Chapter 6. Energy intake and eating motivation

Contents

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Background

Increasing rates of overweight and obesity have stimulated research into the dietary attributes that may facilitate energy intake regulation, enhance satiety and the maintenance of an appropriate body weight. At the simplest level, weight loss is the consequence of an inadequate intake of energy compared with energy expenditure, and weight maintenance is achieved by balancing these two sides of the energy balance equation. However, it would seem that the biological and environmental drives to prevent a negative energy balance are stronger than those that would permit a positive balance (Popkin, 2011;Blundell and Gillett, 2001). A key component of the energy balance system is the appetite regulatory system, which is orchestrated by physiological, psychological and behavioural determinants (Benelam, 2009).

Hunger is one of the main reasons that individuals are unable to comply with an energy restriction regime (Westerterp-Plantenga *et al.*, 2004), so determination of strategies to alleviate hunger is required to improve adherence rates to energy restricted diets and to potentially prevent weight gain.

The role of available carbohydrates in weight gain or incidence of obesity is unclear. The Committee on Medical Aspects of Food Policy report on Dietary Sugars and Disease, which was published in 1989, suggested that there might be *a priori* reasons for an elevation of energy intake with increasing sugars, potentially via the enhancement of palatability and the fact that sugars may be consumed in a form that promotes the addition of energy to the diet e.g. addition to hot beverages (Committee on Medical Aspects of Food Policy, 1989). More recently, researchers have proposed that the theoretical basis for the purported carbohydrate-body weight link lies in the glycaemic response elicited by carbohydrates, with the suggestion that foods with a high glycaemic index or load (GI or GL) may interfere with hunger and satiety signalling, and consequently lead to overconsumption (Bornet *et al.*, 2007;Bellisle and Drewnowski, 2007;Van Dam and Seidell, 2007). There has also been the suggestion that liquid sources of carbohydrates may interfere with appetite regulatory systems where solid sources do not (Van Dam and Seidell, 2007;Bellisle and Drewnowski, 2007). Existing reviews in the field, however, are cautious in their conclusions, citing inconsistencies in the literature (Van Dam and Seidell, 2007;Gibson, 2008;Vega-Lopez and Mayol-Kreiser, 2009).

Dietary macronutrient composition has been implicated in the regulation of energy intake and body weight control. In the Committee on Medical Aspects of Food Policy report on Nutritional Aspects of Cardiovascular Disease, based on the strength of the evidence that high fat diets readily lead to passive energy overconsumption, the recommendation was made that to reduce obesity at the population level, the focus should be on maintaining fat intakes at or below 35% of energy (Committee on Medical Aspects of Food Policy, 1994). Assuming protein intakes in the region of 15% energy, carbohydrate consumption should deliver in the region of 50% of food energy.

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Under conditions where energy density is permitted to vary, short term laboratory studies have suggested that there is a hierarchy in the satiating capacity of macronutrients, with protein being the most satiating, followed by carbohydrate, which in turn is more satiating than fat (Poppitt *et al.*, 1998). However, when foods or diets are matched for energy density, there is no variation in the relative influence of fat and carbohydrate on satiety or energy intake (Raben *et al.*, 2003;Saltzman *et al.*, 1997;Stubbs *et al.*, 1996). Extremely low carbohydrate diets may impact on energy intake and the expression of appetite through the effects of ketosis. At carbohydrate levels below a critical threshold, the production of ketone bodies, which are the by-products of a breakdown of stored fat occurs and it has been reported that this coincides with a reduction in hunger and appetite (Burley *et al.*, 1992). Advocates of very low carbohydrates for weight loss cite this effect as being one of the key benefits of this approach (Atkins, 2002). However, at carbohydrate intakes above the threshold for ketone body production, the effects of a relatively low intake of carbohydrate with concomitant increase in fat, or protein intake (or both) on energy intake and eating motivation are less clear (Eisenstein *et al.*, 2002;Halton and Hu, 2004;Nordmann *et al.*, 2006;Astrup *et al.*, 2000).

The epidemiological evidence suggests that higher intakes of poorly digested carbohydrates, expressed as dietary fibre are associated with lower body weights (Appleby *et al.*, 1998;Du *et al.*, 2010). A range of possible mechanisms have been proposed to explain this association. As discussed in a number of reviews, it has been proposed that dietary fibre may reduce energy intake and enhance satiety via effects on energy density, through increased chewing time, effects on gut distension and transit, through modulation of glycaemia and insulinaemia and via increased faecal energy losses (Wanders *et al.*, 2011;Pereira and Ludwig, 2001;Slavin, 2005).

A detailed description of methodological issues concerning assessment of energy intake and eating motivation is beyond the scope of this review. For recent reviews of guidelines concerning these methodologies see (Blundell *et al.*, 2010;Stubbs *et al.*, 1998).

With regard to the role of dietary fibre in energy intake regulation, certain methodological aspects of study design should initially be taken into consideration. The form in which fibre may be administered within studies may have an impact on the outcome obtained (Wanders *et al.*, 2011;Blundell and Burley, 1987). Fibre can be delivered in the form of foods which are naturally fibre-rich, in which minimal cell disruption has occurred, for example through provision of whole grains, legumes or fibre-rich fruit and vegetables. Diets composed of such foods would be energy-dilute, low in fat, potentially less palatable and may require more chewing than diets composed of more highly refined foods and this provides a challenge in terms of setting an appropriate control or comparison low fibre diet. Alternative modes of fibre administration involve the separation of fibre from the food matrix and either administration as an isolate without the co-ingestion of other energy sources, or via re-incorporation into a food vehicle in generally higher concentrations than would normally be found in foods. In addition, isolated fibres may be chemically or enzymatically modified (e.g. to reduce viscosity and/or improve palatability) and this may impact on physiological efficacy. Each of these different modes of fibre as administration may have a differential effect on the timing, duration and strength of satiety sensations following consumption (Blundell and Burley, 1987). Interpretation of the literature on the effects dietary fibre isolates is further complicated by the fact that the papers rarely provide exact specification of the fibres or characterisation of their physico-chemical properties.

Methodological issues concerning variation in assessment of both carbohydrate and total energy intakes from carbohydrate likely compromise comparability of studies conducted in different countries (Elia and Cummings, 2007). It is recognised that estimates of carbohydrate intake may vary markedly depending on whether food table values based on estimation of carbohydrate ‘by difference’ or by direct analysis are used. The ‘by difference’ approach to analyse food carbohydrate content, in which all non-carbohydrate components are directly analysed (fat, protein, water, ash and alcohol) by default includes non-digestible carbohydrates, whereas the direct analysis approach is able to separate out available and non-available carbohydrates. By way of illustration, in a comparative analysis of 52 food diaries using either Canadian or UK food tables, a difference in carbohydrate intake of 12% was observed which was partly attributed to the different approaches to dietary carbohydrate analysis applied in these countries (Cummings and Stephen, 2007).

The energy values ascribed to different carbohydrates are also a potential source of variation between studies. Elia and Cummings describe considerable differences in the energy values of certain carbohydrates depending on whether the combustible energy, digestible energy, metabolisable energy or net metabolisable energy value is applied (Elia and Cummings, 2007).

In the UK Composition of Foods, the metabolisable energy value of foods listed in the tables is estimated by application of energy conversion factors (Atwater factors) for fat, protein, available carbohydrate (expressed as monosaccharide) and alcohol (Food Standards Agency, 2002). The assumption made in these tables is that non-starch polysaccharides and sugar alcohols do not make a contribution to the energy value of foods. However, it is clear that carbohydrates with poor digestibility and /or high fermentability in the large intestine are not without influence in terms of the effects on the metabolisable energy of the fat, protein and available carbohydrates in food, but may act to decrease available energy from these sources or may be a source of energy through the yield of short-chain fatty acids resulting from their fermentation. Behall and Howe concluded that fermentation of poorly digested carbohydrate may potentially contribute quite significant amounts of energy when consumed in amounts in excess of 20g per day (Behall and Howe, 1995). This energy yield from carbohydrate may not always be taken into consideration in studies exploring the effects of unavailable carbohydrate on energy intake and eating motivation.

Energy yield of poorly digested carbohydrates may also not be consistent between different groups of individuals, and this may further add to increase heterogeneity between studies (Behall and Howe, 1996).

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A number of difficulties exist in designing studies to explore the effects of certain poorly digested carbohydrates on eating motivation. This includes the selection of an appropriate control or placebo to compare with the test food. This should ideally be a product that does not have any effects on eating motivation *per se*. or that brings about a change in any of the physiological variables that might be linked with the mechanisms of satiety, such as postprandial glucose levels or gut hormone release. It should also be comparable to the test food in terms of palatability, texture and other organo-leptic properties.

The accuracy with which studies estimate energy intakes may also be a factor influencing variation in outcomes of studies assessing the effects of carbohydrate on energy intake. Studies employing the doubly-labelled water technique have provided robust evidence of the extent of dietary under reporting of food intake in lean and obese individuals (Bandini *et al.*, 1990;Schoeller, 1990;Prentice *et al.*, 1986). The nature and extent of this under reporting may vary somewhat according to the method of dietary assessment used (food diaries, weighed or unweighed, versus food frequency questionnaires or 24 hour recall) but it is well recognised that the food diary approach is associated with energy under reporting, particularly in obese individuals (Black *et al.*, 1993), and may in itself modify food selection and decrease total energy intake. Nonetheless, the food diary has been more commonly applied in the trials included in this review than some of the other methods. In terms of the number of days of recording required to accurately characterise energy intake in longer term studies, estimates vary, but a minimum of 3 days of recording, and ideally at least 7 days are needed (Whybrow *et al.*, 2008;Fyfe *et al.*, 2010).

The focus of this chapter is to review the literature investigating the relationship between dietary carbohydrates, energy intake and eating motivation. Cohort studies were required to have a minimum duration of follow-up of at least 3 years for inclusion. Intervention trials were only included that were explicitly reported as randomised controlled trials in which the period of assessment of energy intake or eating motivation was at least 3 or more days in duration. Whilst this requirement means that a large body of literature based on acute (1 day or less) studies is excluded, it does provide some assurance of the durability of observed effects.

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Previous studies in COMA reports

The table below lists studies included in previously published reports from the Committee of Medical Aspects of Food Policy (Committee on Medical Aspects of Food Policy, 1989;Committee on Medical Aspects of Food Policy, 1994;Committee on Medical Aspects of Food Policy, 1991) that concerned the relationship between dietary carbohydrates and energy intake and/or satiety. All but one of these papers would have been excluded in this review for the reasons listed in the table below.

Excluded studies

Table 6.1 Previous studies in COMA reports*: excluded studies

Authors, Year	Intervention description	Intervention duration	Exclusion Code that would be applied in this review	Exclusion detail
(Bolton *et al.*, 1981)	1) Whole oranges 2) Orange juice 1) Whole grapes 2) Grape juice 1) Grape juice 2) Grape juice with different osmolarity	Acute meal study	2	Paper did not report that subjects were randomly assigned to groups, therefore assumed not RCT
(Dreon *et al.*, 1988)	Not applicable	Not applicable	2	The study was not a randomised trial or cohort/prospective study (cross-sectional survey).
(Lissner *et al.*, 1987)	1) Low fat, high carbohydrate 2) Medium fat, medium carbohydrate 3) High fat, low carbohydrate	2 weeks	2	Paper did not report that subjects were randomly assigned to groups, therefore assumed not RCT
(Keen *et al.*, 1979)	Not applicable	Not applicable	2	The study was not a randomised trial or cohort/prospective study (cross-sectional survey).
(Mensink and Katan, 1987)	1) Carbohydrate-rich diet 2) Olive-oil rich diet	36 days	2	Paper does not state that subjects were randomly assigned to groups, therefore assumed not to be RCT
(Porikos *et al.*, 1977)	1) Aspartame sweetened products	15 days	2	Paper did not report that subjects were randomly assigned to groups, therefore assumed not RCT
(Porikos *et al.*, 1982)	1) High sucrose diet 2) Aspartame diet	24 days	2	Paper did not report that subjects were randomly assigned to groups, therefore assumed not RCT
(Reiser *et al.*, 1986)	1) Low sugar diet 2) High sugar diet	20 weeks	2	Paper did not report that subjects were randomly assigned to groups, therefore assumed not RCT
(Thornton *et al.*, 1983)	1) Usual diet + refined carbohydrate foods 2) Usual diet + wholegrain foods	6 weeks	6	Subjects did not fit the definition of 'healthy' – all had radiolucent gall stones.
(Werner *et al.*, 1984)	1) Usual diet + sucrose 2) Usual diet + saccharine	6 weeks	6	Subjects did not fit the definition of 'healthy' – all had radiolucent gall stones.

*(Committee on Medical Aspects of Food Policy, 1989;Committee on Medical Aspects of Food Policy, 1994;Committee on Medical Aspects of Food Policy, 1991)

Included studies

No studies from earlier COMA reports would have been eligible for inclusion in this review.

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Summary of the evidence base

Randomised controlled trials were eligible for inclusion if the study design permitted energy intake to vary, even if an energy restriction goal had been advised. If subjects were free-living, it is anticipated that compliance with an energy restriction target would likely be weak. Provided energy intake was captured, this was extracted for the review. However, it is recognised that with this approach, energy intakes recorded may be more prone to under-reporting, and would combine aspects of dietary compliance with the potential impact of the intervention on modulation of energy intake. Accordingly, all trials have been categorised as having an energy restriction goal or not and attention is drawn to such trials within the narrative synthesis around each carbohydrate section.

In the majority of trials included here, the effect of dietary carbohydrate on energy intake or eating motivation was not the primary aim of the study. Frequently, energy intake data were provided as a measure of dietary compliance. Studies in which energy intake or eating motivation were not cited as a primary outcome should be interpreted cautiously.

Cohort Studies

Three cohort studies provided data concerning dietary carbohydrates and energy intake (Phelan *et al.*, 2007;Kvaavik *et al.*, 2005;Fiorito *et al.*, 2009). A description of these cohorts is provided in table 6.3

Please interpret observational data with caution: With observational studies, especially in the field of diet and nutrition, there is substantial potential for biases caused by incomplete adjustment for confounding, measurement error in the exposure estimate, and other biases in participant selection or data collection. The bias could be large in size, and act in either direction, either towards or away from the null.

Table 6.2 Cohort study characteristics table (studies with grey shading are on children and adolescents)

Authors/ Reference	Cohort Name	Population characteristics	Recruitment of participants	Initial cohort size	Losses to follow-up %	Maximum duration of follow up (years)	Dietary assessment methods
(Fiorito *et al.*, 2009)	Pennsylvania Study of Health and Development of Young girls	Non-Hispanic white girls residing in central Pennsylvania Mean age: 5 %Male: 0 Country: USA Ethnicity: Primarily white	Community cohort	170	15	10	Diet was assessed using 3, 24-hour dietary recalls (2 weekdays and 1 weekend day).
(Kvaavik *et al.*, 2005)	Oslo Youth Study	Participating students from 6 schools in Oslo Mean age: 13 %Male: 49 Country: Norway Ethnicity: Not reported	Community cohort	1086	15.7	19	Diet was assessed using a validated general questionnaire administered twice.

Authors/ Reference	Cohort Name	Population characteristics	Recruitment of participants	Initial cohort size	Losses to follow-up %	Maximum duration of follow up (years)	Dietary assessment methods
(Phelan *et al.*, 2007)	National Weight Control Registry (NWCR)	Male and female members of the National Weight Control Registry Mean age: 49.5 %Male: 30 Country: USA Ethnicity: Primarily white	Population-based cohort	891	Not reported	3	Diet was assessed using a FFQ, which was reported to be validated.

Trial design

Studies on energy intake

One hundred and sixty one papers from 152 studies contributed to this review of dietary carbohydrate and energy intake. A description of these trials is included in the trials characteristics table (Table 6.4) and the nature of the trials relating to each specific type of intervention is also described briefly within each results section.

Each study was categorised as having set an energy restriction goal or not, as part of the intervention, and this is captured in the trials characteristics table. One hundred and five trials did not set an energy restriction goal, 44 trials did, and 3 trials did not report this sufficiently clearly to make a judgement.

Of the 161 papers included in the dietary carbohydrate and energy intake review, 40 reported energy intake as a primary outcome. Studies that did not state that energy intake modulation was the primary outcome should be interpreted cautiously.

Two papers reported on the Women's Health Initiative Dietary Modification Trial (Howard *et al.*, 2006;Tinker *et al.*, 2008), multiple papers were published by Leidy *et al.* on the same study (Leidy *et al.*, 2007a;Leidy *et al.*, 2007b), by Davy *et al.* (Davy *et al.*, 2002a;Davy *et al.*, 2002b), by Shah *et al.* (Shah *et al.*, 1996;Shah *et al.*, 1994), Wood *et al.* (Wood *et al.*, 2007;Wood *et al.*, 2006), Garcia *et al.* (Garcia *et al.*, 2007;Garcia *et al.*, 2006), Sharman *et al.* (Sharman *et al.*, 2004;Volek *et al.*, 2004a;Volek *et al.*, 2004b), and He *et al.* (Chen *et al.*, 2006;He *et al.*, 2004).

Studies were conducted in the following countries; Argentina, Australia (8), Belgium (2), Brazil, Canada (10), Denmark (6), Europe (3), Finland (4), France (6), Germany (3), India, Israel, Mexico, New Zealand (3), Philippines, Spain (2), Sweden (4), The Netherlands (9), UK (23), USA (63).

Seven trials were conducted on children or adolescents (Henry *et al.*, 2007;Warren *et al.*, 2003;Dennison and Levine, 1993;Maki *et al.*, 2003;Sondike *et al.*, 2003;Davis *et al.*, 2009;Ebbeling *et al.*, 2003), the majority used adults. Approximately 20% of the adult studies had an average age of 50 or more. Of those studies that provided a mean BMI, approximately 20% reported a mean BMI <25, 25% 25-30, and 37% were >30.

Fifty nine studies were cross-over trials and 93 used parallel groups. Thirty six studies were double-blind, 16 were single-blind, 34 were open and in 66, blinding was not clearly reported.

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The average number of participants in each trial was 83 (excluding the Women's Health Initiative Study, n=48,000+), and the median number was 43.

The method of estimating energy intake is included in each of the results tables, the most common approach being to use food diaries (3-4 days being the most common duration). However, a significant number of studies (n=19) chose to provide food in *ad libitum* quantities and then to carefully monitor amounts consumed and left over. Sixteen studies used the dietary recall method (generally repeated), 5 studies described their approach as a dietary history, and 11 studies used a food frequency questionnaire (sometimes combined with another method).

Studies on eating motivation

Fifty two papers, from 50 studies contributed to this review of dietary carbohydrate and subjective reports of eating motivation. A description of these trials is included in the trials characteristics table (Table 6.4) and the nature of the trials relating to each specific type of intervention is also described briefly within each results section.

Multiple papers were published by Leidy *et al.* on the same study (Leidy *et al.*, 2007a;Leidy *et al.*, 2007b), and by Shah *et al.* (Shah *et al.*, 1996;Shah *et al.*, 1994).

Studies were conducted in the following countries; Argentina, Belgium(2), Brazil, Canada(2), Denmark(2), Europe(3), Finland(1), France(4), Italy, Spain, The Netherlands(6), UK(8), USA (14).

Two trials were conducted on children or adolescents (Vido *et al.*, 1993;Warren *et al.*, 2003), the majority used adults. Of those studies that provided a mean BMI, approximately 24% reported a mean BMI <25, 32% 25-30, and 32% were >30.

Twenty two studies were cross-over trials and 28 used parallel groups. Nineteen studies were double-blind, 4 were single-blind, 8 were open and in 22, blinding was not clearly reported.

The average number of participants in each trial was 65, and the median number was 39.

Risk of bias

A summary of the risk of bias assessment is provided in Table 6.5. Criteria for judging whether a risk of bias was evident were based on the Cochrane Handbook. A judgement of 'unclear' was provided if there was insufficient evidence within the paper to make a clear judgement. Judgements concerning whether there was evidence of a risk of bias in terms of outcome assessment (the experimenters involved in assessing the outcome were aware which intervention had been followed by each participant) are reported as the final column in each of the specific results tables.

Studies on energy intake

Included studies were randomised controlled trials. The majority were judged to be either ‘unbiased’ or ‘unclear’ in terms of allocation sequence generation or allocation concealment; however one study was deemed ‘biased’ with regard to allocation sequence generation (Drummond *et al.*, 2003) and two judged as ‘biased’ relating to allocation concealment (Brehm *et al.*, 2003;Warren *et al.*, 2003). Blinding of participants and researchers to the various dietary approaches was more difficult to achieve, as might be anticipated with dietary intervention trials. Forty-nine papers were judged to be ‘unbiased’ in respect of participants’ awareness of the dietary intervention, and 45 trials were judged to have ‘no bias’ in respect of researchers’ awareness (these generally overlapped). There was some evidence of incomplete outcome reporting in 45 publications, and selective outcome reporting in eleven.

Studies on eating motivation

All trials included were randomised controlled trials. All were judged to be either ‘unbiased’ or ‘unclear’ in terms of allocation sequence generation or allocation concealment. Blinding of participants and researchers to the various dietary approaches was more difficult to achieve, as might be anticipated with dietary intervention trials. However, 21 papers were judged to be ‘unbiased’ in respect of participants’ awareness of the dietary intervention, and 17 trials were judged to have ‘no bias’ in respect of researchers’ awareness (these generally overlapped). There was some evidence of incomplete outcome reporting in 15 publications and selective outcome reporting in five.

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Table 6.3 Trial characteristics for RCTs reporting measures of energy intake or appetite (studies with grey shading are on children or adolescents)

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
(Abrahamsson *et al.*, 1994)	Generally healthy	Sweden 0% Male Age: (27) BMI: (22)	Crossover (washout 0 days)	5 weeks	Substitution No	31	1. Wheat bran buns 2. Oat bran buns	1. 4 buns/day (94g each), providing 20g fibre. Contains 1.1g beta-glucan 2. 4 buns/day (94g each) providing 20g fibre (7.6g beta-glucan)	1. %E: C 57 P 15 F 25 Energy 2460 kcal/d Fibre g/d:32 2. %E: C 58 P 15 F 25 Energy 2440 kcal/d Fibre g/d:34	Yes	Stiftelsen Cerealia
(Alfenas and Mattes, 2005)	Age 18-70y Generally healthy No medication Non smokers Normal glucose tolerance Weight stable	USA 51% Male Age: (25) BMI: (23)	Crossover (washout 15 days)	8 days	All food provided *ad libitum* No	39	1.Low GI 2.High GI	1. Only low GI foods, *ad libitum* (mean GI 39) 2. Only high GI foods, *ad libitum* (mean GI 105) Foods matched on macronutrients and palatability	1. %E: C 52 P 17 F 32 2. %E: C 52 P 17 F 32	As supplied to subjects	Coordenacao de Aperfeicoamento de Pessoal de Nıvel Superior (Capes), Brasılia/Brazil, and the U.S. Department of Agriculture HATCH funds
(Andersson *et al.*, 2007) Uppsala Wholegrain Trial	≥ 1 CHD risk factor Age 30-70y BMI 26-35	Sweden 27% Male Age: 35 - 70(59) BMI: (28)	Crossover (washout 6 weeks)	6 weeks	Supplement No	34	1. Wholegrain products 2. Refined grain products	1. Usual diet + whole grain foods (Bread, muesli & pasta) Minimum 50% wholegrain in provided foods = 112g wholegrain/day 2. Usual diet + refined grain foods (Bread, muesli & pasta)	1. g/d: C 143 P 28 F 8 Energy: 3180kJ/d Fibre g/d:18 2. g/d: C 145 P 23 F 14 Energy: 3340kJ/d Fibre g/d:6	Yes	Government /Research institute funding/Food industry
(Astrup *et al.*, 1990)	BMI >30	Denmark 22% Male Age: (34) BMI: (38)	Crossover (washout 0 days)	2 weeks	All food provided Yes	22	1. VLCD without fibre 2. VLCD with fibre	1. Five low calorie nutrition powder drinks/d. Women: 8MJ/d, Men: 9.5MJ/d. 2. Five low calorie nutrition powder drinks/d. Women: 8MJ/d, Men: 9.5MJ/d plus 30g/d plant fibre (98.5% cellulose, low pectin content).		Yes	Ib Berg Foundation
(Beasley *et al.*, 2009) OMNI-Heart	Age >30y Generally healthy with prehypertension/	USA 55% Male	Crossover (washout 3 weeks)	6 weeks	All food provided to achieve energy	191	1. High carbohydrate 2. High protein	1. High CHO diet provided. 2. High protein diet provided.	1. %E: C 58 P 15 F 27 2. %E: C 48 P 25 F 27	Intended diet	NIH

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	stage 1 hypertension No CVD or T2DM No medications which influence outcomes Not hyperlipidaemic/ cholesterolaemic Weight < 160kg	Age: (54) BMI: (30)			balance No		3. High PUFA	3. High unsaturated fat diet provided Isocaloric and individually prescribed. Dietary fibre, ED and GI similar in all groups	3. %E: C 48 P 15 F 37		
(Bellisle *et al.*, 2007)	Age >18y BMI >25 Free of chronic disease No medication Women	France 0% Male Age: 20 - 72 BMI:25 - 40	Parallel Group	12 weeks	Free living diet plan Yes	96	1. Low GI 2. Control	1. Weight watchers program with a focus on low GI foods (consume >1 low GI food (GI<55) at each meal). 2. Weight watchers program		Yes	Weight Watchers International Inc
(Bhargava, 2006) The Women's Health Trial: Feasibility Study in Minority Populations	Age 50-80y Post-menopausal Women	UK and USA 0% Male Age: 50 - 79 BMI: 29	Parallel Group	12 months	Free living diet plan No	2208	1. Low fat 2. Control	1. Reduce fat intake to 20% and increase fruit, vegetable and grain consumption. 2. No intervention	1. 5430 kJ, E%: F 20, 13g/d sat fat, 13g/d fibre 2. 6149 kJ, 20g/d sat fat, 12g/d fibre	Yes	National Cancer Institute
(Borkman *et al.*, 1991)	Generally healthy	Australia 37.5% Male Age: (37) BMI: (24)	Crossover (washout 0 days)	3 weeks	Free living diet plan No	8	1. High carbohydrate 2. High fat	1. <30% fat, 50% CHO, this level was the high end of mean CHO intake in subjects baseline diet. 2. >45% fat, 40% CHO	1. %E: C 55.4 P 19.6 F 20.1 Energy 1957 kcal/d Fibre g/d:31.9 2. %E: C 31 P 13.5 F 49.8 Energy 2244 kcal/d Fibre g/d:9	Yes	National Health and Medical Research Council of Australia
(Bray *et al.*, 2002) Ole Study	Age 18-70y BMI 25-35 Generally healthy Non smokers Not extremely athletic/active Weight stable	USA 100% Male Age: (37) BMI: (31)	Parallel Group	9 months	All food provided, with extra food units provided on request Low fat groups	45	1. Control 2. Low fat 3. Olestra	1. 33%FAT 2. 25%FAT. Diet designed to be 11% lower energy than control diet 3. 1/3 of dietary fat replaced by olestra (25% metabolizable fat). This group not included in	1. %E: C 52 P 15 F 33 2. %E: C 58 P 17 F 25	Intended diet	United States Department of Agriculture grant and the Procter & Gamble Co, Cincinnati.

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
					designed to provide 11% less energy than control			the review.			
(Brehm *et al.*, 2003) American LC study 1	Age >18y BMI 30-35 Familial CVD/CHD Generally healthy No HTN or T2DM Weight stable	USA 0% Male Age: (44) BMI: (34)	Parallel Group	6 months	Free living diet plan Low fat group energy restricted	53	1. Low carbohydrate 2. Moderate fat	1. Ad libitum food intake. Max CHO intake 20g/d. CHO increased to 40-60g/d if ketosis was induced after 2 weeks. 2. American Heart Association Step 1 diet + restrict energy. Intended intake: 55% CHO, 15% PRO, 30% FAT	1. %E: C 30 P 23 F 46 Energy 1302 kcal/d Fibre g/d:8.4 2. %E: C 53 P 18 F 29 Energy 1247 kcal/d Fibre g/d:12.35	Yes	American Heart Association & NIH
(Brehm *et al.*, 2005) American LC study 2	<10% Change body weight in previous 6m Age >18y BMI 30-35 Free of chronic disease	USA 0% Male Age: 44 BMI: (34)	Parallel Group	4 months	Free living diet plan Low fat group to limit to 1200 kcal/d	50	1. Low carbohydrate 2. Moderate fat	1. Ad libitum food intake. Max CHO intake 20g/d. CHO increased to 40-60g/d if ketosis was induced after 2 weeks. 2. American Heart Association Step 1 diet + restrict energy to 1200kcal/d. Intended intake: 55% CHO, 15% PRO, 30% FAT	1. %E: C 24 P 24 F 52 Energy 1288 kcal/d 2. %E: C 48 P 20 F 32 Energy 1339 kcal/d	Yes	American Heart Association & NIH
(Brynes *et al.*, 2003)	≥1 cardiac risk factor, including BMI >25 Total: HDL-C >5 Waist >1000mm Weight stable	UK 100% Male Age: (45) BMI: (29)	Crossover (washout 3 weeks)	24 days	Free living diet plan, with some foods provided No, but advised to maintain EI	22	1. High MUFA 2. Low GI 3. Sucrose 4. High GI	1. >50%FAT (>34%MUFA). 500ml olive oil provided 2. Intended GI=48. 1200g wholegrain rye bread provided. 3. High CHO diet with >90g sugar/day. 2kg sugar provided 4. Intended GI=72. 700g instant potato provided. Diets consumed *ad libitum*	1. %E: C 29 P 12 F 59 Energy 1650 kcal/d 2. %E: C 51 P 15 F 34 Energy 1650 kcal/d 3. %E: C 53 P 13 F 34 Energy 1650 kcal/d 4. %E: C 52 P 14 F 34 Energy 1650 kcal/d	Intended diet	Sugar Bureau
(Cani *et al.*, 2006)	Generally healthy No medications which influence outcomes Habitual fibre intake <30g/d	Belguim 50% Male Age: 21 - 39(27) BMI:18 - 27(22)	Crossover (washout 2 weeks)	2 weeks	Supplement No	10	1. Oligofructose 2. Placebo (Maltodextrin)	1. Oligofructose 16g/day Raftilose P95 (6.27 kJ/g) – soluble and fermentable 2. Maltodextrin 16g/d Caloreen (16.7 kJ/g) soluble and non-fermentable	8g added to meals twice daily	Yes	FSR grant from the Universite´ catholique de Louvain
(Cani *et al.*, 2009)	Generally healthy No medications which influence	Belgium 50% Male	Parallel Group	2 weeks	Supplement	10	1. Fructans	1. Soluble fructan (Orafti Synergy 1, chicory root fructans) – non digestible, fermentable (6.27 kJ/g). 16g/d	8g added to meals twice daily	Yes	Grants: Walloon Region (General Directory of Agriculture) and

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	outcomes	Age: (26) BMI: (22)			No		2. Dextrin maltose	eaten with food 2. Maltodextrin 16g/d Caloreen (16.7 kJ/g) soluble and non-fermentable			FRS-FNRS (Fonds de la Recherche Scientifique)
(Carels *et al.*, 2005)	BMI >30 No CHD, T2DM or HTN Sedentary only	USA 56% Male Age: (43) BMI: (38)	Parallel Group	Duration of treat-ment program unclear. 12 months follow-up	Free living diet plan Yes	53	1. Weight loss program 2. Weight loss program + low GI education	1. LEARN program only. Advice: increase activity, reduce energy and fat. . GI=56 pre and 57 post intervention. 2. LEARN program + Low GI dietary advice. Advice: increase activity, reduce energy and fat GI= 55 pre and 52 post intervention. GI values from Brand-Miller tables.	1. %E: C 53 P 17 F 32 Energy: 1659kJ/d 2. %E: C 54 P 18 F 29 Energy: 1674kJ/d	Yes	Not reported
(Chen *et al.*, 2006) American Fibre Study	Age 30-65y Good compliance during run-in No antihypertensive / cholesterol lowering No CHD/CVD, T2DM or HTN Serum cholesterol <240 mg/dl	USA 40% Male Age: (48) BMI: (29)	Parallel Group	12 weeks	Substitution Asked to maintain EI	110	1. High fibre 2. Low fibre	1. 60g oat bran in a muffin and 84g of oatmeal squares cereal daily. Soluble fibre 8.1g/d, beta glucan 7.3g/d, insoluble fibre 7.7g/d 2. 93g refined wheat in a muffin and 42g of corn flakes cereal daily. Soluble fibre 0.9g/d, beta glucan 0g/d, insoluble fibre 1.5g/d	1. g/d: C 113.3 P 24 F 13.7 Energy 652 kcal/d Fibre g/d:15.9 2. g/d: C 108.4 P 10.8 F 11 Energy 567 kcal/d Fibre g/d:2.7	For test foods provided	NIH
(Claessens *et al.*, 2009)	BMI >27 No HTN Normal glucose tolerance Normal lipid profile Weight loss >5% during run-in Weight stable	The Netherlands 28% Male Age: 30 - 60(45) BMI: (33)	Parallel Group	12 weeks	Supplement No, EI *ad libitum*	60	1. High carbohydrate supplement 2. High protein supplement - casein 3. High protein supplement - whey	Macronutrient supplements consumed following period of weight loss with a VLCD 1. 50g/d consumed as a flavoured drink (Maltodextrin) 2. 50g/d consumed as a flavoured drink (intact casein) 3. 50g/d consumed as a flavoured drink (whey protein)	1. %E: 55% CHO 2. %E: 25% PRO 3. %E: 25% PRO	Intended	Kerry Bio-Science
(Claesson *et al.*, 2009)	BMI <30 Generally healthy	Sweden 46% Male	Parallel Group	2 weeks	Supplement	26	1. Sweets 2. Peanuts	1. Candy not containing any chocolate or liquorice. 20kcal/kg/day.	1. %E: C 83 P 2 F 4 Fibre g/d:0 2. %E: C 10 P 27 F 49	For test foods	Supported by University Hospital of

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
		Age: 19 - 30(23) BMI:19 - 26(22)			No			2. Roasted salted peanuts. 20kcal/kg/day. 1% salt Over-feeding study - consumed in addition to usual diet	Fibre g/d:8	provided	Linkoping Research Funds, Linkoping University & Gamla Tjanarinnor
(Clapp, 1998)	Women % body fat range 14-30	USA 0% Male Age: 26 - 37(35) BMI: mean not reported	Cross-over (washout 0 days)	7 days	Free living diet plan No, but aim for diets to be isocaloric	14	1. Aboriginal carbohydrate diet 2. Cafeteria carbohydrate diet	1. low GI diet (GI=71) 2. high GI diet (GI=84) (white bread standard used)	1. %E: C 57.5 P 18 F 22.5 2. %E: C 57.5 P 18 F 22.5	Intended diet	NIH
(Clifton *et al.*, 2008) Australian Protein Study	BMI 27-40 Female adults Age 20-65 yr No T2DM	Australia 0% Male Age: (49) BMI: (33)	Parallel Group	12 weeks weight loss and 52 wk follow-up	Free living diet plan Yes, aim for 5600 kJ each group	119	1. High protein diet 2. High carbohydrate diet	1. 46% CHO, 34% PRO, 20% FAT 2. 64% CHO, 17% PRO, 20% FAT	1. %E: C 46.4 P 23.2 F 28.5 g/d: C 179 P 94.6 F 51.4 Energy: 6583kJ/d Fibre g/d:3.9 2. %E: C 50.8 P 19.6 F 27.5 g/d: C 189.5 P 77 F 48.4 Energy: 6391kJ/d Fibre g/d:4.3	Yes	Meat & Livestock, Australia
(Dale *et al.*, 2009)	Age 25-70 yr BMI >27.5 Healthy	New Zealand 0% Male Age: (45) BMI: (32)	Factorial	2 years	Free living diet plan Unclear if energy restricted	200	1. High MUFA diet 2. High carbohydrate diet	1. 40%CHO, 25%PRO, 21%MUFA 2. 55%CHO, 15-20%PRO, 25-30%FAT	1. %E: C 43 P 22 F 31 g/d: C 185 P 88 F 61 Energy: 6985kJ/d Fibre g/d:23 2. %E: C 47 P 22 F 27 g/d: C 183 P 77 F 46 Energy: 6192kJ/d Fibre g/d:23	Yes	Health Research Council of New Zealand
(Dansinger *et al.*, 2005)	≥1 cardiac risk factor BMI 27-42 Free of chronic disease No insulin therapy No medications which influence	USA 49% Male Age: (49) BMI: (35)	Parallel Group	12 months	Free living diet plan Weight Watchers energy restricted.	160	1. Atkins 2. Zone 3. Weight watchers	1. Carbohydrate restriction. 2. Macronutrient balance. 3. Calorie restriction.	1. g/d: C 190 P 82 F 80.5 Energy 1846 kcal/d Fibre g/d:13 2. g/d: C 198 P 90.4 F 66 Energy 1886 kcal/d Fibre g/d:17.4 3. g/d: C 202 P 80 F 58 Energy 1755 kcal/d Fibre g/d:14	Yes	NIH

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	outcomes				Other diets no EI restriction		4. Ornish	4. Fat restriction. For all participants dietary advice was strictly followed for the first 2 months. Participants then selected their own adherence levels.	4. g/d: C 237 P 74 F 54.5 Energy 1711 kcal/d Fibre g/d:14.5		
(Das *et al.*, 2007) CALERIE	BMI 25-30 Generally healthy No medications which influence outcomes Not extremely athletic/active Weight stable	USA % Male: not reported Age: (35) BMI: (28)	Parallel Group	12 months	All food provided Yes	34	1. Energy restricted high GL diet 2. Energy restricted low GL diet	1. 30% calorie restriction. fiber 15 g/1000kcal. Estimated GI=86, GL=116 g/1000 kcal 2. 30% calorie restriction. fiber 15 g/1000 kcal. Estimated GI=53, GL=45 g/1000kcal	1. %E: C 60 P 20 F 20 2. %E: C 40 P 30 F 30	Yes	NIH
(Davidson *et al.*, 1998)	Age 30-75y Mild to moderate lipidaemias (LDL-C 3.63-5.17 mmol/l)	USA 48% Male Age: 30 - 75(60) BMI: (28)	Crossover (washout 6 weeks)	6 weeks	Substitution No	25	1. Inulin 2. Control	1. Low fat diet + inulin food products (chocolate, spread, sweeteners). 18g inulin/d as Raftiline (Orafti) – average degree of polymerisation 10 (2-65) 2. Low fat diet + non-supplemented food products	NCEP Step 1 diet advocated throughout (high carbohydrate, low fat)		Not reported
(Davis *et al.*, 2009)	Age 11-18y BMI >85th centile No medications which influence outcomes No recent weight loss program No T2DM	USA 50% Male Age: 14 - 18(16) BMI: mean not reported	Parallel Group	16 weeks	Free living diet plan No	44	1. Control 2. High fibre, low sugar diet	1. No intervention 2. ≤10% added sugar, >14 g/1000 kcal dietary fibre/d	1. g/d: C 282 P 80 F 80.3 Energy 2146.6 kcal/d Fibre g/d:17.1 2. g/d: C 234 P 71.7 F 61.5 Energy 1752.1 kcal/d Fibre g/d:17.9	Yes	Grants from: National Institutes of Cancer, University of California, National Institute of Child Health and Human Development, Atkins Foundation, NIH, NCI
(Davy *et al.*, 2002a) American Cereal Study	50-75 year old men.BMI 25-35 DBP 85-99mm and/ or SBP 130-159 mm Hg Fibre <30g/d No CHD, T2DM	USA 100% Male Age: 50 - 75(59) BMI: (29)	Parallel Group	12 weeks	Substitution No	36	1. Whole-grain oat cereal 2. Wheat cereal	1. 60g oatmeal plus 76g oat bran ready-to-eat cold cereal (14g fibre/d, 5.5g beta glucan) 2. 60g whole wheat cereal plus 81g Frosted Mini-Wheats (14g	1. g/d: C 95 P 21 F 8 Energy 513 kcal/d Fibre g/d:14 2. g/d: C 112 P 14 F 3 Energy 480 kcal/d Fibre g/d:14	Nutrients from supplem ents	Quaker Oats

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	No medical conditions which influence outcomes Non smokers Normal glucose tolerance Not extremely athletic/active							fibre/d)			
(Davy *et al.*, 2002b) American Cereal Study	50-75 year old men BMI 25-35 DBP 85-99mm and/ or SBP 130-159 mm Hg Fibre <30g/d No CHD, T2DM No medical conditions which influence outcomes Non smokers Normal glucose tolerance Not extremely athletic/active	USA 100% Male Age: (59) BMI: (29)	Parallel Group	12 weeks	Substitution No	36	1. Wheat group 2. Oat group	1. 60g wheat cereal and 81g Frosted Mini-Wheats (14g/d of dietary fibre) 2. 60g oatmeal and 76g oat bran ready-to-eat cold cereal (14g/day of fibre, 5.5g/d beta glucan).	1. g/d: C 112 P 14 F 3 Energy: 2008kJ/d Fibre g/d:14 2. g/d: C 95 P 21 F 8 Energy: 2146kJ/d Fibre g/d:14	Nutrients from supple-ments	Quaker Oats
(de Luis *et al.*, 2007) Spanish Hypocaloric Diet Study	BMI >30 No CHD, T2DM or HTN	Spain 30% Male Age: (43) BMI: (36)	Parallel Group	3 months	Free living diet plan Yes	90	1. Low fat 2. Low carbohydrate	1. Intended diet: 1500 kcal/d. 52% CHO, 20% PRO, 27% FAT 2. Intended diet: 1507kcal/d. 38% CHO, 26% PRO, 36% FAT	1. %E: F 25.4 Energy: 1630kJ/d 2. %E: C 30.9 Energy: 1574kJ/d	Yes	Not reported
(De Roos *et al.*, 1995)	Age 18-70y No T2DM Weight stable Non methane producers	The Netherlands 100% Male Age: 20 - 27(23) BMI:19 - 26(23)	Crossover (washout 0 days)	1 weeks	Supplement No	24	1. Glucose control 2. High-amylose starch 3. Extruded/retro-graded high-	1. Yogurt supplement with high glucose concentration (4g resistant starch/d) 2. Yoghurt supplement with high-amylose corn starch (32g resistant starch/d) (RS2) 3. Yoghurt drink supplement with extruded & retrograded	1. g/d: C 138 P 12 F 0 Energy: 2460kJ/d Fibre g/d:2 2. g/d: C 136 P 12 F 0 Energy: 1980kJ/d Fibre g/d:2 3. g/d: C 136 P 12 F 0 Energy: 1950kJ/d	Yes	Not reported

