Walking, lipids, and lipoproteins: a meta-analysis of randomized controlled trials
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CRD summary
This review assessed the effects of walking on lipids and lipoproteins in adults. The authors concluded that walking reduced low-density lipoprotein cholesterol and the ratio of total cholesterol to high-density lipoprotein cholesterol. The general methodology of the review was sound. However, the strength of the evidence was weakened by the limited quality assessment of the included studies, and the lack of an adjustment for statistical dependency of multiple comparison groups sharing a control group.

Authors' objectives
To assess the effects of walking on lipids and lipoproteins in adults.

Searching
MEDLINE, EMBASE, SPORTDiscus and Dissertation Abstracts Online were searched from inception to 2002 for reports in English; the search terms were reported. The reference lists in selected studies and reviews were checked, and an expert in the field was contacted for details of additional studies. Selected journals were handsearched (no details were reported).

Study selection

Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible for inclusion.

Specific interventions included in the review
Studies of walking programmes lasting at least 8 weeks were eligible for inclusion. In most studies, the programmes involved brisk walking for 30 minutes or more for at least 5 days a week. The interventions lasted from 10 to 104 weeks.

Participants included in the review
Studies of adults aged 18 years or older were eligible for inclusion. Of the 25 included studies, 18 were restricted to women, 13 to healthy people, 2 to insulin diabetics, 6 to overweight or obese people, one to people with hyperlipidaemia, and one to people with intermittent claudication.

Outcomes assessed in the review
Studies that assessed any of the following outcomes in an apparently fasting state were eligible for inclusion: total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), the ratio of TC to HDL-C (TC:HDL-C), or triglycerides (TG). The TC:HDL-C ratio was not calculated for studies where TC and HDL-C were reported, owing to a lack of variance data. These were primary outcomes of the review. The secondary outcomes were changes in body weight, body mass index, percentage body fat, lean body mass and maximum oxygen consumption (VO2max).

How were decisions on the relevance of primary studies made?
Two reviewers independently selected studies and resolved any disagreements through consensus.

Assessment of study quality
Validity was assessed and scored using the Jadad scale, which considers the reporting and handling of randomisation, blinding and handling of withdrawals. The maximum possible score was 5 points. At least two reviewers assessed validity. Inter-rater agreement was measured using the kappa statistic.
Data extraction
Two reviewers independently extracted the data onto coding sheets and resolved any disagreements through consensus, with the aid of a third reviewer where required. Mean differences (MDs) with 95% confidence intervals (CIs) between walking and control groups were calculated for each study.

Methods of synthesis
How were the studies combined?
Pooled MDs, with 95% CIs, between walking and control groups were calculated using a random-effects meta-analysis. The authors seemed to analyse each intervention group within studies as a separate comparison in the meta-analysis (this was not stated explicitly in the text). Publication bias was assessed using the trim-and-fill method of Duvall and Tweedie.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the Q statistic. The influence of the following factors on changes in lipids and lipoproteins was examined: source of study (journal versus dissertation); country (USA versus other); gender; use of drugs potentially effecting lipids and lipoproteins; cigarette smoking; use of alcohol; changes in diet; menopausal status; value of TC, LDL-C and TG; and the health of the participants (healthy or not). The quality of studies published in journals compared with studies in dissertations was investigated using a Mann-Whitney U-test. A regression analysis was used to examine the effect of several continuous variables on changes in lipids and lipoproteins (the variables were listed). The influence of each study on the results was examined by reanalysing the data after removing each study in turn. In a post hoc analysis simple regression was used to examine the relationship between VO2max and age.

Results of the review
Twenty-five parallel group RCTs with 33 comparisons were included (n=1,176).

The mean quality score was 2 out of 5 points. Only one RCT appeared to use intention-to-treat analysis. Final lipid and lipoprotein data were not available for 26% of walkers and 14% of controls.

Walking statistically significantly decreased LDL-C (MD -5.5 mg/dL, 95% CI: -9.9, -1.2) and the TC:HDL-C ratio (MD -0.3 mg/dL, 95% CI: -0.6, -0.1) compared with the control. There were no statistically significant differences between walking and control for TC (MD -3.4 mg/dL, 95% CI: -7.5, 0.7), LDL-C (MD 1.2 mg/dL, 95% CI: -0.3, 2.7) or TG (MD 0.2 mg/dL, 95% CI: -6.2, 6.6). No statistically significant heterogeneity was found for any of the meta-analyses of lipids or lipoproteins.

The authors reported that there was no evidence of publication bias for LDL-C or the TC:HDL-C ratio.

There was no statistically significant difference between walking and control for body weight, body mass index, percentage body fat or lean body mass (results were reported). Walking significantly increased VO2max compared with the control (MD 3.6 mL/kg. 95% CI: 2.6, 4.6). Greater decreases in the TC:HDL-C ratio were found for menopausal women than for premenopausal women (P=0.003).

Authors' conclusions
Walking reduced LDL-C levels and the TC:HDL-C ratio in adults, regardless of changes in body composition.

CRD commentary
The review question was clear in terms of the study design, participants, intervention and outcomes. Several relevant sources were searched, with attempts made to locate unpublished studies, and the possibility of publication bias was assessed. No attempts were made to minimise language bias. Two reviewers independently selected studies, assessed validity and extracted the data, thus reducing the potential for bias and errors. Validity was assessed using specified established criteria, but the tool selected may not have been the most appropriate for an intervention for which patient blinding was not possible, and with objective outcomes measured biochemically.
Adequate information on the included studies was presented, and differences between the studies were described in the text. The studies were appropriately combined in a meta-analysis, statistical heterogeneity was assessed, and the influence of various factors on the results was examined. However, where multiple comparison groups shared a control group, no adjustment was made for statistical dependency. The strength of the evidence was weakened by limited information on the quality of the included studies and the lack of an adjustment of significance levels to take account of multiple outcomes. In addition, most of the participants were women and the results may not generalise to other groups. These limitations should be kept in mind when considering the results and conclusions of the review.

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

Practice: The authors stated that adherence to the guidelines of walking briskly for 30 minutes or more at least 5 days a week would improve LDL-C levels and the TC:HDL-C ratio in adults.

Research: The authors stated that future studies should report in full all variables assessed (with mean and standard deviations), publish intention-to-treat and per protocol analyses, and report compliance with the intervention.

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