Group size 16.	27 (16)	60-70% of maximum heart rate (220-age) by carotid pulse	Average of 33 mins. Once a week for 8 weeks	264	SBP↓ns DBP↓ns Pulse↓ns Attributional style: negative events no change positive events ↑ns CES depression ↓ns Rosenberg self-esteem↑ (p<0.05)

		through advertising. 37.4							VO_2 max↑ (unable to include VO_2max into meta-analysis due to limited data)
Park (2013) [35]	Effects of a low-volume walking programme and vitamin E supplementation on oxidative damage and health-related variables in healthy older adults.	Healthy older adults recruited from the local community. 71.9 (±1.9)	Not stated Japan	Outdoors, supervised by experienced assistants. Walked in the morning. Group size 7.	38 (7)	Low volume walking programme of < 150 minutes per week. 48% HR reserve.	44 mins. 2 times a week for 12 weeks	1056	Results from control group (i.e. no vitamin E supplementation) Body mass ↑ (p 0.020) BMI ↑(p 0.024) Waist circumference ↑(p 0.603) SBP ↑(p 0.265) DBP ↑(p 0.737) Triacylglycerol ↑ (p 0.109) TC↑ (p 0.001) HDL-C ↑ (p 0.081) LDL-C ↑ (p 0.004) Glucose ↑ (p 0.992) Insulin ↑ (p 0.021) HbA1c ↓ (p 0.001) C-peptide ↑(p 0.001) sE-selectin ↑(p 0.001) sVCAM-1 ↑(p 0.019) plasma TBARS ↓ (p 0.038) (This is a sub-set of the Takahashi et al study and therefore only outcomes not included in Takahashi included in meta-analysis)
Reuter (2011) [36]	Effects of a flexibility and relaxation programme, walking, and Nordic walking on Parkinson specific disability and health related quality of life.	Mild to moderate Parkinson's disease with no history of falls. 63 (±3.1)	Not stated Germany	One session a week included walking uphill to improve muscle strength. Their partners were also offered 6 training sessions. Group size 30. Supervised by physiotherapists.	90 (30)	Not stated	70 mins. 3 times a week for 24 weeks	5040 90%	UPDRS sum score ↓ (improved) (p < .05) UPDRS motor score ↓ (improved) (p < .05) Pain (VAS) ↓(p < .05) PDQ39 ↓ (improved quality of life) (p < .001)

Roberts (1990) [37]	Effects of walking on reaction and movement times among elders	Recruited from seven senior citizen centres. 71.8 (±1.3)	Not stated USA	Indoors during poor weather. Implemented in the fall. Group size 6-10	60 (31)	60-70% of age-adjusted maximum HR. increased distance from 0.9 to 1.9 miles	30 mins. 3 times a week for 6 weeks	540 70%	Simple reaction time: ↓ns Choice reaction time: ↓ns Simple movement time: ↓ns Choice movement time: ↓ns
Rooks (1997) [38]	To examine the potential neuromotor benefits of walking in community dwelling older adults	Recruited from a suburban community centre. 79.2 (±4.3)	SE: not stated E: Caucasian USA	Outside in a large parking area, along a wooded path or in a gymnasium depending on the weather. Walked together. Group size 9.	18 (11)	Self- paced	Average 37 mins. Three times a week for 16 weeks	1776 92%	Balance: One-legged stand eyes open ↑(p 0.02) One-legged stand eyes closed↑(p 0.05) Tandem walk↓(p< 0 .01) Mis-steps↓(p 0 .05) Reaction times: Lower extremity↓(p 0 .36) Upper extremity↓(p<0 .96) Knee extension strength: Left ↑(p 0.51). Right ↑(p 0.045) Stair climb ↓(p<0.02)
Silverthorn (1993) [39]	Effects of exercise on aerobic capacity and body composition in adults with Prader-Willi syndrome	Adults with Prader-Willi syndrome from two group homes in USA. 25	Not stated – in residential home USA	A level riverbank trail. Group size 6.	11 (6)	Progressively increased pace - 20-23 mins per km, progressed to 13.5-16.5 mins per km	115 mins. 2-4 times a week for 24 weeks.	8280	Body weight ↓(p<0.016) Biceps skin fold ↓(p<0.023) Triceps skinfold ↓ns Resting HR ↓(< p 0 .05) VO_2max ↑(< p 0 .05)
Song (2013) [40]	To compare the effects of Nordic walking programme to those of a normal walking programme on the body composition, muscle strength and lipid profile of women who are over 65 years of age	Women over 65 68.2 (±2.5)	SE: Level of schooling given E: not stated South Korea	A park with a 400 metre track in a metropolitan city. Gym used during inclement weather. Run by person who majored in PE. Intervention ran from February to May. Group size 21	67 (21)	Progressed from 11-16 on the Borg scale	60 mins. 3 times a week for 12 weeks	2160	Weight↓ (p 0 .002) BMI ↓ (p .257) Total body water ↑ (p 0.626) Skeletal body mass ↑ (p <0.001) Percent body fat ↓ (p 0.005) Grip strength ↑ (< 0.001) Sit to stand (no of times) ↑ (p < 0.001) Arm curls (number of times) ↑ (p < 0.001) Total Cholesterol ↓ (p 0 011) Triglyceride ↓ (p 0 .062) HDL Cholesterol ↑ (p 0.890) LDL Cholesterol ↑ (p 0.860) (Walking is the control group)