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
							amylose starch	high-amylose corn starch (32g resistant starch/d) (RS3)	Fibre g/d:2		
(de Rougemont *et al.*, 2007)	Age 20-60y BMI 25-30 Generally healthy No medications which influence outcomes Not extremely athletic/active Pre-menopausal Regular breakfast cereal eater Weight stable	France 50% Male Age: (38) BMI: (27)	Parallel Group	5 weeks	Substitution No, *ad libitum*	40	1. Low GI 2. High GI	1. GI<50. Some low GI foods were provided (durum wheat and black bread, low GI biscuits GI=46.5, GL=11.3 2. GI>70. Some high GI foods were provided. GI=66.3, GL=16.5	1. g/d: C 199 P 94 F 83 Energy: 8289kJ/d Fibre g/d:26 2. g/d: C 220 P 87 F 88 Energy: 8607kJ/d Fibre g/d:18		European Union
(Dennison and Levine, 1993)	Age 5-17y Generally healthy Mild to moderate lipidaemias No medications which influence outcomes	USA 45% Male Age: 5 - 18(11) BMI: mean not reported	Crossover (washout 2 weeks)	1 months	Substitution No	25	1. Control cereal 2. Psyllium cereal	1. 28g cereal containing 5g insoluble wheat fibre. Participants were also on a low fat, low saturated fat and low cholesterol diet 2. 28g cereal containing 3g insoluble fibre and 3g soluble fibre. Participants were also on a low fat, low saturated fat and low cholesterol diet	Cereals both provided 90 kcal, 3g protein, 23g carbohydrate per serving	Nutrients of cereals provided	NIH
(Donnelly *et al.*, 2008) Jayhawk Observed Eating Trial	Age 18-70y BMI 22-30 Generally healthy Moderate alcohol intake No recent weight loss program Non smokers Sedentary only	USA 63% Male Age: mean mean not reported BMI: 25 (22-29.9)	Parallel Group	12 weeks	Substitution No, *ad libitum*	305	1. Low fat 2. Moderate fat 3. Hight fat	1. <25%FAT. 2. 28-32%FAT 3. >35%FAT Participants consumed two meals per day on weekdays and one meal per day on weekends in a university cafeteria over a 12-week period. Ad lib food consumption at home.	1. %E: C 64.7 P 14.9 F 20.4 Energy 1963 kcal/d 2. %E: C 54.3 P 15 F 30.7 Energy 2328 kcal/d 3. %E: C 44.2 P 15.5 F 40.3 Energy 2513 kcal/d	Yes	University funding & Health Management Resources, (Boston) & National Institute of Diabetes and Digestive and Kidney Diseases
(Drummond and Kirk, 1998)	Age >40y	Scotland 100% Male	Parallel Group	6 months	Free living diet plan	93	1. Control 2. Reduced fat & NMES diet	1. No dietary advice 2. Advice: Reduce fat and NMES, replacing with complex	1.%E: C45 P17 F38 NME 8.8 2. .%E: C48 P18 F33 NME 8.1	Yes	The Sugar Bureau

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided ?	Funding source
		Age: (46) BMI: (28)			No		 3. Reduced fat diet	CHO 3. Advice: Reduce fat, replace with mixture of complex CHO & NMES No absolute targets provided to the subjects	 3. .%E: C49 P 18 F32 NME 10.0		
(Drummond *et al.*, 2003)	Free of chronic disease No medication Total cholesterol >5.5 mmol/l	Scotland 100% Male Age: >40 BMI: not reported	Parallel Group	8 weeks	Free living diet plan No	30	1. Advised to reduce fat 2. Advised to reduce fat and sugar	1. Dietician advised to reduce fat intake only and replace with starch. Fat intake did not actually decrease. 2. Dietician advised to reduce fat and NMES intake and replace with starch. Fat intake did not actually decrease.	1. %E: C 47.4 P F 35.2 Energy: 9210kJ/d 2. %E: C 48.7 P F 33.1 Energy: 8030kJ/d	Yes	The Sugar Bureau
(Due *et al.*, 2008) MonoUnsaturated Fatty acids in Obesity trial	<3kg Δ weight in previous 2m Age 18-35y BMI 28-36 Non smokers No T2DM Pre-menopausal Recently involved in weight loss trial	Denmark 42% Male Age: (28) BMI: (31)	Parallel Group	6 months	Free living diet plan, following intensive weight loss No, *ad libitum*	154	1. High MUFA 2. Low fat 3. Control, moderate fat	1. Dietary counselling and food provided from study supermarket. Prescribed 35-45%FAT, >20%MUFA This diet also included more whole-grains, legumes and nuts. SFA:MUFA:PUFA% 7:20:8 2. Dietary counselling. Food provided from study supermarket. Prescribed 20-30%FAT. SFA:MUFA:PUFA% 8:8:5 3. Dietary counselling. Food provided from study supermarket. Moderate fat (35% energy) with >15% SFA. SFA:MUFA:PUFA% 15:10:4.	1. %E: C 43.3 P 15.3 F 38.4 Energy: 11500kJ/d, fibre 4.2g/MJ 2. %E: C 57.6 P 15.8 F 23.6 Energy: 10500kJ/d, fibre 4.0g/MJ 3. %E: C 49.8 P 15.9 F 32.1 Energy: 10900kJ/d, fibre 2.9g/MJ	Yes	Support from multiple sources including Danish research councils and industry funding
(Due *et al.*, 2004) The Danish Protein Swap Study	Previously overweight/obese	Denmark 24% Male Age: (40) BMI: (30)	Parallel Group	6 months strict, 6-12 mo less strict, plus 24 mo follow up	All food provided 0-6 months, then self maintained No, *ad libitum*	50	1. High protein 2. Moderate protein	1. 25%PRO, <30%FAT 2. 12%PRO, <30%FAT	1. %E: C 48.9 P 21.2 F 30 Energy: 8400kJ/d 2. %E: C 54.7 P 13.9 F 31.4 Energy: 8200kJ/d	Yes	Research institution funded & Industry funded: The Federation of Danish Pig Producers and Slaughterhouse and The Danish Livestock and

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
											Meat Board.
(Dumesnil *et al.*, 2001)	BMI >25 Generally healthy	Canada 100% Male Age: (47) BMI: (33)	Crossover (washout 2 weeks)	6 days	All food provided No, *ad libitum*	12	1. Low GI, low fat, high protein 2. Conventional healthy diet	1. Low GI (carbohydrates with GI >55 were excluded from diet), low fat, high protein, ~30%FAT 2. American Heart Association phase 1 diet (55%CHO, 15%PRO, 30%FAT)	1. %E: C 37 P 31 F 32 Energy: 8815kJ/d Fibre g/d:29 Energy density 4.27 kJ/g 2. %E: C 55 P 15 F 30 Energy: 11695kJ/d Fibre g/d:26 Energy density 5.25 kJ/g	Yes	Foundation of Quebec Heart Institute, Heart and Stroke Foundation, Canada
(Dyson *et al.*, 2007)	Age >18y BMI >25 No T2DM Weight stable	UK 23% Male Age: (51) BMI: (36)	Parallel Group	3 months	Free living diet plan Yes, advised to reduce EI by 500 kcal/d	13	1. Low carbohydrate diet 2. Healthy eating diet	1. Healthy eating advice plus reduction in CHO to <40g/d 2. Dietary guidelines of Diabetes UK (low fat, low GI) plus energy restriction.	1. %E: C 17 P 31 F 46 Energy: 1313 kcal/d 2. %E: C 39 P 20 F 34 Energy: 1593 kcal/d	Yes	Medisense UK, Abbott Laboratories
(Ebbeling *et al.*, 2007)	Age 18-35y BMI >30 Generally healthy No medication No recent weight loss program Non smokers No T2DM	USA 21% Male Age: 18 - 35(27) BMI: mean not reported	Parallel Group	6 months inten-sive, 12 mo follow up. Monthly group workshops through-out 18 mo	Free living diet plan No	73	1. Low GL diet 2. Low fat diet	1. Ad libitum low GL foods. Target: 40% CHO, 25% PRO, 35% FAT. GI @ 6 months 45 2. General healthy eating advice. Target: 55% CHO, 25% PRO, 20% FAT. Ad libitum consumption. GI @ 6 months 57 Fibre similar in both groups	Data in figures only, targets achieved at 6 months		National Institute of Diabetes & Digestive & Kidney Diseases
(Ebbeling *et al.*, 2003)	BMI >95th centile Generally healthy	USA 28% Male Age: 13 - 21(16) BMI: (36)	Parallel Group	6 months strict, 6-12 mo less strict	Free living diet plan 1. Low GL diet – no, *ad libitum* 2. Low fat diet – yes	16	1. Low GL diet 2. Low fat diet	1. Low to moderate GL foods (nonstarchy vegetables, fruits, legumes, nuts, dairy). Target 45-50%CHO, 30-35%FAT. Ad lib diet. GL (g/1000kcal) was 86, 6 at baseline, 68 at 6 months and 69 at 12 months 2. Conventional low fat diet. Increase grains, vegetables & fruit. Target energy reduction 250-500kcal/d. Targets:55-60%CHO, 25-30%FAT. GL	1. %E: C 51 P 19 F 31 Energy 1522 kcal/d 2. %E: C 55 P 18 F 28 Energy 1604 kcal/d		National Institute of Diabetes & Digestive & Kidney Diseases

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
								(g/1000kcal) was 79 at baseline, 77 at 6 months and 79 at 12 months			
(Ebbeling *et al.*, 2005)	Age 18-35y BMI >27.5 Healthy	USA 12% Male Age: 28 BMI: obese (approx. 33)	Parallel Group	6 months strict, 6-12 mo less strict	Free living diet plan 1. Low GL diet – no, *ad libitum* 2. Low fat diet – yes	34	1. Low GI diet 2. Low fat diet	1. Ad lib low GI food, 45-50% CHO, 30-35%FAT. GL 53 g/1000kcal 2. Meal plans based on an exchange system, energy deficit of 250-500kcal/d. GL 77 g/1000 kcal	1. %E: C 47.2 P 21.1 F 33 Energy 1391 kcal/d Fibre g/d:20.7 2. %E: C 59.4 P 18.7 F 23.4 Energy 1409 kcal/d Fibre g/d:17.8		National Institute of Diabetes & Digestive & Kidney Diseases
(Ells *et al.*, 2005)	BMI 20-29 Generally healthy No medications which influence outcomes Normal glucose tolerance Normal lipid profile Pre-menopausal	UK 0% Male Age: 20 - 37(28) BMI: (23)	Crossover (washout 2 weeks)	2 weeks	Substitution No	10	1. Rapidly digestible starch 2. Slowly digestible starch	1. 75g/d C*Set 06598, a rapidly digestible pregelatinized thinned waxy maize starch. Participants replaced regularly consumed starch in the diet with the test starch. 2. 75g/d C*Gel 04201, a slowly digestible native waxy maize starch. Participants replaced regularly consumed starch in the diet with the test starch.	Nutrients of test products not provided	No	BBSRC
(Forcheron and Beylot, 2007)	Healthy Not extremely athletic/active	France 35% Male Age: ~30 BMI: not obese	Parallel Group	6 months	Supplement No	20	1. Fructans 2. Placebo	1. 10g mix (50:50) of inulin and oligofructose(Synergy HP, Orafti). 2. Maltodextrin 10g/d 5g powder in liquid twice daily	No other dietary change prescribed Subjects consumed 40-47% energy from carbohydrate, 35-43% energy from fat		Orafti
(Frisch *et al.*, 2009)	Age 18-70y BMI 25-30 Generally healthy	Germany 31% Male Age: (47) BMI: (34)	Parallel Group	6 months, plus 6 mo follow up Weekly phone contact 1st 6 mo,	Free living diet plan Yes	200	1. Moderate carbohydrate diet 2. High carbohydrate diet	1. Prescribed diet: <40% CHO, 25% PRO, >35% FAT. Energy deficit >500kcal/d. 2. Conventional low fat diet. Prescribed diet: >55% CHO, 15% PRO, <30% FAT. Energy deficit >500kcal/d.	1. %E: C 40.9 P 19.3 F 36.5 Energy 1742 kcal/d 2. %E: C 49.5 P 17.7 F 29.7 Energy 1783 kcal/d		German Health Insurances & the 'Institute for Applied Telemedicine'

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
				then conti-nue diet for next 6 mo							
(Garcia *et al.*, 2007) The Arabinoxylan and Glucose Metabolism study	Age 20-70y BMI >26 Free of chronic disease Generally healthy Impared glucose tolerance No medication	Germany 36% Male Age: 48 - 70(56) BMI: 26 - 46(30)	Crossover (washout 6 weeks)	6 weeks	Supplement No	14	1. Arabinoxylan 2. Placebo	1. Arabinoxylan 15g/d (10g within bread, 5g as powder to be added to foods). 2. Placebo powder and un-supplemented bread rolls. No information on composition of placebo powder provided	1.g/d: C 223 P 93 F 79 Energy 9.1 MJ/d Fibre 24g/d 2. g/d: C 215 P 90 F 76 Energy 8.8 MJ/d Fibre 24g/d (fibre excluding supplement)	Yes	Federal Ministry of Education and Research Germany
(Garcia *et al.*, 2006) The Arabinoxylan and Glucose Metabolism study	Age 20-70y BMI >26 Generally healthy Impared glucose tolerance No chronic illness No medication	Germany 36% Male Age: 48 - 70(56) BMI:26 - 46(30)	Crossover (washout 6 weeks)	6 weeks	Supplement No	14	1. Arabinoxylan 2. Placebo	1. Arabinoxylan 15g/d (10g within bread, 5g as powder to be added to foods). 2. Placebo powder and un-supplemented bread rolls. No information on composition of placebo powder provided	1.g/d: C 223 P 93 F 79 Energy 9.1 MJ/d Fibre 24g/d 2. g/d: C 215 P 90 F 76 Energy 8.8 MJ/d Fibre 24g/d (fibre excluding supplement)	Yes	Federal Ministry of Education and Research Germany
(Genta *et al.*, 2009)	BMI >30 Generally healthy History of constipation Mild lipidaemias Pre-menopausal	Argentina 0% Male Age: (41) BMI: (34)	Parallel Group	120 days	Supplement Unclear, some degree of energy restriction possible	55	1. Fructooligo-saccharide (Yacon) syrup low dose 2. Placebo 3. Fructooligo-saccharide (Yacon) syrup high dose.	1. Provided 0.14g fructooligosaccharides/ kg body weight/d from yacon root syrup (β-(2→1) fructooligosaccharides. 2. Placebo syrup 3. Provided 0.29g fructooligosaccharides/ kg body weight/d from yacon syrop. No data were presented for this group as significant undesirable gastrointestinal side effects were observed.	Diet consumed: % energy – 50% carbohydrate 30% fat, 15% energy. 10g fibre/d	No	CONICET, CIUNT, ANPCyT (Argentine), International Potato Center, Peru
(Gilhooly *et al.*, 2008) CALERIE sub-trial	BMI 25-30 Currently in calorie restriction trial	USA 24% Male	Parallel Group	5 weeks	All food provided Yes	34	1. Insoluble fibre supplementation 2. No fibre	1. 20g/d fibre from a high fibre breakfast cereal (Fibre One) + 30% calorie restriction			NIH

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	Generally healthy	Age: 20 - 42(35) BMI:25 - 30(27)					supplementation	2. 30% calorie restriction only			
(Greenberg *et al.*, 2009) DIRECT	Age 40-65y BMI >27	Israel 86% Male Age: (52) BMI: (31)	Parallel Group	2 years 18 classes over 2 yr, at wks 1, 3, 5, 7, then each 6th week	Free living diet plan Yes, for diet (1)	322	1. Low fat 2. Mediterranean 3. Low carbohydrate	1. Diet based on the American Heart Association guidelines. 2. Mediterranean group not relevant for this review – data not extracted 3. Based on the Atkins diet.	1. %E: C 50.2 P 23.8 F 28 Energy 1261 kcal/d Fibre g/d:22.5 2. %E: C 44.9 P 24 F 32.9 Energy 1393 kcal/d Fibre g/d:22.6 3. %E: C 37.6 P 26.4 F 36.4 Energy 1323 kcal/d Fibre g/d:16	Yes	Research institute funding, Atkins Research Foundation & University funding
(Harvey-Berino, 1998)	Age 25-45y Body weight 120-140% of ideal Free of chronic disease Non smokers	USA 19% Male Age: 25 - 45(38) BMI: 30	Parallel Group	24 weeks	Free living diet plan Yes	80	1. Low fat 2. Energy restriction	1. Fat intake reduced to 22-26g/d (20%FAT) 2. Energy intake reduced to 4186-5023 kJ/d.	1. %E: C 44.4 P 15.9 F 20.9 Energy: 6902kJ/d 2. %E: C 47.2 P 14.2 F 27.2 Energy: 6180kJ/d		Sims Obesity and Nutrition Research Center, USDA
(Haskell *et al.*, 1992) Study# 3 reported in this reference	Age 20-75y Generally healthy Mild to moderate lipidaemias No fibre supplement use No medication Normal glucose tolerance	USA 43% Male Age: (52) BMI: <130% ideal body wt.	Crossover (washout 0 weeks)	12 weeks	Substitution No	16	1. Soluble fibre 2. Guar gum	1. 15g/d soluble fibre (3.9g Pectin, 6.3g Psyllium husk, 3.3g Guar gum, 1.5g Locust bean gum). 45g of fructose/d. Medium viscosity. 2. 10g/d high viscosity Guar Gum plus 5g of fructose/d.	No data provided		Shaklee U.S., Inc., a Division of Yamanouchi Pharmaceutical Corporation
(Haskell *et al.*, 1992) Study# 2 reported in this reference	Age 20-75y Generally healthy Mild to moderate lipidaemias No fibre supplement use No medication No T2DM	USA 50% Male Age: (56) BMI: <130% ideal body wt.	Parallel Group	4 weeks	Substitution No	44	1. Acacia gum 2. Placebo	1. 15g Acacia gum plus 45g of fructose/d. Low viscosity. 2. Placebo powder, same kcal content as soluble fibre powder.	No data provided		Shaklee U.S., Inc., a Division of Yamanouchi Pharmaceutical Corporation
(Haskell *et al.*, 1992) Study# 1	Age 20-75y Generally healthy Mild to moderate	USA 48% Male	Parallel Group	1 months	Substitution	62	1. Mixed soluble fibre	1. 17.2g/d soluble fibre (Agacia gum 9.7g, Psyllium Husk 4.9g, Guar Gum 2.6g). 45g of	No data provided		Shaklee U.S., Inc., a Division of Yamanouchi

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
reported in this reference	lipidaemias No fibre supplement use No medication Normal glucose tolerance	Age: (57) BMI: <130% ideal body wt.			No		2. Placebo	fructose/d. Medium viscosity. 2. Placebo			Pharmaceutical Corporation
(Haskell *et al.*, 1992) Study# 4 reported in this reference	Age 20-75y Generally healthy Mild to moderate lipidaemias No fibre supplement use No medication Normal glucose tolerance	USA 39% Male Age: (56) BMI: <130% ideal body wt.	Parallel Group	1 months	Substitution No	49	1. Study4 Soluble fibre 5g 2. Study4 Soluble fibre 10g 3. Study4 Soluble fibre 15g 4. Study4 Placebo	1. 5g/d soluble fibre (1.3g Pectin, 2.1g Psyllium husk, 1.1g Guar gum, 0.5g Locust bean gum). 45g of fructose/d. 2. 10g/d soluble fibre (2.6g Pectin, 4.2g Psyllium husk, 2.2g Guar gum, 1g Locust bean gum). 30g of fructose/d. 3. 15g/d soluble fibre (3.9g Pectin, 6.3g Psyllium husk, 3.3g Guar gum, 1.5g Locust bean gum). 45g of fructose/d. 4.Placebo powder, same kcal content as soluble fibre powder. All medium viscosity fibres	No data provided		Shaklee U.S., Inc., a Division of Yamanouchi Pharmaceutical Corporation
(He *et al.*, 2004) American Fibre Study	BMI <35 Generally healthy No CHD, T2DM or HTN No medications which influence outcomes Not hyperlipidaemic/ hypercholesterola emic	USA 40% Male Age: (48) BMI: (29)	Parallel Group	12 weeks	Substitution No, but aimed to replace other carbohydrate	110	1. Oat bran and oatmeal 2. Refined wheat and corn	1. 60g oat bran in a muffin and 84g of oatmeal squares cereal daily. Soluble fibre 8g/d, beta glucan 7.3g/d, insoluble fibre 7.7g/d 2. 93g refined wheat in a muffin and 42g of corn flakes cereal daily. Soluble fibre 0.9g/d, beta glucan 0g/d, insoluble fibre 1.5g/d	1. g/d: C 113.3 P 24 F 13.7 Energy 652 kcal/d Fibre g/d:15.9 2. g/d: C 108.4 P 10.8 F 11 Energy 567 kcal/d Fibre g/d:2.7	Intended diet	NIH & Tulane-Charity-LSU General Clinical Research Centre
(Heijnen *et al.*, 1996)	Age 18-70y Generally healthy No recent weight loss program Normal glucose tolerance Normal lipid profile	the Netherlands 45% Male Age: (24) BMI: (22)	Crossover (washout 0 days)	3 weeks	Supplement No	60	1. Glucose yoghurt 2. Raw resistant starch yoghurt (RS2) 3. Retrograde resistant starch	1. Skimmed yogurt and milk with fruit syrup and glucose. 87g/d digestible glucose equivalent 2. Skimmed yogurt and milk with fruit syrup and raw resistant starch. 57g/d digestible glucose equivalent	1. g/d: P 10 F 0.4 Energy: 1824kJ/d 2. g/d: P 10 F 0.4 Energy: 1314kJ/d 3. g/d: P 10 F 0.4 Energy: 1314kJ/d	Nutrients of supplem ents	Unilever Research Laboratory

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
							yoghurt (RS3)	3. Skimmed yogurt and milk with fruit syrup and retrograde resistant starch. 57g/d digestible glucose equivalent	Energy values assume no energy from fermentation		
(Heini *et al.*, 1998)	BMI >30 No T2DM	USA 0% Male Age: (46) BMI:30 - 50(35)	Crossover (washout 1 week)	1 weeks	All food provided Yes	25	1. Hypoenergetic formula diet 2. Hypoenergetic formula diet + guar gum	1. 3.3MJ formula diet with no added fibre 2. 3.3MJ formula diet + 20g of guar gum	1. %E: C 50 P 33 F 17 Energy: 3300kJ/d Fibre g/d:0 2. %E: C 50 P 33 F 17 Energy: 3300kJ/d Fibre g/d:20	Intended	Swiss National Fond/ Novartis Nutrition Corp., Minneapolis
(Henry *et al.*, 2007)	Children aged 8-11 in one primary school	UK 29% Male Age: 8 - 11 BMI: (18)	Crossover (washout 10 weeks)	10 weeks	Substitution No	38	1. High GI breakfast 2. Low GI breakfast	1. High GI breakfast on two non-consecutive mornings per week for 10 weeks. Estimated GI=77, GL=43 2. Low GI breakfast on two non-consecutive mornings per week for 10 weeks. Estimated GI=46, GL=23	Each breakfast provided 1273 kJ (300 kcal) and was matched for macronutrients and fibre	Breakfast provided	The Sugar Bureau
(Herrmann *et al.*, 2001)	BMI 19-25 Generally healthy	USA 55.5% Male Age: (27) BMI: (23)	Crossover (washout 10 days)	8 days	All food provided No, but food provision isocaloric between groups	9	1. High GI, moderate fat 2. Low GI, moderate fat 3. High GI, low fat 4. Low GI, low fat	1. High GI carbohydrates, 30%FAT. GI >65 2. Low GI carbohydrates, 30%FAT. GI <45 3. High GI carbohydrates, 20%FAT. GI >65 4. Low GI carbohydrates, 20%FAT. GI <45	1. %E: C 55 P 15 F 30 2. %E: C 55 P 15 F 30 3. %E: C 65 P 15 F 20 4. %E: C 65 P 15 F 20	Intended	Mars, Inc & Research institute funding
(Howard *et al.*, 2006) The Women's Health Initiative Dietary Modification Trial	Age 50-79y Fat intake >32% Post-menopausal	USA 0% Male Age: (62) BMI: (29)	Parallel Group	6 years	Free living diet plan No	48835	1. Low fat 2. Control	1. Advice: reduce fat intake to 20%, increase fruit, vegetables and wholegrains 2. Received information relating to health and healthy diets	1. %E: C 53.9 P 17.7 F 28.8 Energy 1432 kcal/d Fibre g/d:19.6 2. %E: C 45.9 P 17.1 F 37 Energy 1546 kcal/d Fibre g/d:14.4	Yes	National Heart, Lung, and Blood Institute, US Department of Health and Human Services
(Hunninghake *et al.*, 1994)	Age 18-70y Generally healthy Mild to moderate lipidaemias No medications which influence outcomes Within 30% of	USA 76% Male Age: 52 BMI: 26	Parallel Group	15 weeks	Supplement No	161	1. Placebo 2. Fibre 10g 3. Fibre 20g	1. Placebo sachet before breakfast and dinner while consuming a step 1 diet. 2. Placebo sachet and 10 of fibre supplement before dinner, while consuming a step 1 diet. Fibre = guar gum, pectin, soy,			Sandoz Pharmaceutical Corporation

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided ?	Funding source
	ideal weight							corn bran, pea fibre taken with milk or water 3. 10g of fibre supplement before breakfast and again before dinner, while consuming a step 1 diet. Fibre = guar gum, pectin, soy, corn bran, pea fibre taken with milk or water			
(Jenkins *et al.*, 1998)	Generally healthy	Canada 50% Male Age: (33) BMI: (24)	Crossover (washout 2 weeks)	2 weeks	Supplement No	24	1. Low fibre control 2. Wheat Bran 3. Granular high-amylose starch 4. Retrograded non-granular high-amylose starch	Muffins and cereal provided to all groups as: 1. Low fibre control foods 2. High fibre wheat bran control (30g fibre/d) 3. Granular high-amylose starch (RS2) 21.5 g/d RS, 30g fibre/d 4. Retrograded non-granular high-amylose starch (RS3) 28g/d RS, 30g fibre/d	1. %E: C 59 P 15 F 23 Fibre g/d:22 2. %E: C 59 P 15 F 24 Fibre g/d:45 3. %E: C 61 P 16 F 22 Fibre g/d:43 4. %E: C 58 P 16 F 24 Fibre g/d:44 Supplements provided approx. 30% estimated energy	Yes	Natural Sciences and Engineering Research Council, Canada and Nacan Products Ltd. Canada
(Jenkins *et al.*, 1999)	Generally healthy	Canada 50% Male Age: 17 - 57(36) BMI:18 - 29(24)	Crossover (washout 2 weeks)	2 weeks	Substitution No	24	1. Low-wheat fibre breakfast cereal 2. Coarse bran wheat fibre breakfast cereal 3. Medium particle size wheat fibre breakfast cereal	Habitual diet followed, with 1. 60g cornflakes plus 58g Special K each day 2. Branflakes 145g/d - a mixture of coarse brans with a mean particle size of 1185 um 3. Cornflakes 47g plus 100g wheat bran flakes - ultra-fine and coarse particle size wheat bran in the ratio of 3:2 - mean particle size of 692 um	Breakfast cereals provided 1. g/d: C 93 P 16 F 6 Energy 485 kcal/d Fibre g/d:2.4 2. g/d: C 93 P 16 F 6 Energy 485 kcal/d Fibre g/d:21.5 3. g/d: C 93 P 16 F 6 Energy 485 kcal/d Fibre g/d:21.5	Nutrients of test foods	Natural Sciences and Engineering Research Council, Canada and The Kellogg company
(Jenkins *et al.*, 2000)	Generally healthy Normal lipid profile	Canada 52% Male Age: (37) BMI: (25)	Crossover (washout 2 weeks)	2 weeks	Substitution No	25	1. Low- fibre breakfast cereal 2. Cocoa-Bran breakfast cereal	1. provided 5.6 grams per day of fibre 2. provided 25 grams per day of fibre	1. g/d: C 314 P 71 F 48 Fibre g/d:17 2. g/d: C 335 P 82 F 50 Fibre g/d:39	Yes	Kellogg's Company
(Jensen *et al.*, 1997)	Age 25-65y Generally healthy Mild to moderate lipidaemias Moderately hypercholesterolemic	USA 53% Male Age: (52) BMI: (26)	Parallel Group	24 weeks	Supplement No	58	1. Water soluble dietary fibre (WSDF) - medium viscosity 2. Acacia gum –	1. A mixture of psyllium (2.1g WSDF/serving), pectin (1.3g WSDF/serving), guar gum (1.1g WSDF/serving), and locust bean gum (0.5g WSDF/serving) prepared as a powder in a carbohydrate base (ca 15g	Subjects continued their usual low fat diet (Step1 diet) , plus fibre supplements (15 g/d in both groups)	Yes	Shaklee Corporation, division of Yamanouchi Pharmaceutical

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	No medications which influence outcomes						low viscosity	fructose/serving). 2. 5.0g WSDF/serving, prepared as a powder in the same fructose base.			Co.
(Johnston, 1998)	Age 40-70y Body weight <140% of ideal Mild to moderate lipidaemias No CVD No medications which influence outcomes No metabolic disease	USA 63% Male Age: (57) BMI: mean not reported	Parallel Group	6 weeks	Substitution No	135	1. Control cereal 2. Whole grain oat cereal	1. Cornflakes 90g/d, delivering 2g fibre (0.1g soluble, 1.9g insoluble) 2. Oat Cheerios 90g/d delivering 9g fibre (2.9g soluble, 6.1g insoluble) 6-week pre-treatment STEP 1 (low fat) diet	1. g/d: C 78 P 5.4 F 1.4 Energy: 338kJ/d Fibre g/d:2 2. g/d: C 67.6 P 9.9 F 5.2 Energy: 321kJ/d Fibre g/d:9	Nutrients of test products	General Mills Inc.
(Johnston *et al.*, 2004)	Generally healthy	USA 10% Male Age: 19 - 54 BMI: (29)	Parallel Group	6 weeks	All food provided Yes	20	1. High protein, low fat 2. High carbohydrate, low fat	1. Low fat, energy restricted, 30%PRO 2. Low fat, energy restricted, 60%CHO	1. g/d: C 170 P 134 F 53 Energy 1700 kcal/d Fibre g/d:23 2. g/d: C 280 P 64 F 39 Energy 1700 kcal/d Fibre g/d:25	Intended diet	University funding & Research institute funding
(Johnstone *et al.*, 2008)	Age 20-65y BMI >30 Generally healthy No medications which influence outcomes	Scotland 100% Male Age: 23 - 57(38) BMI:30 - 42(35)	Crossover (washout 3 days)	4 weeks	All food provided No	20	1. Very low carbohydrate diet 2. Medium carbohydrate diet	1. Ad lib consumption of a diet with fixed macronutrient proportions 2. Ad lib consumption of a diet with fixed macronutrient proportions	1. %E: C 5 P 30 F 66 Energy: 7250kJ/d 2. %E: C 35 P 30 F 35 Energy: 7950kJ/d	Yes	Scottish Executive and Environment and Rural Affairs Department
(Johnstone *et al.*, 2000)	Generally healthy No medications which influence outcomes Weight stable	Scotland 100% Male Age: (27) BMI: (24)	Crossover (washout 7 days)	7 days	All food provided No	8	1. High Fat Snack 2. High Carbohydrate Snack 3. High Protein Snack 4. No Snack	1. Snacks = 30% daily energy requirements. CHO:PRO:FAT % 15:15:70 2. Snacks = 30% daily energy requirements. CHO:PRO:FAT % 70:15:15 3. Snacks = 30% daily energy requirements. CHO:PRO:FAT % 15:70:15 4. No snack	1. %E: C 13 P 13 F 74 Energy: 2600kJ/d 2. %E: C 74 P 13 F 13 Energy: 2610kJ/d 3. %E: C 14 P 73 F 13 Energy: 2560kJ/d	Nutrients of snacks provided	The Scottish Office + Slimming World
(Keenan *et al.*, 2007)	49% with metabolic syndrome	USA 48% Male	Parallel Group	6 weeks	Supplement	155	All consumed low fat diet	Fibre incorporated into two functional food products: a ready-to-eat cereal and a		No	Cargill Inc.

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	Age 25-73y Elevated LDL Cholesterol Mild to moderate lipidaemias No chronic illness No medications which influence outcomes No T2DM Weight stable	Age: (55) BMI: (29)			No		1. Low-dose, LMW barley beta glucan 2. High-dose LMW barley beta glucan 3. Low-dose, HMW barley beta glucan 4. High-dose, HMW barley beta glucan 5. Placebo	reduced-calorie fruit juice beverage 1. 3g/d low molecular weight barley beta glucan 2. 5g/d low molecular weight barley beta glucan 3. 3g/d high molecular weight barley beta glucan 4. 5g/d high molecular weight barley beta glucan 5. Placebo - no fibre incorporation			
(Keogh *et al.*, 2008)	≥ 1 metabolic syndrome risk factor Abdominal obesity No CHD or T2DM	Australia % Male: not reported Age: 24 - 64(50) BMI:27 - 44(34)	Parallel Group	8 weeks	Free living diet plan Yes	117	1. Low carbohydrate, high SFA 2. High carbohydrate, low SFA	1. 30% energy restriction. Some key foods were provided top aid compliance. Intended diet: 4%CHO, 35%PRO, 61%FAT 2. 30% energy restriction. Some key foods were provided top aid compliance. Intended diet: 46%CHO, 24%PRO, 30%FAT	1. %E: C 5 P 35 F 59 g/d: C 20 P 133 F 103 Energy: 6608kJ/d Fibre g/d:13 2. %E: C 47 P 24 F 28 g/d: C 172 P 87 F 47 Energy: 6590kJ/d Fibre g/d:32	Yes	National Heart Foundation Australia + National Health and Medical Research Council Australia
(Keogh *et al.*, 2005)	Age 18-70y Generally healthy No HTN or T2DM No medications which influence outcomes Stable activity level	Australia 48% Male Age: (56) BMI: (27)	Crossover (washout 0 days)	3 weeks	Free living diet plan No	50	1. High PUFA 2. High MUFA 3. High SFA 4. High carbohydrate, low fat, high GI	1. Daily test foods: 20g PUFA margarine and 35g walnuts. Foods provided 25g PUFA and ~1600kJ/d 2. Daily test foods: 20g MUFA margarine and 45g almonds. Foods provided 26g MUFA and ~1600kJ/d 3. Daily test food: 50g butter. Foods provided 27g SFA and ~1600kl/d 4. Daily test foods: 70g sultanas and 50g jam. Foods provided 93g carbohydrates and ~1600kJ/d	1. %E: C 45 P 17 F 36 Energy: 8355kJ/d Fibre g/d:31 2. %E: C 44 P 18 F 37 Energy: 8303kJ/d Fibre g/d:31 3. %E: C 45 P 16 F 37 Energy: 8420kJ/d Fibre g/d:27 4. %E: C 65 P 16 F 18 Fibre g/d: 31	Yes	Not reported
(Kerckhoffs *et al.*, 2003)	Age 18-70y BMI <30 Mild to moderate lipidaemias	The Netherlands 43% Male	Parallel Group	4 weeks	Substitution No	51	1. Control foods 2. Beta glucan foods	1. Cookies and bread rich in wheat fibre (minimal beta glucan)	1. %E: 50.3C 39.9 F 15.4 P, 9.3 MJ/d, fibre 3.7 g/MJ	Yes	Raisio, Finland

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	No CHD or HTN Weight stable	Age: (52) BMI: (25)						2. Cookies and bread with half wheat flour replaced by oat bran and oat bran concentrate, target >5g beta glucan/day. Average beta glucan 5.9g/d.	2. %E: 46C 41.6 F 18.4 P, 8.6 MJ/d, fibre 3.6 g/MJ		
(Kesaniemi *et al.*, 1990)	Some with mild HTN, Some with gallstones No heart failure or thyroid, liver, renal, GI diseases	Finland 100% Male Age: 47 - 55(50) BMI:18 - 35(26)	Crossover (washout 0 weeks)	8 weeks	Free living diet plan No	34	1. Low fibre 2. High fibre	1. Advise: avoid unpurified cereals, vegetables, salads, fruit and berries. Low fibre products were recommended, purified wheat products, filtered berry soups and processed juices. Wheat flour hot cereal porridge and fibre-free biscuits provided 2. Advise: eat large quantities of unpurified corn, fruit, vegetables, salads & berries. Given 200ml/day hot porridge: oat flakes, bran, guar gum (9.4g/100g dry) and pectin (2.3g/100g dry) plus graham biscuits fortified with carrots and bran. Mix of soluble and insoluble fibre sources	1. g/d: C 273 P 101 F 109 Energy 2557 kcal/d Fibre g/d:11.6 2. g/d: C 252 P 90 F 105 Energy 2557 kcal/d Fibre g/d:26.2	Yes	Juho Vainio Foundation, Sigrid Juselius Foundation, Medical Council of the Academy of Finland & the Finnish Life Insurance Companies
(Kirk *et al.*, 1997)	Age 17-30y Fat intake >35% Generally healthy Low habitual breakfast cereal consumption	Scotland 4% Male Age: (20) BMI: (23)	Parallel Group	4 weeks	Supplement No	62	1. Control 2. Breakfast cereals (RTE)	1. No change in diet 2. Ready to eat breakfast cereals 60g/day (Cornflakes, Rice Krispies or Special K)	1. %E: 52 34.6 F 12.9 P, 7.75 MJ/d, nsp 8.6 g/d 2. %E: 46.9 29.3 F 12.9 P, 7.92 MJ/d, nsp 10.6g/d	Yes	Kellogg's Company
(Kirkwood *et al.*, 2007)	Age 30-50y BMI 25-40 Generally healthy Not on weight loss diet	Scotland 0% Male Age: (41) BMI: (32)	Parallel Group	12 weeks	Free living diet plan Yes	109	1. Group 1: No advice 2. Group 2: Conventional weight loss diet 3. Group 3: Exercise 4. Group 4: Conventional	1. Comparison for group 2 2. Low fat, high carbohydrate, including sucrose, energy reduced diet 3. Intervention was exercise-based (comparison for group 4) 4. Low fat, high carbohydrate,	1. %E: C 49.6 P 17 F 33.1 Energy: 8100kJ/d 2. %E: C 50.1 P 19.1 F 30.2 Energy: 7100kJ/d 3. %E: C 44.2 P 18.9 F 36.7 Energy: 7400kJ/d 4. %E: C 52.3 P 17.8 F29 Energy: 7100kJ/d	Yes	The Sugar Bureau

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
							weight loss diet + exercise	including sucrose, energy reduced diet plus exercise			
(Kleemola *et al.*, 1999)	BMI >20 Not breakfast cereal eater Moderate alcohol intake No medications which influence outcomes Non diabetic Not very low saturated fat intake	Finland 45% Male Age: 29 - 71 BMI:>20	Crossover (washout 6 weeks)	6 weeks	Substitution No	224	1. Group 1- Cereal diet first 2. Group 2- Control diet first 3. Group 1- Control diet second 4. Group 2- Cereal diet second	Cereal diet: 60 g/d for women and 80 g/d for men, either Cornflakes or Rice Krispies. Control diet: follow usual habits	1. %E: C 55.3 P 16.3 F 28.5 Energy 2094 kcal/d Fibre g/d:22.3 2. %E: C 49 P 16.3 F 34.6 Energy 2063 kcal/d Fibre g/d:21.3 3. %E: C 50.5 P 16.6 F 32.9 Energy 2004 kcal/d Fibre g/d:22.3 4. %E: C 55.4 P15.7 F 28.8 Fibre g/d: 21.3 Energy 1963 kcal/d	Yes	Kellogg's
(Kohl *et al.*, 2009)	BMI >25 Generally healthy	Germany 33% Male Age: (50) BMI: (32)	Crossover (washout4 weeks)	4 weeks	Supplement No	12	1. Placebo capsule 2. Beta-D-glycans capsules	1. Usual diet + waxy maize starch placebo 2. Usual diet + 1.5g/d highly purified Beta-D-Glycans	Diets similar: g/d 230 C, 82 P, 89 F, fibre 18, 8.6 MJ/d	Yes	Institute Danone, Leiber Inc.
(Lasker *et al.*, 2008)	BMI >25 No medications which influence outcomes Non smokers	USA 38% Male Age: (47) BMI: (34)	Parallel Group	4 months	Free living diet plan Yes	65	1. High carbohydrate 2. High protein	1. Energy restriction 500kcal/d 2. Energy restriction 500kcal/d	1. g/d: C 215.4 P 66.7 F 39.2 Energy: 5875kJ/d Fibre g/d:24.3 2. g/d: C 152.6 P 121.4 F 56.2 Energy: 6607kJ/d Fibre g/d:21.1	Yes	National Cattleman's Beef Association, The Beef Board and Kraft Foods
(Layman *et al.*, 2005)	BMI >26 Body weight <140% of ideal No medical conditions or medication which influence outcomes	USA 0% Male Age: 40 - 56(47) BMI: (33)	Parallel Group	16 weeks	Free living diet plan Yes, aim for both diets 7100 kJ/d	48	1. High protein diet 2. High protein diet + exercise 3. High carbohydrate diet 4. High carbohydrate diet	1. Carbohydrate:protein ratio designed to be <1.5. 2. Carbohydrate:protein ratio designed to be <1.5. Exercise recommendations were minimum of 30minutes of walking 5d/week 3. Carbohydrate:protein ratio designed to be >3.5	1. g/d: C 141 P 110 F 52 Energy: 6062kJ/d Fibre g/d:18.6 2. g/d: C 127 P 102 F 46 Energy: 5540kJ/d Fibre g/d:16 3. g/d: C 197 P 58 F 34 Energy: 5377kJ/d Fibre g/d:23	Yes	Illinois Council on Food and Agricultural Research, National Cattlemen's Beef Association, The Beef Board and Kraft Foods.

