Effects of aerobic exercise on non-high-density lipoprotein cholesterol in children and adolescents: a meta-analysis of randomized controlled trials
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CRD summary
The review concluded that aerobic exercise did not reduce non-high density lipoprotein cholesterol but decreased percentage of body fat and increased aerobic capacity in children and adolescents. There were a number of problems with the review that suggest the authors’ conclusions should be interpreted with caution; their recommendation for further research appeared reasonable.

Authors' objectives
To examine the effects of aerobic exercise on non-high density lipoprotein cholesterol (non-HDL-C) in children and adolescents.

Searching
PubMed, EMBASE, SportDiscus, Cochrane Central Register of Controlled Trials (CENTRAL) and Dissertation Abstracts International were searched from 1955 to 2007 for articles, theses and dissertations in English. Reference lists of retrieved articles were searched. A handsearch was undertaken.

Study selection
Randomised controlled trials (RCTs) of aerobic exercise (at least four weeks duration) with no diet interventions and compared with control in children or adolescents aged five to 19 years were eligible for inclusion. Trials had to provide data on total cholesterol and HDL-C so that non-HDL-C could be calculated.

The included RCTs evaluated cycling, jogging, walking, dancing or other activities (alone or in combination) in participants aged eight to 16 years. Some participants had type 1 diabetes and some were overweight or obese. It was unclear whether some studies included participants on medication that could have affected lipid and lipoprotein metabolism. It was unclear whether some trials included participants who consumed alcohol, smoked cigarettes or participated in regular exercise programmes. None of the trials reported that all patients were hyperlipidaemic. Exercise programme duration ranged from five to 16 weeks. The frequency of intervention varied from three times a week to five times a week. Length of exercise sessions ranged from 20 minutes to 135 minutes.

The authors did not state how many reviewers were involved in study selection.

Assessment of study quality
Trial quality was assessed using the Jadad five-point scale to score trials from zero (low quality) to 5 (high quality).

The authors did not state how many reviewers assessed trial quality.

Data extraction
Two reviewers independently extracted data on change in total cholesterol and HDL-C to enable calculation of non-HDL-C. Data were used to calculate mean effect sizes and 95% confidence intervals (CIs). Data on body weight, percentage of body fat and VO_{2max} were extracted.

Methods of synthesis
Pooled effect sizes, together with 95% CIs, were calculated using a random-effects meta-analysis weighted by the inverse of variance. Statistical heterogeneity was assessed using Q and I^2 statistics. Sensitivity analysis deleted one study from the analysis at a time and performed cumulative meta-analysis ranking trials by year. Subgroup analysis grouped trials according to 10 subgroups (such as males, participants with type one diabetes and overweight participants to a 99% significance level). Publication bias was assessed using Egger’s linear regression. Regression analysis was used to
assess the association of seven factors (such as study quality, age of participants, and publication year) on changes in non-HDL-C and initial non-HDL-C.

**Results of the review**

Twelve RCTs with 25 study arms were included in the review (n=404 participants). All trials used per-protocol analysis. Trial intervention and control groups were matched at baseline for non-HDL-C, HDL-C, total cholesterol, VO\textsubscript{2}\text{max}, age, height, body weight and fat. Drop-out ranged from 0% to 28%. Trial quality was generally poor (zero out of 5 to 2 out of 5).

There was no statistically significant difference in non-HDL-C with aerobic exercise compared to control (mean -0.7mg/dL, 95% CI -5.4 to 5.0; 13 study arms, I\textsuperscript{2}=73%). There was no statistically significant difference in total cholesterol (mean -1.0mg/dL, 95% CI -4.8 to 2.9; 13 study arms, I\textsuperscript{2}=39%) or HDL-C (mean -1.2 mg/dL, 95% CI -4.5 to 2.2; 13 study arms, I\textsuperscript{2}=92%). There was no statistically significant difference in body weight (mean 1.1 kg, 95% CI -1.9 to 4.0; 10 study arms, I\textsuperscript{2}=45%), but there was a statistically significant difference in terms of body fat, with greater reductions in the exercise groups (mean -2.1%, 95% CI -3.0 to -1.2; five study arms, I\textsuperscript{2}=0%). There was a statistically significant difference in terms of VO\textsubscript{2}\text{max}, with greater improvements in the exercise groups (mean 3.4mL/kg\textsuperscript{-1}/min\textsuperscript{-1}, 95% CI 1.4 to 5.3; eight study arms, I\textsuperscript{2}=0%).

Sensitivity and subgroup analyses revealed no statistically significant differences in non-HDL-C. Publication bias was not detected in any of the analyses apart from body weight (p=0.01).

**Authors’ conclusions**

Aerobic exercise did not reduce non-HDL-C, but decreased the percentage of body fat and increased aerobic capacity in children and adolescents. Further research was needed.

**CRD commentary**

Inclusion criteria for the review were clearly defined. Several relevant databases were searched for published and unpublished data. Publication bias was assessed and was detected in only one analysis. The search was restricted to English-language articles; this may have introduced language bias. Two reviewers undertook data extraction to minimise risks of error and bias in the analysis; it was unclear whether the same methodology was extended to study selection and quality assessment. The authors acknowledged that the included trials were generally poor quality. The authors stated that most participants had normal baseline values of total cholesterol and HDL-C, but the baseline characteristics of the control arms were unclear. The trials were combined using meta-analysis and subgroup and sensitivity analyses were undertaken, which appeared appropriate. There was evidence of significant statistical heterogeneity, which remained unexplained after further analyses. Sample sizes of the included trials were generally small, which combined with the poor trial quality and potential for review bias, suggested that the authors' conclusions should be interpreted with caution; their recommendation for further research in patients with elevated levels appeared reasonable.

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

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

**Research:** The authors stated that randomised controlled trials focused on children and adolescents with elevated lipid and lipoprotein levels were needed. The association between changes in non-HDL-C and age and training intensity needed investigation.

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