Systematic review and meta-analysis of clinical trials of the effects of low carbohydrate diets on cardiovascular risk factors

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CRD summary
This review concluded that low carbohydrate diets had favourable effects on body weight and major cardiovascular risk factors but effects on long-term health were unknown. These conclusions reflect the presented evidence and appear appropriate but a failure to account for the influence of factors other than diet and to fully incorporate uncertainty raise concerns about their reliability.

Authors' objectives
To estimate the effect of low carbohydrate diets on weight loss and cardiovascular risk factors.

Searching
MEDLINE, Cochrane Central Register of Controlled Trials (CENTRAL) and Scopus were searched from 1980 to March 2011 for publications in English, Spanish, Portuguese or French. Search terms were reported. Reference lists of the included studies were searched and studies included in previous meta-analyses were identified.

Study selection
Randomised controlled trials that evaluated the effect of low carbohydrate diets on weight loss in adults (≥18 years) were eligible for inclusion if they followed up at least 100 participants for three months or longer.

Mean body mass index (BMI) among included studies ranged from 29.1kg/m² to 42.9kg/m². Around half of the evaluated low carbohydrate diets were directly based on the Atkins diet.

Three authors independently selected studies for inclusion.

Assessment of study quality
The authors stated that three investigators independently assessed study quality. No details of this assessment were presented.

Data extraction
Two authors extracted mean difference in weight loss and any reported cardiovascular risk factors between baseline and follow-up for participants on low carbohydrate diets. Four follow-up periods were defined (less than six months, six to 12 months, 12 to 23 months and 24 months or more). Authors of trials were contacted for additional data where necessary.

Methods of synthesis
A fixed-effect inverse variance model was used to pool mean differences across studies. Statistical heterogeneity was assessed using the $I^2$ calculation.

Results of the review
Seventeen randomised trials were included in the review (1,141 obese patients). Follow-up ranged from three to 36 months.

Low carbohydrate diets were associated with significant decreases in body weight (-7.04kg, 95% CI -7.20 to 6.88; $I^2$=96%), body mass index (-2.09kg/m², 95% CI -2.15 to -2.04; $I^2$=91%), abdominal circumference (-5.74cm, 95% CI -6.07 to -5.41; $I^2$=90%), systolic blood pressure (-4.81mmHg, 95% CI -5.33 to -4.29; $I^2$=77%), diastolic blood pressure (-3.10mmHg, 95% CI -3.45 to -2.74; $I^2$=77%), plasma triglycerides (-29.71mg/dL, 95% CI -31.99 to -27.44; $I^2$=83%), fasting plasma glucose (-1.05mg/dL, 95% CI -1.67 to -0.44; $I^2$=81%), glycated haemoglobin (-0.21%, 95% CI -0.24 to -0.18; $I^2$=77%), plasma insulin (-2.24 micro IU/mL, 95% CI -2.65 to -1.82; $I^2$=73%) and plasma C-reactive protein (-0.22mg/L, 95% CI -0.33 to -0.11; $I^2$=41%) and an increase in high-density lipoprotein cholesterol (1.73mg/dL, 95%
Low-density lipoprotein cholesterol and creatinine did not change significantly. Data on plasma uric acid were limited.

**Authors' conclusions**
Low carbohydrate diets had favourable effects on body weight and major cardiovascular risk factors; effects on long-term health were unknown.

**CRD commentary**
The research question for this review was stated clearly and supported by appropriate inclusion criteria. The authors attempted to identify most of the relevant evidence and minimised potential for errors and bias in the selection of this evidence. However, there was no indication of whether there may be unpublished studies with systematically different results to those presented here (publication bias).

The methods used to pool studies appeared appropriate. The decision to look only at changes within the low carbohydrate diet treatment groups means that the influence of factors other than diet on the reported outcomes could not be ruled out; the authors did not investigate this possibility in their analysis. Most analyses included studies with statistically heterogeneous results so a fixed-effect model may not have adequately reflected the overall uncertainty around these estimates. A random-effects model might have resulted in some of the smaller pooled effects becoming statistically non-significant.

The authors' conclusions reflect the presented evidence and appear appropriate but a failure to account for the influence of factors other than diet and to fully incorporate uncertainty raise concerns about their reliability.

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

**Research**
The authors stated that further research was needed on the long-term effects of low carbohydrate diets, perhaps including the follow-up of existing cohorts.

**Funding**
Not stated.

**Bibliographic details**

**PubMedID**
22905670

**DOI**
10.1111/j.1467-789X.2012.01021.x

**Original Paper URL**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Blood Glucose /metabolism; Blood Pressure; Cardiovascular Diseases /blood /diet therapy /metabolism; Cholesterol /blood; Diet, Carbohydrate-Restricted; Dietary Carbohydrates /administration & dosage; Humans; Insulin /blood; Randomized Controlled Trials as Topic; Risk Factors; Treatment Outcome; Triglycerides /blood; Weight Loss /drug effects /physiology
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.