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
							+ exercise	4. Carbohydrate:protein ratio designed to be >3.5. Exercise recommendations were minimum of 30minutes of walking 5d/week			
(Layman *et al.*, 2009)	BMI >25	USA 45% Male Age: 40 - 56(45) BMI: (33)	Parallel Group	12 months	Free living diet plan Yes	130	1. High carbohydrate, low protein diet 2. Low carbohydrate, high protein diet	1. 4 month energy restriction phase and 8 month maintenance. Protein provided ~15% energy intake, with carbohydrate:protein ratio >3.2 and lipids ~30% energy intake. Protein provided 0.8g.kg/d. kcal and fibre were similar between groups 2. 4 month energy restriction phase and 8 month maintenance. Protein provided ~30% energy intake, with carbohydrate:protein ratio <1.5 and lipids ~30% energy intake. Protein provided 1.6g.kg/d. kcal and fibre were similar between groups	1. g/d: C 232 P 70 F 51 Energy: 6800kJ/d Fibre g/d:25 2. g/d: C 168 P 116 F 67 Energy: 7180kJ/d Fibre g/d:20	Yes	The National Cattlemen's Beef Association, Beef Checkoff, and Kraft Foods
(Lee *et al.*, 2009)	Age 20-70y BMI 25-35 Fasting plasma glucose <5.6mmol/l Free of chronic disease Moderate alcohol intake No change in medications which influence outcomes within previous 3m No untreated HTN Non smokers Weight stable	Australia 25% Male Age: mean not reported BMI: mean not reported	Parallel Group	16 weeks	Substitution	88	1. Control bread 2. Lupin flour bread	1. Replaced 15-20% TE with white bread 2. Replaced 15-20% TE with lupin kernal flour-enriched bread (high protein, high fibre)	1. g/d: C 45.2 P 9.6 F 4.6 Fibre g/d:2.7 2. g/d: C 24.9 P 15.8 F 3.6 Fibre g/d:9.5	Yes	Government funding
(Leidy *et al.*, 2007a) American Protein	Age >18y BMI >25 Non smokers Normal blood	USA 0% Male	Parallel Group	12 weeks	Free living diet plan	54	1. High protein, energy restricted 2. Moderate	1. 750 kcal/d energy-deficit diet, 30% PRO	1. %E: C 172 P 115 F 42 Energy: 1500 kcal/d 2. %E: C 214 P 67 F 36	Yes	National Pork Board

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Study	profiles Normal glucose tolerance Stable activity level Weight stable Women	Age: 28 - 80 BMI:26 - 37			Yes		protein, energy restricted	2. 750 kcal/d energy-deficit diet, 18% PRO	Energy: 1540 kcal/d		
(Leidy *et al.*, 2007b) American Protein Study	Age >18y BMI >25 Non smokers Normal blood profiles Normal glucose tolerance Stable activity level Weight stable Women	USA 0% Male Age: 28 - 80 BMI:26 - 37	Parallel Group	9 weeks	Free living diet plan Yes	54	1. High protein, energy restricted 2. Moderate protein, energy restricted	1. 750 kcal/d energy-deficit diet, 30% PRO 2. 750 kcal/d energy-deficit diet, 18% PRO	1. g/d: C 173 P 116 F 45 Energy: 1560 kcal/d 2. g/d: C 205 P 66 F 40 Energy: 1440 kcal/d	Yes	National Pork Board
(Letexier *et al.*, 2003)	Generally healthy No medications which influence outcomes No T2DM	France 50% Male Age: 23 - 32 BMI:19 - 25	Crossover (washout 4 months)	6 weeks	Supplement No	8	1. Inulin 2. Placebo	High-carbohydrate, low-fat diet (55% of total energy) plus 1. Inulin 10g/d (Raftiline HP – Orafti). Average degree polymerisation 25 (12-65) 2. Maltodextrin 10g/d	Nutritional details of the supplements not provided	No	European Union
(Luo *et al.*, 1996)	Generally healthy	France 100% Male Age: 19 - 32(24) BMI: (21)	Crossover (washout 2 weeks)	4 weeks	Supplement No	12	1. Fructooligo-saccharides 2. Sucrose	1. Short-chain fructooligosaccharides (Actilight 950P), 20g/daily within 100g cookies 2. Sucrose 20g/daily within 100g cookies	Cookies: 1. g/d: C 67.7 P 7.2 F 20 2. g/d: C 70.19 P 7.1 F 18.5	Nutrients of test foods provided	Béghin-Meiji Industries
(Maki *et al.*, 2003)	Age 5-18y Mild to moderate lipidaemias	USA 72% Male Age: 6 - 14(11) BMI: (27)	Crossover (washout 0 days)	4 weeks	Substitution No	29	1. Control cereal 2. Beta-glucan cereal	1. Control RTE cereal 2. Ready to eat cereal providing 3g/d of beta-glucan NCEP Step 1 diet in both groups	1. %E: C 51.8 P 16.9 F 31.6 Energy: 2016.6 kcal/d Fibre g/d:13 2. %E: C 52.4 P 17.3 F 32.2 Energy: 1790.8 kcal/d Fibre g/d:15.3	Yes	General Mills, Inc.

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(Maki *et al.*, 2007a)	Generally healthy No medications which influence outcomes Normal lipid profile No T2DM	USA 100% Male Age: (42) BMI: (28)	Crossover (washout 2 weeks)	2 weeks	Substitution No	33	1. Oat based cereals 2. Wheat based cereals	1. 76g/d of oat bran cereal plus 60g/d of oatmeal. Supplements provided 5.7g/d beta glucan 2. 81g/d of frosted mini-wheat cereal plus 60g/d hot rolled wheat cereal	1. g/d: C 98 P 18 F 8 Energy: 534kJ/d Fibre g/d:13 2. g/d: C 111 P 15 F 3 Energy: 529kJ/d Fibre g/d:14	Yes	Quaker Oats
(Maki *et al.*, 2007b)	Age >40y DBP 85-109mmHg Fibre <20g/d Mid upper arm circumference <42cm No CHD or T2DM SBP 130-179mmHg Waist circumference >96.5 (m) >88.9 (f)	USA 55% Male Age: >40 BMI: (32)	Parallel Group	12 weeks	Substitution No	97	1. Oat beta-glucan cereal 2. Wheat cereal	1. 90g/d oat bran cereal + 60g/d oatmeal + 20g/d powdered oat beta-glucan. 7.7g/d beta glucan 2. 90g/d wheat cereal + 65g/d low fibre hot cereal oatmeal + 12g/d maltodextrin powder Throughout, both groups advised to follow a low fat healthy eating plan	1. g/d: C 124.3 P 20.3 F 8.9 Enrgy: 658 kcal/d Fibre g/d:17.3 2. g/d: C 139.5 P 10 F 2.1 Enrgy: 641 kcal/d Fibre g/d:1.9	Yes	Quaker Oats
(Marett and Slavin, 2004)	Age 18-55y Generally healthy	USA 52% Male Age: (29) BMI: mean not reported	Parallel Group	6 months	Supplement No	54	1. Placebo 2. Larch arabinogalactan 3. Tamarack arabinogalactan	1. Rice starch 8.4g/d added to food or drinks 2. 8.4g/d Larch arabinogalactan (non viscous soluble fibre) added to food or drinks 3. 8.4g/d Tamarack arabinogalactan (non viscous soluble fibre) added to food or drinks	Nutrients of products not provided		The Sota-Tec Fund
(Martin *et al.*, 2000)	Generally healthy	France 100% Male Age: (28) BMI: (22)	Crossover (washout 4 weeks)	2 weeks	Substitution No	10	1. Low-energy breakfast 2. High-energy breakfast	1. Low energy breakfast, 418 kJ (100 kcal) 2. High energy breakfast, 2920 kJ (700 kcal) Effectively a carbohydrate supplement	1. %E: C 42 P 8.4 F 24.6 2. %E: C 48 P 3.6 F 34.4	Yes	The Nutrition Department of Nestlé, France
(Mattes, 2002)	Age 20-60y BMI 25-35	USA	Parallel Group	2 weeks	Substitution	103	1. Single breakfast cereal diet	1. 1 serving of special k plus 2/3 cup skimmed milk and 1	Macronutrient composition of plans not		Kellogg Company

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided ?	Funding source
	Generally healthy Low dietary disinhibition No medications which influence outcomes Stable activity level Weight stable	24% Male Age: (42) BMI: (29)			No		2. Variety breakfast cereal diet 3. Control group	piece of fruit as a replacement for either breakfast or lunch 2. 1 serving of any ready-to-eat Kelloggs cereal plus 2/3 cup skimmed milk and 1 piece of fruit as a replacement for either breakfast 3. No dietary instruction	provided		
(Mattes, 2007)	Age 20-60y BMI 25-30 Generally healthy Not extremely athletic/active Weight stable	USA 40% Male Age: (27) BMI: (27)	Crossover (washout 9 days)	5 days	Substitution No	25	1. Breakfast bar + fibre 2. Placebo bar	1. Breakfast bar containing guar fibre (3.9g/55g serving) and sodium alginate (1.1g/55g serving) 2. Breakfast bar of same ingredients minus guar and alginate	1. g/d: C 37.6 P 5.78 F 3.77 Energy: 196 kcal/d Fibre g/d:4.49 2. g/d: C 38.56 P 5.17 F 3.66 Energy: 207 kcal/d Fibre g/d:0.62	Yes	Ross Products Division, Abbott Laboratories
(Mazlan *et al.*, 2006)	BMI 19-30 Generally healthy Low dietary restraint	UK 100% Male Age: (36) BMI: (26)	Crossover (washout 5 days)	7 days	All food provided No, food provided *ad libitum*	24	1. Control for high fat snack 2. 1.5MJ high fat snack 3. 3.0MJ high fat snack 4. Control for high sugar snack 5. 1.5MJ high sugar snack 6. 3.0MJ high sugar snack	1. No snacks given 2. One (1.5MJ) high fat snack (am). 3. Two (1.5MJ) high fat snacks, (am+pm). 4. No snacks given 5. One (1.5MJ) high sugar snack (am). Snack provided 80% energy from sugar/ highly assimilated starch. 6. Two (1.5MJ) high sugar snacks	High fat snacks %E: C 10 P 10 F 80 Low fat snacks %E: C 80 P 10 F 10	Intended diet	Scottish Executive Rural Affairs Department & University funding
(McManus *et al.*, 2001)	Age 18-70y BMI >25 Free of chronic disease	USA 10% Male Age: (44) BMI:27 - 46(34)	Parallel Group	18 months	Free living diet plan Yes	101	1. Moderate fat diet 2. Low fat diet	1. Intended diet: 45-50%CHO, 30%FAT. Energy limit of 1200kcal/d (women) or 1500kcal/d (men). 2. Intended diet:60-65%CHO, 20%FAT. Energy limit of 1200kcal/d (women) or 1500kcal/d (men)	1. %E: C 47 P 19 F 35 Energy: 1877kJ/d Fibre g/d:25 2. %E: C 50 P 19 F 30 Energy: 1697kJ/d Fibre g/d:19	Yes	The Peanut Institute, the International Olive Oil Council, & the International Tree Nut Council

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided ?	Funding source
(McMillan-Price *et al.*, 2006)	<150 kg <5kg Δ weight in the previous 2m Age 18-40y BMI >25 Maintain current PA levels No chronic illness No medication	Australia 24% Male Age: (32) BMI: (31)	Parallel Group	12 weeks	All food provided Yes	129	1. High CHO, high GI diet 2. High CHO, low GI diet 3. High protein, high GI diet 4. High protein, low GI diet	All groups: 1400 kcal/d women and 1900 kcal/d men. 1. 55% CHO, 15% PRO, <30% FAT, fibre 30g/d. Diet based on high-GI whole grains, fiber-rich cereals/breads. 2. 55% CHO, 15% PRO, <30% FAT, fibre 30g/d. Diet based on low-GI food 3. 45% CHO, 25% PRO, <30%FAT, fibre 30g/d. Diet based on lean red meat and high-GI CHO whole grains. 4. 45% CHO, 25% PRO, <30%FAT, fibre 30g/d. Diet based on lean red meat and low-GI CHO foods.	1. %E: C 60 P 18 F 19 Energy: 9630kJ/d Fibre g/d:23 2. %E: C 56 P 19 F 22 Energy: 9030kJ/d Fibre g/d:20 3. %E: C 42 P 28 F 27 Energy: 9220kJ/d Fibre g/d:19 4. %E: C 40 P 26 F 29 Energy: 8890kJ/d Fibre g/d:21	Yes	National Heart Foundation of Australia and Meat and Livestock Australia.
(Meckling *et al.*, 2004)	BMI >25 Generally healthy Highly motivated to lose weight No medications which influence outcomes	Canada 29% Male Age: 24 - 61 BMI: (32)	Parallel Group	10 weeks	Free living diet plan Yes	40	1. Low fat 2. Low carbohydrate	1. Energy restriction was matched to the low CHO group 2. CHO 50-70 g/d plus concomitant energy restriction	1. %E: C 61.9 P 19.5 F 17.8 Energy: 6077kJ/d Fibre g/d:20.3 2. %E: C 15.4 P 26.2 F 55.5 Energy: 6421kJ/d Fibre g/d:8.9	Yes	Natural Sciences Engineering Research Council, Canada
(Meckling and Sherfey, 2007)	BMI 25-30 No chronic illness No CHD/ T2DM No medication Pre-menopausal	Canada 0% Male Age: (43) BMI: (30)	Parallel Group	12 weeks	Free living diet plan Yes	60	1. Hypocaloric control diet 2. Hypocaloric control diet + exercise 3. Hypocaloric protein rich diet 4. Hypocaloric protein rich diet + exercise	1. Hypoenergetic (-500 kcal/day). Target PRO:CHO ratio 1:3 (WHO standards) 2. Hypoenergetic (-500 kcal/day). Target PRO:CHO ratio 1:3 (WHO standards). Supervised curcuit training exercise 3d/week 3. Hypoenergetic (-500 kcal/day). Target PRO:CHO ratio 1:1 (Fat intake >30%). 4. Data not extracted	1. %E: C 49.5 P 16 F 33.8 g/d: C 171 P 56 F 53 Energy: 5822kJ/d 2. %E: C 50.2 P 18.4 F 29.4 g/d: C 160 P 59 F 42 Energy: 5271kJ/d 3. %E: C 36.6 P 24.3 F 38.6 g/d: C 127 P 84 F 60 Energy: 5787kJ/d	Yes	Not reported
(Meksawan *et al.*, 2004)	Generally healthy No HTN/ T2DM No medications which influence	USA 45% Male	Crossover (washout 1 weeks)	3 weeks	Free living diet plan No	11	1. High carbohydrate 2. Low	1. Intended diet: 61%CHO, 20%PRO, 19%FAT 2. Intended diet: 30%CHO,	1. %E: C 64 P 17 F 19 Energy: 1748 kcal/d 2. %E: C 31 P 19 F 50	Yes	University funding

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	outcomes	Age: (23) BMI: (22)					carbohydrate diet	20%PRO, 50%FAT	Energy: 1995 kcal/d		
(Morgan *et al.*, 2009)	Age 18-70y BMI >25 Generally healthy	UK 30% Male Age: 21 - 60(40) BMI: (32)	Parallel Group	6 months	Free living diet plan Yes	300	1. Control 2. Atkins 3. Weight Watchers 4. Slim Fast 5. Rosemary Conley	1. No intervention 2. Atkins Diet - very low carbohydrate 3. Weight Watchers Pure Points programme (an energy-controlled low-fat healthy eating diet) 4. The Slim-Fast Plan (a low-fat meal replacement approach) 5. Rosemary Conley's 'Eat yourself Slim' Diet and Fitness Plan (energy controlled, low-fat healthy eating diet and weekly group exercise class) Group not included as a comparison as it includes an exercise component	1. %E: C 43 P 16 F 36 Energy: 7947kJ/d 2. %E: C 12 P 28 F 57 Energy: 6809kJ/d 3. %E: C 47 P 19 F 29 Energy: 6084kJ/d 4. %E: C 50 P 19 F 28 Energy: 6076kJ/d	Yes	The British Broadcasting Corporation
(Nestel *et al.*, 2004)	Moderate alcohol intake No medications which influence outcomes No supplement use Non smokers Not extremely athletic/active	Australia 47% Male Age: (57) BMI: (26)	Crossover (washout 0 days)	6 weeks	Substitution No	21	1. Chickpea based foods 2. Wheat based foods	1. Cooked chickpeas plus bread and biscuits baked with 30% chickpea flour. 2. Included whole-grain shredded wheat cereal plus bread and biscuits made from whole-grain flour.	1. %E: C 47 P 19 F 30 Energy: 7424kJ/d Fibre g/d:33 2. %E: C 44 P 19 F 31 Energy: 7524kJ/d Fibre g/d:26		Australian Grains Research and Development Corp.
(Nickols-Richardson *et al.*, 2005)	BMI 25-40 Generally healthy No medications which influence outcomes Non smokers Not extremely athletic/active Weight stable	USA 0% Male Age: 40 BMI: 31	Parallel Group	6 weeks	Free living diet plan Yes	28	1. Low carbohydrate 2. High carbohydrate	1. <20g CHO for 1st 2wks, increased by 5g/wk to 40g/d by 6wk 2. Energy restriction (1500 or 1700 kcal/day), 60%CHO, 25%FAT	1. %E: C 12 P 26 F 61 Energy: 1420 kcal/d 2. %E: C 60 P 18 F 22 Energy: 1395 kcal/d	Yes	Not reported
(Olendzki *et al.*, 2009)	Age 18-70y	USA	Parallel Group	6 months	Free living diet plan	31	1. Hypoenergetic	In all conditions, energy restriction goal plus:	1. %E: C 51.4 P F 27.6	Yes	Not reported

This document was prepared for consideration by the Scientific Advisory Committee on Nutrition. It does not necessarily represent the final views of SACN or the advice/policy of Public Health England and Health Departments.

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	BMI 25-40 Healthy	16% Male Age: (48) BMI: (31)			Yes		high fibre 2. Hypoenergetic low saturated fat 3. Hypoenergetic high fibre and low saturated fat	1. Increase fibre to 30g/day 2. saturated fat < 7% 3. low saturated fat <7% and high fibre > 30g	Energy: 1511 kcal/d Fibre g/d:24.6 2. %E: C 49.9 P F 27.5 Energy: 1523 kcal/d Fibre g/d:17.4 3. %E: C 52.1 P F 26.2 Energy: 1511 kcal/d Fibre g/d:23.7		
(Panlasigui *et al.*, 2003)		Philippines 20% Male Age: 28 - 61(41) BMI: (25)	Crossover (washout 2 weeks)	8 weeks	Substitution (Carageenan-supplemente d foods provided) No	20	1. Usual diet 2. Carageenan-added test foods	1. No intervention - usual diet consumed 2. Typical Philipino test foods with carrageenan partly substituting similar items in the usual diet (to provide 40g/d fibre)	1. g/d: C 273.1 P 58.2 F 40.1 Fibre g/d:10.7 Energy: 1685 kcal/d 2. g/d: C 315.8 P 67.4 F 38.7 Energy: 1881 kcal/d Fibre g/d:39.9	Yes	Phillipine Council for Health and Development
(Park *et al.*, 2007)	Generally healthy BMI 19.4-47 Unrestrained eaters	USA 26.9% Male Age: (37) BMI: (28)	Parallel Group	2 weeks	All food provided No	52	1. Protein supplement 2. Fat supplement 3. Carbohydrate supplement 4. Standard diet	All groups follow weight-maintenance diet: 50%CHO, 20% PRO, 30% FAT plus ice cream shake with: 1. extra 500kcal of protein (skim milk, Beneprotein) 2. extra 500kcal of fat (cream) 3. extra 500kcal of carbohydrate (Polycose) 4. extra 500kcal on top of energy requirements	1. %E: C 40 P 36 F 24 Energy: 2500 kcal/d 2. %E: C 40 P 16 F 44 Energy: 2500 kcal/d 3. %E: C 60 P 16 F 24 Energy: 2500 kcal/d 4. %E: C 50 P 20 F 30 Energy: 2500 kcal/d	Intended diet	NIH, Fiterman Digestive Diseases Research Fund
(Parnell and Reimer, 2009)	Age 18-70y BMI >25	Canada 18% Male Age: (40) BMI: (30)	Parallel Group	12 weeks	Supplement No	48	1. Maltodextrin placebo 2. Oligofructose	No dietary prescription other than equicaloric doses of: 1. Maltodextrin placebo 21g/d, added to drinks 2. 21g/d oligofructose (Raftilose P95) per day, added to drinks	Supplements each provided 31.5 kcal/d	Yes	Quadra Chemicals Ltd
(Pasman *et al.*, 1997a) Study #1 from this reference	Obese Weight loss >5kg during run-in	the Netherlands 0% Male Age: (39) BMI: (32)	Crossover (washout 0 days)	1 week	Supplement No	17	1. Study 1 Guar gum 2. Study 1 Control	1. Orange juice twice daily with 20g fibre dissolved (40g/d). Fibre = Benefiber®, Sandoz 2. Orange juice twice daily Consumed under free-living conditions, eating usual diet	Details not provided		Sandoz Nutrition Ltd (Novartis Nutrition)

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
(Pasman *et al.*, 1997a) Study #2 from this reference	Obese Weight loss >5kg during run-in	The Netherlands 0% Male Age: (45) BMI: (29)	Crossover (washout unclear)	1 week	Free living diet plan Yes	14	1. Hypocaloric diet (4MJ/d) 2. Hypocaloric diet (4MJ/d) + guar gum 3. Hypocaloric diet (6MJ/d) 4. Hypocaloric diet (6MJ/d) + guar gum	Groups 2 and 4: 20g/d guar gum dissolved in orange juice Consumed under free-living conditions, energy intake either 4 or 6MJ/day	Details not provided		Sandoz Nutrition Ltd (Novartis Nutrition)
(Pasman *et al.*, 1997b)	BMI >30 Energy restriction during trial run-in Good compliance during run-in	The Netherlands 0% Male Age: (35) BMI: (31)	Parallel Group	14 months	Supplement No	33	1. CHO/Cr-Pic (Chromium III)/Fibre/Caffeine 2. Carbohydrate supplement 3. Control	1. Group not comparable, multi-ingredient supplement. Data not extracted 2. 50g carbohydrate daily, dissolved in 250ml water (42% glucose, 58% maltodextrin) 3. No supplement	2. %E: C 50 P 13 F 36 Energy: 8100kJ/d Fibre g/d:12 3. %E: C 42 P 15 F 37 Energy: 7600kJ/d Fibre g/d:15	Yes	Novartis Nutrition Ltd
(Pasman *et al.*, 2006)	BMI <30 Generally healthy Middle-aged adults	The Netherlands 100% Male Age: (35) BMI: (25)	Parallel Group	5 weeks	Supplement No	48	1. Placebo 2. 30g oligosaccharide NUTRIOSE 3. 45g oligosaccharide NUTRIOSE	1. Maltodextrin (Glucidex®) dissolved in food as placebo. DP=21.5, 4kcal/g 2. 30g/d purified dextrin (NUTRIOSE®) dissolved in food. Partially hydrolysed due to a-1,6 linkages and the presence of nondigestible glucoside linkages.DP 15.3, 2kcal/g 3. 45g/d NUTRIOSE®	1. %E: C 48.3 P 16.4 F 32.6 Energy: 13.3MJ/d Fibre:2.4 g/MJ 2. %E: C 45.5 P 16.8 F 34.1 Energy: 10.9 MJ/d Fibre:5.0 g/MJ 3. %E: C 45.9 P 15.8 F 35.6 Energy: 10.7 MJ/d Fibre 6.4 g/MJ	Yes	Funding source not reported.
(Paxman *et al.*, 2008)	Age 18-70y Generally healthy	UK 44.1% Male Age: (25) BMI:18 - 33(24)	Crossover (washout 2 weeks)	7 days	Supplement No	69	1. Alginate 2. Control	1. Strong-gelling sodium alginate formulation, single dose before food each day 2. Slimfast preload replaced the alginate	1. g/d: C 235.3 P 69.3 F 63.2 Energy: 1848 kcal/d 2. g/d: C 250.7 P 75.2 F 70.4 Energy: 1986.9 kcal/d	Yes	Technostics Limited, UK
(Pedersen *et al.*, 1997)	Generally healthy Normal lipid profile	Denmark 0% Male Age: 20 - 36	Crossover (washout 0 days)	4 weeks	Substitution No	72	1. Control spread 2. Inulin spread	1. Added 40g of a low fat spead/day 2. Added 40g of a low fat	1. g/d: C 284 P 73 F 72 Energy: 9200kJ/d Fibre g/d:26.3 2. g/d: C 294 P 76 F 72	Yes	Unilever

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
		BMI: (22)						spead/day containing 14g of inulin/day	Energy: 9000kJ/d Fibre g/d:38.5		
(Pelkman *et al.*, 2007)	Age 20-40y BMI 25-35 Generally healthy Pre-menopausal Weight stable	USA 0% Male Age: 20 - 40(33) BMI:28 - 34(31)	Crossover (washout 7 days)	7 days	Supplement No	35	1. Placebo drink 2. Lower fibre drink 3. Higher fibre drink	1. Fruit-flavoured matched control drinks 2. Drink with 1g alginate + 1g pectin 3. Drink with 2.8g alginate + 2.8g pectin	1. kcal: C 1433 P342 F 868 Energy: 2716 kcal/d 2. kcal: C 1341 P329 F 855 Energy:2594 kcal/d 3. kcal: C 1344 P325 F 853 Energy:2591 kcal/d Includes energy from test beverages	Yes	McNeil Nutritionals
(Pereira *et al.*, 2004)	Age 18-35y BMI >25 Generally healthy No medications which influence outcomes No recent weight loss program Non smokers Not extremely athletic/active Weight stable	USA 23.7% Male Age: (31) BMI: mean not reported	Parallel Group	Mean interval from baseline to follow-up = 65d in low GL group and 69d in low fat	All food provided Yes	39	1. Hypoenergetic low GL diet 2. Hypoenergetic low fat diet	1. Energy restricted low glycaemic load diet (60% of predicted requirements) . GL 82 2. Energy restricted low fat diet (60% of predicted requirements). 18%FAT. GL 205. NCEP Step 1 diet	1. %E: C 43 P 27 F 30 Energy: 1500 kcal/d Fibre g/d:32 2. %E: C 65 P 17 F 18 Energy: 1500 kcal/d Fibre g/d:20	As provided	National Institute of Diabetes, NIH, Digestive and Kidney Diseases, Charles H. Hood Foundation & General Mills
(Petersen *et al.*, 2006) NUGENOB	Age 20-50y BMI >30 No HTN or T2DM Not hyperlipidaemic/ hypercholesterolaemic Weight stable	Europe 25% Male Age: (38) BMI: (35)	Parallel Group	10 weeks	Free living diet plan Yes	771	1. Hypoenergetic high carbohydrate, low fat diet 2. Hypoenergetic low carbohydrate, high fat diet	1. Hypoenergetic (-600 kcal/d) 60-65% CHO, 15% PRO, 20-25% FAT 2. Hypoenergetic (-600 kcal/d) 40-45% CHO, 15% PRO, 40-45% FAT	1. %E: C 57 P 18 F 25 Energy: 1561kcal/d Fibre g/d:23 2. %E: C 43 P 17 F 40 Energy: 1620kcal/d Fibre g/d:19	Yes	European Community
(Philippou *et al.*, 2008)	≥1 CHD risk factor Age 35-65y No chronic illness	UK 38% Male Age: mean not reported	Parallel Group	12 weeks	Free living diet plan Yes	18	1. Low GI 2. High GI	1. Healthy eating advice plus low GI diet (median GI: 51.3) 2. Healthy eating advice plus high GI diet (median GI: 59.3)	1. %E: C 46 P 17.1 F 32.8 Energy: 1773kcal/d 2. %E: C 49.4 P 19.6 F 29.2	Yes	British Heart Foundation

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
		BMI: mean not reported						Overweight subjects advised to reduce EI by 500 kcal/d	Energy: 1308 kcal/d		
(Philippou *et al.*, 2009b)	Age 18-65y BMI 27-45 Generally healthy Recently involved in weight loss trial and lost at least 5% body weight	UK % Male: male and female Age: mean not reported BMI: 32	Parallel Group	4 months	Free living diet plan No	43	1. High GI 2. Low GI	1. 4 month GI=64, GL=137. High GI foods at each meal (white/wholemeal bread, cornflakes, weetabix, potatoes, couscous, melon, pineapple and rice cakes) 2. 4 month GI=50 GL=90. Low GI food at each meal (seeded bread, brown pitta, muesli, sweet potatoes, pasta, noodles, basmati slow-cook rice, beans, lentils, apples and dried fruit)	1. %E: C 50 P 19 F 31 Energy: 1604 kcal/d Fibre g/d:11 2. %E: C 48 P 20 F 32 Energy: 1604 kcal/d Fibre g/d:13 Weight maintenance diets	Yes	Funding source not reported. Authors from Imperial College London, UK & Kings College London, UK. Slimfast products donated by Unilever, UK.
(Philippou *et al.*, 2009a)	≥1 cardiac risk factor (BMI 27-35 kg/m2, waist ≥94 cm, total cholesterol to high-density lipoprotein ratio ≥5.0, raised BP up to a maximum of 140/90 mm Hg) No medication	UK 100% Male Age: 35 - 65 BMI: mean not reported	Parallel Group	6 months	Substitution Yes	56	1. High GI 2. Low GI	Those with BMI>25 also received weight management advice 1. High GI, carbohydrate foods (e.g. white/wholemeal bread, cornflakes, weetabix, potatoes, couscous, risotto rice, melon, pineapple, rice cakes) 2. Low GI, carbohydrate foods (e.g. seeded bread, wholemeal pita, muesli, porridge, sweet potatoes, pasta, noodles, basmati slow-cook rice, beans, lentils, apples, dried fruit, nuts)	Both groups decreased EI (greater in low GI group), but no macronutrient differences between groups	Yes	British Heart Foundation
(Pittaway *et al.*, 2007)	Age 18-70y No medications which influence outcomes	Australia 37% Male Age: (51) BMI: (29)	Crossover (washout 6 weeks)	5 weeks	Substitution No	31	1. Chickpea diet 2. Low Fibre Wheat diet	1. 140g/d chickpeas plus bread and biscuits made with 30% chickpea flour. Chickpea based foods provided approx 3.4MJ/d 2. Daily consumption of wholemeal bread and high wheat fibre breakfast cereal (>3g/100g)	1. Fibre g/d:28, 34%F, 44% C, 17P 2. Fibre g/d:29, 34%F, 43%C, 18%P	Yes	Grains Research and Development Corporation, Australia
(Poppitt *et al.*, 2002)	≥3 metabolic syndrome risk factors	Europe 31% Male	Parallel Group	6 months	Free living diet plan	46	1. Low-fat, high-"simple" carbohydrate diet	1. 60-70% of the diet was provided. 17.6% energy from "simple" CHO, 35.5% energy	1. %E: F 26 Energy: 7316kJ/d	Yes	EU-FAIR program and European

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	Age >38y No intention to begin a weight loss program Not on weight loss diet Overweight/ Obese	Age: (46) BMI: (32)			No, fully *ad libitum*		2. Low-fat high-complex carbohydrate diet 3. Control diet	from complex CHO 2. 60-70% of the diet was provided. 28.9% energy from "simple" CHO, 28.5% energy from complex CHO 3. 60-70% of the diet was provided. 20.6% energy from "simple" CHO, 28.6% energy from complex CHO	2. %E: F 19.6 Energy: 9790kJ/d 3. %E: F 31.2 Energy: 8281kJ/d		Sugar Industries
(Raben *et al.*, 2002) Danish Sweetened Beverage Study	Age 20-50y BMI 25-30 Generally healthy Not on weight loss diet	Denmark 15% Male Age: mean not reported BMI: 28	Parallel Group	10 weeks	Supplement No	42	1. Sucrose 2. Sweetener	1. Sucrose-containing food and drinks provided ~2g/kg/day (~23% total energy). 80% of sucrose within drinks and 20% within food. 2. Food and drinks provided matched sucrose intervention but contained non-caloric sweeteners	From supplements: 1. g/d: C 176 P 9 F 9 Energy: 3349kJ/d 2. g/d: C 31 P 9 F 9 Energy: 963kJ/d	Yes	Danish Research and Development programme for Food Technology and Danisco Sugar. Drinks supplied by Coca Cola
(Racette *et al.*, 1995)	Age 21-47y Body weight 140-180% of ideal Fat mass >35% body weight Generally healthy Pre-menopausal Weight stable	USA 0% Male Age: (39) BMI: (34)	Factorial	16 weeks	Free living diet plan Yes	41	1. Low fat diet 2. Low carbohydrate diet 3. Low fat diet + exercise 4. Low carbohydrate diet + exercise	For all groups: For the first 12 weeks, the prescribed diet aimed to provide 75% of energy for resting metabolic rate (no food was provided). After the weight reduction phase there was a maintenance phase for 4 weeks with higher energy intake prescribed.	1. %E: C 59 P 24 F 18 Energy: 51500kJ/d 2. %E: C 27 P 24 F 49 Energy: 48000kJ/d 3. %E: C 57 P 24 F 19 Energy: 48600kJ/d 4. %E: C 26 P 25 F 49	Yes	NIH and The Quaker Oats Co.
(Rankin and Turpyn, 2007)	BMI >25 Generally healthy Pre-menopausal Sedentary only Weight stable	USA 0% Male Age: (40) BMI: (32)	Parallel Group	4 weeks	Free living diet plan Yes, for high carbohydrate	32	1. Very low carbohydrate 2. High carbohydrate	1. Ad libitum low carbohydrate, high fat, high protein. Dieters were provided with a copy of The New Diet Revolution" by Robert Atkins 2. Goal: 60% CHO, 15-20% PRO, 20-25% FAT	1. %E: C 9 P 34 F 55 Energy: 1251 kcal/d 2. %E: C 58 P 19 F 25 Energy: 1283 kcal/d	Yes	National Science Foundation, USA
(Reid *et al.*, 2007)	Age 20-60y BMI 19-25 Generally healthy Not on weight loss	UK 0% Male Age: (32)	Parallel Group	4 weeks	Supplement No	161	1. Sucrose 2. Aspartame	1. 1000ml/day: Sucrose-sweetened Iron-Bru contained 180 kJ/100 ml, 10·5g carbohydrate.	1. g/d: C 235.39 P 73.96 F 70 Energy: 7929.13kJ/d 2. g/d: C 232.02 P 69.88	Yes	BBSRC, UK

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	diet	BMI: (22)						2. 1000ml/day: Diet Iron-Bru had 17 kJ/100 ml and 0·89g carbohydrate.	F 70.3 Energy: 7799.6kJ/d		
(Reynolds *et al.*, 2000)	Age 18-70y Generally healthy	USA % Male Age: 27 - 68 BMI: (25)	Parallel Group (washout 4 weeks)	4 weeks	Substitution No	43	1. Corn cereal 2. Oat cereal	1. Placebo, 85g of cornflakes produced to look like intervention cereal 2. 85g of cheerios (cereal high in oat flour)	1. g/d: C 72.7 P 5.8 F 1.5 Energy: 309.4 kcal/d Fibre g/d:1.7 2. g/d: C 61.3 P 10.9 F 6 Energy: 309.4 kcal/d Fibre g/d:7.6	Yes	Funding source not reported
(Rigaud *et al.*, 1990)	Age 16-60y BMI >25 No medications which influence outcomes No T2DM Weight stable	France 21% Male Age: (37) BMI: (29)	Parallel Group	6 months	Free living diet plan Yes	52	1. Hypocaloric diet + fibre tablets 2. Hypocaloric diet + placebo tablets	1. Hypoenergetic (25-30% below run-in period diet) diet with a dietary fibre tablets (beet, barley, citrus fibre, 90% insoluble) providing 7g/day. 2. Hypoenergetic (25-30% below run-in period diet) diet with placebo tablets containing 1g fibre/d.	not reported		Funding source not reported.
(Robitaille *et al.*, 2005)	BMI >25 Generally healthy No medications which influence outcomes Pre-menopausal	Canada 0% Male Age: 18 - 53(38) BMI: (29)	Parallel Group	4 weeks	Supplement No	37	1. Low fat 2. Low fat + oat bran	1. National Cholesterol Education Program Step 1 diet (<30%FAT, <10%SFA, <300mg cholesterol/day). No supplement 2. As above plus, 28g oat bran/day (2.3g beta glucan/day) in muffins (376kcal)	Nutrients provided by muffins: g/d: C 56 P 9 F 13 Energy: 376 kcal/d Fibre g/d:6.2	Nutrients of test products	Reseau de Sante cardiovasculaire du Fonds de la Recherche en Sante de Quebec
(Rodriguez-Rodriguez *et al.*, 2008)	BMI 25-35 Currently in calorie restriction trial Generally healthy No recent weight loss program Not alcoholics	Spain 0% Male Age: 20 - 35(28) BMI: (28)	Parallel Group	6 weeks	Free living diet plan Yes	59	1. Increased cereal diet 2. Increased fruit & veg diet	1. Energy restriction (1200kcal/d) + increased cereal consumption, especially breakfast cereal 2. Energy restriction (1200kcal/d) + increased vegetables/fruit	1. g/d: C 203.8 P 70.8 F 50.6 Energy: 1612 kcal/d 2. g/d: C 178.3 P 64.9 F 57.2 Energy: 1558 kcal/d	Yes	Kellogg's, Spain
(Rumpler *et al.*, 2006)	Generally healthy No medications which influence outcomes	USA 100% Male	Crossover (washout 0 days)	8 weeks	All food provided No	12	1. High carbohydrate drink 2. High fat drink	1. Drinks provided ~2MJ/d. Carbohydrate was provided by sucrose.	1. g/d: C 113 P 6 F 4 Energy: 2130kJ/d 2. g/d: C 8 P 7 F 50	Yes	Funding source not reported.