Takahashi, (2013) [41]	To examine the effects of a low-volume exercise-training program (100 min/week) on oxidative stress and leukocyte activation marker levels in older adults.	Older adults from the local community. Gender not stated 67.8 (±1.3)	Not stated Japan	In the local community supervised by trainers in the morning (9-10 am) between March and May 2011. The environment was fairly flat road but some parts of road were uphill (but nothing very difficult to walk for older adults). Group size 14	28 (14)	Low volume exercise training under the 150 mins. Per week as recommended by the WHO	50 mins. 2 times per week for 12 weeks	1200	Body mass ↓ ($p < 0.01$) BMI ↓ ($p < 0.01$) Waist circumference ↓ ($p < 0.01$) SBP ↓ ($p < 0.01$) DBP ↓ ($p < 0.01$) AOPP ↓($p 0.014$) SOD ↑ ($p 0.619$) CAT↓ ($p 0.106$) GPX ↑ ($p 0.242$) TRX ↑ ($p 0.444$) TNF-α ↑ ($p 0.144$) IL-1β ↓ ($p 0.864$) IL-10 ↓ ($p 0.094$) MPO ↓ ($p 0.101$) Calprotectin ↑ ($p 0.129$) CD66b ↓ ($p 0.001$) CD62L ↑ ($p < .05$)
Thomas (2006) [42]	The effect of a Supervised walking programme on wandering among residents with dementia	Nursing home residents selected by the nursing staff with dementia and a 'wanderer'. Ranged from 71-89	Not stated USA	The walking environment included other units in the facility, social areas and the outdoor grounds which comprised sidewalks and seated areas surrounding the facility. Reminiscence was used. Late morning walks. A group of 6 and a group of 7.	13 (13)	Not stated. Residential in a nursing home	30-40 minutes. Frequency not stated. The study was for 3 weeks	Unable to assess from the data.	General wandering decreased, especially in those in early to middle stages of dementia.
van Uffelen (2007) [43] [44] [45]	The effects of aerobic exercise or vitamin B supplementation on cognitive function in older adults with mild cognitive impairment (2008) _____	Community-dwelling adults aged 70–80 with mild cognitive impairment recruited via a publicity campaign in a Dutch town.	SE: Level of education stated E: not stated Netherlands	In municipal parks near the subjects' own neighbourhood. Eight classes were started in four districts. 4 trained walking instructors were hired for the	152 (77)	Designed to improve aerobic fitness. Moderate intensity (three METs)	60 mins. 2 times a week for 52 weeks	6240 63%	Walking programme v placebo MMSE ↓ (men) no change in women ns AVLT 1–5 (words) ↓ (men and women) AVLT 6 (words) ↓ (men and women) SCWT-A task 1 ↑ (men)↓ (women) both SCWT-A task 2 ↓ (men and women) SCWT-A task 3 ↓ (men and women)

