Effect of reducing total fat intake on body weight: systematic review and meta-analysis of randomised controlled trials and cohort studies

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CRD summary
Authors concluded that lower fat intake was associated with a small but clinically meaningful reduction in body weight in adults; similar findings were also identified in children and young people. This was mainly a well-conducted review and the conclusions appear reliable.

Authors' objectives
To examine the association between total fat intake and body weight in adults and children.

Searching
MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched up to June 2010; search terms were reported. A systematic review was checked for further trials. Experts were contacted for further trials through regional offices of the World Health Organization (WHO) and the WHO nutrition advisory group. No language restrictions were applied.

Study selection
Randomised controlled trials (RCTs) and prospective cohort studies in apparently healthy children or adults were eligible for inclusion. Eligible interventions aimed to reduce total fat intake (either reducing percentage energy from fat or total fat in grams per day) in comparison with usual diet over a minimum of 26 weeks. Treatments comprising a low fat diet and a non-dietary intervention were included if the control group also received a non-dietary intervention. Some measure of body fatness was required for inclusion; for cohort studies this data was required for at least one year after baseline measurement. Studies where weight loss was intended were excluded.

Most studies were RCTs of interventions for adults with mean age ranging from 35 to 62 years. Studies targeted a range of different participants including healthy people, those with risk factors (such as high lipid levels), and those with current illnesses (such as diabetes, coronary heart disease, cancer). For most studies, participants were either all female or both males and females. Twenty studies were conducted in North America, 12 in Europe and one in New Zealand.

Two reviewers independently selected studies for inclusion, with any differences resolved through discussion or consultation with a third reviewer.

Assessment of study quality
The quality of RCTs was assessed according to criteria from the Cochrane Collaboration handbook for systematic reviews and additional review-specific criteria (presence of other dietary interventions in combination with reducing total fat intake, similarity of type and intensity of intervention in both groups). Modified Newcastle-Ottawa criteria were used to assess the quality of cohort studies.

Two reviewers independently quality assessed studies, with any differences resolved through discussion or consultation with a third reviewer.

Data extraction
Outcomes (body weight, body mass index (BMI), and waist circumference) were extracted to calculate mean differences (MDs) and 95% confidence intervals (CIs) for each study. Where possible, data were collected on potential effect modifiers (such as baseline BMI, alcohol intake, baseline total fat intake).

Two reviewers independently performed data extraction, with any differences resolved through discussion or consultation with a third reviewer.

Methods of synthesis
RCTs on adults were pooled using a random-effects inverse-variance model. $X^2$ and $I^2$ were used to assess statistical heterogeneity. Publication bias was assessed using funnel plots.

A number of planned subgroup analyses were conducted including difference in fat intake between intervention and control group, total fat intake of control group, and health status of participants.

Meta-regression analyses were conducted on study duration, amount of reduction in total fat in intervention compared with control, and fat intake in control group, as subgroup analyses suggested that these may be predictors of effectiveness.

Sensitivity analyses were conducted using a fixed-effect model in the meta-analysis and by excluding: the largest RCT, trials with systematic differences in care, dietary differences between interventions other than fat, trials without allocation concealment, and trials using intention-to-treat analyses.

Cohort studies and trials of children and young people were narratively summarised using vote counting methods.

**Results of the review**

Forty-seven studies were included in the review: 33 RCTs in adults (73,589 participants) and one in children and young people (191 participants); 10 cohort studies in adults (107,624 participants) and three in children and young people (1,430 participants). Duration of trials ranged from 0.45 to 8.1 years.

**Adults (RCTs)**

Quality assessment showed that randomisation was adequate for most trials, allocation concealment was unclear in over half of trials, and most trials did not include blinding.

There was a mean weight reduction of 1.57kg associated with low fat interventions (MD -1.57, 95% CI -1.97 to -1.16; 27 comparisons) with high heterogeneity ($I^2=75\%$). In trials where the total fat intake differed between intervention and control arms by more than 5%, differences in weight were statistically significant. Trials with a shorter duration (less than five years) and a lower baseline fat intake found larger effect sizes. When these three factors were included in the meta-regression, the association with trial duration no longer remained statistically significant.

There were also statistically significant reductions in body mass index (BMI MD -0.51, 95% CI -0.76 to -0.26; $I^2=77\%$; nine RCTs) and waist circumference (MD -0.30cms, 95% CI -0.58 to -0.02; one RCT) associated with low fat interventions.

**Adults (cohort studies)**

Nine studies were rated as being at high risk of bias. One study was rated moderate risk of bias.

Of 16 comparisons on body weight, 11 found no statistically significant differences and five found statistically significant reduction in body weight.

Of four comparisons on waist circumference, three found no statistically significant differences and one found lower fat intake increased waist circumference.

**Children and young people (RCT and cohort studies)**

The one RCT had adequate randomisation and allocation concealment. However, it did not include blinding and had systematic differences in care between intervention and control groups. There was a statistically significant reduction in BMI from baseline for the intervention group (23.3, standard deviation 2.8 versus 24.0, standard deviation 3.1), but no significant change for the control group.

Of the three cohort studies, two were rated as being at high risk of bias and one was moderate risk of bias. Two of the cohort studies found a statistically significant association with reduction in weight or BMI; the other cohort study found a marginally significant association with BMI ($p=0.05$).
Authors' conclusions
Lower total fat intake was associated with a small, but clinically meaningful, statistically significant reduction in body weight in adults. Similar effects were also found in children and young people.

CRD commentary
The review question was clear, but there were some ambiguities in the inclusion criteria. For example, although participants were required to be 'apparently healthy' studies included both participants with risk factors for long-term conditions and patients with long-term conditions. Appropriate methods were used to minimise error and bias in review processes, and to reduce language and publication biases.

Suitable methods were used to assess heterogeneity among RCTs. Although there was high heterogeneity for most analyses, there was extensive exploration of potential causes of this inconsistency. However, cohort studies were not reviewed in detail for most outcomes and the use of vote counting (such as counting the number of statistically significant results) may sometimes be misleading.

This was a mainly well-conducted review and the conclusions appear reliable.

Implications of the review for practice and research
Practice: The authors stated that where mean total fat intake was at least 30% of energy, attempts should be made to reduce total fat intake.

Research: The authors stated that high quality research was needed on the impact in developing countries of reducing fat intake on body weight where total fat intake was at least 30% of energy. In addition, high quality trials were required in children.

Funding
World Health Organization (WHO).

Bibliographic details

PubMedID
23220130

Original Paper URL
http://www.bmj.com/content/345/bmj.e7666

Indexing Status
Subject indexing assigned by NLM

MeSH
Adult; Alcohol Drinking /physiopathology; Blood Pressure /physiology; Body Mass Index; Child; Cohort Studies; Diet, Fat-Restricted; Dietary Carbohydrates /administration & dosage; Dietary Fats /administration & dosage; Energy Intake /physiology; Female; Humans; Lipids /blood; Male; Randomized Controlled Trials as Topic; Risk Factors; Waist Circumference; Weight Loss /physiology

AccessionNumber
12012056004

Date bibliographic record published
10/12/2012

Date abstract record published
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.