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	Weight stable	Age: (39) BMI: (24)					3. High protein drink	2. Drinks provided ~2MJ/d. Fat was provided by heavy whipping cream 3. Drinks provided ~2MJ/d. Protein was provided by egg white and the drink provided half of the RDA for protein	Energy: 2110kJ/d 3. g/d: C 83 P 34 F 4 Energy: 2110kJ/d		
(Sacks *et al.*, 2009)	Age 30-70y BMI 25-40 No CVD or T2DM	USA 36% Male Age: (51) BMI: (33)	Parallel Group	2 years	Free living diet plan Yes	811	1. Low-fat, average-protein 2. Low-fat, high-protein 3. High-fat, average-protein 4. High-fat, high-protein	ALL DIETS: energy restriction 750kcal/d 1. 20% fat, 15% protein and 65% CHO. 2. 20% fat, 25% protein and 55% CHO. 3. 40% fat, 15% protein and 45% CHO 4. 40% fat, 25% protein and 35% CHO	1. %E: C 57.5 P 17.6 F 26.2 Energy: 1636 kcal/d 2. %E: C 53.4 P 21.8 F 25.9 Energy: 1572 kcal/d 3. %E: C 49.1 P 18.4 F 33.9 Energy: 1607 kcal/d 4. %E: C 43 P 22.6 F 24.3 Energy: 1624 kcal/d	Yes	National Heart, Lung and Blood Institute and NIH, USA
(Salas-Salvado *et al.*, 2008)	Age 18-70y BMI >25 Generally healthy Highly motivated to lose weight No medication No recent weight loss program	Spain 22% Male Age: 18 - 70(48) BMI: (31)	Parallel Group	16 weeks	Supplement Yes	200	1. Mixed soluble fibre twice a day 2. Mixed soluble fibre 3 times a day 3. Placebo	1. Mixed fibre dose (3g Plantago ovata husk and 1g glucomannan) added to hypoenergetic diet (-2.5MJ/d) twice a day. 2. Mixed fibre dose (3g Plantago ovata husk and 1g glucomannan) added to hypoenergetic diet (-2.5MJ/d) three times a day. 3. 3g microcrystalline cellulose added to an energy restricted diet (reduced by 2.5MJ/d)	1. %E: C 45 P 25 F 35 2. %E: C 45 P 25 F 35 3. %E: C 45 P 25 F 35	Intended diet	MADAUS, S.A. and the Carlos III Health Institute funding
(Saltzman *et al.*, 2001) American Oat Study	BMI 18-38 Fibre <16g/d Free of chronic disease Generally healthy Low dietary restraint Moderate alcohol intake No medications which influence	USA 49% Male Age: (44.7) BMI: (26.3)	Parallel Group	6 weeks	All food provided Yes	41	1. Control 2. Oat diet	1. Hypocaloric (minus 4.2 MJ/d). Same macronutrient composition as intervention but with 45g/1000 kcal of wheat products instead of oats. Matched for insoluble fibre. 2. Hypocaloric (minus 4.2 MJ/d). Same macronutrient composition as control but with 45g/1000 kcal of rolled	1. %E: C 48.8 P 19.2 F 32.6 Energy: 1932 kcal/d Fibre g/d:12.9 2. %E: C 49 P 18.9 F 32.2 Energy: 1873 kcal/d Fibre g/d:16.7	Yes	Quaker Oats Company & NIH

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	outcomes Not extremely athletic/active Weight stable							oats.			
(Saltzman *et al.*, 1997)	Generally healthy Weight stable	USA 100% Male Age: 20 - 44(26) BMI:20 - 30(24)	Crossover (washout 4 weeks)	9 days	All food provided *ad libitum* No	14 7 pairs of twins	1. Low fat diet (20%) 2. High fat diet (40%)	1. Menu providing around 20% energy as fat with carbohydrate replacing fat in the diet. 2. Menu providing around 40% energy as fat. Diets were matched for fibre, palatability and energy density	1. %E: C 64 P 16 F 20 2. %E: C 46 P 14 F 40	As provided	NIH
(Sanders and Reddy, 1992)	Generally healthy Normal lipid profile	UK (England) 100% Male Age: (29) BMI: (23)	Crossover (washout 0 days)	3 weeks	Supplement No	18	1. Wheat bran 2. Rice bran (15g) 3. Rice bran (30g)	1. Biscuits providing 15g of wheat bran per day 2. Biscuits providing 15g of rice bran per day 3. Biscuits providing 30g of rice bran per day	1. %E: C 44.5 P 12.8 F 35.2 Energy: 2211 kcal/d 2. %E: C 46.4 P 12.6 F 34 Energy: 2188 kcal/d 3. %E: C 46.3 P 12.9 F 33.8 Energy: 2271 kcal/d	Yes	Masterfoods, NV, Belgium
(Saris *et al.*, 2000) CARMEN	Age 20-55y BMI 26-35 Generally healthy Moderate alcohol intake No weight loss >5kg in past 6m Not extremely athletic/active Not on weight loss diet	Denmark 49.1% Male Age: (39) BMI: (30)	Parallel Group	6 months	All food provided *ad libitum* No	398	1. Low-fat, high-"simple" carbohydrate diet 2. Low-fat high-complex carbohydrate diet 3. Control diet	For all groups, diets *ad libitum*. 60-70% food provided via study supermarket. 3. Control diet corresponds to average national intake.	1. %E: C 51.6 P 15.3 F 25.7 Energy: 10.8kJ/d 2. %E: C 49.3 P 18.8 F 26.4 Energy: 10.5kJ/d 3. %E: C 47.7 P 17.2 F 31.3 Energy: 9.6kJ/d	Yes	EU-FAIR & European Sugar industries. Food donated by various brands.
(Schlundt *et al.*, 1993)	At least 20% >ideal weight	USA 13% Male Age: group means 41-46 BMI: group means 30-37	Parallel Group	18 weeks	Free living diet plan Yes	60	1. Low fat 2. Low calorie	1. Low fat *ad libitum* carbohydrate. 16 - 20 week programme 2. Low fat with caloric restriction. 16 - 20 week programme	1. g/d: C 210 P 64 F 30 Energy: 5965kJ/d 2. g/d: C 179 P 61 F 28 Energy: 5292kJ/d	Yes	Not reported

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided ?	Funding source
(Schwab *et al.*, 2006)	Abnormal glucose metabolism Age 30-65y BMI <35 No CHD No insulin treatment Not taking lipid lowering drugs Plasma glucose <8 mmol/l TC <7.5 mmol/l TG <4 mmol/l	Finland 43.9% Male Age: (53) BMI: (29)	Parallel Group	12 weeks	Supplement No	70	1. Pectin 2. Polydextrose 3. Placebo	1. Sugar-beet pectin, drinks. 400ml/day, containing 16g pectin, of which 76% soluble fiber 2. Polydestrose, drinks. 400ml/day, containing 40g/d polydextrose 3. Placebo drinks 400ml/d	1. %E: C 51.3 P 17.8 F 28.4 Energy: 7768kJ/d 2. %E: C 51.3 P 17.8 F 26.4 Energy: 7978kJ/d 3. %E: C 53.2 P 18.8 F 26.3 Energy: 7978kJ/d	Yes	Danisco Ltd
(Sciarrone *et al.*, 1993)	Age 30-59y No chronic illness Normal BP only	Australia 100% Male Age: (41) BMI: (26)	Parallel Group	6 weeks	Free living diet plan No	21	1. Omnivorous diet 2. Lacto-ovovegetarian diet	1. Omnivorous diet 25% total energy complex carbohydrates, 20% sugar + fibre intake <8g/1000kcal 2. Lacto-ovovegetarian diet 35% total energy complex carbohydrates, 20% sugar + fibre intake of approx 20g/1000kcal	1. g/d: C 314 P 100 F 114 Energy: 2658 kcal/d Fibre g/d:24 2. g/d: C 339 P 78 F 86 Energy: 2437 kcal/d Fibre g/d:41	Yes	Research institute funding & the National heart Foundation & the Clive & Vera Ramaciotti Foundation & Sanitarium Health Foods
(Segal-Isaacson *et al.*, 2004)	BMI >25 No CHD or T2DM No medications which influence outcomes Post-menopausal Weight stable	USA 0% Male Age: (52) BMI: (33)	Crossover (washout 0 days)	6 weeks	All food provided Yes	4	1. Low fat diet 2. Very low carbohydrate	1. High protein, low fat diet. Resting energy expenditure -200kcal = approx 1400 kcal/d. Carbohydrates were provided as low GI starches and fruit. 2. Atkins type diet. Resting energy expenditure -200kcal = approx 1400 kcal/d	1. %E: C 50 P 30 F 20 2. %E: C 5 P 30 F 65	Intended diet	The Robert C. Atkins Foundation. Research institute funding. Protein powder & vitamin supplements donated by Atkins Nutritionals.
(Seshadri *et al.*, 2005)	Age >18y BMI >35 Free of severe chronic disease No medications which influence outcomes No uncontrolled	USA 85% Male Age: 54 BMI: 43	Parallel Group	6 months	Free living diet plan Yes	132	1. Low carbohydrate diet 2. Standard diet, energy restricted	1. Limit CHO intake to <30g/d 2. National Heart, Lung and Blood Institute obestiy management guidelines. Calorie restriction 500kcal/d.	1. %E: C 31 P 25 F 44 Energy: 1343 kcal/d 2. %E: C 51 P 16 F 32 Energy: 1590 kcal/d	Yes	Veteran Affairs Healthcare Network Competitive Pilot Project Grant

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided ?	Funding source
	diabetes										
(Shah *et al.*, 1996) American Low-fat Study	20-40% above ideal weight Age 25-45y Generally healthy Moderate alcohol intake Non smokers Without chronic disease	USA 0% Male Age: 25 - 45(36) BMI: (30)	Parallel Group	6 months	Free living diet plan Yes	122	1. Low fat, high complex carbohydrate diet 2. Energy restricted diet	1. Ad lib consumption of fat reduced diet (20g/d), high in complex carbohydrates 2. Energy restriction to 4184 or 5021kJ/d (based on weight). Reduce fat intake to <30% total energy. Increase complex carbohydrates such as grains, legumes, fruits & vegetables. Reduce "simple" sugar consumption	1. %E: C 61 P 16 F 22 Energy: 1617 kcal/d Fibre g/d:17.4 2. %E: C 54 P 16 F 30 Energy: 1531 kcal/d Fibre g/d:16.7	Yes	NIH
(Shah *et al.*, 1994) American Low-fat Study	20-40% above ideal weight Age 25-45y Generally healthy Moderate alcohol intake Non smokers Without chronic disease	USA 0% Male Age: 25 - 45(36) BMI: (30)	Parallel Group	6 months	Free living diet plan Yes	122	1. Energy restricted diet 2. Low fat, high complex carbohydrate diet	1. Energy restriction to 4184 or 5021kJ/d (based on weight). Reduce fat intake to <30% total energy. Increase complex carbohydrates such as grains, legumes, fruits & vegetables. Reduce "simple" sugar consumption 2. Ad lib consumption of fat reduced diet (20g/d), high in complex carbohydrates	1. %E: C 54 P 16 F 30 g/d: C 206 P 60 F 54 Energy: 6488kJ/d Fibre g/d:16.7 2. %E: C 61 P 16 F 22 g/d: C 244 P 60 F 37 Energy: 6612kJ/d Fibre g/d:17.4	Yes	NIH
(Sharman *et al.*, 2004) American VLC study	Generally healthy No medications which influence outcomes Non smokers Not extremely athletic/active Not on weight loss diet Weight stable	USA 100% Male Age: (33) BMI: (34)	Crossover (washout 0 days)	6 weeks	Free living diet plan Yes	15	1. Low fat 2. Very low carbohydrate	1. <30%FAT, hypoenergentic (-500 kcal/d) <10% SAFA, <300mg cholesterol 2. <10%CHO, hypoenergentic (-500 kcal/d)	1. %E: C 56 P 20 F 23 Energy: 6540kJ/d Fibre g/d:17 2. %E: C 8 P 28 F 63 Energy: 7770kJ/d Fibre g/d:8	Yes	The Robert C. Atkins Foundation
(Sheppard *et al.*, 1991) The Women's	<150% of ideal weight for frame Age 45-69y At risk of breast	USA 0% Male	Parallel Group	24 months	Free living diet plan No	303	1. Low fat diet	1. Dietary advice aimed to decrease fat intake: 20% FAT (from 39%). No emphasis on weight loss.	1. %E: C 58.7 P 19.1 F 22.8 Energy: 5640kJ/d	Yes	National Cancer Institute cooperative

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
Health Trial Feasibility Study	cancer Not on low fat diet	Age: (56) BMI: (26)					2. Control	2. No intervention	2. %E: C 46.9 P 16.1 F 36.5 Energy: 6748kJ/d		agreements
(Sichieri *et al.*, 2007)	Age 25-45y BMI 23-30 Generally healthy No T2DM Parity ≥1 Pre-menopausal	Brazil 0% Male Age: (37) BMI: (27)	Parallel Group	18 months	Substitution, free living diet plan Yes	203	1. Low GI/GL diet 2. High GI/GL diet	1. Energy restriction 100-300kcal/d. Staple foods provided. At 18m, GI=40, GL=104 2. Energy restriction 100-300kcal/d. Staple foods provided. At 18m, GI=72, GL=280	1. %E: C 60 P F 27 Energy: 11200kJ/d Fibre g/d:36 2. %E: C 62 P F 26 Energy: 14000kJ/d Fibre g/d:45	Yes	Research institute funding
(Singh *et al.*, 1992) Data not included in review – concerns about veracity											
(Sloth *et al.*, 2004) The Danish GI study	Age 20-40y BMI 25-30 Generally healthy Moderate alcohol intake No medical conditions which influence outcomes No medication, HTN, smokers Not extremely athletic/active	Denmark 0% Male Age: 20 - 40 BMI: (28)	Parallel Group	10 weeks	Substitution No, diets *ad libitum*	55	1. Low GI diet 2. High GI diet	1. Received low GI test foods in place of their usual CHO rich foods (wholegrain wheat bread, wholegrain rye bread, mashed potato, pasta, long grain rice) 2. Received high GI test foods in place of their usual CHO rich foods (wheat bread, rye bread, mashed potato, pasta, round grain rice)	1. %E: C 81.2 P 12.8 F 5.9 Energy: 4860kJ/d Fibre g/d:29.3 2. %E: C 81.7 P 12.6 F 5.7 Energy: 4886kJ/d Fibre g/d:32.2 Aim for 55-60% energy from carbohydrate, 20-30% energy from fat	Nutrients of provided foods	Danone Vitapole. Food donated by Masterfoods a.s., Denmark, Euryza GmbH, Germany, and by Cerealia R&D, Schulstad Brød A/S, Denmark
(Smith *et al.*, 2008)	<5kg Δ weight in previous 3m Age 22-66y BMI <30 Free of chronic disease Generally healthy Mild to moderate lipidaemias	USA 29% Male Age: mean not reported BMI: mean not reported	Parallel Group	6 weeks	Supplement No	90	1. Beta glucan, low molecular weight 2. Beta glucan, high molecular weight	1. Low molecular weight barley B-glucan. 6g B-glucan per day was given as a dietary supplement powder, consumed as a beverage with morning and evening meals. 2. High molecular weight barley B-glucan. 6g B-glucan			NIH

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
	No medications which influence outcomes Non smokers							per day was given as a dietary supplement			
(Sondike *et al.*, 2003)	Age 12-18y BMI >95th centile Generally healthy No familial hypercholesterolemia No T2DM	USA % Male: not reported Age: (14) BMI: (36)	Parallel Group	12 weeks	Free living diet plan Yes	39	1. Very low carbohydrate 2. Low fat	1. Instructed to consume <20g/d CHO for 2wk then <40g/d for 10wk. Ad lib PRO and FAT 2. <30%FAT (<40g/d), plus 5 servings of starch per day (5x15g CHO per serving) and *ad libitum* fat-free dairy foods, fruits, vegetables.	1. %E: C 8 F 60 g/d: C 37 F 121 Energy: 1830kJ/d 2. %E: C 56 F 12 g/d: C 154 F 15 Energy: 1100kJ/d	Yes	Not reported
(Stimson *et al.*, 2007)	Generally healthy No medications which influence outcomes	UK 100% Male Age: (38) BMI: (35)	Crossover	4 weeks	All food provided No	17	1. High fat diet 2. Moderate fat diet	1. Prescribed diet: 5% CHO, 30% PRO, 66% FAT 2. Prescribed diet: 35% CHO, 30% PRO, 35% FAT	1. %E: C 5 P 29 F 66 Energy: 1753 kcal/d 2. %E: C 34 P 29 F 37 Energy: 1907 kcal/d	Yes	British Heart Foundation and Scottish Executive Environment and Rural Affairs Department.
(Stoernell *et al.*, 2008)	Triglycerides 1.60-6.78 mmol/l No recent weight loss program No T2DM	USA 46% Male Age: 48-57 BMI: 30-35	Parallel Group	8 weeks	Free living diet plan Yes	28	1. Low carbohydrate diet 2. Low fat diet	1. E% goal: 15%CHO, 25-30%PRO, <10% SAFA 2. Low fat diet goal, E% 50-60% CHO, 15%pro, <30%FAT. Energy restriction goal 104.6 kJ/kg body weight	1. %E: C 20 P 25 F 55 Energy: 5475kJ/d 2. %E: C 48 P 20 F 33 Energy: 6898kJ/d	Yes	Not reported
(Stubbs *et al.*, 1996)	BMI 19-25 Generally healthy	UK 100% Male Age: (37) BMI: (22)	Crossover	14 days	All food provided No	6	1. Low fat 2. Moderate fat 3. High fat	1. 68%CHO, 15%PRO, 20%FAT (macronutrients by food weight, not total energy) 2. 50%CHO, 13%PRO, 40%FAT (macronutrients by food weight, not total energy) 3. 30%CHO, 12%PRO, 59%FAT (macronutrients by food weight, not total energy)	Energy density of diets 488kJ/100g	As provided	Pfizer Scholarship
(Sundberg, 2008)	Generally healthy LDL-C >3.2 mmol/l	Sweden 29% Male Age: (63)	Crossover	4 weeks	Supplement No	48	1. Barley fibre flakes 2. Wheat flakes	1. 60g/day barley flakes. 5.1% beta glucans. Average molecular wt. of barley beta-glucans 0.6×10^6 daltons 2. 60g/day. Wheat flakes with	1. g/100g: C 70 P 11.2 F 1.7. Total fibre 20, insoluble 12.1, soluble 7.9 2. g/100g: C 70 P 11.2 F	Product information	Staerkelseproducenter UPA & Frebaco AB in Sweden

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
		BMI: (25)						cellulose, 1.5% beta glucans Flakes added to yoghurt or eaten as snacks	1.7. Total fibre 21, insoluble 20.4, soluble 1.5 Both provide 175-180 kcal/d		
(Surwit *et al.*, 1997)	Generally healthy No medications which influence outcomes Non smokers Sedentary only	UK 0% Male Age: 41 BMI: 36	Parallel Group	6 weeks	All food provided Yes	52	1. High sucrose diet 2. Low sucrose diet	1. Hypoenergetic diet: low fat high sucrose diet (43% TE from sucrose) 2. Hypoenergetic diet: low fat, low sucrose diet (4% TE from sucrose)	1. %E: C 73.3 P 18.7 F 10.8 Energy: 4552.2kJ/d Fibre g/d:10.4 2. %E: C 70.9 P 19.3 F 10.6 Energy: 4840.9kJ/d Fibre g/d:14.9	Diets as supplied	NIH & The Sugar Association, Inc; the Kellogg Company, mc, Battle Creek, Ml.
(Swain *et al.*, 1990)	No HTN Not hyperlipidaemic/ hypercholesterolaemic Not obese Not taking lipid lowering drugs	USA 20% Male Age: 23 - 49(30) BMI: mean not reported	Crossover (washout 2 weeks)	6 weeks	Supplement	24	1. Oat bran supplement 2. Low fibre wheat supplement	1. Participants were asked to eat muffins or entrees containing a total of 100g oat bran/d. 2. Participants were asked to eat muffins or entrees containing a total of 100g low fibre wheat/d.		Yes	National, Heart, lung and Blood Institute and NIH
(Swinburn *et al.*, 1999) New Zealand Diabetic Workforce Study	Age >40y Impaired glucose tolerance	New Zealand 73% Male Age: >40(53) BMI: mean approx. 28	Parallel Group	12 months	Free living diet plan No	176	1. Control 2. Low fat	1. No intervention 2. Education for dietary fat reduction, with *ad libitum* energy intake	1. %E: C 45.6 P 16.5 F 33.8 Energy: 2307 kcal/d Fibre g/d:18.4 2. %E: C 54.5 P 18.6 F 25.9 Energy: 1832 kcal/d Fibre g/d:20.5	Yes	Auckland Medical Research Foundation, the National Heart Foundation of New Zealand, and the Lotteries Medical Board
(Theuwissen and Mensink, 2007)	<3kg Δ weight in previous 3m Age 18-65y BMI <32 Free of chronic disease Mild to moderate lipidaemias No medications which influence outcomes	The Netherlands 47.6% Male Age: (54) BMI: (26)	Crossover (washout 2 weeks)	4 weeks	Substitution No	43	1. Control muesli 2. Beta-glucan muesli	1. 100g/d muesli (5g/d wheat fibre) 2. 100g/d muesli (5g/d oat beta-glucan)	1. g/d: C 13.9 P 9.6 F 15.2 Energy: 1683kJ/d Fibre g/d:11.4 2. g/d: C 14.2 P 13.4 F 15.3 Energy: 1671kJ/d Fibre g/d:11.7	Nutrients of test foods	Raisio Group, Benecol

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
	Normal BP only										
(Thomas *et al.*, 1992)	Non obese + no obese 1st degree relative No T2DM Obese with at least 2 obese 1st degree relatives Weight stable	USA 52% Male Age: (27) BMI: (27)	Crossover (washout 1 months)	7 days	All food provided No	21	1. High Fat 2. High Carbohydrate	1. High fat diet (52% total energy). All foods were provided but could be consumed *ad libitum*. 2. High carbohydrate diet (62% total energy). All foods were provided but could be consumed *ad libitum*.	1. %E: C 35.4 P 12.6 F 52 2. %E: C 61.6 P 12.7 F 25.7	As supplied	NIH
(Thompson *et al.*, 2005)	BMI 30-40 No medications which influence outcomes No supplement use Weight stable	USA 14% Male Age: 25-70 BMI: 35	Parallel Group	48 weeks	Free living diet plan Yes	90	1. Energy restricted diet 2. Energy restriction + dairy 3. Energy restriction + dairy + fibre	1. Calorie deficit of 500kcal/d. 50%CHO, 20%PRO, 30%FAT. Dairy 2 servings/d 2. Calorie deficit of 500kcal/d. 50%CHO, 20%PRO, 30%FAT. Dairy 4 servings/d (at least 2 fluid milk). 3. Calorie deficit of 500kcal/d. 50%CHO, 20%PRO, 30%FAT. Dairy 4 servings/d, high fibre	1. %E: C 54.5 P 18.8 F 26.3 Energy: 1437.1 kcal/d Fibre g/d:18.8 2. %E: C 53.6 P 21.5 F 24.6 Energy: 1490.1 kcal/d Fibre g/d:17.6 3. %E: C 58.1 P 20.9 F 20.6 Energy: 1510.2 kcal/d Fibre g/d:28.9	Yes	National Dairy Council
(Tinker *et al.*, 2008) The Women's Health Initiative Dietary Modification Trial	Age 50-79y Fat intake >32% Post-menopausal	USA 0% Male Age: (62) BMI: (29)	Parallel Group	8 years	Free living diet plan No	48835	1. Control 2. Low fat	1. Received information relating to health and healthy diets 2. Advice: reduce fat intake to 20%, increase fruit, vegetables and wholegrains	1. %E: C 48 P 16.8 F 35 Energy: 1594 kcal/d Fibre g/d:15.5 2. %E: C 58.5 P 17.6 F 24.2 Energy: 1502 kcal/d Fibre g/d:18.5		NIH
(Tinker *et al.*, 1991)	Age 18-70y Mild lipidaemias	USA 100% Male Age: (46) BMI: (25)	Crossover (washout 0 days)	4 weeks	Supplement No	41	1. Prunes 2. Grape juice	1. Habitual diet plus 100g/d prunes (6g fibre) 2. Habitual diet plus 360ml grape juice/day (similar "simple" CHO as prunes, but no fibre)	1. %E: C 51 P 14 F 30 Energy: 10791kJ/d Fibre g/d:24 2. %E: C 51 P 15 F 30 Energy: 10761kJ/d Fibre g/d:18		University funding & California Prune Board

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
(Tredger *et al.*, 1991)	No medications which influence outcomes Normal lipid profile	UK 100% Male Age: 24 - 56 BMI:20 - 27	Crossover (washout 21 days)	14 days	Substitution No	15	1. Guar gum 2. Sugar beet fibre 3. Wheat bran	1. Guar gum 20g/d within bread (80% NSP) 2. 20g/d fibre preparation within bread (80% NSP) 3. Fibre preparation 20g/d within bread (36% NSP)	1. %E: C 45.2 P F 36.8 Energy: 11000kJ/d Fibre g/d:41 2. %E: C 42.8 P F 40.2 Energy: 12000kJ/d Fibre g/d:42.8 3. %E: C 44.6 P F 35.9 Energy: 11200kJ/d Fibre g/d:44.1	Yes	British Sugar
(Turley *et al.*, 1998)	Generally healthy Mild to moderate lipidaemias	New Zealand 100% Male Age: (37) BMI: (26)	Crossover (washout 1 weeks)	6 weeks	Free living diet plan No	38	1. Western diet 2. Low fat, high carbohydrate diet	1. Western diet high in saturated fat, 20% TE 2. 5%TE from saturated fat	1. %E: C 43 P 16 F 36 Energy: 11400kJ/d Fibre g/d:22 2. %E: C 59 P 15 F 22 Energy: 9500kJ/d Fibre g/d:40	Yes	New Zealand Lottery Health Research
(Turpeinen *et al.*, 2000)	Generally healthy Mild lipidaemias	Finland 45% Male Age: (43) BMI: (25)	Crossover (washout 4 weeks)	4 weeks	Substitution No	43	1. Wholemeal rye bread 2. Low fibre wheat bread	1. At least 4-5 portions of wholemeal rye bread/day, to provide 20% total energy. 2. At least 4-5 portions of low fibre wheat bread/day, to provide 20% total energy.	1. %E: C 49 P 17 F 32 Energy: 7900kJ/d Fibre g/d:28.6 2. %E: C 49.5 P 16.5 F 32.5 Energy: 8100kJ/d Fibre g/d:13.2	Yes	Fazer Bakeries Ltd, Lahti Finland; Vaasan & Vaasan Ltd, Helsinki, Finland
(van den Heuvel *et al.*, 2004)	Generally healthy	The Netherlands 100% Male Age: (32) BMI: (24)	Crossover (washout 1 weeks)	3 weeks	Supplement No	20	1. Placebo low dose 2. Placebo high dose 3. Fibre (NUTRIOSE) low dose 4. Fibre (NUTRIOSE) high dose	1. Placebo - Maltodextrin increasing to 60g/d week 3 2. Placebo - Maltodextrin increasing to 80g/d week 3 3. NUTRIOSE Purified glucose polymer (high dietary fibre content, high 1,6 linkages,) increasing to 60g/d week 3 4. NUTRIOSE Purified glucose polymer increasing to 80g/d week 3		No	Research institute funding
(Vega-Lopez *et al.*, 2001)	Age >18y Generally healthy No CHD	Mexico 35% Male Age: (46) BMI: (28)	Crossover (washout 21 days)	30 days	Supplement Yes	68	1. Psyllium cookies 2. Control cookies	1. 5 cookies daily, containing 12g of fibre in total 2. 5 cookies per day with no added fibre	1. g/d: P 4.8 C 65.7 F 20.5 Energy: 1803kJ/d Fibre g/d:12 2. g/d: P 5.9 C 64.9 F 20.6 Energy: 1996kJ/d	Nutrients of test products	Research institute funding

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
									Fibre g/d:1.6		
(Vido *et al.*, 1993)	Age <15y	Italy 55% Male Age: (11) BMI: mean not reported	Parallel Group	2 months	Supplement No	60	1. Glucomannan supplement 2. Placebo	1. 2 glucomannan capsules one hour before every meal. Equivalent to 2g/day. 2. 2 capsules one hour before every meal.			Dicofarm
(Volek *et al.*, 2004a) American VLC study	BMI >25 Generally healthy Normal lipid profile	USA 0% Male Age: (34) BMI: (30)	Crossover	4 weeks	Free living diet plan Yes	13	1. Low fat 2. Very low carbohydrate	1. <30%FAT, hypoenergentic (-500 kcal/d) <10% SAFA, <300mg cholesterol 2. <10%CHO, hypoenergentic (-500 kcal/d)	1. %E: C 58.9 P 18.9 F 20.6 Energy: 1243 kcal/d Fibre g/d:16.3 2. %E: C 9.1 P 27.8 F 62.5 Energy: 1288 kcal/d Fibre g/d:7.6	Yes	Atkins Foundation
(Volek *et al.*, 2004b) American VLC study	Generally healthy Weight stable	USA 53.6% Male Age: (34) BMI: (32)	Crossover (0 days)	40 days	Free living diet plan Yes	28	1. Very low carbohydrate 2. Low Fat	1. <10%CHO, hypoenergentic (-500 kcal/d) 2. <30%FAT, hypoenergentic (-500 kcal/d) <10% SAFA, <300mg cholesterol	1. %E: C 8.5 P 28 F 63 Energy: 1592 kcal/d Fibre g/d:8 2. %E: C 57.5 P 19.5 F 22 Energy: 1414 kcal/d Fibre g/d:16.5	Yes	Atkins Foundation
(Volp *et al.*, 2008)	Generally healthy No medications which influence outcomes Non smokers Not extremely athletic/active Weight stable	Brazil 0% Male Age: 19 - 24(21) BMI: (25)	Crossover	14 days	All food provided Yes	12	1. High sucrose diet 2. High fat diet	1. 23% sucrose. Diets were designed to be weight-maintaining in free-living conditions. 2. 1.3% sucrose. Diets were designed to be weight-maintaining in free-living conditions.	1. %E: C 64 P 15 F 24 Energy: 2031kJ/d Fibre g/d:30 2. %E: C 51 P 16 F 33 Energy: 1741kJ/d Fibre g/d:12.5	Yes	Government funding
(Vuksan *et al.*, 1999)	BMI 19-25 Generally healthy	Canada 50% Male Age: 21 - 60(31) BMI: mean not reported	Crossover (washout 2 weeks)	2 weeks	Substitution No	24	1. Reduced starch wheat flakes 2. Wheat bran 3. Low fibre breakfast cereal	1. 21g fibre/d from high fibre, high protein flakes (produced by the amylotic digestion of wheat in ethanol manufacture) 2. 21g fibre/d from wheat bran 3. 1.7g fibre/day from a supplement of crushed corn flakes	1. Fibre g/d:21 2. Fibre g/d:21 3. Fibre g/d:1.7	Not reported	Research institute funding, plus Mohawk Canada Ltd.

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consumption data provided?	Funding source
(Waller *et al.*, 2004)	Age 18-70y BMI >25 Weight stable	USA 22.6% Male Age: 18 - 65(50) BMI: (35)	Parallel Group	4 weeks	Supplement No	62	1. Cereal group 2. Control	1. Consume 1 cup of ready-to-eat-cereal with 2/3 cup low fat milk at least 90 mins after dinner each day 2. No intervention		Not reported	Kellogg Company
(Warren *et al.*, 2003)		UK 41% Male Age: 9 - 13(11) BMI: (19)	Crossover (washout 5 weeks)	3 days of break-fasts	Substitution No	38	1. Low GI breakfast 2. Low GI + sucrose breakfast 3. High GI breakfast	1. Low GI breakfast (GI<55) all-bran, muesli, porridge or soya+linseed bread. 2. Low GI breakfast cereal with 10% energy from added sucrose (GI<55) all-bran, muesli, porridge or soya+linseed bread plus sucrose 3. High GI breakfast, GI between 75 and 100. Choice of Corn Flakes, Coco-Pops, Rice Krispies or white bread	1. %E: C 60 P 15 F 25 Energy: 363 kcal/d Fibre g/d:5.9 2. %E: C 77 P 9 F 14 Energy: 396 kcal/d Fibre g/d:5.9 3. %E: C 75 P 10 F 15 Energy: 359 kcal/d Fibre g/d:1.3	Nutrients of test break-fasts supplied	University funding & The Sugar Bureau (UK)
(Westerterp-Plantenga *et al.*, 2009)	BMI 19-25 Generally healthy No medications which influence outcomes	The Netherlands 100% Male Age: 18 - 40(25) BMI:20 - 25(23)	Crossover	3 days	All food provided No	10	1. Adequate protein diet 2. High protein diet		1. %E: C 60 P 10 F 30 2. %E: C 40 P 30 F 30	Yes	University funding
(Whelan *et al.*, 2006)	Generally healthy	UK 36% Male Age: 21 - 34(28) BMI: (24)	Crossover (washout 6 weeks)	2 weeks	All food provided Not hypoenergetic, but food not *ad libitum* (appetite only assessed)	14	1. Standard formula 2. Pea-fibre/Fructooligosaccharide formula	1. Standard liquid enteral formula. No other food consumed. 2. Standard liquid enteral formula supplemented with pea-fibre (10g/L) and short-chain fructo-oligosaccharides (5g/L). No other food consumed	1. g/d: C 251 P 79.5 F 75.5 Energy: 8316 kJ/d 2. g/d: C 245 P 77.7 F 73.6 Energy: 8103 kJ/d	Yes	University & Nestle´ UK.
(Whyte *et al.*, 1992)	Mild lipidaemias	Australia 100% Male Age: (45)	Crossover (washout 0 days)	4 weeks	Supplement No	23	1. Wheat dietary period 2. Oat dietary period	1. 2 breakfast cereals containing 54g of wheat bran/day 2. 2 breakfast cereals containing 123g of oat	1. %E: C 49.4 P 17.8 F 31.9 Energy: 1950 kcal/d Fibre g/d:28.4 2. %E: C 49.3 P 18 F 31.9 Energy: 1860 kcal/d	Yes	Uncle Toby's (Australia)

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
		BMI: (26)						bran/day	Fibre g/d:27.8		
(Wolever and Mehling, 2002) American GI & carbohydrate study	≥1 diabetes risk factor Age 30-65y BMI <40 Impared glucose tolerance Not hyperlipidaemic/ hypercholesterola emic	USA 20% Male Age: (57) BMI: (30)	Parallel Group	4 months	Free living diet plan No	37	1. High carbohydrate, high GI 2. High carbohydrate, low GI 3. Low carbohydrate, high MUFA	1. Ad libitum diet. 55%CHO, 30%FAT. At least one serving of a high GI food with each meal. Provided foods included breakfast cereal, breads, polished rice, crackers and instant potato 2. Ad libitum diet. 55%CHO, 30%FAT. At least one serving of a low GI food with each meal. 3. Ad libitum diet. 45%CHO, 40%FAT (20%MUFA).	1. %E: C 52.8 P 17.4 F 27.9 Energy: 1712 kcal/d Fibre g/d:22.7 2. %E: C 54.8 P 19.4 F 24.7 Energy: 1693kcal/d Fibre g/d:36.2 3. %E: C 47.4 P 16.4 F 35.4 Energy: 1877 kcal/d Fibre g/d:23.7	Yes	Canadian Diabetes Association & The International Olive Oil Council
(Wood *et al.*, 2007) American Soluble Fibre Study	<2.5kg Δ weight in previous 6m Age 20-69y BMI 25-35 DBP <90mmHg No CHD or T2DM Not taking lipid lowering drugs SBP <160mmHg	USA 100% Male Age: 20 - 69(39) BMI:25 - 35(30)	Parallel Group	12 weeks	Free living diet plan No	30	1. Low carbohydrate diet + konjac-mannan 2. Low carbohydrate diet + maltodextrin	1. Ad libitum diet: 13% CHO, 27% PRO, 60% FAT. Supplement: Konjac-mannan 3g/d 2. Ad libitum diet: 13% CHO, 27% PRO, 60% FAT. Supplement: Maltodextrin 3g/d	1. %E: C 12.5 P 28.4 F 60.7 Energy: 6866kJ/d Fibre g/d:12.7 2. %E: C 13.3 P 27.1 F 59.6 Energy: 7017kJ/d Fibre g/d:9.6	Yes	University funding & Nutraquest
(Wood *et al.*, 2006) American Soluble Fibre Study	DBP <90mmHg Weight loss <2.5kg in the past 6m No CHD or T2DM Not on CHO restricted diet Not taking lipid lowering drugs SBP <160mmHg	USA 100% Male Age: 20 - 69(39) BMI:25 - 35(30)	Parallel Group	12 weeks	Free living diet plan No	30	1. Low carbohydrate diet + Soluble fibre 2. Low carbohydrate diet + placebo	1. Ad libitum diet: 13% CHO, 27% PRO, 60% FAT. Supplement: Konjac-mannan 3g/d 2. Ad libitum diet: 13% CHO, 27% PRO, 60% FAT. Supplement: Maltodextrin 3g/d	1. %E: C 12.5 P 28.4 F 60.7 Energy: 1632 kcal/d Fibre g/d:12.7 2. %E: C 13.3 P 27.1 F 59.6 Energy: 1632 kcal/d Fibre g/d:9.6	Yes	Not reported
(Zaveri and Drummond, 2009)	Age 25-50y BMI 25-35 Free of chronic disease Generally healthy Not on weight loss	Scotland 100% Male Age: [39.6] BMI: [29.8]	Parallel Group	12 weeks	Supplement No	45	1. Control 2. Cereal bar 3. Almond snack	1. Healthy eating advice 2. Healthy eating advice plus 2 cereal bars daily (30g each) 3. Healthy eating advice plus 28g almonds/day. Group not relevant to this review so	Cereal bars provided: g/d C 44 P 3.0 F 4.7 Energy: 227 kcal/d	Intended diet	Kellogg Group Almonds supplied by the Almond Board of

Authors, Study Name	Subject inclusion criteria	Characteristics of participants	Trial Design (washout duration)	Inter-vention duration	Intervention Style/ Energy restriction goal?	Number of subjects	Intervention group names	Intervention Description	Diet/Supplement nutritional characteristics	Actual consump tion data provided ?	Funding source
	diet							results not extracted.			California

Table 6.4 Risk of bias information for the trials reporting energy intake or eating motivation

Authors	Allocation sequence generation	Allocation concealment	Participant blinding	Researcher Blinding	Incomplete outcome reporting	Selective outcome reporting	Any other bias
(Abrahamsson *et al.*, 1994)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Alfenas and Mattes, 2005)	No Bias	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias
(Andersson *et al.*, 2007)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Astrup *et al.*, 1990)	Unclear	No Bias	No Bias	Bias	No Bias	No Bias	No Bias
(Beasley *et al.*, 2009)	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias
(Bellisle *et al.*, 2007)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Bhargava, 2006)	Unclear	Unclear	Bias	Unclear	Unclear	No Bias	No Bias
(Borkman *et al.*, 1991)	Unclear	Unclear	Bias	Bias	Unclear	No Bias	No Bias
(Bray *et al.*, 2002)	No Bias	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Brehm *et al.*, 2005)	No Bias	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Brehm *et al.*, 2003)	No Bias	Bias	Bias	Unclear	Unclear	No Bias	No Bias
(Brynes *et al.*, 2003)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Cani *et al.*, 2006)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Cani *et al.*, 2009)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Carels *et al.*, 2005)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Chen *et al.*, 2006)	No Bias	No Bias	No Bias	No Bias	No Bias	Bias	Bias
(Claessens *et al.*, 2009)	Unclear	Unclear	Bias	Unclear	Unclear	No Bias	No Bias
(Claesson *et al.*, 2009)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Clapp, 1998)	Unclear	Unclear	Bias	Bias	Unclear	Unclear	Unclear
(Clifton *et al.*, 2008)	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear

Authors	Allocation sequence generation	Allocation concealment	Participant blinding	Researcher Blinding	Incomplete outcome reporting	Selective outcome reporting	Any other bias
(Dale *et al.*, 2009)	No Bias	No Bias	Bias	Bias	No Bias	No Bias	No Bias
(Dansinger *et al.*, 2005)	No Bias	No Bias	Bias	Bias	No Bias	No Bias	No Bias
(Das *et al.*, 2007)	No Bias	Unclear	Bias	Unclear	No Bias	Bias	No Bias
(Davidson *et al.*, 1998)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Davis *et al.*, 2009)	No Bias	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Davy *et al.*, 2002a)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Davy *et al.*, 2002b)	Unclear	Unclear	Bias	No Bias	No Bias	No Bias	No Bias
(de Rougemont *et al.*, 2007)	No Bias	No Bias	Bias	Bias	No Bias	No Bias	No Bias
(De Roos *et al.*, 1995)	Unclear	Unclear	No Bias	Bias	Bias	Bias	Bias
(de Luis *et al.*, 2007)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Dennison and Levine, 1993)	No Bias	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Donnelly *et al.*, 2008)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Drummond *et al.*, 2003)	Bias	Unclear	Bias	Unclear	Unclear	Bias	Bias
(Drummond and Kirk, 1998)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Due *et al.*, 2008)	No Bias	No Bias	Bias	Bias	Bias	No Bias	No Bias
(Due *et al.*, 2004)	No Bias	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
(Dumesnil *et al.*, 2001)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Dyson *et al.*, 2007)	No Bias	No Bias	Bias	Bias	No Bias	No Bias	No Bias
(Ebbeling *et al.*, 2003)	Unclear	Unclear	Bias	Bias	No Bias	Bias	Bias
(Ebbeling *et al.*, 2005)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Ebbeling *et al.*, 2007)	No Bias	No Bias	Bias	No Bias	No Bias	No Bias	No Bias
(Ells *et al.*, 2005)	No Bias	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Forcheron and Beylot, 2007)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Frisch *et al.*, 2009)	No Bias	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Garcia *et al.*, 2007)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Garcia *et al.*, 2006)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Genta *et al.*, 2009)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Gilhooly *et al.*, 2008)	Unclear	Unclear	Bias	Bias	Unclear	No Bias	Unclear
(Greenberg *et al.*, 2009)	No Bias	Unclear	Unclear	Unclear	No Bias	Bias	Bias
(Harvey-Berino, 1998)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Haskell *et al.*, 1992)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Haskell *et al.*, 1992)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Haskell *et al.*, 1992)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Haskell *et al.*, 1992)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias

Authors	Allocation sequence generation	Allocation concealment	Participant blinding	Researcher Blinding	Incomplete outcome reporting	Selective outcome reporting	Any other bias
(He *et al.*, 2004)	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias
(Heijnen *et al.*, 1996)	Unclear	Unclear	No Bias	No Bias	Unclear	No Bias	No Bias
(Heini *et al.*, 1998)	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias
(Henry *et al.*, 2007)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Herrmann *et al.*, 2001)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Howard *et al.*, 2006)	No Bias	Unclear	Bias	No Bias	No Bias	No Bias	No Bias
(Hunninghake *et al.*, 1994)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Jenkins *et al.*, 1998)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Jenkins *et al.*, 1999)	Unclear	Unclear	Bias	Bias	Unclear	No Bias	No Bias
(Jenkins *et al.*, 2000)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Jensen *et al.*, 1997)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Johnston *et al.*, 2004)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Johnston, 1998)	No Bias	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Johnstone *et al.*, 2008)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Johnstone *et al.*, 2000)	Unclear	Unclear	Unclear	Bias	No Bias	No Bias	No Bias
(Keenan *et al.*, 2007)	No Bias	Unclear	No Bias	No Bias	No Bias	Bias	Bias
(Keogh *et al.*, 2005)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Keogh *et al.*, 2008)	No Bias	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Kerckhoffs *et al.*, 2003)	Unclear	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Kesaniemi *et al.*, 1990)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Kirk *et al.*, 1997)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Kirkwood *et al.*, 2007)	Unclear	Unclear	Unclear	Unclear	Unclear	Bias	Bias
(Kleemola *et al.*, 1999)	Unclear	Unclear	Bias	Bias	Unclear	No Bias	No Bias
(Kohl *et al.*, 2009)	No Bias	Unclear	No Bias	No Bias	Unclear	Unclear	Unclear
(Layman *et al.*, 2009)	Unclear	Unclear	Bias	Unclear	No Bias	Unclear	Unclear
(Layman *et al.*, 2005)	No Bias	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Lasker *et al.*, 2008)	No Bias	Unclear	Bias	Unclear	No Bias	Bias	Bias
(Lee *et al.*, 2009)	No Bias	No Bias	Bias	Bias	Bias	No Bias	No Bias
(Leidy *et al.*, 2007a)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Leidy *et al.*, 2007b)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Letexier *et al.*, 2003)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Luo *et al.*, 1996)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Maki *et al.*, 2007a)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Maki *et al.*, 2007b)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias

Authors	Allocation sequence generation	Allocation concealment	Participant blinding	Researcher Blinding	Incomplete outcome reporting	Selective outcome reporting	Any other bias
(Maki *et al.*, 2003)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Marett and Slavin, 2004)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Martin *et al.*, 2000)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Mattes, 2002)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Mattes, 2007)	Unclear	Unclear	No Bias	No Bias	Bias	Bias	Bias
(Mazlan *et al.*, 2006)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(McManus *et al.*, 2001)	No Bias	No Bias	Bias	Bias	Bias	No Bias	No Bias
(McMillan-Price *et al.*, 2006)	No Bias	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Meckling and Sherfey, 2007)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Meckling *et al.*, 2004)	Unclear	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Meksawan *et al.*, 2004)	Unclear	Unclear	Bias	No Bias	Bias	No Bias	No Bias
(Morgan *et al.*, 2009)	Unclear	Unclear	Bias	Unclear	Unclear	No Bias	No Bias
(Nestel *et al.*, 2004)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Nickols-Richardson *et al.*, 2005)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Olendzki *et al.*, 2009)	No Bias	Unclear	Bias	Bias	Bias	Unclear	Unclear
(Panlasigui *et al.*, 2003)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Parnell and Reimer, 2009)	No Bias	No Bias	No Bias	No Bias	Unclear	Unclear	Unclear
(Park *et al.*, 2007)	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias
(Pasman *et al.*, 1997a)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Pasman *et al.*, 1997b)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Pasman *et al.*, 2006)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Paxman *et al.*, 2008)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Pedersen *et al.*, 1997)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Pelkman *et al.*, 2007)	No Bias	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Pereira *et al.*, 2004)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Petersen *et al.*, 2006)	No Bias	No Bias	Bias	Bias	Unclear	No Bias	No Bias
(Philippou *et al.*, 2008)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Philippou *et al.*, 2009a)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Philippou *et al.*, 2009b)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Pittaway *et al.*, 2007)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Poppitt *et al.*, 2002)	Unclear	Unclear	Bias	Bias	Unclear	No Bias	No Bias
(Raben *et al.*, 2002)	No Bias	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Racette *et al.*, 1995)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias

Authors	Allocation sequence generation	Allocation concealment	Participant blinding	Researcher Blinding	Incomplete outcome reporting	Selective outcome reporting	Any other bias
(Rankin and Turpyn, 2007)	Unclear	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Reid *et al.*, 2007)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Reynolds *et al.*, 2000)	No Bias	No Bias	No Bias	No Bias	Bias	No Bias	No Bias
(Rigaud *et al.*, 1990)	Unclear	Unclear	No Bias	No Bias	Bias	Unclear	Unclear
(Robitaille *et al.*, 2005)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Rodriguez-Rodriguez *et al.*, 2008)	Unclear	Unclear	Bias	Unclear	Unclear	No Bias	No Bias
(Rumpler *et al.*, 2006)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Sacks *et al.*, 2009)	No Bias	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Salas-Salvado *et al.*, 2008)	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias	No Bias
(Saltzman *et al.*, 2001)	No Bias	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Saltzman *et al.*, 1997)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Sanders and Reddy, 1992)	Unclear	Unclear	No Bias	Unclear	No Bias	Bias	Bias
(Saris *et al.*, 2000)	No Bias	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Schlundt *et al.*, 1993)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Schwab *et al.*, 2006)	Unclear	Unclear	No Bias	No Bias	Unclear	No Bias	No Bias
(Sciarrone *et al.*, 1993)	Unclear	Unclear	Bias	No Bias	No Bias	No Bias	No Bias
(Segal-Isaacson *et al.*, 2004)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Seshadri *et al.*, 2005)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Shah *et al.*, 1996)	Unclear	Unclear	Bias	Unclear	Unclear	No Bias	No Bias
(Shah *et al.*, 1994)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Sharman *et al.*, 2004)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Sheppard *et al.*, 1991)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Sichieri *et al.*, 2007)	No Bias	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Sloth *et al.*, 2004)	No Bias	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Smith *et al.*, 2008)	No Bias	Unclear	No Bias	No Bias	No Bias	Bias	Bias
(Sondike *et al.*, 2003)	Unclear	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Stimson *et al.*, 2007)	Unclear	Unclear	Unclear	Bias	No Bias	No Bias	No Bias
(Stoernell *et al.*, 2008)	Unclear	Unclear	Bias	Unclear	Bias	No Bias	No Bias
(Stubbs *et al.*, 1996)	Unclear	Unclear	No Bias	Unclear	No Bias	No Bias	No Bias
(Sundberg, 2008)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Surwit *et al.*, 1997)	Unclear	Unclear	Unclear	Unclear	Bias	No Bias	No Bias
(Swain *et al.*, 1990)	Unclear	Unclear	No Bias	No Bias	Bias	No Bias	No Bias
(Swinburn *et al.*, 1999)	No Bias	Unclear	Bias	Unclear	Unclear	No Bias	No Bias
(Theuwissen and Mensink, 2007)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias

Authors	Allocation sequence generation	Allocation concealment	Participant blinding	Researcher Blinding	Incomplete outcome reporting	Selective outcome reporting	Any other bias
(Thomas *et al.*, 1992)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Thompson *et al.*, 2005)	No Bias	No Bias	Bias	Bias	No Bias	No Bias	No Bias
(Tinker *et al.*, 2008)	No Bias	Unclear	Bias	No Bias	No Bias	No Bias	No Bias
(Tinker *et al.*, 1991)	Unclear	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Tredger *et al.*, 1991)	Unclear	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias
(Turley *et al.*, 1998)	Unclear	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Turpeinen *et al.*, 2000)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(van den Heuvel *et al.*, 2004)	Unclear	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Vega-Lopez *et al.*, 2001)	Unclear	Unclear	Unclear	Bias	No Bias	No Bias	No Bias
(Vido *et al.*, 1993)	No Bias	Unclear	No Bias	No Bias	No Bias	Bias	Bias
(Volek *et al.*, 2004a)	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias	No Bias
(Volek *et al.*, 2004b)	Unclear	Unclear	Bias	Unclear	No Bias	No Bias	No Bias
(Volp *et al.*, 2008)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Vuksan *et al.*, 1999)	Unclear	Unclear	Bias	Bias	No Bias	No Bias	No Bias
(Waller *et al.*, 2004)	No Bias	Unclear	Bias	Bias	Bias	No Bias	No Bias
(Warren *et al.*, 2003)	Unclear	Bias	Bias	Bias	No Bias	No Bias	No Bias
(Westerterp-Plantenga *et al.*, 2009)	Unclear	Unclear	No Bias	Bias	No Bias	No Bias	No Bias
(Whelan *et al.*, 2006)	No Bias	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Whyte *et al.*, 1992)	Unclear	Unclear	Unclear	Unclear	Unclear	No Bias	No Bias
(Wolever and Mehling, 2002)	No Bias	Unclear	Bias	Unclear	Unclear	Bias	Bias
(Wood *et al.*, 2006)	No Bias	Unclear	No Bias	No Bias	Unclear	No Bias	No Bias
(Wood *et al.*, 2007)	No Bias	Unclear	No Bias	No Bias	No Bias	No Bias	No Bias
(Zaveri and Drummond, 2009)	No Bias	Unclear	Bias	Unclear	No Bias	No Bias	No Bias

Results – Energy Intake, Eating motivation and Dietary Carbohydrate

Energy intake, total carbohydrate intake and high carbohydrate diets

Summary of cohort results

One cohort study reported data on the effect of dietary carbohydrate intake at study entry on energy intake at follow-up (Phelan *et al.*, 2007). In this study, the primary outcomes were weight change, changes in eating, including energy intake, changes in exercise and dietary restraint (Phelan *et al.*, 2007). The individuals in the National Weight Control Registry cohort were previous weight loss programme participants who were self-enrolled into the cohort and then monitored over time to explore factors influencing weight maintenance. Findings from this cohort of US weight maintainers may not therefore be applicable to the general UK population. In this cohort, no association was observed between percentage of energy from carbohydrates and long term energy intakes.

