Effects of low-carbohydrate vs low-fat diets on weight loss and cardiovascular risk factors: a meta-analysis of randomized controlled trials


CRD summary
The review assessed low-carbohydrate versus low-fat diets. The authors concluded that low-carbohydrate non-energy-restricted diets appear at least as effective as low-fat energy-restricted diets in inducing weight loss for up to one year. Potential favourable effects on triglyceride and high-density lipoprotein cholesterol should be weighed against potential unfavourable effects on low-density lipoprotein cholesterol when considering low-carbohydrate diets. The conclusions appear reliable.

Authors’ objectives
To compare the effects of low-carbohydrate diets without energy restriction versus energy restricted low-fat diets on weight loss, blood-pressure, and lipid values in randomised controlled trials (RCTs) with dietary interventions for at least 6 months.

Searching
The authors searched MEDLINE, EMBASE, Pascal, Global Health, HEALTH, Web of Science and the Cochrane Library from January 1980 to the end of February 2005. They also reviewed UptoDate (version 2005) and Clinical Evidence Concise (2004), contacted experts and checked the reference lists of identified publications.

Study selection
Study designs of evaluations included in the review
Parallel-group RCTs with a follow-up of at least 6 months were eligible for inclusion. Crossover or sequential designs were excluded.

Specific interventions included in the review
Trial assessing low-carbohydrate diets (allowing up to 60 g of carbohydrates per day) without energy intake restriction versus low-fat diets (allowing up to 30% of the daily energy intake from fat) with energy intake restriction were eligible for inclusion. In the included trials, carbohydrate intake was restricted to between 20 and 50 g/day, while the allowed fat intake varied from 10 to 30% of energy from fat. All of the included participants prepared their own food.

Participants included in the review
Trials of participants with a body mass index (BMI) of at least 25, and who were at least 16 years old, were eligible for inclusion. The participants in the included studies had a BMI of 30 to 35, 30 to 60, 27 to 42, or were reported as having a BMI above 35. The mean ages ranged from 42 to 49 years and most of the participants were women.

Outcomes assessed in the review
Studies that reported changes in body weight using an intention-to-treat analysis were included. The review assessed weight loss, completion rates, blood-pressure, lipid values, glucose and insulin values.

How were decisions on the relevance of primary studies made?
Two reviewers screened studies independently. Any disagreements were resolved by discussion until consensus was reached.

Assessment of study quality
Allocation concealment, blinded outcome assessment, loss to follow-up, and full descriptions of losses to follow-up and withdrawals were assessed. Two reviewers independently assessed the quality of the studies.
Data extraction
The data were extracted in duplicate. The reviewers extracted the mean difference in weight loss between the two groups from baseline to 6 or 12 months as the main outcome, and further mean differences in percentage change of body weight, systolic and diastolic blood-pressure, blood lipid levels, fasting glucose level, fasting insulin level and quality of life.

Methods of synthesis
How were the studies combined?
Weighted mean differences (WMDs) and 95% confidence intervals (CIs) across trials were computed using a random-effects model. Publication bias was assessed with a funnel plot.

How were differences between studies investigated?
Statistical heterogeneity was assessed with the Cochran Q test and I-squared statistic. Heterogeneity between the trials was explored in a sensitivity analysis.

Results of the review
Five trials (n=447) met the inclusion criteria.

All trials used concealed treatment allocation, patient blinding was not possible, and an independent blinded outcome assessment was not used.

The funnel plot did not indicate publication bias.

All arms of the 5 trials showed weight loss after the diet: this ranged from -12 to -3.2 kg in the low-carbohydrate group and from -1.9 to 6.5 kg in the low-fat intake group after 6 months. After 12 months, the low-carbohydrate groups showed weight losses between -7.2 and -2.1 kg. Weight losses in the low-fat group ranged from -4.4 to -3.1 kg in the 3 studies that provided these data.

The participants on low-carbohydrate diets were more likely to complete the trial (statistically significant for 6 months' follow-up).

After 6 months, individuals on low-carbohydrate diets had lost significantly more weight than individuals randomised to low-fat diets (WMD -3.3 kg, 95% CI: -5.3, -1.4; 5 trials). The results showed statistical heterogeneity (P=0.02), which was traced to one trial allowing 10% energy intake from fat compared with 30% in the other trials. After 12 months, the difference was reduced to a mean of -1.0 kg (95% CI: -3.5, 1.5; not significant; based on 3 trials).

No differences in blood-pressure were found. A low-carbohydrate diet had favourable effect on triglyceride levels (WMD -22.1 mg/dL, 95% CI: -38.1, -5.3; 4 trials) and high-density lipoprotein cholesterol values (WMD 4.6 mg/dL, 95% CI: 1.5, 8.1; 4 trials). A low-fat diet showed favourable results on total cholesterol (WMD 8.9 mg/dL, 95% CI: 3.1, 14.3; 4 trials) and low-density lipoprotein cholesterol values (WMD 5.4 mg/dL, 95% CI 1.2, 10.1; 4 trials).

Authors' conclusions
Low-carbohydrate, non-energy restricted diets appear at least as effective as low-fat, energy-restricted diets in inducing weight loss for up to one year. Potential favourable changes in triglyceride and high-density lipoprotein cholesterol values should be weighed against potential unfavourable changes in low-density lipoprotein cholesterol values when low-carbohydrate diets are considered.

CRD commentary
This was a well reported systematic review with a clear question and clear inclusion criteria. The search encompassed several databases. It is, however, unclear whether any language restrictions were applied or whether a systematic approach to finding unpublished studies would have located more studies; the authors inspected a funnel plot for publication bias. Measures were taken to reduce errors and bias in the selection of trials and the extraction of data. The
included studies appear to have had little control over adherence to the diet restrictions, and drop-outs and losses to follow-up were substantial. The quality of the included studies was assessed with appropriate criteria and the results were reported. Details of the included studies were reported and systematically assessed (e.g. drop-outs), and the results were critically discussed. The study results were pooled in a meta-analysis, identified heterogeneity between study results was successfully traced for the main outcome, and sensitivity analyses were performed. The conclusions appear to be reliable, although the small number of included studies and participants should be kept in mind.

The authors stated that the funding source played no role in the review process.

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

**Practice:** The authors stated that there was insufficient evidence to make recommendations about the use of low-carbohydrate diets to induce weight loss (especially for long-term weight loss).

**Research:** The authors stated that future trials should obtain complete evaluations of body weight and cardiovascular risk factors for all participants, regardless of their adherence to the allocated diet.

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