Using pedometers to increase physical activity and improve health: a systematic review

CRD summary
The review concluded that the use of a pedometer is associated with significant increases in physical activity and may be associated with clinically relevant reductions in body mass index and blood-pressure in adult out-patients. The authors' conclusions are likely to be reliable. However, long-term effects remained undetermined and the generalisability of the results to older and male populations is limited.

Authors' objectives
To assess the effectiveness of pedometer use on physical activity and other health outcomes in adult outpatients.

Searching
MEDLINE (January 1966 to February 2007), EMBASE, SPORTDiscus, PsycINFO, the Cochrane Library, Thompson Scientific databases and ERIC (January 1966 to May 2006) were searched for English language papers; the search terms were reported. References of relevant articles and conference proceedings were also checked for additional studies.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) and observational studies were included in the review. Studies were required to have more than 5 participants to be eligible for inclusion.

Specific interventions included in the review
Studies that assessed pedometer use were eligible for inclusion. Studies that had sealed the pedometer (i.e. intervention participants were blinded to the number of steps walked per day) were excluded, as were studies that used a pedometer to assess the effects of a drug on physical activity. The mean duration of the physical activity interventions was 18 weeks (range: 3 to 104). Five took place in the workplace, 23 included a step diary, 17 included physical activity counselling, and 3 included dietary counselling.

Participants included in the review
Studies of adult out-patients were eligible for inclusion. Studies of hospitalised patients or patients confined to a research centre were excluded. The mean age of the included participants was 49 years and the majority were female (85%). Most of the participants were overweight, normotensive, had relatively well-controlled serum lipid levels, and were relatively inactive at baseline (mean 7,473 steps per day).

Outcomes assessed in the review
Studies that reported the change in number of steps walked per day were eligible for inclusion. Health outcomes, including change in body mass index (BMI) and blood-pressure, were also reported.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for inclusion, or how many reviewers performed the selection.

Assessment of study quality
Two authors independently assessed the methodological quality of the primary studies using the following criteria: the method of blinding control participants to step counts; the extent to which participants took part in the activity programme; the methods used to determine baseline physical activity; completeness of follow-up; the use of validity- and reliability-tested pedometers; and the extent to which concurrent interventions may have affected physical activity.

Data extraction
Two authors independently extracted data from the primary studies; any discrepancies were resolved by consensus.
terms of outcome data, immediate post-intervention data rather than longer term follow-up were extracted for inclusion in the primary analysis. The mean difference and the standardised mean difference for change in steps walked (pre-post intervention) were calculated for all studies. For all included RCTs, the difference in the pre- and post-intervention scores between the intervention and control groups was also calculated.

Methods of synthesis
How were the studies combined?
Meta-regression, weighted by sample size, was used to calculate the summary effect of the physical activity and participant characteristics on the outcome variables. A random-effects model was used. Publication bias was assessed by visual inspection of funnel plots.

How were differences between studies investigated?
Heterogeneity was assessed using the Q statistic and the I-squared statistic. In addition, each study was removed individually to evaluate the effect of that study on the summary estimates. Subgroup analyses looking at demographics, BMI, baseline activity, intervention type, intervention setting and study design were also conducted.

Results of the review
Twenty-six studies (n=2,767) were included in the review: 8 RCTs and 18 observational studies.

Quality.
Four studies did not specify the methods by which the participants' baseline physical activity was determined. Nine studies had 100% of participants complete the intervention; the average drop-out rate of the remaining studies was 20%. Sixteen studies used a well-validated pedometer.

Pedometer use and physical activity.
A significant increase in the number of steps per day was found in the intervention group compared with controls (mean difference in change 2,491, 95% confidence interval, CI: 1,098, 3,885, p<0.001; based on 8 RCTs, n=277. Evidence of statistical heterogeneity was found. An increase in the summary estimate without evidence of statistical heterogeneity was found with the removal of a 24-week trial involving postmenopausal hypertensive women, which had reported a higher increase in physical activity than any other trial. Overall, the results of the observational studies found that pedometer users increased their physical activity by 26.9%, with a significant increase in physical activity over baseline (2,183 steps per day; p<0.01).

The results of the meta-regression indicated that increases were associated with having a step goal, using a step diary, and having the intervention set in places other than the workplace. There was also a trend for younger pedometer users and those with less baseline activity to show the greatest increases in physical activity.

Pedometer use and health outcomes (both RCTs and observational studies).
Pedometer use was found to significantly decrease the BMI by 0.38 from baseline (p=0.03); no evidence of statistical heterogeneity was found. The decrease was associated with older age, ethnicity (greater percentage of white participants), having a step goal, and interventions of longer duration.

Pedometer use was found to significantly decrease systolic blood-pressure by 3.8 mmHg (p<0.001) and diastolic blood-pressure by 0.3 mmHg (p=0.001). Evidence of statistical heterogeneity was found.

Intervention was not found to significantly improve serum lipid levels or decrease fasting serum glucose concentration.

No evidence of publication bias was found for the effect of pedometer use on physical activity.

Authors' conclusions
The use of a pedometer is associated with significant increases in physical activity and may be associated with clinically relevant reductions in BMI and blood-pressure. However, the long-term effects remain undetermined.

**CRD commentary**

The review question was supported by clear inclusion criteria. The authors searched several relevant sources, although this search was limited to papers published in English; publication bias was assessed. The methodology undertaken to data extract and assess study quality was likely to have minimised reviewer error or bias. It is not clear how the papers were initially selected, therefore it is not possible to assess whether error or bias could have been introduced at this stage. The analyses appear appropriate, statistical heterogeneity was assessed, and the authors investigated several possible sources of heterogeneity. In addition, the authors rightly highlighted that the generalisability of the results to older and male populations is limited. Overall, the authors’ conclusions appear to reflect the results presented.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that large randomised trials investigating pedometer use in both men and women over a range of ages in out-patient settings are required. The authors also indicated a number of comparisons that such trials should consider, and that key outcomes (physical activity and health outcomes) should include both short- and long-term assessments.

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These additional published commentaries may also be of interest.


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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.