Please interpret observational data with caution: With observational studies there is substantial potential for biases.

Summary of trials results

Sixty eight papers provided data on the effects of variation in dietary carbohydrate on energy intake. Some papers presented data from the same study in multiple publications, so the total number of studies is 63. Of these, sixteen reported energy intake as a primary outcome (Donnelly *et al.*, 2008;Drummond and Kirk, 1998;Johnstone *et al.*, 2000;Martin *et al.*, 2000;Mazlan *et al.*, 2006;Meksawan *et al.*, 2004;Rumpler *et al.*, 2006;Saltzman *et al.*, 1997;Shah *et al.*, 1996;Stubbs *et al.*, 1996;Swinburn *et al.*, 1999;Zaveri and Drummond, 2009;Harvey-Berino, 1998;Schlundt *et al.*, 1993;Sheppard *et al.*, 1991;Thomas *et al.*, 1992).

For most studies, the average BMI of trial participants was indicative of overweight or obesity (>25), the small number of exceptions with mean BMI <25kg/m^2 being (Saltzman *et al.*, 1997;Rumpler *et al.*, 2006;Johnstone *et al.*, 2000;Borkman *et al.*, 1991;Stubbs *et al.*, 1996;Meksawan *et al.*, 2004;Martin *et al.*, 2000). Just 2 studies of children or adolescents (Sondike *et al.*, 2003;Ebbeling *et al.*, 2003) were identified. Sixteen studies included females only, and 14 studies males only.

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Trials were conducted in a wide range of countries including, Australia (5), Brazil (1), Canada (4), Denmark (2), Europe (1), France (1), Germany (1), Israel (1), New Zealand (3), Spain (2), the Netherlands (1), and the UK (10), but the evidence base is dominated by studies conducted in the USA (32).

Eighteen of the 63 studies used a cross-over design as described in the Trial Characteristics Table and the others used a parallel group approach. Twenty nine studies described an energy restriction goal for one or both of the intervention groups, but as the participants were free-living, they were still able to deviate from that goal by eating more or less. This is also marked in the Trial Characteristics Table (Table 6.3).

Twenty studies had more than 100 participants. The mean number of subjects per trial was 118 (excluding the very large Womens' Health Initiative Trial with 48,000+) and the median number was 50.

The method of energy intake assessment used is described briefly against each result in the tables below. A small number of trials monitored energy intake through provision of all food and recording uneaten items, generally over a relatively short time frame and with smaller numbers of participants (Landry *et al.*, 2003;Due *et al.*, 2008;Stubbs *et al.*, 1996;Rumpler *et al.*, 2006;Mazlan *et al.*, 2006;Bray *et al.*, 2002). Some studies used the 24-hour dietary recall technique (often repeated) (Ebbeling *et al.*, 2007;Stoernell *et al.*, 2008;Shah *et al.*, 1994;Shah *et al.*, 1996;Seshadri *et al.*, 2005), and some used a food frequency questionnaire (Bhargava, 2006;Tinker *et al.*, 2008;Howard *et al.*, 2006;Greenberg *et al.*, 2009), however the majority used food diaries (most commonly 3 consecutive days).

Trials were separated into 3 main types on the basis of the proportion of energy derived from the macronutrients. For inclusion in a meta-analysis a 5% difference in energy from carbohydrate was taken as meaningful. Actual consumption was used rather than the intended diet unless otherwise stated – see trial characteristics table.

If a trial tested the effects of diets which differed by 5% or more of energy from carbohydrate it was then further categorised into one of 3 categories. Higher carbohydrate, lower fat diets were differentiated from lower carbohydrate, higher fat diets where percentage of energy from fat also differed by 2% or more. Higher carbohydrate, lower protein diets were differentiated from lower carbohydrate, higher protein diets where percentage of energy from protein differed by 2% or more and higher carbohydrate, lower protein and fat diets were differentiated from lower carbohydrate, higher protein and fat diets where percentage of energy from fat differed by 2% or more, but protein intakes were also different by more than 2%.

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In the meta-analyses, all studies included adults as participants. Studies where energy intake was presented as kcal were converted to kJ. The first follow up reported at the end of the intervention and over 3 days was used. This varied from 6 days to 1 year.

Fifteen studies reported results from more than two groups. Seven studies reported results from four groups (Brynes *et al.*, 2003;Johnstone *et al.*, 2000;Park *et al.*, 2007;Morgan *et al.*, 2009;Keogh *et al.*, 2005;McMillan-Price *et al.*, 2006;Dansinger *et al.*, 2005) and eight studies reported results from three groups (Rumpler *et al.*, 2006;Stubbs *et al.*, 1996;Mazlan *et al.*, 2006) (Donnelly *et al.*, 2008);(Drummond and Kirk, 1998;Wolever and Mehling, 2002;Due *et al.*, 2008;Claessens *et al.*, 2009). The group with the lowest carbohydrate intake was compared with the group with highest carbohydrate intake.

Eight studies could not be included in meta-analyses where data on measures of variation were not provided (Mazlan *et al.*, 2006;Johnstone *et al.*, 2000;Rumpler *et al.*, 2006;Park *et al.*, 2007;Stubbs *et al.*, 1996;Meckling and Sherfey, 2007;de Luis *et al.*, 2007;Brehm *et al.*, 2003). None of these studies showed a significant energy intake difference between high and low carbohydrate diets.

Eight studies could not be included that had differences in carbohydrate energy of less than 5% between groups (Schlundt *et al.*, 1993;Harvey-Berino, 1998;Dale *et al.*, 2009;Clifton *et al.*, 2008;McManus *et al.*, 2001;Ebbeling *et al.*, 2005;Drummond *et al.*, 2003;Kirkwood *et al.*, 2007). Two studies reported that energy intake was significantly lower with a high carbohydrate diet (Clifton *et al.*, 2008;Dale *et al.*, 2009), but none of the other studies reported an effect of carbohydrate manipulation on energy intake.

Two further studies conducted by Ebbeling and colleagues were also not included in the meta-analyses. One provided energy intake data in figures only, which prohibited accurate data extraction. This study compared a low carbohydrate, low GI, 35% fat diet with a higher carbohydrate (55% energy), 20% fat diet. Energy intake on the high carbohydrate diet was in the region of 100 kcal per day lower, but this was not statistically different from the low carbohydrate diet (Ebbeling *et al.*, 2007).

Ebbeling *et al.* (Ebbeling *et al.*, 2003) also conducted a study using obese adolescents, in which an *ad libitum* reduced GL diet (51% carbohydrate) was compared with a conventional reduced fat, energy restricted diet (55% carbohydrate). Energy intakes at the end of the intensive phase of the intervention (6 months) were lower in the lower carbohydrate group and had decreased by 30% from baseline compared with an 8% decrease in the conventional diet group (significance of the difference not reported). These differences were reflected in greater weight losses in the lower carbohydrate group.

The study reported by Stubbs *et al.* (Stubbs *et al.*, 1996) was not included in the meta-analysis due to lack of clarity concerning measures of variance around energy intakes under the 3 dietary conditions. In this 14-day randomised cross-over *ad libitum* feeding trial, the provision of high, medium and low fat diets (% energy from fat, carbohydrate, protein respectively 60:28:12, 40:48:12, 20:68:12) that were balanced for energy density led to similar total energy intakes (main effect of diet p=0.34), with no indication of any changes over time. The weight of food consumed did differ between conditions, however (2.45, 2.51 and 2.39 kg/d for low, medium and high fat diets respectively, p=0.03). Despite large variations in the macronutrient composition of the menus provided *ad libitum*, energy intakes in these male subjects remained relatively stable during the trial. Saltzman *et al.* (Saltzman *et al.*, 1997), using a similar design with 7 pairs of twins, also found no difference in energy intake when comparing high and low fat diets of equivalent energy density. These two small, relatively short-term studies conducted in a controlled environment indicate that energy density has a stronger impact on energy intake than the macronutrient composition *per se.*

Higher carbohydrate/lower fat vs. lower carbohydrate/higher fat

Twenty six studies were included in the meta-analysis comparing diets high in carbohydrate and low in fat with diets lower in carbohydrate and higher in fat (Figure 6.1). The pooled estimate has little meaning and is not presented as overall heterogeneity, denoted by I^2, was high at 84%. A funnel plot indicated some risk of publication bias for studies reporting lower energy intake with higher intakes of carbohydrate (Figure 6.2). In the majority of the studies, the mean difference in energy intake between high and low carbohydrate diet groups was close to zero, or the 95% confidence interval around the mean difference included zero. In 8 of the 26 studies, mean energy intake was significantly higher in low carbohydrate, higher fat diet consumers. In just 3 studies, the opposite was true and energy intakes were higher with consumption of higher carbohydrate, low fat diets. These studies should also be compared against those that could not be incorporated into the meta-analysis.

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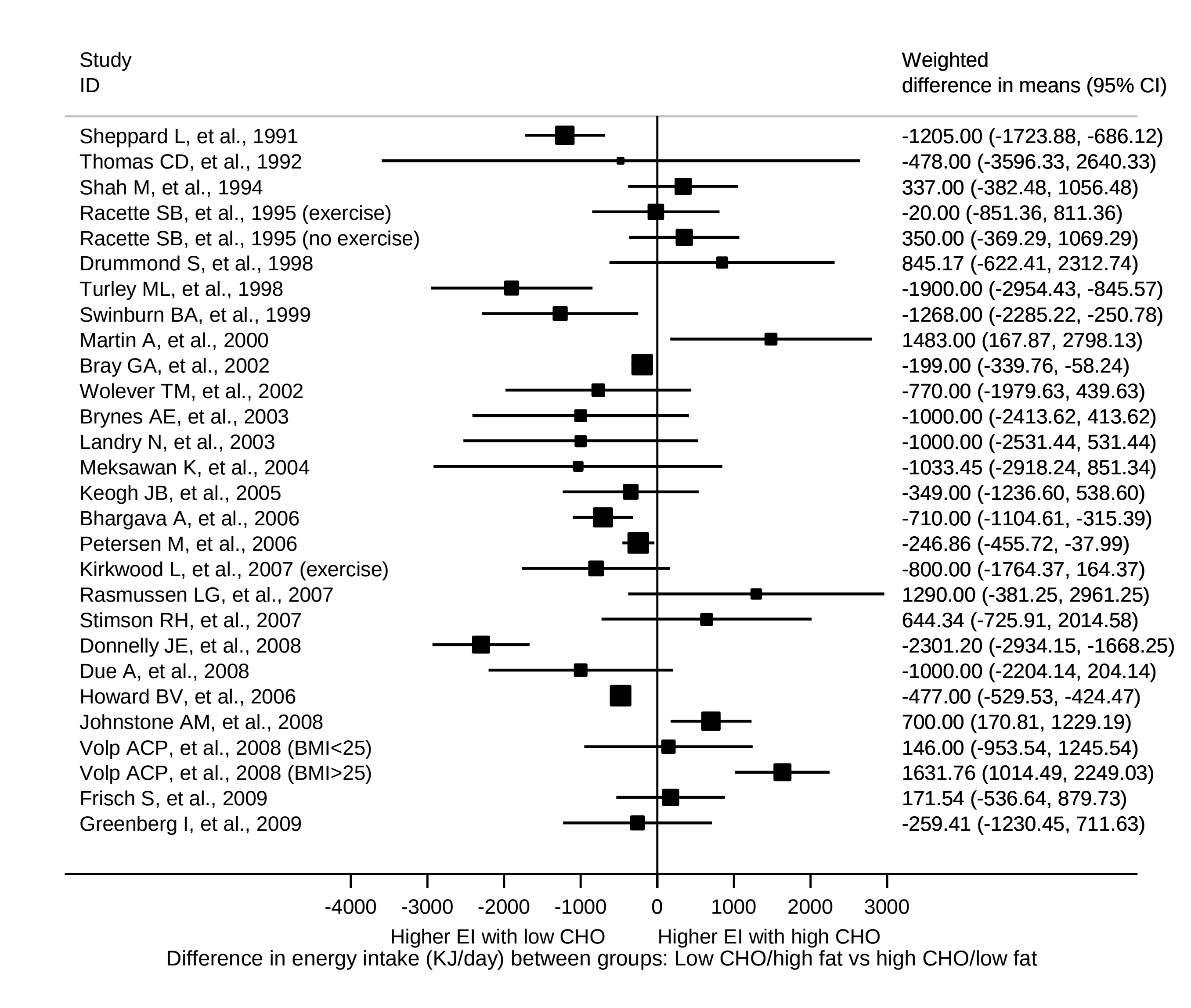
Figure 6.1 Forest plot for lower carbohydrate, higher fat diets and higher carbohydrate, lower fat diets and energy intake (kJ per day)



A sensitivity analysis was conducted, excluding studies with a stated energy restriction goal for at least one group of the trial. Heterogeneity remained high at 81%. The pooled estimate, which due to high heterogeneity has little meaning, was higher than when all studies were included.

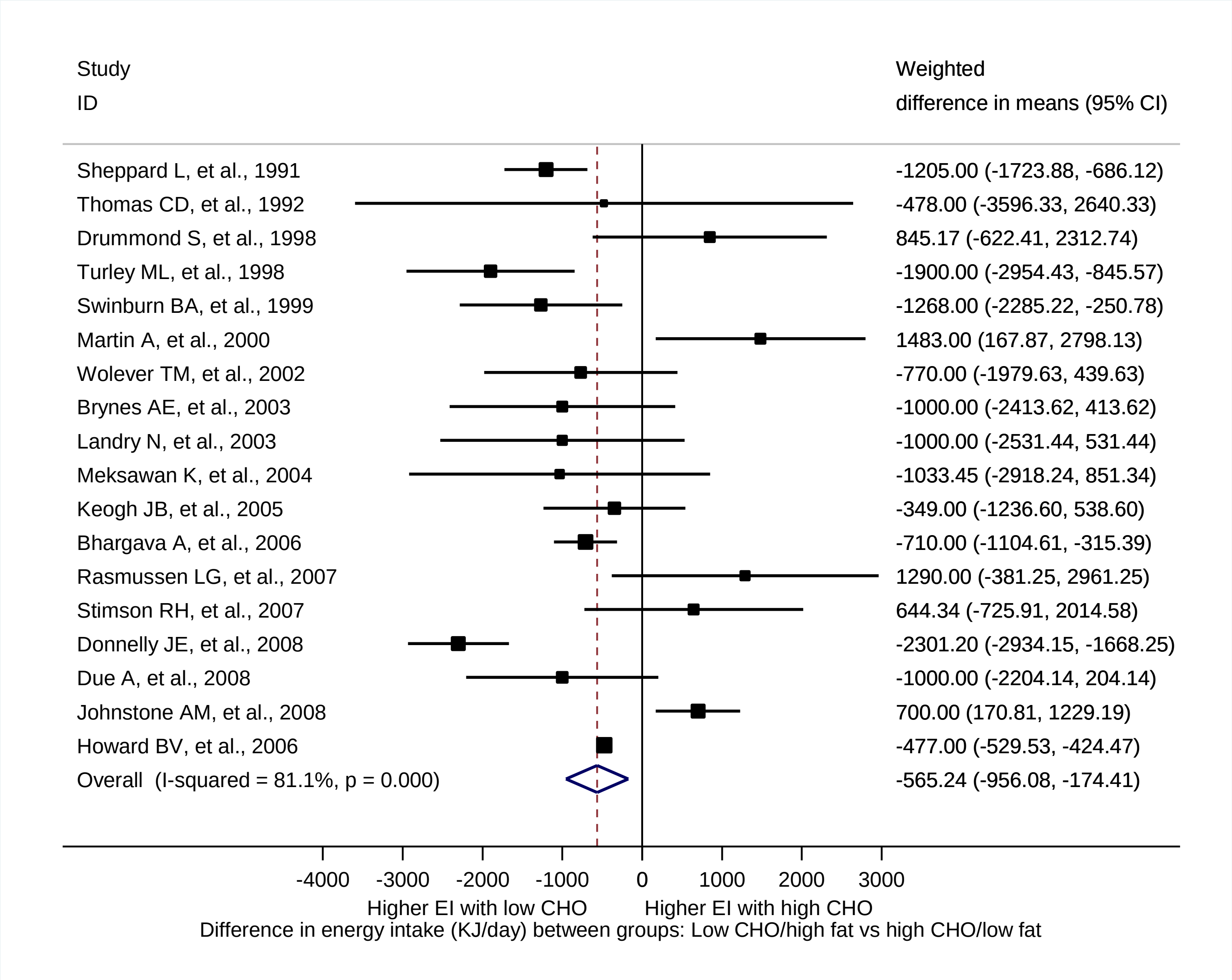
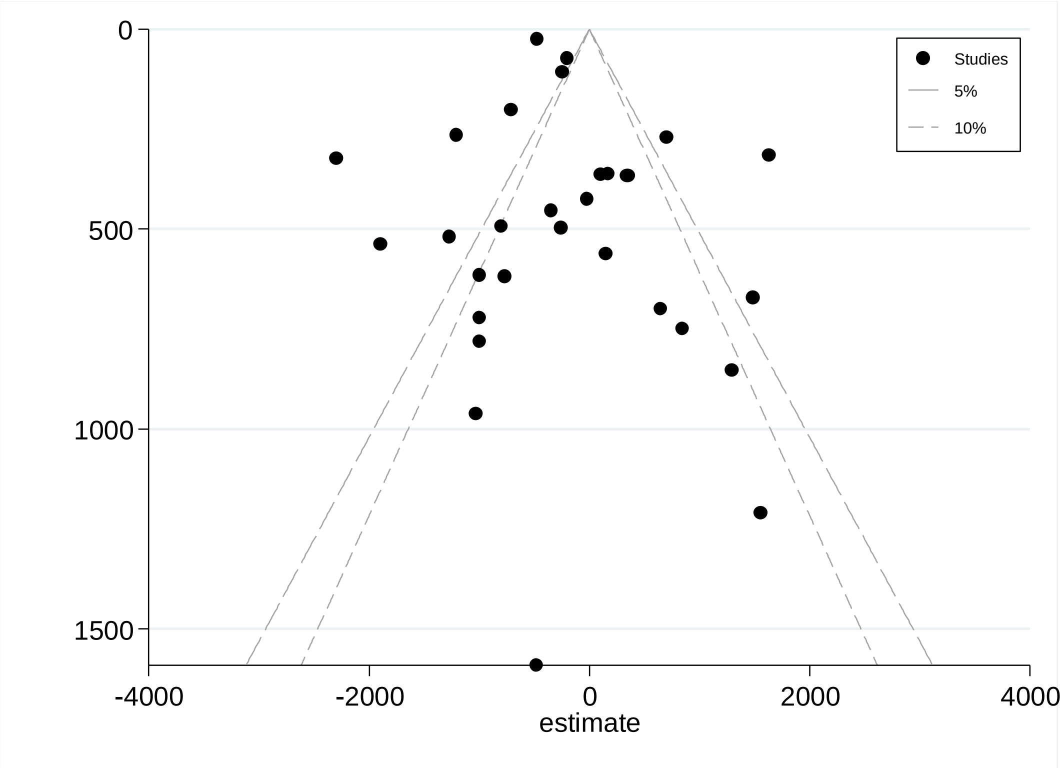


Figure 6.2 Funnel plot for higher carbohydrate, low fat diets and lower carbohydrate, high fat diets



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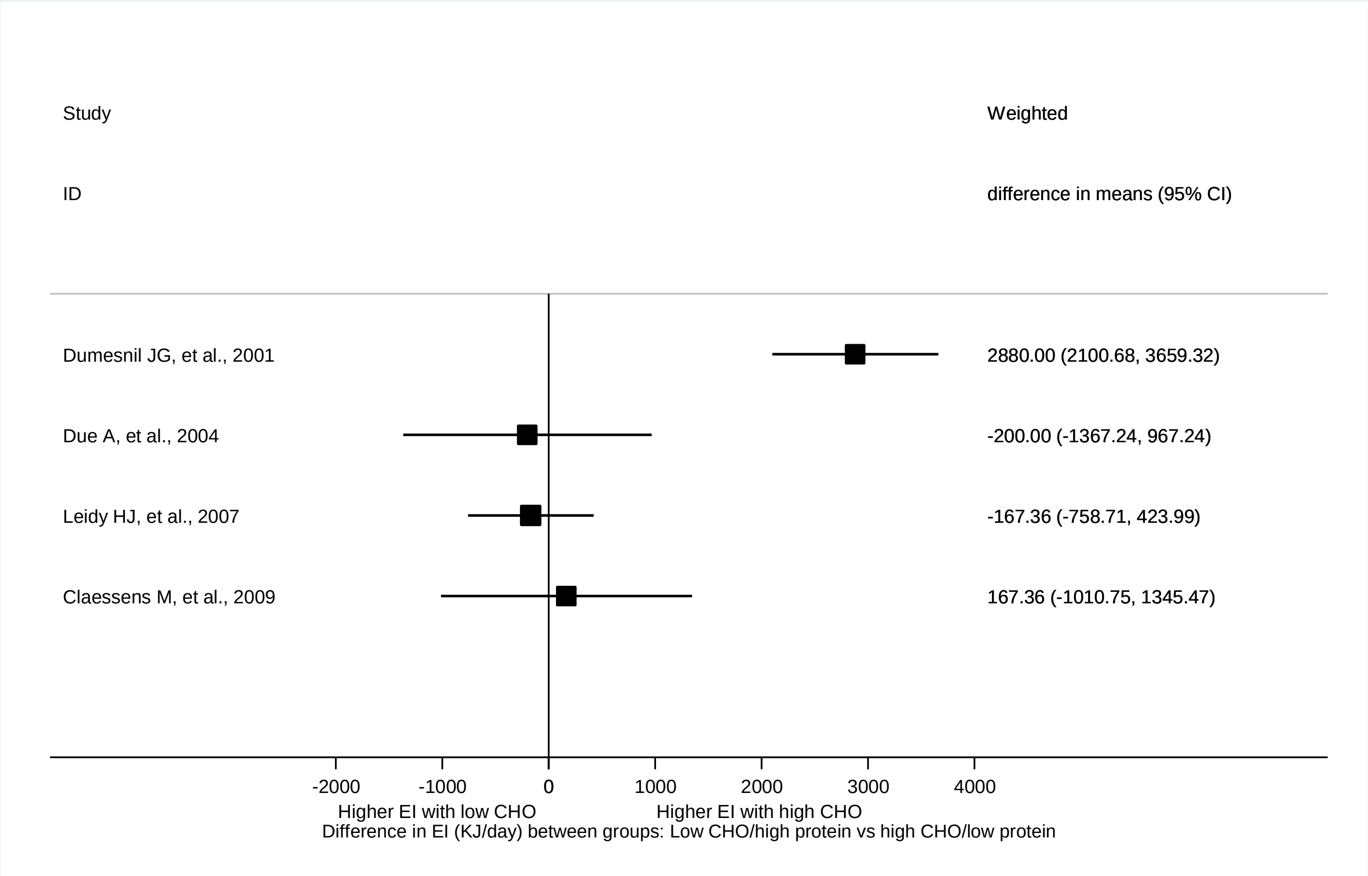
Higher carbohydrate/lower protein vs. lower carbohydrate/higher protein

Four studies were included in the meta-analysis comparing high carbohydrate low protein diets with lower carbohydrate, higher protein diets. Heterogeneity was high at 93% and therefore the pooled estimate is not included in the plot. There were not enough studies to carry out a funnel plot. Three studies found no difference in energy intake comparing high carbohydrate, low protein with low carbohydrate, high protein diets, but the study by Dumesnil *et al.* found a higher energy intake with a high carbohydrate (55% energy), lower protein diet (termed the conventional healthy diet by the authors) compared with a higher protein (31% energy) diet. However, it should be noted that the higher protein diet also differed in dietary GI and energy density (see trial characteristics table) compared with the high carbohydrate diet.

Figure 6.3 Forest plot for lower carbohydrate, higher protein diets and higher carbohydrate, lower protein diets and energy intake (kJ per day)



Removing the study by Leidy *et al.* (Leidy *et al.*, 2007b) which had set an energy restriction goal did not improve heterogeneity (I^2 = 92%).

Higher carbohydrate/lower fat/lower protein vs. lower carbohydrate/higher fat/higher protein

Seventeen studies were included in the meta-analysis to compare diets high in carbohydrate and low in fat and protein with diets lower in carbohydrate and higher in both fat and protein. Only 2 studies had not provided an energy restriction goal (Borkman *et al.*, 1991;Volek *et al.*, 2004a). The overall pooled estimate indicated that energy intake was 20kJ (5kcal) (95% CI, -282kJ (-67kcal) to 323kJ (77kcal)) higher with consumption of a high carbohydrate diet. This was not significantly different from zero (p=0.90). Heterogeneity denoted by I^2 was 62% (95% CI, 37 to 77%). A funnel plot indicated low risk of publication bias. Statistically, there was no evidence that a diet higher in carbohydrate and lower in fat and protein is associated with differences in energy intake when comparing groups with a difference in carbohydrate of at least 5%.

Figure 6.4 Forest plot for lower carbohydrate, higher fat and protein diets and higher carbohydrate, lower fat and protein diets and energy intake (kJ per day)

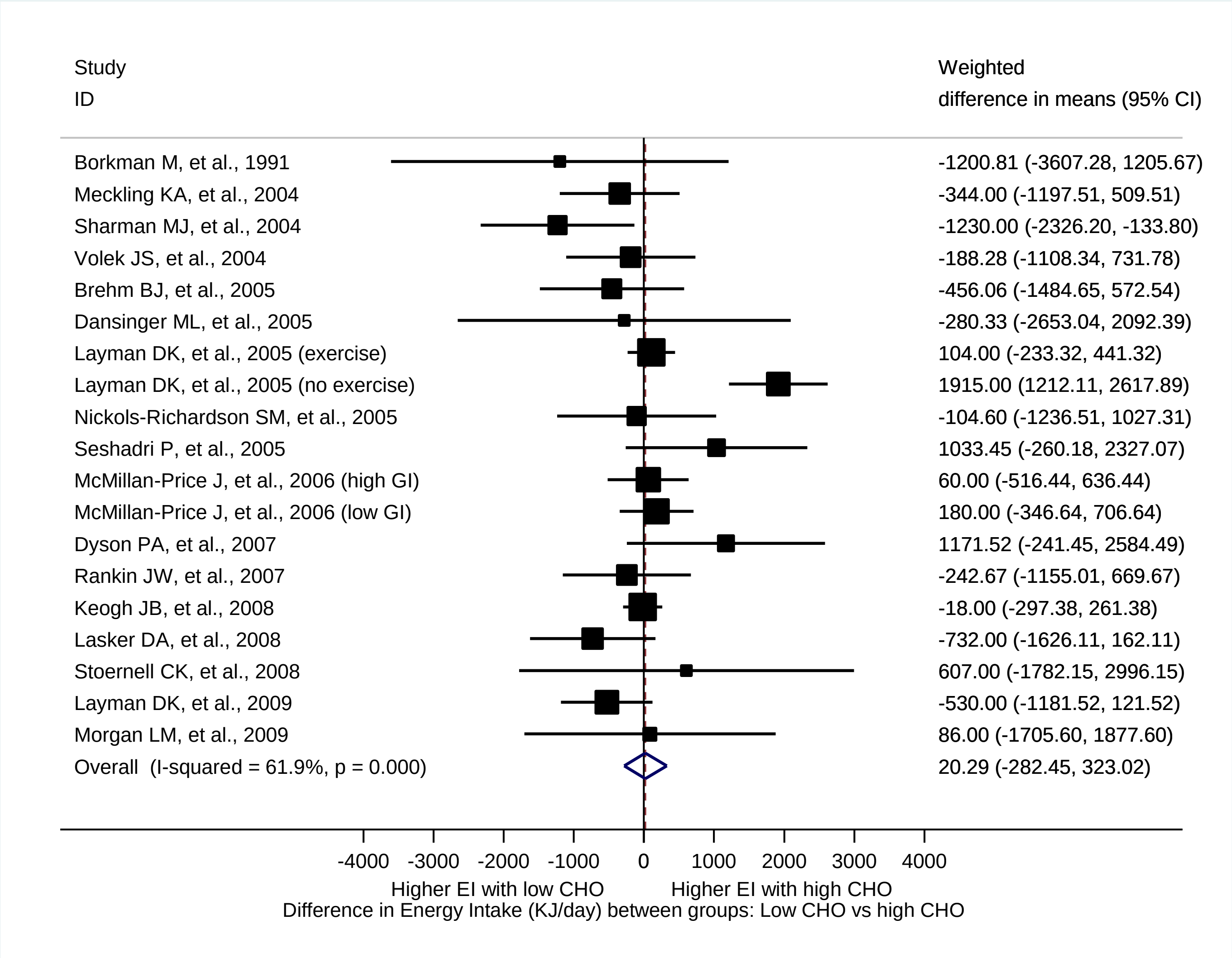


Figure 6.5 Funnel plot for lower carbohydrate, higher fat and protein diets and higher carbohydrate, lower fat and protein diets and energy intake (kJ per day)

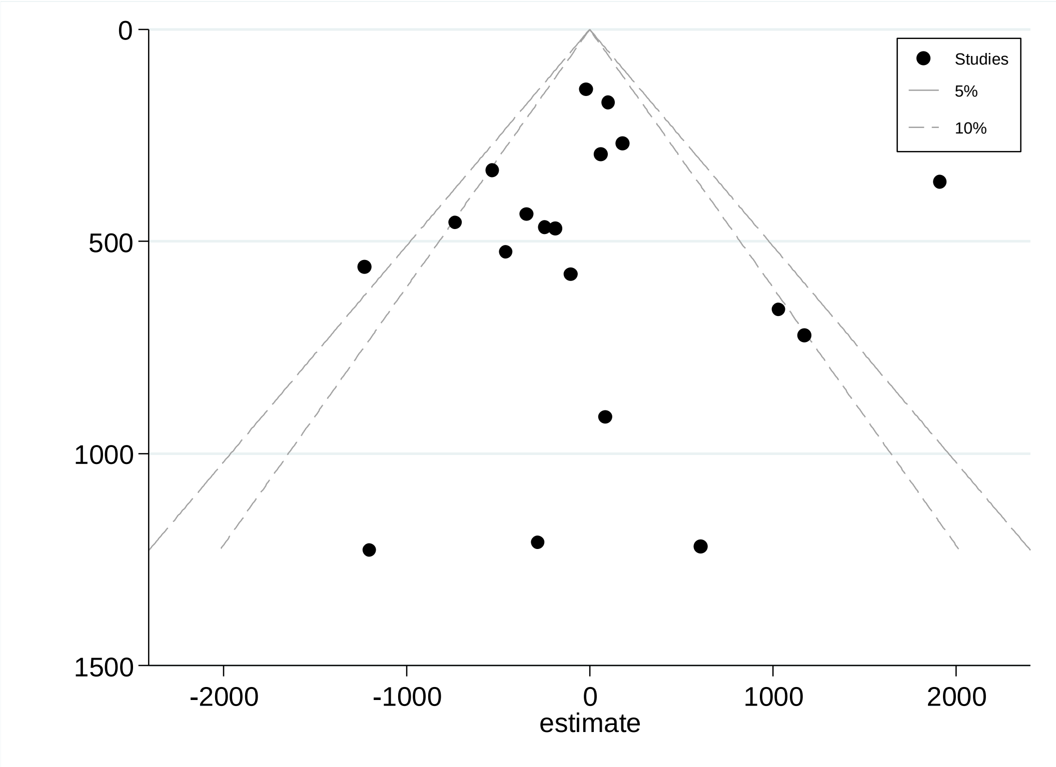


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Table 6.5 Energy Intake – Total Carbohydrate: Cohort studies

Result ID/ Reference/ Cohort Name	Country, Ethnicity, Inclusion criteria	Age range (mean) %Male	(Cases)/Total	Follow Up (% loss)	Diet Assessment	Exposure	Outcome/ Assessment Details	Units	Beta coefficient (SE)/(CI)	P trend
14747 (Phelan *et al.*, 2007) National Weight Control Registry	USA, Previous weight loss programme participants	(50) %M 29	891	3 years	FFQ	Carbohydrate, total (% energy)	Energy intake FFQ	1 % Energy	Not reported	NS

Table 6.6 Energy Intake – High carbohydrate vs. low carbohydrate diets: RCT data

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
Adolescent studies															
15022 (Ebbeling *et al.*, 2003)		Low fat diet	7/8	1752 (SE 140)	1604 (SE 213)	-8%					Not reported	7d food diary (kcal/day)	6 months	No change	unclear
		Low GL diet	7/8	2214 (SE 294)	1522 (SE 67)	- 31%								Decrease	
15023		Low fat diet	7/8	1752 (SE 140)	1439 (SE 104)							7d food diary (kcal/day)	1 year	No change	unclear
		Low GL diet	7/8	2214 (SE 294)	1621 (SE 159)									Decrease	
15988 (Sondike *et al.*, 2003)		Low fat	11/19		1100 (SD 297)							3-day food diary (kcal/day)	12 weeks	Decrease	bias
		Very low carbohydrate	11/20		1830 (SD 615)			0.03						Decrease	
Adult studies															
*16867 (Bhargava, 2006)		Low fat	615/ allocated not reported	7461 (SD 3624)	5430 (SD 2358)		0.05	0.05				FFQ (kJ/day)	12 months	Decrease	unclear
		Control	379/ allocated not reported	7185 (SD 3218)	6140 (SD 3131)		0.05							Decrease	
*14394 (Borkman *et al.*, 1991)		High carbohydrate	7/8		1957 (SE 246)			Not reported				4d food diary (kJ/day)	2 weeks	No change	unclear
		High fat	7/8		2244 (SE 160)									Small increase	

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
14958 (Bray *et al.*, 2002)		Control	12/15		12891 (SE 384)	-556 (SE 59.8)						Total energy intake Metabolic ward records (kJ/day)	9 months-average	Decrease	unclear
		Low fat	13/15		11240 (SE 364)	-755 (SE 39.7)								Decrease	
*14971		Control minus low fat	Low fat: 13/15 Control: 12/15						6479 (SE 281) (155 kcal/d)		0.02	Energy content of extra food requested. Metabolic ward records (kJ/day)	9 months-average	Decrease	unclear
15716 (Brehm *et al.*, 2003)		Low carbohydrate	22/22	1608 (SD 123)	1156			Not reported				3d food diary (kJ/day)	3 months	Decrease	unclear
		Moderate fat	20/20	1707 (SD 104)	1245									Decrease	
15718		Low carbohydrate	22/22	1608 (SD 123)	1302							3d food diary (kJ/day)	6 months	Decrease	unclear
		Moderate fat	20/20	1707 (SD 104)	1247									Decrease	
16389 (Brehm *et al.*, 2005)		Low carbohydrate	20/25	2166 (SE 128)	1288 (SE 104)							3d food diary (kJ/day)	2 months	Decrease	unclear
		Moderate fat	20/25	2176 (SE 118)	1339 (SE 72)			NS						Decrease	
*16390		Low carbohydrate	20/25	2166 (SE 128)	1531 (SE 102)							3d food diary (kJ/day)	4 months	Decrease	unclear
		Moderate fat	20/25	2176 (SE 118)	1422 (SE 73)			NS						Decrease	
*14395 (Brynes *et al.*, 2003)		High GI	17/22		9.02 (SE 0.34)							7d food diary (kJ/day)	3 weeks	No change	unclear
		High MUFA	17/22		10.9 (SE 0.51)						Sig. diff from all 3 high carbohydrate groups, P<0.05			No change	
		Low GI	17/22		7.82 (SE 0.45)									Decrease	
		Sucrose	17/22		9.9 (SE 0.51)									Increase	
*16813 (Claessens *et al.*,		High carbohydrate supplement	16/ allocated not	2398 (SE 141)	1868 (SE 142)		<0.005	Not reported				3d food diary (kJ/day)	12 weeks	Increase	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
2009)			reported												
		High protein supplement - casein	14/ allocated not reported	2045 (SE 142)	1848 (SE 108)		NS							Decrease	
		High protein supplement - whey	18/ allocated not reported	2252 (SE 122)	1812 (SE 103)		<0.005							Decrease	
16011 (Clifton *et al.*, 2008)		High carbohydrate diet	36/38		6391 (SD 1312)							3d food diary (kJ/day)	1.25 years	Decrease	unclear
		High protein diet	37/41		6583 (SD 1157)						NS			Decrease	
15964 (Dale *et al.*, 2009)		High carbohydrate diet	89/100	7595 (SD 2188)	6192 (SD 1610)							3d food diary (kJ/day)	1 years	Decrease	unclear
		High MUFA diet	85/100	7953 (SD 2883)	6513 (SD 1701)									Decrease	
17416		High carbohydrate diet	89/100	7595 (SD 2188)	6192 (SD 1679)							3d food diary (kJ/day)	2 years	Decrease	unclear
		High MUFA diet	85/100	7953 (SD 2883)	6985 (SD 2006)			0.014						Decrease	
15691 (Dansinger *et al.*, 2005)		Atkins	40/40	1898	1705		0.05					3d food diary (kcal/day)	1 month	Decrease	No bias
		Ornish	40/40	1945	1393		0.05							Decrease	
		Weight watchers	40/40	2056	1477		0.05							Decrease	
		Zone	40/40	2059	1417		0.05							Decrease	
16419		Atkins	40/40	1898	1736		0.01					3d food diary (kcal/day)	2 months	Decrease	No bias
		Ornish	40/40	1945	1439		0.05							Decrease	
		Weight watchers	40/40	2056	1615		0.05							Decrease	
		Zone	40/40	2059	1434		0.05							Decrease	
16420		Atkins	40/40	1898	1846		0.01					3d food diary (kcal/day)	6 months	Decrease	No bias
		Ornish	40/40	1945	1771		0.05							Decrease	
		Weight watchers	40/40	2056	1755		0.05							Decrease	