	The effects of walking and vitamin B supplementation on quality of life in community dwelling adults with mild cognitive impairment (2007) _____ Feasibility and effectiveness of a walking program for community dwelling older adults with mild cognitive impairment (2009)	75 (±2.7)		study. Group size 9-18					DSST (symbols) no change (men) and ↑ (women) VFT (words) ↑ (men and women) Difference between baseline and 12 months D-QoL sumscore no change D-QoL aesthetics ↑ns D-QoL belonging no change D-QoL negative effect↑ns D-QoL positive effect no change D-QoL self esteem ↑ns SF12 – mental component summary↑ns SF12 – physical component summary ↑ns

AIMS2, arthritis impact measurement scale 2,AOPP advanced oxidation protein products, AVLT, auditory verbal learning test (higher score indicates better performance),BAI, Beck anxiety inventory, BMI, body mass index, BPM, beats per minute, CAT, catalase, CES, center of epidemiological studies, CGI-S, Clinical Global impression Severity, CGI-I, Improvement scale, Chol., cholesterol, CS-PFP, continuous scale physical functional performance test, DASS, depression anxiety stress scale, DBP, diastolic blood pressure, D-QoL,dementia quality of life, DSST, digit symbol substitution test, EPDS, Edinburgh postnatal depression scale, F(F)M, fat (free) mass, FIQ, Fibromyalgia impact questionnaire, FM, fat mass, GPX, glutathione peroxidase, HAQ, Patient-Reported Outcomes Measurement Information System Health Assessment Questionnaire, HDL, high-density lipoprotein, HDL-C, high density lipoprotein cholesterol, HDS, Hamilton depression scale, HOMA2-IR: computerized homeostasis model assessment of insulin resistance, HR, heart rate, IGF-1, serum insulin growth factor, IGFBP3, insulin-like binding protein, IKES, isometric knee extensor strength, IL, interleukin, LDL, low-density-lipoprotein, LDL-C, low density lipoprotein cholesterol, LEP, leg extensor power, MCA, maximum current activity, MAP, mean arterial pressure, MFI, Multidimensional Fatigue Inventory, MMSE, mini mental state examination, MPO, myeloperoxidase, NII, Normative impairment index, PDQ39, Parkinson's disease questionnaire 39, PGMS, Philadelphia geriatric morale state, PMDRS, psychogenic movement disorder rating scale, PWC, physical work capacity, PWVcf, pulse wave velocity carotid–femoral, PWVcr, pulse wave velocity carotid–radial, SAD, sagittal abdominal diameter, SBP, systolic blood pressure, SCWT-A, Stroop colour word test–abridged, SEES, 12 item subjective exercise experience scale, sE-selectin, soluble E-selectin, SOD, superoxide dismutase, sVCAM-1, soluble vascular adhesion molecule-1, TBARS,,thiobarbituric acid reactive substances, TC, total cholesterol, TG, triglycerides, TNF-α, tumour necrosis factor alpha, TRX, thioredoxin, UPDRS, unified Parkinson's disease rating scale, VAS, visual analogue scale,VFT, verbal fluency test, WHO, World Health Organisation, WHR, waist to height ratio, WOMAC, Western Ontario MacMaster Osteoarthritis Index

Notes:

1. Results are difference between baseline and the end of the intervention. Results for other time points may be available from the text.
2. There may also be physical activity outcomes within the study and available from the text.
3. Summary table may include additional information provided by the author that cannot be found in the published text.
4. P values given where they were available. Not significant (ns) only used where this is the information that the author has provided.
5. ↑ = increase in a measurement – this may or may not be an improvement.
6. Volume of walking applies to walking with the group as stated in the study. No assumptions have been made about additional walking.
7. **Emboldened and underscored** authors indicates that the study is included in the meta-analysis

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