Cholesterol-lowering effects of dietary fiber: a meta-analysis

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Authors' objectives
To quantify the cholesterol-lowering effect of major water-soluble dietary fibres.

Searching
The authors searched MEDLINE (1966 to 1996) and also scanned the references of retrieved articles for additional relevant data. Although unpublished material and non-English articles were excluded, one unpublished trial that was mentioned in the published literature was retrieved from the Quaker Oats company.

Study selection
Study designs of evaluations included in the review
Controlled trials with either a randomised crossover (32 studies) or parallel study design (35 studies) with a lead-in time of 14 days and an intervention period equal or greater than 14 days. The analysis was limited to primary sources of fibre for which there were more than 5 trials per type of fibre (i.e. for oat products, psyllium, pectin and guar gum).

Specific interventions included in the review
Water-soluble dietary fibres from a single source, including pectin, oat bran, guar gum, and psyllium.

Participants included in the review
Participants were men and women (1,733 men and 1,011 women, 246 sex not specified) whose average age was 50 years. Participants were either healthy or hyperlipidemic, or diabetic.

Outcomes assessed in the review
Outcome measures were net changes in total cholesterol, LDL cholesterol, HDL cholesterol, and triacylglycerols measured in units of mmol per litre per gram. For studies with parallel group designs, lipid effects were calculated by subtracting the mean change in the control (low fibre) group from that in the treatment (high fibre) group. In cross-over studies, the estimate represents the difference in post-treatment lipid concentrations for the high-fibre and low- fibre periods. The net change was divided by the daily dose of soluble fibre.

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

Assessment of study quality
The authors do not state that they assessed quality.

Data extraction
The authors do not state who, or how many of the authors, performed the data extraction.

For each individual trial, the authors estimated the standard error (SE) of the treatment effect for the lipid outcome measures by using the SDs of paired differences (follow-up minus initial) for the treatment and control groups. If the SDs were not provided, the authors used the SE values derived from the exact t ratios, p values, or 95% confidence intervals (Cis).

For one-third of the studies, the within-study SE was divided by the average daily dose for each study to estimate the SE of the treatment effect per gram fibre. For the other two-thirds, the authors estimated the SE by using previously published methods and data from the Lipid Research Clinics.
Methods of synthesis
How were the studies combined?
The authors computed summary estimates (effect sizes) of the net lipid changes by combining the mean effect sizes reported by individual studies weighted by the inverse of the individual and between-study variance according to a random-effects model with 95% confidence intervals (CIs).

Summary estimates were computed for each type of soluble fibre separately and for all fibres combined.

For meta-analyses of each fibre type, the authors selected one set of lipid results per study to avoid undue weighting of a study. When more than one dose was studied, the mean lipid change across all doses was used to provide an average effect size.

How were differences between studies investigated?
The authors assessed the homogeneity of effect sizes by the Q test. Weighted least-squares regression analyses were performed by using the general linear models procedure of the SAS programme to test for differences in lipid changes. The independent variables tested in this model were: initial cholesterol concentration, type of dietary fibre, study design, health status of study population, mean age, background diet, dietary changes in total fat, saturated fat, and dietary cholesterol, type of control, and treatment length.

Models of dose response were examined, and the authors also performed calculations to determine whether lipid changes could be attributed to dietary changes other than the inclusion of soluble fibre in the diet.

Results of the review
Sixty-seven controlled trials were included in the review with 2,990 participants. The crossover design trials had 863 participants in the treatment group and 863 in the control group, and the parallel design trials had 1,146 in the treatment group and 981 in the control group. There were 25 trials of oat products, 17 of psyllium, 7 of pectin, and 18 of guar gum.

Soluble fibre (2-10 g/d) was associated with small but statistically significant decreases in total cholesterol (-0.045 mmol per litre per gram soluble fibre, 95% CI: -0.054, -0.035) and LDL cholesterol (-0.057 mmol per litre per gram soluble fibre, 95% CI: -.070, -0.044).

The effects on plasma lipids of soluble fibre from oat, psyllium, or pectin were not statistically significantly different. It was not possible to determine the effects for guar gum because of a lack of data.

Triacylglycerols and HDL cholesterol were not significantly influenced by soluble fibre.

Lipid changes were independent of study design, treatment length, and background dietary fat content.

Authors’ conclusions
Various soluble fibres reduce total and LDL cholesterol by similar amounts. The effect is small within the practical range of intake. Three grams of soluble fibre from oats (3 servings of oatmeal, 28 grams each) can decrease total and LDL cholesterol by approximately 0.13 mmol/L. Increasing soluble fibre can make only a small contribution to dietary therapy to lower cholesterol.

CRD commentary
The authors have stated their research question and inclusion/exclusion criteria and have performed a reasonable search of the literature. It is not clear whether additional relevant data may have been missed since unpublished literature and non-English publications were not included in the review. The authors also restricted their search to MEDLINE and may therefore have missed studies published outside of the United States. Heterogeneity was found between the studies, but the authors have proceeded with a statistical combination of the data and investigated the effects of the heterogeneity using various statistical modelling tools.
There may be bias in the review because there is no information reported about the selection or data extraction processes for the included studies. The authors also have not performed a quality assessment of the included individual studies. For these reasons, the results of this review should be viewed with caution.

Implications of the review for practice and research
The authors did not state any implications for further research and practice.

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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.