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
		Zone	40/40	2059	1886		0.01							Decrease	
*16421		Atkins	40/40	1898	1886	-138	0.01	<0.01				3d food diary (kcal/day)	1 year	Decrease	No bias
		Ornish	40/40	1945	1819	-192	0.01							Decrease	
		Weight watchers	40/40	2056	1832	-244	0.05							Decrease	
		Zone	40/40	2059	1757	-251	0.05							Decrease	
16320 (de Luis *et al.*, 2007)		Low carbohydrate	47/47	1915 (SD 907)	1574	-341		Not reported				3d food diary (kJ/day)	3 months	Decrease	unclear
		Low fat	43/43	1891 (SD 907)	1630	-261								Decrease	
*14724 (Donnelly *et al.*, 2008)		High fat	84/102	2526 (SD 689)	2513 (SD 545)			0.05			P<0.001	Recall and observation (kcal/day)	12 weeks	No change	No bias
		Low fat	90/105	2446 (SD 626)	1963 (SD 451)			0.05						No change	
		Moderate fat	86/98	2502 (SD 664)	2328 (SD 481)			0.05						No change	
14855 (Drummond and Kirk, 1998)		Control	25/25	2495 (SD 398.6)	2359 (SD 406.3)		NS	Not provided				4d food diary (kcal/day)	2 weeks	No change	unclear
		Reduced fat & sugar diet	24/24	2566 (SD 534.7)	1970 (SD 427.1)		<0.001							No change	
		Reduced fat diet	25/25	2639 (SD 399.3)	2239 (SD 461.4)		<0.005							Decrease	
14856		Reduced fat & sugar diet	24/24	2566 (SD 534.7)	2051 (SD 422.3)		<0.001	Not provided				4d food diary (kcal/day)	4 weeks	No change	unclear
		Reduced fat diet	25/25	2639 (SD 399.3)	2316 (SD 547.5)		<0.01							Decrease	
		Control	25/25	2495 (SD 398.6)	2357 (SD 410.0)		NS							No change	
14857		Reduced fat & sugar diet	24/24	2566 (SD 534.7)	2141 (SD 403.3)		<0.001	Not provided				4d food diary (kcal/day)	6 weeks	No change	unclear
		Reduced fat diet	25/25	2639 (SD 399.3)	2280 (SD 459.1)		<0.001							Decrease	
		Control	25/25	2495 (SD 398.6)	2420 (SD 428.4)		NS							No change	
*14858		Control	25/25	2495 (SD 398.6)	2424 (SD 483.8)		NS	Not provided				4d food diary (kcal/day)	6 months	No change	unclear
		Reduced fat & sugar diet	24/24	2566 (SD 534.7)	2253 (SD 599.6)		<0.001							No change	
		Reduced fat diet	25/25	2639 (SD 399.3)	2455 (SD 664.2)		NS							Decrease	

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15103 (Drummond *et al.*, 2003)		Advised to reduce fat	completers not reported/~ 22	9.7 (SE 0.38)	9.21 (SE 0.8)		NS					4- day food diary (MJ/day)	4 weeks	Not reported	unclear
		Advised to reduce fat and NMES	completers not reported/~ 22	8.49 (SE 0.27)	8.03 (SE 0.76)		NS	NS						Not reported	
15104		Advised to reduce fat	completers not reported/~ 22	9.7 (SE 0.38)	9.39 (SE 0.54)		NS					4- day food diary (MJ/day)	8 weeks	Not reported	unclear
		Advised to reduce fat and NMES	completers not reported/~ 22	8.49 (SE 0.27)	8.39 (SE 0.47)		NS	NS						Not reported	
*16404 (Due *et al.*, 2008)		Control	24/25		10.9 (CI 9.6, 12.3)							All food weighed by investi-gators (MJ/day)	6 months	Increase	unclear
		High MUFA	39/52		11.5 (CI 10.6, 12.4)			NS						Increase	
		Low fat	43/48		10.5 (CI 9.7, 11.3)			NS						Increase	
17637 (Due *et al.*, 2004)		High protein	23/25	9.5 (CI 8.6, 10.5)	9.0 (CI 8.2, 9.7)							All food weighed by invest-igators (MJ/day)	6 months	Decrease	unclear
		Moderate protein	23/25	9.9 (CI 8.8, 11.0)	10.8 (CI 10.1, 11.5)			0.001						Decrease	
*17524 (Due *et al.*, 2004)		High protein	25/23	9.5 (CI 8.6, 10.5)	8.4 (CI 7.6, 9.3)							7d food diary (kJ/day)	1 year	Decrease	unclear
		Moderate protein	25/18	9.9 (CI 8.8, 11.0)	8.2 (CI 7.4, 9.0)			NS						Decrease	
*14348 (Dumesnil *et al.*, 2001)		Conventional healthy diet	12/12		11695 (SD 1163)							Metabolic ward records – food provided ad libitum and monitored (kJ/day)	6 days	No change	unclear
		Low GI, low fat, high protein	12/12		8815 (SD 738)			0.05						Decrease	
*16352 (Dyson *et al.*, 2007)		Healthy eating diet	4/~6	2130 (SD 457)	1593 (SD 277)							3d food diary (kcal/day)	3 months	Decrease	unclear
		Low	6/~6	2130 (SD 457)	1313 (SD 205)			0.036						Decrease	

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		carbohydrate diet													
15423 (Ebbeling *et al.*, 2007)		Low fat diet	ITT: 37/37			decrease						3x 24hr recalls	6 months	Decrease	unclear
		Low GL diet	ITT: 36/36			decrease		NS						Decrease	
15441		Low fat diet	ITT: 37/37			decrease						3x 24hr recalls	1 year	Decrease	unclear
		Low GL diet	ITT: 36/36			decrease		NS						Decrease	
15442		Low fat diet	ITT: 37/37			decrease						3x 24hr recalls	18 months	Decrease	unclear
		Low GL diet	ITT: 36/36			decrease		NS						Decrease	
15473 (Ebbeling *et al.*, 2005)		Low fat diet	12/17	1802 (SE 116)	1409 (SE 46)							7d food diary (kcal/day)	6 months-average	Decrease	unclear
		Low GI diet	11/17	1860 (SE 72)	1391 (SE 79)			NS						Decrease	
15474		Low fat diet	12/17	1802 (SE 116)	1472 (SE 85)							7d food diary (kcal/day)	1 year	Decrease	unclear
		Low GI diet	11/17	1860 (SE 72)	1494 (SE 82)			NS						Decrease	
14076 (Frisch *et al.*, 2009)		High carbohydrate diet	100/100	2192 (SD 668)	1755 (SD 478)		0.05					3d food diary (kcal/day)	3 months	Decrease	unclear
		Moderate carbohydrate diet	100/100	2140 (SD 696)	1700 (SD 591)		0.05	0.474						Decrease	
15140		High carbohydrate diet	100/100	2192 (SD 668)	1759 (SD 468)		0.05					3d food diary (kcal/day)	1 month	Decrease	unclear
		Moderate carbohydrate diet	100/100	2140 (SD 696)	1697 (SD 503)		0.05	0.370						Decrease	
*15147		High carbohydrate diet	100/100	2192 (SD 668)	1783 (SD 597)		0.05					3d food diary (kcal/day)	6 months	Decrease	unclear
		Moderate carbohydrate diet	100/100	2140 (SD 696)	1742 (SD 624)		0.05	0.636						Decrease	
15148		High carbohydrate	100/100	2192 (SD 668)	1854 (SD 624)		0.05					3d food diary	1 year	Decrease	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
		diet										(kcal/day)			
		Moderate carbohydrate diet	100/100	2140 (SD 696)	1866 (SD 710)		0.05	0.903						Decrease	
15659 (Greenberg *et al.*, 2009)		Low carbohydrate	18/109		1281 (SD 380)			NS				24hr Recall (kcal/day)	1 month	Decrease	unclear
		Low fat	27/104		1347 (SD 239)									Decrease	
*15660		Low carbohydrate	18/109		1323 (SD 368)			NS				24hr Recall (kcal/day)	1 year	Decrease	unclear
		Low fat	27/104		1261 (SD 342)									Decrease	
17466 (Harvey-Berino, 1998)		Energy restriction	29/40	9083 (SD 2344)		-2903 (SD 2118)					<0.05	3d food diary (kcal/day)	24 weeks	Decrease	unclear
		Low fat, high carb	28/40	8070 (SD 2122)		-1168 (SD 2188)								Decrease	
16257 (Howard *et al.*, 2006)		Control	22958/29294	1789.4 (SD 703.0)	1593.8 (SD 644.0)							FFQ (kcal/day)	1 year	No change	No bias
		Low fat	14885/19541	1790.2 (SD 710.1)	1500.5 (SD 544.2)			<0.001						Decrease	
16258		Control	22958/29294	1789.4 (SD 703.0)	1546.2 (SD 639.5)							FFQ (kcal/day)	6 years	No change	No bias
		Low fat	14885/19541	1790.2 (SD 710.1)	1431.8 (SD 551.7)			<0.001						Decrease	
*14467 (Johnstone *et al.*, 2008)		Medium carbohydrate diet	17/20	12.6 (SE 0.27)	7.95							Average intake from baseline to follow-up Metabolic ward records, (MJ/day)	4 weeks	Decrease	unclear
		Very low carbohydrate diet	17/20	12.6 (SE 0.27)	7.25			0.02						Decrease	
14398 (Johnstone *et al.*, 2000)		High Carbohydrate Snack	8/8		11.7 (14.1)							Average intake exclusive and (inclusive) of snacks Metabolic ward records, (MJ/day)	7 days	No change	bias
		High Fat Snack	8/8		11.7 (14.8)									No change	
		High Protein Snack	8/8		12.2 (14.3)			NS						No change	
		No Snack	8/8		13.9 (13.9)									No change	

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*16717 (Keogh *et al.*, 2008)		High carbohydrate, low SFA	47/50		6590 (SD 717)							3d food diary (kJ/day)	8 weeks	Decrease	unclear
		Low carbohydrate, high SFA	52/57		6608 (SD 664)			NS						Decrease	
*15079 (Keogh *et al.*, 2005)		High carbohydrate, low fat, high GI	40/40		8006 (SD 2137)							3d food diary (kJ/day)	3 weeks	No change	unclear
		High MUFA	40/40		8303 (SD 1874)			NS						No change	
		High PUFA	40/40		8355 (SD 1907)			NS						No change	
		High SFA	40/40		8420 (SD 1932)			NS						No change	
15662 (Kirkwood *et al.*, 2007)		Group 1: No advice	18/ allocated not reported	9.6 (SE 0.44)	8.1 (SE 0.62)		0.05	Unclear				4d food diary (MJ/day)	6 weeks	No change	unclear
		Group 2: Conventional weight loss diet	16/ allocated not reported	8.6 (SE 0.5)	7.1 (SE 0.45)		NS							Decrease	
15663		Group 3: Exercise	19/ allocated not reported	8.2 (SE 0.3)	7.4 (SE 0.34)		0.05					4d food diary (MJ/day)	6 weeks	Decrease	unclear
		Group 4: Conventional weight loss diet + exercise	16/ allocated not reported	9.6 (SE 0.36)	7.1 (SE 0.32)		0.001							Decrease	
15664		Group 1: No advice	18/ allocated not reported	9.6 (SE 0.44)	8 (SE 0.48)		0.01					4d food diary (MJ/day)	12 weeks	No change	unclear
		Group 2: Conventional weight loss diet	16/ allocated not reported	8.6 (SE 0.5)	6.6 (SE 0.35)		0.001							Decrease	
15665		Group 3: Exercise	19/ allocated	8.2 (SE 0.3)	7.5 (SE 0.39)		NS					4d food diary	12 weeks	Decrease	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
			not reported									(MJ/day)			
		Group 4: Conventional weight loss diet + exercise	16/ allocated not reported	9.6 (SE 0.36)	6.7 (SE 0.3)		0.001							Decrease	
*15994 (Landry *et al.*, 2003)		High carbohydrate	19/19		12 (SD 2.2)							All food weighed by investigators (MJ/day)	7 weeks	Decrease	unclear
		Low carbohydrate, high fat diet	18/18		13 (SD 2.6)			NS						Decrease	
*15896 (Lasker *et al.*, 2008)		high carbohydrate	25/33	9147 (SE 486)	5875 (SE 391)			NS				3d food diary (kJ/day)	4 months	Decrease	unclear
		High protein	25/32	9952 (SE 566)	6607 (SE 235)									Decrease	
*16169 (Layman *et al.*, 2005)		High carbohydrate diet	12/12	8479 (SE 452)	7977 (SE 339)		<0.05					3d food diary (kJ/day)	16 weeks	Decrease	unclear
		High protein diet	12/12	8888 (SE 384)	6062 (SE 117)		<0.05	0.79						Decrease	
*16170		High carbohydrate diet + exercise	12/12	7977 (SE 339)	5644 (SE 108)		<0.05					3d food diary (kJ/day)	16 weeks	Decrease	unclear
		High protein diet + exercise	12/12	8362 (SE 322)	5540 (SE 134)		<0.05	0.34						Decrease	
14953 (Layman *et al.*, 2009)		High carbohydrate, low protein diet	51/66	8.78 (SE 0.38)	6.2 (SE 0.24)							3d food diary (kJ/day)	4 months	Decrease	unclear
		Low carbohydrate, high protein diet	52/64	10.06 (SE 0.38)	6.73 (SE 0.23)			NS						Decrease	
*14954		High carbohydrate, low protein diet	30/66	8.78 (SE 0.38)	6.2 (SE 0.24)							3d food diary (kJ/day)	1 year	Decrease	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
		Low carbohydrate, high protein diet	41/64	10.06 (SE 0.38)	6.73 (SE 0.23)			NS						Decrease	
*16831 (Leidy *et al.*, 2007a)		High protein, energy restricted	21/27		1540 (SE 60)			Not reported				Food log (kcal/day)	12 weeks	Decrease	unclear
		Moderate protein, energy restricted	25/27		1500 (SE 40)									Decrease	
16848		High protein, energy restricted	21/27		1560 (SE 60)							Food log (kcal/day)	1 week	Decrease	unclear
		Moderate protein, energy restricted	25/27		1530 (SE 40)									Decrease	
*14454 (Leidy *et al.*, 2007b)		High protein, energy restricted	21/27		1560 (SE 60)			NS				Food log (kcal/day)	9 weeks	Decrease	unclear
		Moderate protein, energy restricted	17/27		1440 (SE 50)									Decrease	
*16976 (Martin *et al.*, 2000)		High-energy breakfast	10/10		11737 (SD 1141)			<0.05				2 week food diary (kJ/day)	2 weeks-average	Decrease	unclear
		Low-energy breakfast	10/10		10254 (SD 1789)									Decrease	
14546 (Mazlan *et al.*, 2006)	Lean subjects	1.5MJ high fat snack	6/12		10.8			NS				EI excluding supplement All food weighed by investigators (MJ/day)	7 days	No change	unclear
	Lean subjects	3.0MJ high fat snack	6/12		10.9			NS						No change	
	Lean subjects	Control for high fat snack	6/12		11.2									No change	
17015	Overweight subject	1.5MJ high fat snack	6/12		12.7		NS					EI excluding supplement All food	7 days	No change	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	s											weighed by investigators (MJ/day)			
	Overweight subjects	3.0MJ high fat snack	6/12		11.9		NS							No change	
	Overweight subjects	Control for high fat snack	6/12		12.6									No change	
17016	Lean subjects	1.5MJ high sugar snack	6/12		10.4		NS	Unclear				EI excluding supplement All food weighed by investigators (MJ/day)	7 days	No change	unclear
	Lean subjects	3.0MJ high sugar snack	6/12		10.4		0.05							No change	
	Lean subjects	Control for high sugar snack	6/12		11.3									No change	
17017	Overweight subjects	1.5MJ high sugar snack	6/12		11.7		NS					EI excluding supplement All food weighed by investigators (MJ/day)	7 days	No change	unclear
	Overweight subjects	3.0MJ high sugar snack	6/12		10.6		0.05							No change	
	Overweight subjects	Control for high sugar snack	6/12		11.6									No change	
14881 (McManus *et al.*, 2001)		Low fat diet	22/51	2002 (SD 697)	1633 (SD 538)							7-day food diary (kcal/day)	6 months	Increase	
		Moderate fat diet	32/50	1886 (SD 657)	1861 (SD 545)			0.13						Decrease	
14882		Low fat diet	9/51	2002 (SD 697)	1671 (SD 741)							7-day food diary (kcal/day)	1 year	Increase	unclear
		Moderate fat diet	26/50	1886 (SD 657)	1783 (SD 450)			0.68						Decrease	
14883		Low fat diet	9/51	2002 (SD 697)	1697 (SD 526)							7-day food diary (kcal/day)	18 months	Increase	unclear
		Moderate fat diet	24/50	1886 (SD 657)	1877 (SD 454)			0.08						Decrease	
*16231		High CHO,	32/32	9630 (SE 470)	6010 (SE 240)			NS				3-day food	12 weeks	Decrease	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
(McMillan-Price *et al.*, 2006)		high GI diet										diary (kJ/day)			
		High CHO, low GI diet	32/32	9030 (SE 460)	6150 (SE 190)								12 weeks	Decrease	
		High protein, high GI diet	32/32	9220 (SE 450)	5950 (SE 170)			NS					12 weeks	Decrease	
		High protein, low GI diet	33/33	8890 (SE 470)	5970 (SE 190)			NS					12 weeks	Decrease	
*14869 (Meckling *et al.*, 2004)		Low carbohydrate	15/10	9616 (SE 600)	6421 (SE 353)		0.05	NS				7 day food diary at 2 time points (kJ/day)	10 weeks-average	Decrease	unclear
		Low fat	16/10	8617 (SE 414)	6077 (SE 255)		0.05							Decrease	
16362 (Meckling and Sherfey, 2007)		Hypocaloric control diet	8/15	7422	5822							Continuous food diary (kJ/day)	9 weeks	Decrease	unclear
		Hypocaloric protein rich diet	10/15	7422	5787			NS						Decrease	
*16364		Hypocaloric control diet + exercise	11/15	7422	5271							Continuous food diary (kJ/day)	9 weeks	Decrease	unclear
		Hypocaloric protein rich diet + exercise	14/15	7422	5094			NS						Decrease	
*14450 (Meksawan *et al.*, 2004)		High carbohydrate	10/11		1748 (SE 149)							Average intake from baseline to follow-up food diary, (kcal/day)	3 weeks	Decrease	No bias
		Low carbohydrate diet	10/11		1995 (SE 175)			<0.05						No change	
14699 (Morgan *et al.*, 2009)		Atkins	31/57	9550 (SD 2684)	6809 (SD 2312)						Equivalent decreases other than control, but stats not provided	7-day food diary (kJ/day)	8 weeks	Decrease	unclear
		Control	29/61	9512 (SD 3025)	7947 (SD 2620)									No change	
		Slim Fast	36/59	9512 (SD 3025)	6076 (SD 1900)									Decrease	
		Weight Watchers	45/58	9706 (SD 3111)	6084 (SD 1605)									Decrease	
*14700		Atkins	8/57	9550 (SD 2684)	6823 (SD 1522)	Approx. -30%					Equivalent decreases other than	7-day food diary (kJ/day)	24 weeks	Decrease	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
		Control	7/61	9512 (SD 3025)	6678 (SD 2264)	Approx. -10%					control, but stats not provided			No change	
		Slim Fast	11/59	9512 (SD 3025)	7408 (SD 2709)	Approx. -30%								Decrease	
		Weight Watchers	16/58	9706 (SD 3111)	6909 (SD 2090)	Approx. -30%								Decrease	
*14906 (Nickols-Richardson *et al.*, 2005)		High carbohydrate	11/15	2340 (SD 1236)	1395 (SD 264)		0.05		NS			4-day food diary (kcal/day)	6 weeks	Decrease	unclear
		Low carbohydrate	12/13	2025 (SD 645)	1420 (SD 374)		0.05							Decrease	
14427 (Park *et al.*, 2007)		Carbohydrate supplement	13/13		1007 (869-1140)			No difference in median intake between conditions				Energy intake (kcal) from *ad libitum* test meal All food weighed by investi-gators (kcal/meal)	2 weeks	No change	No bias
		Fat supplement	13/13		991 (867-1227)									No change	
		Protein supplement	13/13		964 (790-1409)									No change	
		Standard diet	13/13		1028 (899-1169)									No change	
*17193 (Petersen *et al.*, 2006)		Hypoenergetic high carbohydrate, low fat diet	377/389	2187 (SD 691)	1561 (SD 371)		<0.05					3-day food diary (kcal/day)	10 weeks-average	Decrease	bias
		Hypoenergetic low carbohydrate, high fat diet	370/382	2187 (SD 691)	1620 (SD 327)		<0.05	<0.05						Decrease	
17194	Women	Hypoenergetic high carbohydrate, low fat diet	284/389	2029 (SD 550)	1447 (SD 258)		<0.05					3-day food diary (kcal/day)	10 weeks-average	Decrease	bias
	Women	Hypoenergetic low carbohydrate, high fat diet	287/382	2029 (SD 550)	1514 (SD 258)		<0.05							Decrease	
17195	Men	Hypoenergetic high carbohydrate, low fat diet	93/389	2675 (SD 838)	1900 (SE 442)		<0.05					3-day food diary (kcal/day)	10 weeks-average	Decrease	bias

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	Men	Hypoenergetic low carbohydrate, high fat diet	92/382	2675 (SD 838)	1928 (SE 312)		<0.05							Decrease	
*16430 (Racette *et al.*, 1995)		Low carbohydrate diet	6/ allocated not reported		4.8 (SD 0.41)			Not reported				7-day food diary (MJ/day)	16 weeks	Decrease	unclear
		Low fat diet	7/ allocated not reported		5.15 (SD 0.80)									Decrease	
*16600		Low carbohydrate diet + exercise	5/ allocated not reported		4.88 (SD 0.64)							7-day food diary (MJ/day)	16 weeks	Decrease	unclear
		Low fat diet + exercise	5/ allocated not reported		4.86 (SD 0.7)									Decrease	
*14451 (Rankin and Turpyn, 2007)		High carbohydrate	completers not reported/~ 16	2274 (SD 1095)	1395 (SD 325)							4-day food diary (kcal/day)	4 weeks- average	Decrease	unclear
		Very low carbohydrate	completers not reported/~ 16	2001 (SD 24)	1453 (SD 304)			NS						Decrease	
14408 (Rumpler *et al.*, 2006)		High carbohydrate drink	8/8		11.8						No significant difference between diets	Average intake from baseline to follow-up Metabolic ward records, (MJ/day)	8 weeks	No change	No bias
		High fat drink	8/8		12.5									No change	
		High protein drink	8/8		12.6									No change	
14499		High carbohydrate drink	08-Aug		lower			<0.05				Metabolic ward records	2 weeks	No change	No bias
		High fat drink	08-Aug		higher									No change	
14501		High protein drink minus high carbohydrate	Cross-over: 8/8					No significant difference				Metabolic ward records	2 weeks	No change in both	No bias

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
		drink													
14502		High protein drink minus high fat drink	Cross-over: 8/8					No significant difference				Metabolic ward records	2 weeks	No change in both	No bias
14374 (Saltzman *et al.*, 1997)		High fat diet (40%)	14/14		10.7 (0.3)			NS				Metabolic ward records (MJ/day)	9 days	Not reported	bias
		Low fat diet (20%)	14/14		10.3 (0.2)									Not reported	
15304 (Schlundt *et al.*, 1993)		Low fat and ad lib carbohydrate	25/30	9204 (SD 3009)	5965 (SD 1630)	- 3240		NS				Behavioural food diary throughout (kJ/day)	18 weeks-average vs. 2 week pre-study	Decrease	unclear
		Low fat and caloric restriction	24/30	8364 (SD 2572)	5292 (SD 1041)	-3072								Decrease	
*16094 (Seshadri *et al.*, 2005)		Low carbohydrate diet	40/ allocated not reported	2153 (SD 1060)	1343 (SD 731)		0.001	0.05				1 x 24 hr recall (kcal/day)	6 months	Decrease	unclear
		Standard diet, energy restricted	35/ allocated not reported	1882 (SD 820)	1590 (SD 679)		0.057							Decrease	
*15415 (Shah *et al.*, 1996)		Energy restricted diet	36/36	2179 (SD 577)	1531 (SD 452)				NS			3x24 hr recalls (kcal/day)	6 months	Decrease	unclear
		Low fat, high complex CHO	39/39	1956 (SD 499)	1617 (SD 409)									Decrease	
15416		Energy restricted diet	36/36	2179 (SD 577)	1718 (SD 1049)				NS			3x24 hr recalls (kcal/day)	1 year	Decrease	unclear
		Low fat, high complex CHO	39/39	1956 (SD 499)	1602 (SD 472)									Decrease	
*13059 (Shah *et al.*, 1994)		Energy restricted diet	42/ allocated not reported	8868 (SD 2422)	6488 (SD 1880)	-1991 (SD 267)						1x 24hr recall, (kJ/day)	6 months	Decrease	unclear
		Low fat, high	47/	7919 (SD	6612 (SD	-1654 (SD		NS						Decrease	

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
		complex carbohydrate diet	allocated not reported	2088)	1667)	252)									
*14748 (Sharman *et al.*, 2004)		Low fat	15/15	10.86 (SD 2.47)	6.54 (SD 1.19)		0.05					3x 7-day food diary (MJ/day)	6 weeks-average	Decrease	unclear
		Very low carbohydrate	15/15	10.86 (SD 2.47)	7.77 (SD 1.81)		0.05	0.05						Decrease	
15712 (Sheppard *et al.*, 1991)		Control	105/119	7196 (SD 1866)		-649 (SD 1920)		Not reported				4-day food diary (kJ/day)	6 months	No change	unclear
		Low fat diet	171/184	7293 (SD 1957)		-1757 (SD 1381)								Decrease	
15713		Control	105/119	7196 (SD 1866)	-8%	-594 (SD 1946)						4-day food diary (kJ/day)	1 year	No change	unclear
		Low fat diet	171/184	7293 (SD 1957)	-25%	-1845 (SD 1674)								Decrease	
*15714		Control	94/119	7196 (SD 1866)		-448 (SD 1950)						4-day food diary (kJ/day)	24 months	No change	unclear
		Low fat diet	158/184	7293 (SD 1957)		-1653 (SD 1669)								Decrease	
*14453 (Stimson *et al.*, 2007)		High fat diet	17/17	2829 (SE 60)	1753 (SE 112)			<0.05				Average intake from baseline to follow-up Metabolic ward records, (kcal/day)	4 weeks	Decrease	unclear
		Moderate fat diet	17/17	2829 (SE 60)	1907 (SE 124)									Decrease	
*16548 (Stoernell *et al.*, 2008)		Low carbohydrate diet	10/14	7095 (SD 2520)		-1620 (SD 2219)	0.036	NS				3x 24 hr recalls (kJ/day)	8 weeks-average	Decrease	unclear
		Low fat diet	13/14	7911 (SD 3211)		-1013 (SD 3152)	0.036							Decrease	
14428 (Stubbs *et al.*, 1996)		High fat	6/6		10900						0.340	All food provided *ad libitum* and monitored (kJ/day)	14 days-average	Decrease	unclear
		Low fat	6/6		10690									Decrease	
		Moderate fat	6/6		11020									Decrease	
*15276		Control	61/61	2366 (SD 693)	2307 (SD 856)	-59 (SD						3-day food	1 year	No	unclear

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups (at follow-up)	Difference between groups (Δ from baseline)	p-value (difference between groups)	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
(Swinburn *et al.*, 1999)						83)						diary (kcal/day)		change	
		Low fat	49/49	2195 (SD 610)	1832 (SD 481)	-362 (SD 92)		0.02						Decrease	
*14404 (Thomas *et al.*, 1992)		High Carbohydrate	21/21		11939 (SE 1026)							Metabolic ward records (kJ/day)	7 days	No change	unclear
		High Fat	21/21		12417 (SE 1216)			<0.05						No change	
15378 (Tinker *et al.*, 2008)		Control	25182/29294	1788 (SD 699)	1594 (SD 640)							FFQ (kcal/day)	1 year	No change	unclear
		Low fat diet	17117/19541	1790 (SD 709)	1502 (SD 541)			0.001						Decrease	
15390		Control	21759/29294	1788 (SD 699)	1548 (SD 635)							FFQ (kcal/day)	6 years	No change	unclear
		Low fat diet	14117/19541	1790 (SD 709)	1435 (SD 549)			0.001						Decrease	
*15203 (Turley *et al.*, 1998)		Low fat, high carbohydrate diet	35/38	11.9 (SD 2.6)	9.5 (SD 2.3)			0.001				7-day food diary (MJ/day)	6 weeks	Decrease	unclear
		Western diet	36/38	11.9 (SD 2.6)	11.4 (SD 2.2)									Decrease	
*14376 (Volek *et al.*, 2004a)		Low fat	13/13	1931 (SD 306)	1243 (SD 291)							3x7-day food diaries (kcal/day)	4 weeks-average	Decrease	unclear
		Very low carbohydrate	13/13	1931 (SD 306)	1288 (SD 281)			NS						Decrease	
*14409 (Volek *et al.*, 2004b)	Men	Low Fat	15/28	2593 (SD 568)	1562 (SD 285)							3x7-day food diaries (kcal/day)	50 days-average	Decrease	unclear
	Men	Very low carbohydrate	15/28	2593 (SD 568)	1855 (SD 432)			0.05						Decrease	
*14410	Women	Low Fat	13/28	1931 (SD 306)	1243 (SD 291)							3x7-day food diaries (kcal/day)	30 days-average	Decrease	unclear
	Women	Very low carbohydrate	13/28	1931 (SD 306)	1288 (SD 281)			NS						Decrease	
*16391 (Volp *et al.*, 2008)	BMI < 25	High fat diet	5/12	2065	1729			NS				3-day food diary (kcal/day)	14 days	No change	unclear
	BMI < 25	High sucrose diet	5/12	2065	1764									No change	

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*16392	BMI 25+	High fat diet	5/12	1997	1753			NS				3-day food diary (kcal/day)	14 days	No change	unclear
	BMI 25+	High sucrose diet	5/12	1997	2143									No change	
*15939 (Wolever and Mehling, 2002)		High carbohydrate, high GI	11/11	7.32 (SE 0.28)	7.17 (SE 0.39)		NS				Diet* time interaction, p=0.03	3-day food diary (MJ/day)	8 weeks	Decrease	unclear
		High carbohydrate, low GI	13/13	7.78 (SE 0.5)	7.09 (SE 0.28)		NS							Decrease	
		Low carbohydrate, high MUFA	11/11	6.99 (SE 0.49)	7.86 (SE 0.55)		NS							Increase	

*These results was used in the meta-analyses of high carbohydrate diets and energy intake (Figures 6.1-6.5)

Eating motivation, total carbohydrate intake and high carbohydrate diets

Summary of cohort results

One cohort study reported data on the effect of dietary carbohydrate intake at study entry on subjective reports of appetite (Phelan *et al.*, 2007). The individuals in the National Weight Control Registry cohort were previous weight loss programme participants who were monitored over time to explore factors influencing weight maintenance. Low carbohydrate dieters tended to report lower hunger ratings than other dieters in this cohort. As self-selected cohort members, they may not be generally representative of the general public.

Please interpret observational data with caution: With observational studies there is substantial potential for biases.

Summary of trials results

Thirteen trials, reported in 15 papers explored the effects of diets high in carbohydrate compared to lower carbohydrate diets, with the carbohydrate replaced by either fat or protein, or both macronutrients. Five of these studies used a cross-over design (Beasley *et al.*, 2009;Herrmann *et al.*, 2001;Johnstone *et al.*, 2008;Johnstone *et al.*, 2000;Segal-Isaacson *et al.*, 2004) and the others employed the parallel groups approach. Two studies were conducted in the UK (Johnstone *et al.*, 2008;Johnstone *et al.*, 2000), but the remaining studies were American. The average number of participants in each trial was 107, but the median number is 28, which is thought to be an adequate number for many study designs using eating motivations as an outcome (Blundell *et al.*, 2010). Two larger trials had respectively 811 (Sacks *et al.*, 2009) and 191 (Beasley *et al.*, 2009) participants. The mean BMI in each trial was generally indicative of an overweight or obese population, however 2 trials included subjects with an average BMI less than 25kg/m^2 (Johnstone *et al.*, 2000;Herrmann *et al.*, 2001). All studies included adults only. Three studies were double-blind (Beasley *et al.*, 2009;Park *et al.*, 2007;Sacks *et al.*, 2009), but the remaining studies did not provide clear information concerning blinding of subjects or researchers.

Two studies in particular emerge as being of high quality, with large numbers of participants and validated methods of assessing subjective reports of eating motivation (Beasley *et al.*, 2009;Sacks *et al.*, 2009).

Due to variation in study designs, the method of assessing eating motivation and the nature of each intervention, it was not possible to combine these studies using meta-analysis.

The OMNI-Heart study reported by Beasley *et al.* (Beasley *et al.*, 2009) explored the effects of 3 diets that differed in macronutrient composition, but that were otherwise balanced for dietary fibre,

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palatability, energy density and GI in 164 overweight men and women. All food was provided and although there was no energy restriction goal, the aim was for the diets to be isocaloric. Appetite was assessed using visual analogue scales and a pre- and post-meal summary appetite measures were generated (ratings of hunger, plus prospective consumption, minus fullness). Self-reported appetite was 10-15% lower on the higher protein/lower carbohydrate (25% protein/48% carbohydrate) than the lower protein/higher carbohydrate diet (15% protein/58% carbohydrate) (p=0.01). Replacing the carbohydrate for fat did not invoke a differential effect on appetite (p=0.92). A similar reduction in hunger with a higher protein/lower carbohydrate diet was observed by Johnston *et al.* in the first month of their trial (Johnston *et al.*, 2004), by Johnstone *et al.* with a ketogenic high protein/low carbohydrate diet (Johnstone *et al.*, 2008), by Nickols-Richardson *et al.* (Nickols-Richardson *et al.*, 2005) and by Westerterp-Plantenga *et al.* in their 3-day feeding trial of a high protein/lower carbohydrate diet compared to a high carbohydrate, adequate protein diet (Westerterp-Plantenga *et al.*, 2009).

The two papers from the same study by Leidy and colleagues also assessed the effect of a higher protein/lower carbohydrate diet. Appetite data were reported in slightly different ways in the 2 papers (Leidy *et al.*, 2007a;Leidy *et al.*, 2007b). This study compared 12-week, energy-restricted higher protein/lower carbohydrate and normal protein/higher carbohydrate diets in 46 women. On 3 non-consecutive days, aspects of appetite were tracked for 24 hours using a personal digital assistant (Palm Pilot) that was able to capture visual analogue scales responses concerning hunger, desire to eat and fullness. Additionally, a test day, conducted at 9 weeks in which the women were fed a meal representative of either the high or moderate protein diets was employed. Appetite was characterised for 4 hours around the test meal and an area under the curve (AUC) for 195 minutes for hunger, desire to eat and fullness was generated. This latter approach indicated a reduced acute meal AUC for hunger and desire to eat, but not fullness when the higher protein/low carbohydrate meal was consumed. The chronic analysis of appetite responses did not reveal any differential effect of the 2 diets, although there was some evidence of meal-related reductions in fullness (data not in tables).

Other studies, including the very large high quality study reported by Sacks *et al.*, did not report an effect of higher protein/low carbohydrate diets on appetite (Sacks *et al.*, 2009;Westerterp-Plantenga *et al.*, 2009) or a differential effect of macronutrient-specific supplements (Park *et al.*, 2007). Collectively however, there appears to be a greater number of studies which provide some evidence that replacement of some dietary carbohydrate with energy from protein may enhance subjective reports of reduced hunger.

The macronutrient composition of snacks was tested by Johnstone *et al.* (Johnstone *et al.*, 2000). Using a within subjects cross-over design with 9 healthy males under controlled *ad libitum* feeding conditions, the effect of mandatory consumption of snacks of equal energy density, but which varied in fat, protein and carbohydrate composition compared with a no snack condition were tested. Within the 9-day protocol for each snack type, the macronutrient composition had little impact on average ratings of hunger, desire to eat, fullness and prospective consumption. Hunger reported at midday was greater in the no snack condition compared with the other conditions.

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Other studies undertook an assessment of the replacement of carbohydrate with fat or a mixture of fat and protein. In Pereira *et al.* (Pereira *et al.*, 2004) lower ratings of hunger were reported in response to the question ‘How hungry have you been over the past 24 hours?’ in the low carbohydrate, low GI group compared to the high carbohydrate, low fat group. A similar but non-significant reduction in reported hunger was observed when asked before each lunch ‘How hungry are you right now?’. Under energy-restricted conditions, overweight or obese young adults appear to have experienced less hunger when consuming a lower carbohydrate, low GI diet compared to a more traditional high carbohydrate, lower fat diet.

Shah *et al.* compared a low-fat, *ad libitum*, complex-carbohydrate diet with a standard low-energy diet over a period of 6 months (Shah *et al.*, 1994). Satiety was reported to be enhanced in the group following the low-fat, complex-carbohydrate diet but was somewhat adversely affected in the low energy dieters. A later paper from the same study provided results at 6 and 12 months and at that point indicated that there was no significant main effect of diet group, or diet group by time interaction and thus no differential effect of the 2 diets on appetite (Shah *et al.*, 1996). Satiety was assessed in this study using a visual analogue scale (VAS) anchored with hunger at one end and fullness at the other, which would not permit dissociation of what may well not be a continuum of the same feelings. Neither paper was clear concerning the frequency of use of these scales.

Herrmann *et al.* (Herrmann *et al.*, 2001) fed 8 males in a randomised cross-over design, diets which were high or low total fat (30 or 20%), and either high or low GI (>65 or >45). All food was provided to ensure diets were isocaloric, and after 7 days, a ‘test’ day was conducted during which appetite was assessed around a lunch meal (representative of the diet group) using VAS. Data from ratings of hunger, fullness, prospective consumption and desire to eat were pooled (due to reported similarities). Data are not provided in the paper, but the authors stated that satiety did not differ after the 4 test lunches and was therefore not affected by the carbohydrate content of the diet.

Stoernel *et al* compared the effects of very low carbohydrate (20% energy) diet with a higher carbohydrate (48% energy), low fat energy restricted diet in hypertriglyceridaemic subjects for 8 weeks, but found no difference in satiety between the groups (Stoernell *et al.*, 2008).

Collectively, studies are inconclusive regarding the impact on satiety of replacement of dietary carbohydrate with energy derived from dietary fat or protein.

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Table 6.7 Eating motivation – Total Carbohydrate: Cohort studies

Result ID/ Reference/ Cohort Name	Country, Ethnicity, Inclusion criteria	Age range (mean) %Male	(Cases)/Total	Follow Up (% loss)	Diet Assessment	Exposure	Outcome/ Assessment Details	Mean Outcome (SD)
14752 (Phelan *et al.*, 2007) National Weight Control Registry	USA, Previous weight loss programme participants	(50) %M 29	891	3 years	FFQ	Carbohydrate, total (% energy)	Hunger ratings Bipolar scale	Low carbohydrate dieters: 4.2 (SD 3.2) Other dieters: 4.7 (SD 3.5)

Table 6.8 Eating motivation – High vs. low carbohydrate diets: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
16296 (Beasley *et al.*, 2009)	High carbohydrate	161/164		89 (CI 81, 96)						Premeal appetite summary measure**	VAS 100mm	6 weeks	No change	No bias
	High protein	161/164		78 (CI 69, 87)			0.01						No change	
	High PUFA	161/164		89 (CI 81, 97)			0.92						No change	
16297	High carbohydrate	161/164		-48 (CI -54, -42)						Postmeal appetite summary measure**	VAS 100mm	6 weeks	No change	No bias
	High protein	161/164		-55 (CI -61, -50)			0.005						No change	
	High PUFA	161/164		-48 (CI -54, -42)			0.99						No change	
14346 (Herrmann *et al.*, 2001)	High GI, low fat	9/9		Data not provided			NS			Hunger, Fullness, Prospective consumption, Desire to eat ratings – pooled and averaged	VAS 100mm	8 days	No change	unclear
	High GI, moderate fat	9/9					NS						No change	
	Low GI, low fat	9/9					NS						No change	
	Low GI, moderate fat	9/9					NS						No change	
14361 (Johnston *et al.*, 2004)	High carbohydrate, low fat minus high protein, low fat	High CHO: 7/10 High protein: 9/10						Hunger lower in HPLF	ns	Hunger ratings	Likert scale	1 week	Decrease in both	unclear
14364	High carbohydrate, low fat minus	High CHO: 7/10						Hunger lower in HPLF	ns	Hunger ratings	Likert scale	2 weeks	Decrease in both	unclear

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
	high protein, low fat	High protein: 9/10												
14365	High carbohydrate, low fat minus high protein, low fat	High CHO: 7/10 High protein: 9/10						Hunger lower in HPLF	0.06	Hunger ratings	Likert scale	3 weeks	Decrease in both	unclear
14366	High carbohydrate, low fat minus high protein, low fat	High CHO: 7/10 High protein: 9/10						Hunger lower in HPLF	0.09	Hunger ratings	Likert scale	4 weeks	Decrease in both	unclear
14367	High carbohydrate, low fat minus high protein, low fat	High CHO: 7/10 High protein: 9/10						Hunger lower in HPLF	ns	Hunger ratings	Likert scale	5 weeks	Decrease in both	unclear
14368	High carbohydrate, low fat minus high protein, low fat	High CHO: 7/10 High protein: 9/10						Hunger lower in HPLF	ns	Hunger ratings	Likert scale	6 weeks	Decrease in both	unclear
14403 (Johnstone *et al.*, 2000)	High Carbohydrate Snack	8/8		43						Average over whole day Fullness	VAS 100mm	7 days	No change	bias
	High Fat Snack	8/8		38									No change	
	High Protein Snack	8/8		41									No change	
	No Snack	8/8		37					0.0035				No change	
14399	High Carbohydrate Snack	8/8		32						Average over whole day Hunger ratings	VAS 100mm	7 days	No change	bias
	High Fat Snack	8/8		34									No change	
	High Protein Snack	8/8		32									No change	

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
	No Snack	8/8		37					0.102				No change	
14401	High Carbohydrate Snack	8/8		23						Hunger ratings Midday hunger	VAS 100mm	7 days	No change	bias
	High Fat Snack	8/8		19									No change	
	High Protein Snack	8/8		26									No change	
	No Snack	8/8		37					0.017				No change	
14402	High Carbohydrate Snack	8/8		20						Desire to eat At midday	VAS 100mm	7 days	No change	bias
	High Fat Snack	8/8		15									No change	
	High Protein Snack	8/8		23									No change	
	No Snack	8/8		35					0.003				No change	
14473 (Johnstone *et al.*, 2008)	Medium carbohydrate diet	17/20		23.0 (SE 2.59)						Desire to eat	VAS	4 weeks	Decrease	No bias
	Very low carbohydrate diet	17/20		18.7 (SE 2.59)			0.093						Decrease	
14472	Medium carbohydrate diet	17/20		54.2 (SE 2.02)						Fullness	VAS	4 weeks	Decrease	No bias
	Very low carbohydrate diet	17/20		54.3 (SE 2.02)			0.975						Decrease	
14471	Medium carbohydrate diet	17/20		21.4 (SE 1.76)						Hunger ratings	VAS	4 weeks	Decrease	No bias
	Very low carbohydrate diet	17/20		16.8 (SE 1.76)			0.014						Decrease	

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
14475	Medium carbohydrate diet	17/20		15.6 (SE 1.41)						Preoccupation with food	VAS	4 weeks	Decrease	No bias
	Very low carbohydrate diet	17/20		13.6 (SE 1.41)			0.177						Decrease	
14474	Medium carbohydrate diet	17/20		26.4 (SE 1.92)						Prospective consumption	VAS	4 weeks	Decrease	No bias
	Very low carbohydrate diet	17/20		23.1 (SE 1.92)			0.07						Decrease	
14557	Medium carbohydrate diet	17/20		88.5 (SE 1.67)						Satisfaction with the amount of food given	VAS	4 weeks	Decrease	No bias
	Very low carbohydrate diet	17/20		86 (SE 1.67)			0.164						Decrease	
16835 (Leidy *et al.*, 2007a)	High protein, energy restricted	21/27					NS			Desire to eat	VAS 100mm Personal digital assistant	12 weeks chronic study (average across 3 days)	Decrease	Unclear
	Moderate protein, energy restricted	25/27											Decrease	
16837	High protein, energy restricted	21/27					NS			Fullness	VAS 100mm Personal digital assistant	12 weeks chronic study (average across 3 days)	Decrease	Unclear
	Moderate protein, energy restricted	25/27											Decrease	
16833	High protein, energy restricted	21/27					NS			Hunger ratings	VAS 100mm Personal digital assistant	12 weeks chronic study (average across 3 days)	Decrease	unclear

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Result ID/ Author	Intervention group	Complet ers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcom e Assess-ment Bias
	Moderate protein, energy restricted	25/27											Decrease	
14457 (Leidy *et al.*, 2007b)	High protein, energy restricted	21/27		5365 (SE 622)			0.001			Desire to eat	AUC 195 minutes VAS 100mm	9 weeks Acute meal	Decrease	unclear
	Moderate protein, energy restricted	17/27		6448 (SE 722)									Decrease	
14458	High protein, energy restricted	21/27		13664 (SE 782)			0.123			Fullness	AUC 195 minutes VAS 100mm	9 weeks Acute meal	Decrease	unclear
	Moderate protein, energy restricted	17/27		13405 (SE 783)									Decrease	
14455	High protein, energy restricted	21/27		5365 (SE 622)			0.001			Hunger ratings	AUC 195 minutes VAS 100mm	9 weeks Acute meal	Decrease	unclear
	Moderate protein, energy restricted	17/27		6448 (SE 722)									Decrease	
14905 (Nickols-Richards on *et al.*, 2005)	High carbohydrate	15/15	7.1 (SD 4)	5.9 (SD 3.8)		NS			Not reported	Hunger ratings	Hunger sub-scale of the Stunkard and Messick Eating Inventory completed weekly	6 weeks	Decrease	unclear
	Low carbohydrate	13/13	6.3 (SD 4.1)	3.2 (SD 2.4)		0.03							Decrease	
14425 (Park *et al.*, 2007)	Carbohydrate supplement	13/13	70	75					NS	Fullness	Graded, 5 category rating scale plus 100mm VAS during liquid nutrient satiation test conducted before and after 14d macronutrient supplementation	2 weeks	No change	No bias
	Fat supplement	13/13	75	80									No change	
	Protein supplement	13/13	61	73									No change	
	Standard diet	13/13	72	73									No change	
17034 (Pereira *et al.*, 2004)	Hypoenergetic low fat diet	17/23		4.2 (SD 0.3)						Hunger ratings (over past 24hr)	10 category question	67 days	Decrease	unclear
	Hypoenergetic low GL diet	22/23		3.3 (SD 0.28)			0.04						Decrease	
17035	Hypoenergetic	17/23		4.5 (SD 0.38)						Midday hunger	VAS	67 days	Decrease	unclear

Result ID/ Author	Intervention group	Complet ers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
	low fat diet													
	Hypoenergetic low GL diet	22/23		3.6 (SD 0.33)			0.1						Decrease	
16004 (Sacks *et al.*, 2009)	High-fat, average-protein	ITT: /204		59.4 (SD 17.3)					NS	Desire to eat	VAS 100mm	6 months	Decrease	No bias
	High-fat, high-protein	ITT: /201		61.7 (SD 17.6)									Decrease	
	Low-fat, average-protein	ITT: /204		60.1 (SD 18.8)									Decrease	
	Low-fat, high-protein	ITT: /202		60.1 (SD 17.4)									Decrease	
16005	High-fat, average-protein	ITT: /204		61.5 (SD 18.2)					NS	Desire to eat	VAS 100mm	2 years	Decrease	No bias
	High-fat, high-protein	ITT: /201		62.861.2 (SD 17.7)									Decrease	
	Low-fat, average-protein	ITT: /204		61 (SD 16.5)									Decrease	
	Low-fat, high-protein	ITT: /202		61 (SD 16.3)									Decrease	
16000	High-fat, average-protein	ITT: /204		63.3 (SD 20.3)					NS	Fullness	VAS 100mm	6 months	Decrease	No bias
	High-fat, high-protein	ITT: /201		64.1 (SD 18.9)									Decrease	
	Low-fat, average-protein	ITT: /204		63.5 (SD 20.4)									Decrease	
	Low-fat, high-protein	ITT: /202		62.7 (SD 20)									Decrease	
16001	High-fat, average-protein	ITT: /204		63.1 (SD 18.9)					NS	Fullness	VAS 100mm	2 years	Decrease	No bias
	High-fat, high-protein	ITT: /201		62.8 (SD 19.3)									Decrease	
	Low-fat, average-protein	ITT: /204		62 (SD 21.3)									Decrease	
	Low-fat, high-protein	ITT: /202		61.4 (SD 19.6)									Decrease	
16002	High-fat, average-protein	ITT: /204		34.9 (SD 22.1)					NS	Hunger ratings	VAS 100mm	6 months	Decrease	No bias

Result ID/ Author	Intervention group	Complet ers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcom e Assess-ment Bias
	High-fat, high-protein	ITT: /201		36.5 (SD 20.7)									Decrease	
	Low-fat, average-protein	ITT: /204		37.1 (SD 21.9)									Decrease	
	Low-fat, high-protein	ITT: /202		37.1 (SD 20.9)									Decrease	
16003	High-fat, average-protein	ITT: /204		39 (SD 20.3)						Hunger ratings	VAS 100mm	2 years	Decrease	No bias
	High-fat, high-protein	ITT: /201		41.4 (SD 19.2)					NS				Decrease	
	Low-fat, average-protein	ITT: /204		42.2 (SD 21.2)									Decrease	
	Low-fat, high-protein	ITT: /202		38 (SD 20.1)									Decrease	
14979 (Segal-Isaacson *et al.*, 2004)	Low fat diet	4/4		12						Average over whole follow-up Hunger report frequency (days)	Questionnaire	6 weeks	Decrease	unclear
	Very low carbohydrate	4/4		12			0.974						Decrease	
16289 (Shah *et al.*, 1994)	Energy restricted diet	42/ allocated not reported	68.0 (SD 13.8)	65.4 (SD 12.1)	-1.6 (SD 1.8)			NS	Some decrease, but NS	Hunger – Fullness Scale	VAS 100mm	6 months	Decrease	unclear
	Low fat, high complex carbohydrate diet	47/ allocated not reported	65.1 (SD 11.7)	66.3 (SD 12.3)	0.3 (SD 1.7)		NS						Decrease	
15418 (Shah *et al.*, 1996)	Energy restricted diet	36/36	68.7 (SD 14.1)	66.4 (SD 11.7)						Hunger – Fullness Scale	VAS 100mm	6 months	Decrease	unclear
	Low fat, high complex carbohydrate diet	39/39	66 (SD 12.4)	66.5 (SD 11.9)					Time*diet interaction P=0.67				Decrease	
15419	Energy restricted diet	36/36	68.7 (SD 14.1)	65.5 (SD 14.5)						Hunger – Fullness Scale	VAS 100mm	1 year	Decrease	unclear
	Low fat, high complex carbohydrate diet	39/39	66 (SD 12.4)	64.6 (SD 13.2)									Decrease	

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
16550 (Stoernell *et al.*, 2008)	Low carbohydrate diet	10/14		Scores not provided			NS			Hunger/satiety ratings	7 category Likert scale	8 weeks-average	Decrease	unclear
	Low fat diet	13/14											Decrease	
14479 (Westerterp-Plantenga *et al.*, 2009)	Adequate protein diet	10/10		1120 (SD 360)						Average over whole day Hunger ratings	24hr AUC VAS 100mm, (mm/AUC)	4 days	Not reported	unclear
	High protein diet	10/10		985 (SD 252)			<0.05						Not reported	
14480	Adequate protein diet	10/10		926 (SD 214)						Average over whole day Satiety	24hr AUC VAS 100mm	4 days	Not reported	unclear
	High protein diet	10/10		1065 (SD 220)			<0.05						Not reported	

**appetite summary measure generated from ratings of hunger, plus prospective consumption, minus fullness ratings)

Results - Energy Intake and Carbohydrate Supplements

Summary of cohort results

No cohort studies provided data

Summary of trials results

One randomised double blind trial explored the effects of a 50g carbohydrate supplement (42% glucose, 58% maltodextrins) compared to a control (do nothing) intervention on energy intake over 16 months (Pasman *et al.*, 1997b). An initial 2 month weight loss phase with a very low energy diet was employed, and then the trajectory of weight gain was compared in the 2 groups over a further 14 months in the carbohydrate and control groups. Energy intake data were provided after 2, 8 and 14 months. A further group was also followed which consumed a combination supplement of carbohydrate, chromium-picolinate, caffeine and soluble fibre. These data were not extracted. Details concerning the design, participants, duration and nature of the interventions are included in the trial characteristics table. No significant differences in reported energy intake between groups were observed at any of the assessed time points. These data are consistent with the lack of difference in weight change between groups.

nb. while the authors claim the study was double-blind, it is unclear how this was achieved without a placebo product.

Table 6.9 Energy Intake – Carbohydrate supplement: RCT data

Result ID/ Authors	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
15494 (Pasman *et al.*, 1997b)	Carbohydrate	11/10	7.7 (SD 2.1)	8.3 (SD 1.2)	NS	Energy intake	3-day food diary (MJ/day)	2 months	Increase	unclear
	Control	9/9	5.6 (SD 1.9)	6.6 (SD 2.5)					Increase	
15495	Carbohydrate	11/10	7.7 (SD 2.1)	9.0 (SD 2.1)	NS	Energy intake	3-day food diary (MJ/day)	8 months	Increase	unclear
	Control	9/9	5.6 (SD 1.9)	6.6 (SD 1.7)					Increase	
15496	Carbohydrate	11/10	7.7 (SD 2.1)	8.1 (SD 1.5)	NS	Energy intake	3-day food diary (MJ/day)	14 months	Increase	unclear
	Control	9/9	5.6 (SD 1.9)	7.6 (SD 1.9)					Increase	

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Results - Energy Intake, Eating motivation and Dietary Sugars

Energy intake and dietary sugars

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Ten trials provided data on the effects of diets which varied in sugars (mainly sucrose) content. Of these trials, only four reported energy intake as a primary outcome (Drummond and Kirk, 1998;Mazlan *et al.*, 2006;Raben *et al.*, 2002;Reid *et al.*, 2007).

Three trials used a cross-over design (Brynes *et al.*, 2003;Mazlan *et al.*, 2006;Volp *et al.*, 2008), and the rest used parallel groups. Trial duration ranged from 7 days to 6 months. Most papers did not state, or make clear the extent of blinding of subjects and/or researchers, but 2 were open (Davis *et al.*, 2009;Brynes *et al.*, 2003) and one was classified as single blind (Volp *et al.*, 2008). Trials were conducted in the UK (Brynes *et al.*, 2003;Mazlan *et al.*, 2006;Reid *et al.*, 2007;Drummond and Kirk, 1998;Drummond *et al.*, 2003), the USA (Davis *et al.*, 2009), Europe (Poppitt *et al.*, 2002;Saris *et al.*, 2000), Denmark (Raben *et al.*, 2002) and Brazil (Volp *et al.*, 2008). The number of participants in these trials ranged from 12 to 398, and the median number was 43. Trials by Reid *et al.* (Reid *et al.*, 2007) and Saris *et al.* (Saris *et al.*, 2000) with 161 and 398 participants respectively were particularly large studies.

Other than Davis *et al.* (Davis *et al.*, 2009), which was a study of adolescents, all others used adults (mean age within each trial 21 – 46 years). Four studies used males only (Drummond and Kirk, 1998;Drummond *et al.*, 2003;Brynes *et al.*, 2003;Mazlan *et al.*, 2006), and 2 used females only (Volp *et al.*, 2008;Reid *et al.*, 2007).

Other than the study by Volp *et al.* (Volp *et al.*, 2008) none of these trials advocated an energy restriction goal and participants were free to select their own energy intake level. This was assessed using food diaries in all but one study, where food intake was assessed by monitoring selection from a range of freely available foods over a 7-day period (Mazlan *et al.*, 2006).

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Three studies were not included in a meta-analysis (Volp *et al.*, 2008;Mazlan *et al.*, 2006;Davis *et al.*, 2009). It was not possible to include two of these studies in the meta-analysis due to lack of measures of variation (Volp *et al.*, 2008;Mazlan *et al.*, 2006). Volp *et al.* (Volp *et al.*, 2008) provided energy intakes after 2-weeks of a weight-maintaining, sucrose-rich diet (59% total carbohydrate with 23% sucrose; 28% fat) and a high-fat diet (42% total carbohydrate with 1.3 % sucrose; 45% fat) in 12 lean and obese women. Energy intakes were somewhat higher in the obese group, but in neither group of women was there an energy intake difference between diets.

The study by Mazlan *et al.* was a within-subject, repeated measures study in which 6 lean, unrestrained males consumed mandatory high fat or high sucrose snacks at three energy levels (1, 1.5 or 3.0 MJ/d) for 7 days. In exploring the effect of an increasing mandatory energy intake from high sucrose snacks, energy intake compensation for these snacks was incomplete, and in the region of 30% when the highest energy snacks were consumed. This was somewhat higher (but not statistically so) than that observed for the equivalent high fat snacks (18%). These data indicate that when lean, healthy males are 'forced' to eat high energy snacks which are either sugary or fatty, but of equal energy density, energy compensation is poor and energy overconsumption occurs regardless of the macronutrient source.

The study reported by Davis *et al.* (Davis *et al.*, 2009) was conducted using adolescent subjects and was therefore not included in the meta-analysis. In this study of 54 overweight Latino adolescents, the primary outcomes were insulin sensitivity and measures of adiposity. Subjects were randomised to one of three groups, a control (do nothing group), a reduced sugar, higher fibre diet group and a diet plus exercise group (data not extracted). After 16 weeks, there were no body weight changes in either group, and although the reduced sugar/higher fibre diet group reported consuming 10% less energy than the control group, these means were not significantly different. In the reduced sugar, higher fibre diet group, total carbohydrate intake decreased by 9%, but there was no significant change from baseline in added sugar or dietary fibre.

Collectively, the three studies not included in the meta-analysis do not provide robust and consistent evidence of an effect of variation in sugars intake on energy intake.

Seven studies providing dietary differences in sugar intake between groups were included in the meta-analysis. All studies included adults as participants. Levels of sugar are reported in the trial characteristics table. Studies vary according to whether a substitution or supplementation design was employed, use of non-caloric sweeteners and the form of sugars consumed (solid vs. liquid). In the CARMEN study, a diet with higher "simple" carbohydrate content was compared with a diet high in "complex" carbohydrates and a control diet (Saris *et al.*, 2000;Poppitt *et al.*, 2002). "Simple" carbohydrate provided 18, 21 and 29% of energy in the 'complex', control and high "simple" carbohydrate groups of the study respectively. Between 60-70% of food was provided to the participants from a study supermarket, and "simple" sugars were provided through the provision of both solid and liquid products. In the 'complex' carbohydrate diet, some provided drinks were sweetened with non-caloric sweeteners. Two studies compared a high sugars diet with non-calorically sweetened diet (Drummond *et al.*, 2003;Reid *et al.*, 2007) and one study compared a low fat diet containing 'normal' sugar levels with a low fat, low sugar diet (Raben *et al.*, 2002).

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In the 3-week intervention trial conducted by Brynes *et al.* (Brynes *et al.*, 2003) 4 diets were compared in which the type of carbohydrate was manipulated (high GI, low GI and high sucrose) and compared with a high fat diet. This was achieved by providing participants with a specific food to incorporate into their usual diet, substituting this for other energy sources. The foods were respectively, instant potato, wholegrain rye bread, table sugar and olive oil. Despite guidance to maintain equivalent energy intakes between diets, energy intake during the high fat phase of this cross-over trial was higher than during all three high carbohydrate phases ($p<0.05$). There was no significant difference in energy intake between the high sucrose (90g/d) and the two other high carbohydrate diets (high- and low-GI). Energy intakes were lowest on the low-GI group (non-significant) and this was reflected in the small weight loss experienced during this phase. Since the fibre content of the diets is relatively similar, it is the difference in energy intakes between the high sucrose and high GI groups that was included in the meta-analysis. After 24 days, there were small weight increases in the high fat, sucrose and high GI diet groups (+0.4 to 0.8 kg), and a small decrease in the low GI group (-0.3kg). The latter diet, whilst being low GI, was also the highest in dietary fibre content (31 g/d vs. 19-22 g/d).

Reid *et al.* instead explored the effects of sugars *addition* to the diet, rather than a decrease from habitual intakes (Reid *et al.*, 2007). Diets of 133 women were supplemented with four sucrose or non-calorically sweetened beverages (1000ml in total) daily for 4 weeks. Only partial energy compensation for the additional 1800 kJ consumed daily in the sucrose group was achieved, and total energy intakes remained elevated by 1000 kJ. However, it should be noted that this approach does not demonstrate the impact on energy intake of sugars supplementation *per se*. since no comparison with supplemental fat or protein was undertaken. Similarly, Raben *et al.* employed a sugars supplementation design, albeit with both solid and liquid sources of carbohydrate (Raben *et al.*, 2002). In this study, overweight men and women consumed sucrose supplements which provided 3.4 MJ and 152g sucrose daily or sweetener supplements which provided 1.0 MJ and 0g sucrose daily. After 10 weeks, the sucrose group exhibited only partial compensation for the additional energy provided and energy intakes remained higher by 1.6 MJ per day.

Two studies with a similar design were reported by Drummond *et al.* Both were designed to compare the impact of advice to reduce either fat intake only or both fat and sugars intake on dietary intake, body weight and body composition in Scottish men. In the 1998 study by Drummond and Kirk, fat intakes were reduced in both the groups advised to do so (from 39-40% to 32-33% energy) (Drummond and Kirk, 1998). In the group advised to reduce both fat and sugars, a small reduction in non-milk extrinsic sugars (NMES) and 'added sugars' was also achieved (NMES % 9.9 to 8.1) over 6 months. This energy was partially replaced with an increase in starch, but overall energy intakes were lowest in the reduced fat and sugars group (12% reduction) compared with the fat reduction (7% reduction) or control (3% reduction) groups. The later study by this group repeated this approach but in males with elevated blood cholesterol (Drummond *et al.*, 2003). In this study, fat intakes remained unchanged in both groups, but sugars were reduced in the sugar-reduction advice group (by 14 g/d). At the 8-week intake assessment, energy intakes were lower in the fat and sugar reduction group. However, there was a baseline energy intake imbalance, with lower energy intakes in this group initially.

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The first follow up reported at the end of the intervention was used in the meta-analysis. This varied from 4 weeks to 6 months. The overall pooled estimate indicated that energy intake was 1274 kJ (304 kcal) (95% CI, 889 kJ (212 kcal) to 1660 kJ (397 kcal)) higher with consumption of a high sugar diet. This was significantly different from zero ($p<0.001$). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 71%). Statistically, there was evidence of lower energy intakes with diets lower in sugar content when compared with higher sugar diets, however it should be recognised that diets that vary in sugars tend also to vary in dietary fibre, energy density and GI.

Figure 6.6 Forest plot for dietary sugars and energy intake (kJ/d)

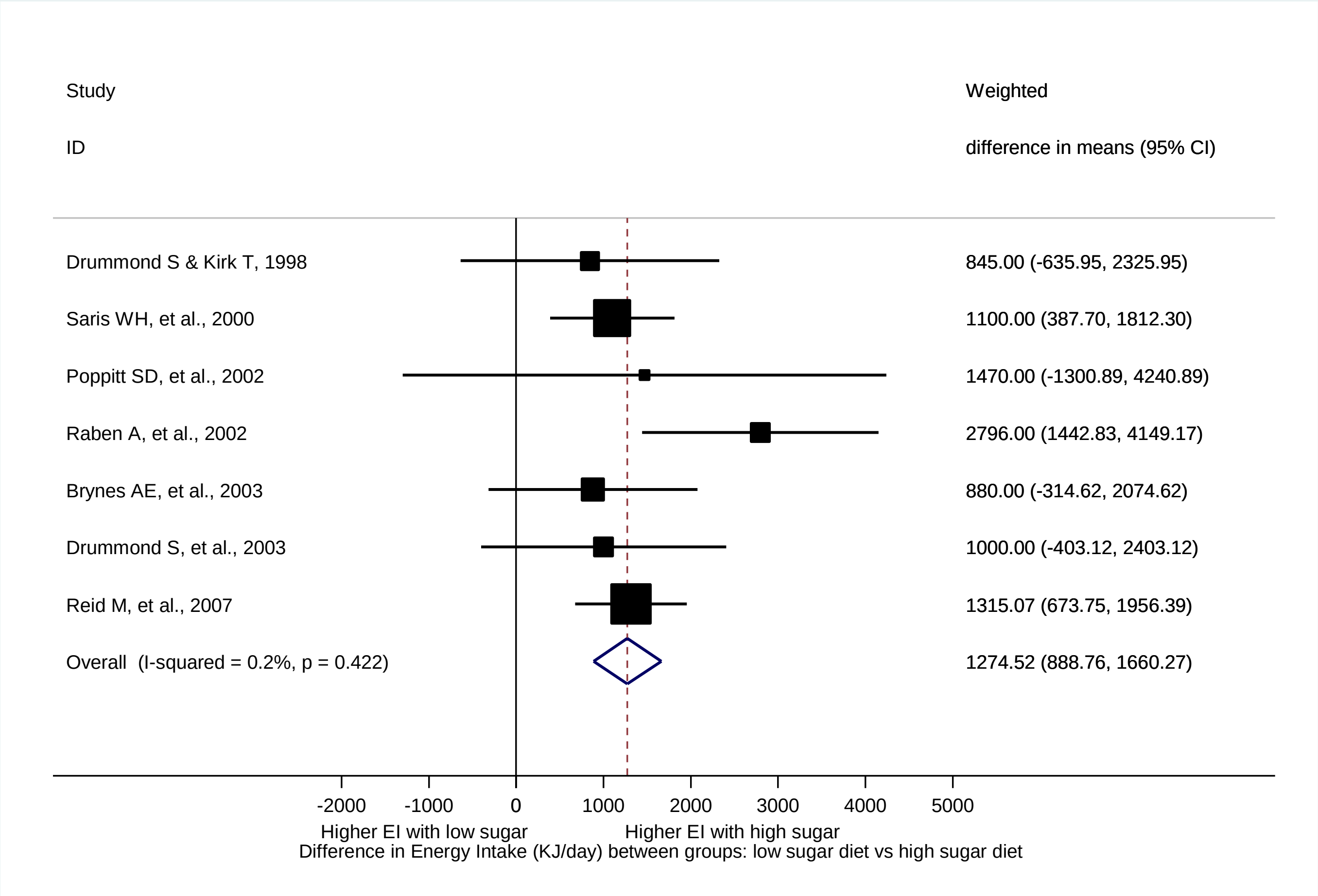

Table 6.10 Energy Intake – High sugar diets: RCT data

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
Adolescent study												
15367 (Davis *et al.*, 2009)	Control	16/22	1957.7 (SE 721.9)	2146.6 (SE 987.0)				Energy intake	3-day food diary (kcal/day)	16 weeks	No change	unclear
	High fibre, low sugar diet	21/22	1954.5 (SE 678.8)	1752.1 (SE 616)			NS				No change	
Adult studies												
*14395 (Brynes *et al.*, 2003)	High GI	17/22		9.02 (SE 0.34)				Energy intake	7d food diary (kJ/day)	3 weeks	No change	unclear
	High MUFA	17/22		10.9 (SE 0.51)			Sig. diff from all 3 high carbohydrate groups, P<0.05				No change	
	Low GI	17/22		7.82 (SE 0.45)							Decrease	
	Sucrose	17/22		9.9 (SE 0.51)							Increase	
14855 (Drummond and Kirk, 1998)	Control – no advice	25/25	2495 (SD 398.6)	2359 (SD 406.3)		NS	Not provided	Energy intake	4 day food diary (kcal/day)	2 weeks	No change	unclear
	Advised to reduce fat, added sugar and NMES	24/24	2566 (SD 534.7)	1970 (SD 427.1)		<0.001					No change	
	Advised to reduce fat	25/25	2639 (SD 399.3)	2239 (SD 461.4)		<0.005					Small decrease	
14856	Control – no advice	25/25	2495 (SD 398.6)	2357 (SD 410.0)		NS	Not provided	Energy intake	4 day food diary (kcal/day)	4 weeks	No change	unclear
	Advised to reduce fat, added sugar and NMES	24/24	2566 (SD 534.7)	2051 (SD 422.3)		<0.001					No change	
	Advised to reduce fat	25/25	2639 (SD 399.3)	2316 (SD 547.5)		<0.01					Small decrease	
*14857	Control – no advice	25/25	2495 (SD 398.6)	2420 (SD 428.4)		NS	Not provided	Energy intake	4 day food diary (kcal/day)	6 weeks	No change	unclear
	Advised to reduce fat, added sugar and NMES	24/24	2566 (SD 534.7)	2141 (SD 403.3)		<0.001					No change	

Result ID/ Author		Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
		Advised to reduce fat	25/25	2639 (SD 399.3)	2280 (SD 459.1)		<0.001					Small decrease	
14858		Control – no advice	25/25	2495 (SD 398.6)	2424 (SD 483.8)		NS	Not provided	Energy intake	4 day food diary (kcal/day)	6 months	No change	unclear
		Advised to reduce fat, added sugar and NMES	24/24	2566 (SD 534.7)	2253 (SD 599.6)		<0.001					No change	
		Advised to reduce fat	25/25	2639 (SD 399.3)	2455 (SD 664.2)		NS					Small decrease	
15103 (Drummond *et al.*, 2003)		Advised to reduce fat	completers not reported/~ 22	9.7 (SE 0.38)	9.21 (SE 0.8)		NS		Energy intake	4- day food diary (MJ/day)	4 weeks	Not reported	unclear
		Advised to reduce fat and NMES	completers not reported/~ 22	8.49 (SE 0.27)	8.03 (SE 0.76)		NS	NS				Not reported	
*15104		Advised to reduce fat	completers not reported/~ 22	9.7 (SE 0.38)	9.39 (SE 0.54)		NS		Energy intake	4- day food diary (MJ/day)	8 weeks	Not reported	unclear
		Advised to reduce fat and NMES	completers not reported/~ 22	8.49 (SE 0.27)	8.39 (SE 0.47)		NS	NS				Not reported	
17016 (Mazlan *et al.*, 2006)	Lean subjects	1.5MJ high sugar snack	6/12		10.4		NS		Energy intake	EI excluding supplement All food weighed by investigators (MJ/day)	7 days	No change	unclear
	Lean subjects	3.0MJ high sugar snack	6/12		10.4		0.05					No change	
	Lean subjects	Control for high sugar snack	6/12		11.3							No change	
17017	Overweight subjects	1.5MJ high sugar snack	6/12		11.7		NS		Energy intake	EI excluding supplement All food weighed by investigators (MJ/day)	7 days	No change	unclear
	Overweight subjects	3.0MJ high sugar snack	6/12		10.6		0.05					No change	
	Overweight subjects	Control for high sugar snack	6/12		11.6							No change	
16474 (Raben *et*		Sucrose	20/21	9835 (SE 616)	11202 (SE 517)		NS	<0.001	Energy intake	7-day food diary	5 weeks	Increase	unclear

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
al., 2002)	Sweetener	20/20	9095 (SE 563)	8713 (SE 542)		NS			(kJ/day)		Decrease	
*16476	Sucrose	21/21	9835 (SE 616)	11452 (SE 551)		<0.05	<0.0001	Energy intake	7-day food diary (kJ/day)	10 weeks	Increase	unclear
	Sweetener	20/20	9095 (SE 563)	8656 (SE 416)		NS					Decrease	
*14424 (Reid *et al.*, 2007)	Aspartame	65/65	7799.63 (SD 1915.92)	7407.37 (SD 1955.5)				Energy intake	7-day food diary (kJ/day)	4 weeks	Decrease	unclear
	Sucrose	68/68	7929.13 (SD 1809.33)	8722.44 (SD 1770.68)			<0.001				Increase	
	Low sucrose diet	22/24		4840.9							No change	
15386 (Poppitt *et al.*, 2002)	Control	completers not reported/15	8366	7860			Means not different	Energy intake	3-7-day food diary (kJ/day)	1 month	No change	bias
	Low-fat high-”complex” carbohydrate diet	completers not reported/16	9430	7829							Decrease	
	Low-fat, high-”simple” carbohydrate diet	completers not reported/15	9365	8167							No change	
15387	Control	completers not reported/15	8366	8478			Means not different	Energy intake	3-7 day food diary (kJ/day)	3 months	No change	bias
	Low-fat high-”complex” carbohydrate diet	completers not reported/16	9365	8240							Decrease	
	Low-fat, high-”simple” carbohydrate diet	completers not reported/15	9430	9962							No change	
15388	Control	completers not reported/15	8366	7467			Means not different	Energy intake	3-7 day food diary (kJ/day)	4 months	No change	bias
	Low-fat high-”complex” carbohydrate	completers not reported/1	9430	9050							Decrease	

Result ID/ Author		Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
		diet	6										
		Low-fat, high-"simple" carbohydrate diet	completers not reported/15	9365	10392							No change	
15389		Control	7/15	8366	8281			Means not different	Energy intake	3-7 day food diary (kJ/day)	6 months	No change	bias
		Low-fat high-"complex" carbohydrate diet	12/16	9430	7316							Decrease	
		Low-fat, high-"simple" carbohydrate diet	13/15	9365	9790							No change	
*15396		Control	7/15	8366	8022 (SD 1868)			Means sig. different from each other, P<0.05	Energy intake	3-7 day food diary (kJ/day)	6 months-average	No change	bias
		Low-fat high-"complex" carbohydrate diet	12/16	9430	8108 (SD 2689)							Decrease	
		Low-fat, high-"simple" carbohydrate diet	13/15	9365	9578 (SD 2600)							No change	
*15222 (Saris *et al.*, 2000)		Control diet	77/77	11.1 (SD 3.6)		-0.8 (SD 2.4)			Change in energy intake	3-7 day food diary (MJ/day)	6 months	No change	unclear
		Low-fat high-"complex" carbohydrate diet	83/83	11.1 (SD 3.6)		-1.8 (SD 2.4)		<0.05				Decrease	
		Low-fat, high-"simple" carbohydrate diet	76/76	11.1 (SD 3.6)		0.7 (SD 2.1)		<0.01				Decrease	
16391 (Volp *et al.*, 2008)	BMI < 25	High fat diet	5/12	2065	1729			NS	Energy intake	3-day food diary (kcal/day)	14 days	No change	unclear
	BMI < 25	High sucrose diet	5/12	2065	1764							No change	
16392	BMI 25+	High fat diet	5/12	1997	1753			NS	Energy intake	3-day food	14 days	No change	unclear

Result ID/ Author		Intervention group	Completers / Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
	BMI 25+	High sucrose diet	5/12	1997	2143					diary (kcal/day)		No change	

*This result was used in the meta-analysis of high sugar diets and energy intake (Figure 6.6)

Eating motivation and dietary sugars

Summary of cohort results

No cohort studies provided data

Summary of trials results

Two studies provided data on the effects of sugars (both sucrose) on eating motivation. Due to an insufficient number of studies, it was not possible to combine these studies using meta-analysis.

Mazlan *et al.* (Mazlan *et al.*, 2006) undertook a within-subject, repeated measures study in which 6 lean, unrestrained males consumed mandatory high fat or high sucrose snacks at three energy levels (1, 1.5 or 3.0 MJ/d) for 7 days. In exploring the effect of an increasing mandatory energy intake from high sucrose snacks, no effect on any of the ratings of eating motivation was found. Energy intake compensation for these snacks was incomplete, and in the region of 30% when the highest energy snacks were consumed. This was somewhat higher (but not statistically so) than that observed for the equivalent high fat snacks (18%). These data indicate that when lean, healthy males are 'forced' to eat high energy snacks which are either sugary or fatty, but of equal energy density, energy compensation is poor and energy overconsumption occurs. This study also indicates that under conditions of equal energy density, the macronutrient source itself does not have a marked impact on energy intake compensation.

Using a more ecologically-valid design, Surwit *et al.* (Surwit *et al.*, 1997) explored the effects of energy-restricted, low fat, high or low sucrose diets on hunger ratings in 42 obese black and white women. All foods were supplied to the study participants, using a 3-d rotating menu and hunger was reported each evening by the subjects in a daily diary using a 5 point scale with 1= not a problem, 3 = moderate problem, or 5 = significant problem. Mean scores at baseline and post treatment (see table below) indicated no differences between the diets in terms of problems with hunger (p for interaction term = 0.53). This study provides evidence that under conditions of energy restriction, the inclusion of sucrose as part of a low fat weight loss regimen does not have an impact on subjective reports of hunger when compared to a low sucrose diet.

Neither of these studies indicate an effect of high sucrose-containing foods on aspects of eating motivation. The study reported by Mazlan *et al.* (Mazlan *et al.*, 2006) was well-controlled, being conducted under laboratory conditions in which all foods other than the mandatory snack items were provided in excessive, *ad libitum* quantities in order to permit the free expression of eating motivation. It was therefore a potentially sensitive design in terms of being able to detect small effects of macronutrients on eating motivation. However, only a small number of male participants were used, and the study duration was relatively short. Whether the subjects would have compensated more fully for the snack manipulations in time, is unknown.

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Table 6.11 Eating motivation – High sugar diets: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
15055 (Surwit *et al.*, 1997)	High sucrose diet	20/28	1.93 (SD 0.89)	1.62 (SD 0.85)	NS	Hunger ratings	5-category scale recorded in daily diary	6 weeks	Decrease	unclear
	Low sucrose diet	22/24	1.58 (SD 0.63)	1.26 (SD 0.61)				6 weeks	Decrease	
(Mazlan *et al.*, 2006) 17028	1.5MJ high sugar snack	12/12			NS	Desire for something sweet	VAS (mm)	7 days	No change	unclear
	3.0MJ high sugar snack	12/12			NS				No change	
	Control for high sugar snack	12/12							No change	
17024	1.5MJ high sugar snack	12/12			NS	Desire for something savoury	VAS (mm)	7 days	No change	unclear
	3.0MJ high sugar snack	12/12			NS				No change	
	Control for high sugar snack	12/12							No change	
17026	1.5MJ high sugar snack	12/12			NS	Fullness	VAS (mm)	7 days	No change	Unclear
	3.0MJ high sugar snack	12/12			NS				No change	
	Control for high sugar snack	12/12							No change	
17025	1.5MJ high sugar snack	12/12			NS	Hunger ratings	VAS (mm)	7 days	No change	unclear
	3.0MJ high sugar snack	12/12			NS				No change	
	Control for high sugar snack	12/12							No change	
17027	1.5MJ high sugar snack	12/12			NS	Prospective consumption	VAS (mm)	7 days	No change	unclear
	3.0MJ high sugar snack	12/12			NS				No change	
	Control for high sugar snack	12/12							No change	

Results - Energy Intake and “Complex” Carbohydrate

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Two trials provided data on the effects of consuming diets high or low in “complex” carbohydrate on energy intake as assessed using food diaries (Poppitt *et al.*, 2002;Saris *et al.*, 2000). Thirteen subjects in the trial reported by Poppitt *et al.* (n=46) were participants in the CARMEN study reported by Saris *et al.* (n=398), so there is an overlap of subjects between these 2 trials. They were of similar design; both were parallel group design trials which compared a control group (diet representative of the national average – 48% carbohydrate), a high “complex” carbohydrate (49% carbohydrate - polysaccharides), low fat diet and a high “simple” carbohydrate, low fat diet. Neither paper defined the term “complex” carbohydrate. The term has a different meaning in different studies and across time. In these studies, the “complex” carbohydrate diet was high in polysaccharides (starch), and the “simple” carbohydrate diet was high in mono- and disaccharides. All diets were completely *ad libitum*, and energy intakes were assessed using food diaries. In the region of 60-70% of all food was provided. Each trial lasted 6 months. In both trials, participants were overweight or obese, and in Poppitt *et al.* also had ≥3 metabolic syndrome risk factors.

Comparison of energy intakes between the diet groups indicated that in both studies there were statistically significant differences between all groups. In Poppitt *et al.* the 6-month average energy intake was lower in the high “complex” carbohydrate group than the high “simple” carbohydrate group, but slightly higher than the control group. In Saris *et al.* the greatest decrease in energy intake was reported by the high “complex” carbohydrate group and this was reflected in weight losses (albeit non-significantly different from ‘simple’ carbohydrate group) observed in this group. Poppitt *et al.* highlight the large degree of under-reporting within the trial and urge caution in interpretation of the macronutrient changes reported. Saris *et al.* however, consider that compliance with the dietary changes was robust in their study because of the use of a shop system for delivery of study foods.

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Table 6.12 Energy Intake – “Complex” carbohydrates: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
15386 (Poppitt *et al.*, 2002)	Control	completers not reported/15	8366	7860		Means not different	Energy intake	3-7d food diary (kJ/day)	1 month	No change	bias
	Low fat, high complex CHO	completers not reported/16	9430	7829						Decrease	
	Low fat, high “simple” CHO	completers not reported/15	9365	8167						No change	
15387	Control	completers not reported/15	8366	8478		Means not different	Energy intake	3-7d food diary (kJ/day)	3 months	No change	bias
	Low fat, high complex CHO	completers not reported/16	9365	8240						Decrease	
	Low fat, high “simple” CHO	completers not reported/15	9430	9962						No change	
15388	Control	completers not reported/15	8366	7467		Means not different	Energy intake	3-7d food diary (kJ/day)	4 months	No change	bias
	Low fat, high complex CHO	completers not reported/16	9430	9050						Decrease	
	Low fat, high “simple” CHO	completers not reported/15	9365	10392						No change	
15389	Control	7/15	8366	8281		Means not different	Energy intake	3-7d food diary (kJ/day)	6 months	No change	bias
	Low fat, high complex CHO	12/16	9430	7316						Decrease	
	Low fat, high “simple” CHO	13/15	9365	9790						No change	
15396	Control	7/15	8366	8022 (SD 1868)		Means sig. different from each other, P<0.05	Energy intake	3-7d food diary (kJ/day)	6 months-average	No change	bias
	Low fat, high complex CHO	12/16	9430	8108 (SD 2689)						Decrease	
	Low fat, high “simple” CHO	13/15	9365	9578 (SD 2600)						No change	
15222 (Saris *et al.*, 2000)	Control diet	77/77	11.1 (SD 3.6)		-0.8 (SD 2.4)		Change in energy intake	3-7d food diary (kJ/day)	6 months	No change	unclear
	Low-fat high-complex carbohydrate diet	83/83	11.1 (SD 3.6)		-1.8 (SD 2.4)	<0.05				Decrease	
	Low-fat, high-”simple” carbohydrate diet	76/76	11.1 (SD 3.6)		-0.7 (SD 2.1)	<0.01				Decrease	

Results - Energy Intake and High Fibre Diets

Summary of cohort results

No cohort studies provided data

Summary of trials results

Eight studies provided data on the effects of high fibre diets composed of naturally fibre–rich foods rather than single source fibre isolates (Andersson *et al.*, 2007;Kesaniemi *et al.*, 1990;Olendzki *et al.*, 2009;Sciarrone *et al.*, 1993;Singh *et al.*, 1992;Thompson *et al.*, 2005;Davis *et al.*, 2009;Lee *et al.*, 2009). Of these studies, one reported energy intake as a primary outcome (Kesaniemi *et al.*, 1990).

Data from one study were not included in the tables or the meta-analysis due to convincing evidence of poor study quality (Singh *et al.*, 1992).

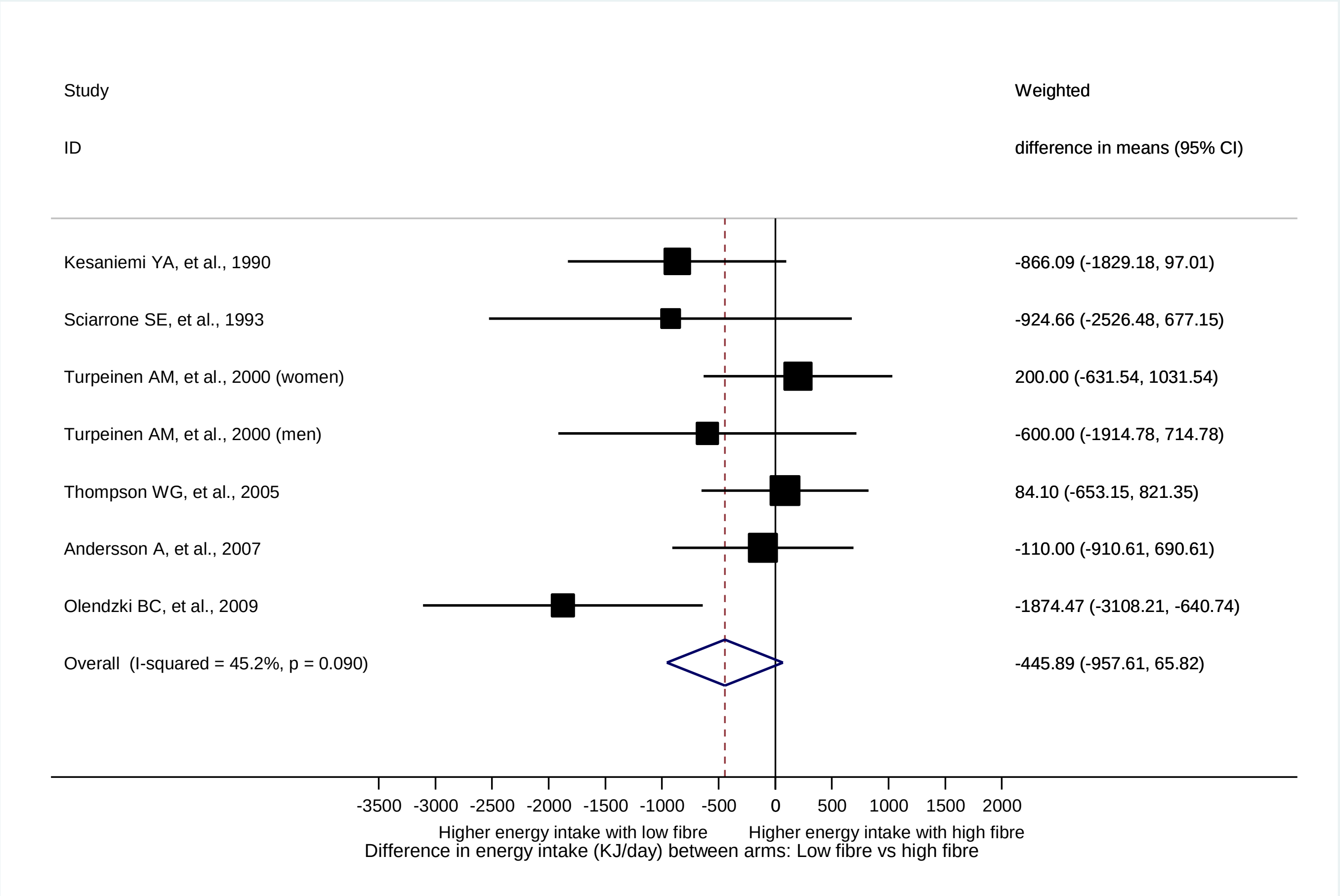
These studies were conducted in Sweden, Finland (2), USA (4), and Australia. The study mean BMI in each trial ranged from 26 to 35g/m^2. One study included adolescents aged 14-18 years (Davis *et al.*, 2009), but the mean age within each of the other trials ranged from 41 to 59. Other than the study by Kesaniemi *et al.* (Kesaniemi *et al.*, 1990) which included males only, all were mixed gender.

Four studies used a cross-over design (Andersson *et al.*, 2007;Kesaniemi *et al.*, 1990;Turpeinen *et al.*, 2000;Swain *et al.*, 1990) and the others studied parallel dietary groups. The study by Sciarrone *et al.* was single blind (Sciarrone *et al.*, 1993) from the perspective of the research staff being blind to group allocation of each participant for biochemical assessments but it is unclear if this was also the case for analysis of food intake reports. In none of the other studies were participants and research staff blind to the nature of the diet allocated. Two studies were judged to be clearly free of bias concerning allocation sequence generation and concealment (Thompson *et al.*, 2005;Olendzki *et al.*, 2009); none were judged to be clearly biased in these respects. The average sample size was rather small at 41 subjects, with a median of 35. Two studies assessed energy intake using the dietary recall method (Olendzki *et al.*, 2009;Kesaniemi *et al.*, 1990) but all others employed the food diary approach.

Six studies providing dietary differences in fibre intake between groups were included in the meta-analysis. All studies included adults as participants. The study by Davis *et al.* was not included as the participants were adolescents aged 14-18 years (Davis *et al.*, 2009). In this study, of 54 overweight Latino adolescents, the primary outcomes were insulin sensitivity and measures of adiposity. Subjects were randomised to one of three groups, a control (do nothing group), a reduced sugar, higher fibre diet group and a diet plus exercise group (data not extracted). After 16 weeks, there were no body weight changes in any group, and although the reduced sugar/higher fibre diet group reported consuming 10±9% less energy than the control group, these means were not significantly different. In the reduced sugar, higher fibre diet group, total carbohydrate intake decreased by 9 ±14%, but there was no significant change from baseline in added sugar or dietary fibre despite this being a stated intervention intention. The study by Swain *et al.* was mistakenly omitted from the meta-analysis. In this 6-week cross-over study 24 participants were given foods containing 100g/day of oat bran or low fibre wheat. Energy intake at study end was not significantly different between the groups (Swain *et al.*, 1990).

Definitions of different dietary fibre interventions are reported in the trial characteristics table, but the low fibre dietary groups consumed between 13 and 24g per day (mainly AOAC fibre), and the high fibre comparison diets delivered between 25 and 41g per day. On average, there was an 83% increase in dietary fibre intake in moving from the low to the high fibre diets. The first follow up reported at the end of the intervention was used. This varied from 3 weeks and 48 weeks. The overall pooled estimate indicated that energy intake was 446 kJ (107kcal) (95% CI, -66 kJ (-16 kcal) to 958 kJ (229 kcal)) lower with consumption of a high fibre diet but this was not significantly different from zero (p=0.09). Heterogeneity denoted by I^2 was 45% (95% CI, 0 to 77). Statistically, there was no evidence of a difference in energy intake with differences in fibre intake.

Figure 6.7 Forest plot for high fibre diets and energy intake (kJ per day)



Note: Results from one study were mistakenly omitted from the meta-analysis. No significant difference in energy intake was reported in this study between the oat bran or low fibre wheat supplement groups (Swain *et al.*, 1990) (see Table 6.13).

Table 6.13 Energy Intake – High fibre diets: RCT data

Result ID/ Author	Subgroup detail	Intervention group	Compl-eters/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value difference between groups	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
Adolescent study													
15367 (Davis *et al.*, 2009)		Control	16/22	1957.7 (SE 721.9)	2146.6 (SE 987.0)				Energy intake	3-day food diary (kcal/day)	16 weeks	No change	unclear
		High fibre, low sugar diet	21/22	1954.5 (SE 678.8)	1752.1 (SE 616)		NS					No change	
Adult studies													
*14067 (Andersson *et al.*, 2007)		Refined grain products	28/30	8005 (SD 1420)	9065 (SD 1475)				Energy intake	3-day food diary (kJ/day)	6 weeks	No change	unclear
		Wholegrain products	27/30	8600 (SD 1645)	8955 (SD 1580)		0.73					No change	
*14677 (Kesaniemi *et al.*, 1990)		High fibre	34/34		2350 (SE 92)		<0.001		Energy intake	7 day food diary (kcal/day)	8 weeks	No change	unclear
		Low fibre	34/34		2557 (SE 73)							No change	
*17101 (Olendzki *et al.*, 2009)		Hypoenergetic high fibre	12/12	2041.49 (SE 101.1)		-464.05 (SE 94.52)		No sig. diff among conditions over time	Energy intake	3x24 hr recall (kcal/day)	3 months	Decrease	unclear
		Hypoenergetic high fibre and low saturated fat	9/9	2137.37 (SE 116.75)		-638.91 (SE 109.15)						Decrease	
		Hypoenergetic low saturated fat	10/10	1710.28 (SE 110.75)		-190.9 (SE 103.54)						Decrease	
17103		Hypoenergetic high fibre	12/12	2041.49 (SE 101.1)		-364.82 (SE 94.52)			Energy intake	3x24 hr recall (kcal/day)	6 months	Decrease	unclear
		Hypoenergetic high fibre and low saturated fat	9/9	2137.37 (SE 116.75)		-626.32 (SE 109.15)						Decrease	
		Hypoenergetic low saturated fat	10/10	1710.28 (SE 110.75)		-187.19 (SE 103.54)						Decrease	
*17464 (Sciarrone *et al.*, 1993)		Lacto-ovovegetarian diet	10/~10		2437 (SD 452)		NS		Energy intake	4 x 1 day weighed food records (kcal/day)	6 weeks	Decrease	No bias
		Omnivorous diet	10/~10		2658 (SD 421)							Decrease	
16358 (Singh *et al.*, 1992)													
(Swain *et al.*, 1990)		Low fibre wheat supplement	11/11	2065 (SD 598)	2315 (SD 616)		NS		Energy intake	4-day food diary (kcal/day)	6 weeks	No change	No bias
		Oat bran supplement	9/9		2429 (SD 675)							No change	
*17078 (Thompson *et al.*, 2005)		Energy restriction + dairy	22/30		1490.1 (SD 233.7)		NS		Energy intake	3-day food diary (kcal/day)	48 weeks	Decrease	bias
		Energy restriction + dairy + fibre	24/31		1510.2 (SD 351)							Decrease	

*14430 (Turpeinen *et al.*, 2000)	Men	Low fibre wheat bread	18/43	9400 (SE 600)		Energy intake	4-day food diary (kJ/day)	3 weeks	No change	unclear
	Men	Wholemeal rye bread	18/43	8800 (SE 300)	NS				No change	
*14431	Women	Low fibre wheat bread	21/43	6800 (SE 300)		Energy intake	4-day food diary (kJ/day)	3 weeks	No change	unclear
	Women	Wholemeal rye bread	21/43	7000 (SE 300)	NS				No change	

*This result was used in the meta-analysis of high fibre diets and energy intake

Results - Energy Intake, Eating Motivation and Fibre Isolates, Fermentable Oligosaccharides

Intakes of fermentable oligosaccharides in Western populations have been estimated to range between 2 to 12g per day (Roberfroid, 1993), with certain plants being rich sources such as artichokes, onions, asparagus and chicory. Additionally, certain fermentable oligosaccharides are used as a food additive, either for gelling and/or thickening effects or as a prebiotic. Various oligosaccharide preparations have been explored in studies with an intervention duration ranging from 2 weeks to 6 months. The range of different fermentable oligosaccharides here included inulin (Letexier *et al.*, 2003), mixed inulin-type fructans which are a mixture of low-, medium and high degree of polymerisation fructans, such as Synergy 1 or Synergy HP (Forcheron and Beylot, 2007;Cani *et al.*, 2009), Yacon syrup (Genta *et al.*, 2009), oligofructose products such as Raftilose P95, which is a short- and medium-chain preparation with a degree of polymerisation between 2 to 10 and an average of 4. These were administered in doses ranging from 10-18g/d, and were compared to placebo or control products such as maltodextrin. In the study by Luo *et al.* however, 20g short-chain fructooligosaccharides were included in 100g cookies and compared with a similar sucrose-sweetened product (Luo *et al.*, 1996). For a review of the chemistry, nomenclature and functional food properties of the inulin-type fructans see (Roberfroid, 2007).

Various methods of administration were employed to incorporate the fermentable oligosaccharide products into the diet. The majority of studies asked the participants to add the powdered product to either food or drinks, generally in 2-3 doses across the day (Cani *et al.*, 2006;Cani *et al.*, 2009;Forcheron and Beylot, 2007;Letexier *et al.*, 2003;Parnell and Reimer, 2009;Pasman *et al.*, 2006;van den Heuvel *et al.*, 2004;Whelan *et al.*, 2006). Alternatively, the fermentable oligosaccharides were incorporated into food products such as cookies (Luo *et al.*, 1996), or spreads (Davidson *et al.*, 1998;Pedersen *et al.*, 1997), or consumed as a naturally rich source e.g. yacon root syrup (Genta *et al.*, 2009).

Energy intake and fibre isolates, fermentable oligosaccharides

Summary of cohort results

No cohort studies provided data

Summary of trials results

Eleven studies provided data on the effects of fermentable oligosaccharide consumption on energy intake.

The most common method used to assess energy intake in these studies was the food diary or food record. In most cases, insufficient details are provided concerning the methods used and this is likely because energy intake assessment was not one of the primary outcomes of the studies (except (Cani *et al.*, 2006;Cani *et al.*, 2009;Parnell and Reimer, 2009;Pasman *et al.*, 2006)).

The subjects in these trials tended to be younger adults (between 20 and 35 years), although in Davidson *et al.* the mean age was 60 years (Davidson *et al.*, 1998). Two studies used female subjects only (Genta *et al.*, 2009;Pedersen *et al.*, 1997) and 3 males only (Luo *et al.*, 1996;Pasman *et al.*, 2006;van den Heuvel *et al.*, 2004). In 7 of the 11 studies, average BMI was indicative of a lean population (BMI ≤25), and in the remaining 4 studies the average was 28-34kg/m^2. It is possible that the participants included in these trials, being generally fairly young and non-obese are better energy intake regulators than would be an older, more obese population.

Studies were conducted in Argentina, Belgium (2), Canada, Denmark, France (3), The Netherlands (2) and the USA.

One trial was categorised as single-blind (Cani *et al.*, 2006), but all others were judged to be double-blind. Six trials used a cross-over design (van den Heuvel *et al.*, 2004;Pedersen *et al.*, 1997;Luo *et al.*, 1996;Letexier *et al.*, 2003;Davidson *et al.*, 1998;Cani *et al.*, 2006) and 5 trials used the parallel group approach (Pasman *et al.*, 2006;Parnell and Reimer, 2009;Genta *et al.*, 2009;Forcheron and Beylot, 2007;Cani *et al.*, 2009). The mean number of participants per trial was small (n=30), with a median of 20. The study by Genta *et al.* (Genta *et al.*, 2009) did not provide a sufficiently clear explanation of the nature of the interventions to categorise the study as providing an energy restriction goal or not. None of the other studies advocated an energy restriction goal. Most advised participants to follow their usual diet and consume the fermentable oligosaccharide/placebo as a supplement.

Forcheron and Beylot (Forcheron and Beylot, 2007) investigated the long-term (6 months) effects of supplementing the diet with 10g inulin-type fructans compared to a maltodextrin placebo in 17 healthy volunteers. Energy intake reported in the final week of the intervention (expressed as kcal/kg/day) was not significantly different between groups.

The randomised, double blind study by Parnell and Reimer (Parnell and Reimer, 2009) reported the effects of 12 weeks supplementation with either 21g oligofructose or an isocaloric supplement of maltodextrin in 48 healthy overweight participants. Energy intake was assessed weekly using a 3-day food diary and was generally lower in the oligofructose than the control group, with a statistically significant difference at 6 weeks (29% difference between groups, $p<0.05$). However, by 12 weeks of supplementation, the extent of difference between the groups was diminished and not statistically significant.

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Three studies were not included in the meta-analysis. In 2 studies, reports of energy intake were provided in the text of the paper, but no data were included which could be incorporated in tables or meta-analysis (van den Heuvel *et al.*, 2004;Genta *et al.*, 2009). Van den Heuvel *et al.* (van den Heuvel *et al.*, 2004) reported that the increasing dose of NUTRIOSE (a modified non-digestible dextrin) administered over 3 weeks to 10 healthy males, did not alter food habits relative to the placebo product (dextrin). Genta *et al.* (Genta *et al.*, 2009) assessed the effect of yacon root syrup, a rich source of frucooligosaccharides, on various aspects of health in a group of 55 obese, mildly dyslipidaemic pre-menopausal women. Consumption of yacon syrup at an approximate dose of 10g frucooligosaccharides per day did not influence apparent energy intakes differentially when compared with consumption of an equivalent methylcellulose-based syrup, although weight loss was experienced by the former group only. The study reported by Letexier *et al.* was not included as energy intake was reported in kJ/kg/d but no weight of subjects was reported to convert to total energy intake (Letexier *et al.*, 2003). A somewhat lower energy intake was reported by those consuming inulin (Raftiline HP) at a dose of 10g/d when compared with the equivalent dose of a maltodextrin placebo product. However, the difference was not statistically significant. These 3 studies suggest either no effect of fermentable oligosaccharides on energy intake, or some reduction in intake.

Eight studies providing dietary differences in fermentable oligosaccharides intake between groups were included in the meta-analysis. All studies included adults as participants. Definitions of different levels of fermentable oligosaccharides are reported in the trial characteristics table. The high fermentable oligosaccharide groups administered doses in the range of 10-20g/d (Pasman *et al.* used 30-45g/d) and compared this with either no dietary addition (spread without inulin) (Pedersen *et al.*, 1997) or an equivalent weight of maltodextrin (nb. the energy value of fermentable oligosaccharides is estimated as 1 kcal/g and this may not have been taken into consideration when assessing the impact of these fermentable oligosaccharides on energy intake (Roberfroid *et al.*, 1993)). The first follow up reported at the end of the intervention was used. This varied from 2 weeks to 26 weeks.

The overall pooled estimate indicated that energy intake was 378kJ (95% CI, +36kJ to -791kJ) lower with consumption of a high fermentable oligosaccharide diet. This was not significantly different from zero (p=0.07). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 51). Statistically, these studies do not indicate that a diet high in fermentable oligosaccharides is associated with a lower energy intake when compared with a placebo or control product (generally maltodextrin).

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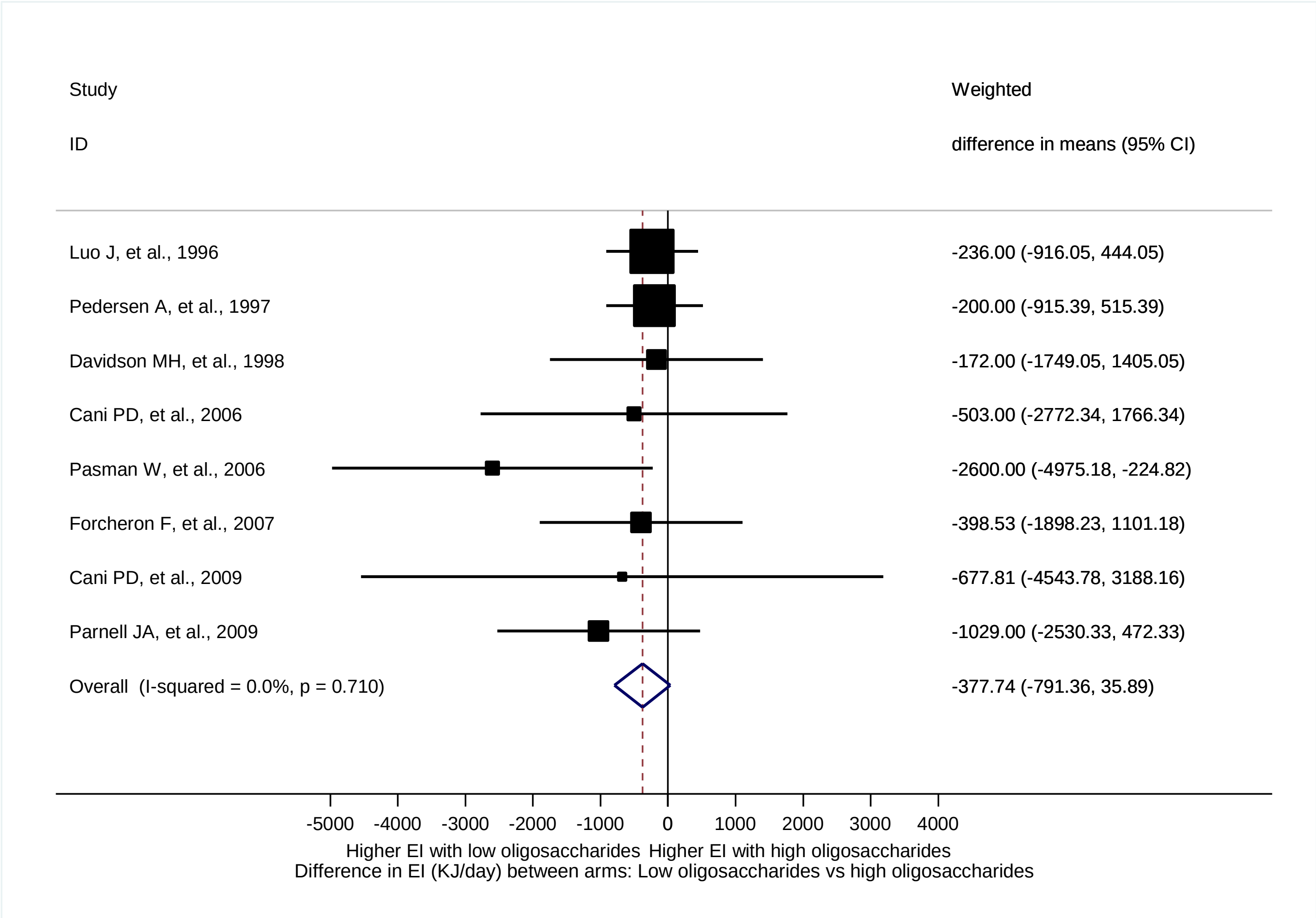
Figure 6.8 Forest plot for fibre isolates, fermentable oligosaccharides and energy intake (kJ per day)



Some exploration of whether there is a dose response effect between oligosaccharides and energy intake was undertaken. The plot below has arranged the studies by order of difference in oligosaccharide between study groups. There does not appear to be any evidence of a dose response below 20g. There is some suggestion that differences larger than 20g may lead to larger effects. However it was not possible to formally test this as there is only 1 study with a difference of more than 21g.

Figure 6.9 Forest plot for fibre isolates, fermentable oligosaccharides and energy intake – exploration of a dose-response effect

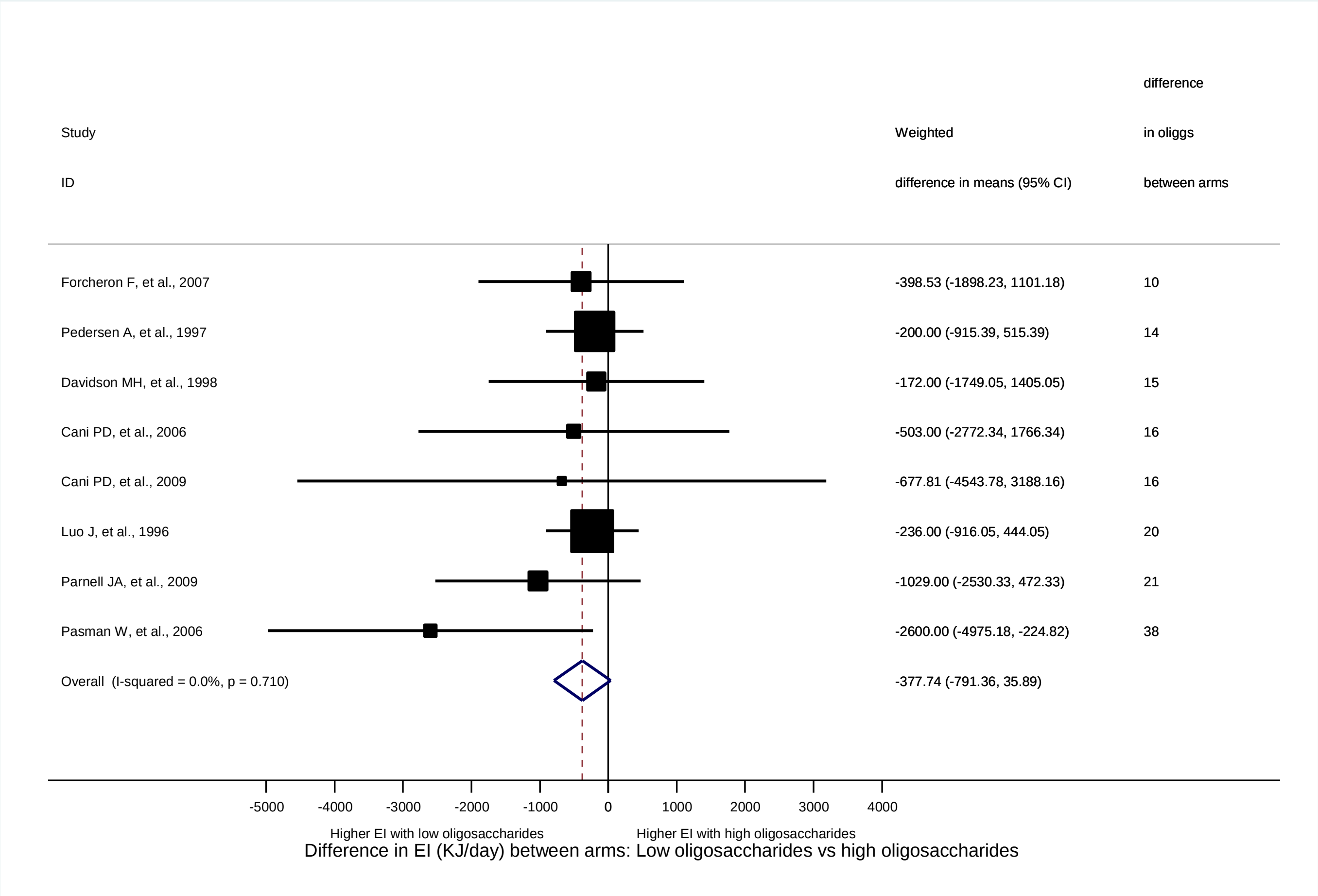


Table 6.14 Energy Intake – Fibre isolates, fermentable oligosaccharides: RCT data

Result ID#/ Reference	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*14432 (Cani *et al.*, 2006)	Oligofructose	10/10		8937 (SE 920)		0.05	Energy intake	Average intake from baseline to follow-up food diary, plus 1 d monitored buffet meals (kJ/day)	2 weeks	Not reported	unclear
	Placebo (Maltodextrin)	10/10		9440 (SE 703)						Not reported	
*14844 (Cani *et al.*, 2009)	Dextrin maltose	5/5		2501 (SE 418)			Energy intake	On day 14, food recall (kcal/d) plus monitored buffet breakfast	14 days	Not reported	No bias
	Fructans	5/5		2339 (SE 218)		NS				Not reported	
*17581 (Davidson *et al.*, 1998)	Control	21/25	6701 (SE 397)	6404 (SE 648)		NS	Energy intake, excluding study foods	3 day food record (kJ/day)	6 weeks	No change	No bias
	Inulin	21/25	6483 (SE 472)	6232 (SE 477)						No change	
*14831 (Forcheron and Beylot, 2007)	Fructans	9/10	30.2 (SE 1.7)	30 (SE 1.6)		Unclear/ NS	Energy intake	7 day food record (no details provided) (kcal/kg/day)	6 months	No change	No bias
	Placebo	8/10	32.7 (SE 2)	31.5 (SE 2.4)						No change	
14558 (Genta *et al.*, 2009)	Placebo syrup	15/15		No data reported	NS	Not reported	Energy intake	Diary maintained throughout (details not provided)	120 days	No change	No bias
	Yacon syrup low dose	completers not reported/20		No data reported	NS					Decrease	
14917 (Letexier *et al.*, 2003)	Inulin	8/8		146 (SE 4)		NS	Energy intake	7-day food diary (kJ/kg/day)	6 weeks	No change	unclear
	Placebo	8/8		151 (SE 5)						No change	
*14360 (Luo *et al.*, 1996)	Fructooligosaccharides	12/12	10677 (SE 245)	10729 (SE 232)		NS	Energy intake	24 hour diary (kJ/day)	4 weeks	No change	No bias
	Sucrose	12/12	10677 (SE 245)	10965 (SE 258)						No change	
*15904 (Parnell and Reimer, 2009)	Maltodextrin placebo	18/18	2249 (SE 132)	2003 (SE 143)			Energy intake	3-day food diary (kcal/day)	12 weeks	No change	unclear
	Oligofructose	21/21	2155 (SE 111)	1757 (SE 114)						Decrease	
*14418	30g	14/14	12.1 (SD 3.9)	10.9 (SD 2.1)		NS	Energy intake	FFQ	35 days	No change	No bias

(Pasman *et al.*, 2006)	oligosaccharide NUTRIOSE						(no details provided) (MJ/day)			
	45g oligosaccharide NUTRIOSE	16/16	10.8 (SD 3.2)	10.7 (SD 3.0)	NS				No change	
	Placebo	13/13	13.5 (SD 3.7)	13.3 (SD 3.4)					Increase	
*14939 (Pedersen *et al.*, 1997)	Control spread	60/72		9.2 (SD 2.1)		Energy intake (MJ/d)	3-day food diary (MJ/day)	4 weeks	Not reported	unclear
	Inulin spread	60/72		9.0 (SD 1.9)	NS				Not reported	
17642 (van den Heuvel *et al.*, 2004)	Placebo low dose	10/10			No differential effect on 'food habits'	Energy intake	FFQ (no details provided)	3 weeks	Not reported	No bias
	Placebo high dose	10/10								
	Fibre (NUTRIOSE) low dose	10/10								
	Fibre (NUTRIOSE) high dose	10/10								

*This result was used in the meta-analysis of fibre isolates, fermentable oligosaccharides and energy intake

Eating motivation and fibre isolates, fermentable oligosaccharides

Summary of cohort results

No cohort studies provided data

Summary of trials results

Seven trials provided data concerning subjective ratings of appetite and fermentable oligosaccharides (Cani *et al.*, 2006;Cani *et al.*, 2009;Genta *et al.*, 2009;Parnell and Reimer, 2009;Pasman *et al.*, 2006;van den Heuvel *et al.*, 2004;Whelan *et al.*, 2006)

Due to variation in study designs, the method of assessing eating motivation and the nature of each intervention, it was not possible to combine these studies using meta-analysis.

Three studies used a cross-over design (Whelan *et al.*, 2006;van den Heuvel *et al.*, 2004;Cani *et al.*, 2006), and 4 the parallel group approach (Pasman *et al.*, 2006;Parnell and Reimer, 2009;Genta *et al.*, 2009;Cani *et al.*, 2009). Studies were conducted in Belgium (2), Argentina, Canada, The Netherlands (2), and the UK. Subject numbers were small, with an average of 29 per study (median = 20). Average body mass index was in the obese range for 2 studies (Parnell and Reimer, 2009;Genta *et al.*, 2009), but in 4 studies it was in the lean range (less than 25kg/m^2) (Cani *et al.*, 2009;Cani *et al.*, 2006;Whelan *et al.*, 2006;van den Heuvel *et al.*, 2004). Participants were all adults. Two studies recruited males only (van den Heuvel *et al.*, 2004;Pasman *et al.*, 2006), and one study included only women (Genta *et al.*, 2009).

Methods of assessing subjective eating motivation varied across studies, although most commonly 100mm visual analogue scales (VAS) were used with a variety of end descriptors.

Other than Genta *et al.* (Genta *et al.*, 2009), in which it was unclear, no studies set an energy restriction goal as part of the intervention.

The 2 studies conducted by the Belgian group tested the effects of daily consumption of 16g of oligofructose compared to 16g/d of maltodextrin on energy intake and satiety (Cani *et al.*, 2006) and (Cani *et al.*, 2009). The earlier study used a single-blinded, crossover, placebo-controlled design, and the later study a double-blind, parallel group design. Both studies used a small number of participants, but both reported some evidence of decreased eating motivation (assessed with 100mm VAS) on a test day conducted after 2 weeks.

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Genta *et al.* 2009 (Genta *et al.*, 2009) reported increased satiety with consumption of yacon syrup (a naturally rich source of fermentable oligosaccharides) compared to a control syrup, but no data were provided, nor was the method of reporting satiety made clear other than that this was recorded in diaries on a daily or frequent basis.

Parnell and Reimer, 2009 (Parnell and Reimer, 2009) conducted a randomized, double-blind, placebo-controlled trial. Overweight adults (n=48) were randomly assigned to receive 21 g/d oligofructose (Raftilose P95) or a placebo (maltodextrin) for 12 weeks. The incremental area under the curve for hunger and desire to eat (assessed using visual analogue scales) associated with a meal tolerance test, were not significantly altered by oligofructose consumption despite reductions in reported energy intake assessed by food diary analysis.

Pasman *et al.* (Pasman *et al.*, 2006) found no impact on hunger and satiety scores in 48 subjects randomised to a maltodextrin placebo (Glucidex®6), 30g, or 45g/d of the dextrin NUTRIOSE® for 4-5 weeks.

The study reported by Van den Heuvel *et al.* (van den Heuvel *et al.*, 2004) had a complex design which aimed to assess the effects of consuming an incompletely hydrolysed dextrin derived from wheat starch, NUTRIOSE ®FB. Using 20 non-obese, healthy males, the effect of increasing doses of this fermentable oligosaccharide on tolerance, food habits and subjective ratings of hunger and satiety were compared with the placebo product maltodextrin (Glucidex®6). Each dose was consumed for 7 days, and on this final day, aspects of hunger and satiety were assessed for 480 minutes from before breakfast using 5, 100mm visual analogue scales (appetite for something sweet, appetite for something savoury, appetite for a meal, satiety (fullness) and feeble/weak with hunger). The data from 10 and 15g/d doses are presented as figures in the paper for hunger and satiety only and expressed as the area under the 480 minute curve (AUC). The authors report that the hunger AUC was lower when the participants consumed NUTRIOSE at the 15/d dose ($p<0.04$). However, there were no apparent differences in hunger between the 10g/d NUTRIOSE and placebo groups, or any differences in subjective satiety at either dose.

Whelan *et al.* (Whelan *et al.*, 2006) reported the effects on 11 healthy normal weight participants of either a pea fibre, inulin and oligofructose-supplemented or standard enteral formula as their sole source of nutrition for 2 weeks. Mean daily fullness ratings were higher during the modified formula phase compared to the standard enteral formula phase ($p=0.03$). Mean daily ratings of desire to eat, hunger, preoccupation with food, and prospective consumption were somewhat lower during the modified enteral formula phase compared to the standard enteral formula phase. However, none of these differences achieved statistical significance. Since the modified enteral formula delivered a mixture of non-digestible carbohydrates, it was not possible to ascribe the increased fullness to the effects of the inulin or fermentable oligosaccharides rather than the pea fibre.

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Five of the seven trials reported reductions in hunger or increased satiety with increased consumption of fermentable oligosaccharides despite large variations in the quality of the studies and methods of assessment.

Table 6.15 Eating motivation - Fibre isolates, fermentable oligosaccharides: RCT data

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
14435 (Cani *et al.*, 2006)	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Fullness Post breakfast	VAS 100mm	2 weeks	Not reported	bias
14441	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Fullness Post dinner	VAS 100mm	2 weeks	Not reported	bias
14438	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Fullness Post lunch	VAS 100mm	2 weeks	Not reported	bias
14434	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Hunger ratings Post breakfast	VAS 100mm	2 weeks	Not reported	bias
14443	Oligofructose	10/10		lower	0.04			Hunger ratings Post dinner	VAS 100mm	2 weeks	Not reported	bias
	Placebo (Maltodextrin)	10/10		higher						2 weeks	Not reported	
14439	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Hunger ratings Post lunch	VAS 100mm	2 weeks	Not reported	bias
14436	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Post breakfast Prospective consumption	VAS 100mm	2 weeks	Not reported	bias
14433	Oligofructose	10/10		higher	0.04			Post breakfast Satiety score	VAS 100mm	2 weeks	Not reported	bias
	Placebo (Maltodextrin)	10/10		lower							Not reported	
14444	Oligofructose	10/10		lower	0.05			Post dinner Prospective consumption	VAS 100mm	2 weeks	Not reported	bias
	Placebo (Maltodextrin)	10/10		higher							Not reported	
14442	Oligofructose	10/10		higher	0.04			Post dinner Satiety score	VAS 100mm	2 weeks	Not reported	bias
	Placebo (Maltodextrin)	10/10		lower							Not reported	
14437	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Post lunch Prospective consumption	VAS 100mm	2 weeks	Not reported	bias
14440	Placebo (maltodextrin) minus oligofructose	Crossover: 10/10				No significant diff		Post lunch Satiety score	VAS 100mm	2 weeks	Not reported	bias
14846 (Cani *et al.*,	Dextrin maltose minus fructans	DM: 5/5 Fructans:				Hunger reduced (treatment X	0.014	Hunger ratings	VAS	14 days	Not reported	No bias

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
2009)		5/5				time effect)						
14845	Dextrin maltose minus fructans	DM: 5/5 Fructans: 5/5				No significant difference (treatment X time effect)	0.1757	Satiety	VAS	14 days	Not reported	No bias
14563 (Genta *et al.*, 2009)	Low dose fructooligosaccharide syrup	unclear		No data			increased satiety reported, but no data provided	Satiety	Diaries (detail not provided)	120 days	Decrease	No bias
	Placebo syrup	15/15		No data							No change	
17167 (Parnell and Reimer, 2009)	Maltodextrin placebo	16/18	72.8 (SD 5.4)	75.3 (SD 6.5)	0.15			Desire to eat	VAS, incremental AUC on meal tolerance test day	12 weeks		No bias
	Oligofructose	21/21	82.0 (SD 5.2)	69.5 (SD 6.3)							No change	
17168	Maltodextrin placebo	16/18	78.2 (SD 4.1)	77.6 (SD 6.4)	NS			Hunger ratings	VAS, incremental AUC on meal tolerance test day	12 weeks		No bias
	Oligofructose	21/21	79.2 (SD 4.1)	66.3 (SD 6.4)							No change	
14423 (Pasman *et al.*, 2006)	30g oligosaccharide NUTRIOSE	14/14			NS			Appetite for a snack	VAS 100mm	35 days	No change	No bias
	45g oligosaccharide NUTRIOSE	16/16			NS						No change	
	Placebo	13/13									Increase	
14420	30g oligosaccharide NUTRIOSE	14/14			NS			Appetite for something savoury	VAS 100mm	35 days	No change	No bias
	45g oligosaccharide NUTRIOSE	16/16			NS						No change	
	Placebo	13/13									Increase	
14419	30g oligosaccharide NUTRIOSE	14/14			NS			Appetite for something sweet	VAS 100mm	35 days	No change	No bias
	45g oligosaccharide NUTRIOSE	16/16			NS						No change	
	Placebo	13/13									Increase	
14421	30g oligosaccharide NUTRIOSE	14/14			NS			Satiety score	VAS 100mm	35 days	No change	No bias
	45g oligosaccharide NUTRIOSE	16/16			NS						No change	
	Placebo	13/13									Increase	
14422	30g oligosaccharide NUTRIOSE	14/14			NS			Weak with hunger	VAS 100mm	35 days	No change	No bias

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	45g oligosaccharide NUTRIOSE	16/16			NS					35 days	No change	
	Placebo	13/13								35 days	Increase	
14380 (van den Heuvel *et al.*, 2004)	Fibre (NUTRIOSE) high dose minus placebo high dose (15g)	Cross-over: 10/10				Hunger ratings lower for NUTRIOSE	0.04	Hunger ratings (ave over day)	480 min AUC	3 weeks	Not reported in both	No bias
14378	Fibre (NUTRIOSE) low dose minus placebo low dose (10g)	Cross-over: 10/10					NS	Hunger ratings (ave over day)	480 min AUC	3 weeks	Not reported in both	No bias
14382	Fibre (NUTRIOSE) low dose minus placebo low dose (10g)	Cross-over: 10/10					NS	Satiety score	480 min AUC	3 weeks	Not reported in both	No bias
14381	Fibre (NUTRIOSE) high dose minus placebo high dose (15g)	Cross-over: 10/10					NS	Satiety score	480 min AUC	3 weeks	Not reported in both	No bias
14415 (Whelan *et al.*, 2006)	Pea-fibre and fructooligosaccharide formula	11/14		47 (CI 34, 59)	0.233			Desire to eat (mean daily value)	(mm/ day)	2 weeks	Decrease	No bias
	Standard enteral formula	11/14		55 (CI 48, 62)							Decrease	
14413	Pea-fibre and fructooligosaccharide formula	11/14		46 (CI 38, 54)	0.035			Fullness (mean daily value)	(mm/ day)	2 weeks	Decrease	No bias
	Standard enteral formula	11/14		37 (CI 26, 48)							Decrease	
14412	Pea-fibre and fructooligosaccharide formula	11/14		42 (CI 33, 51)	0.113			Hunger ratings (mean daily value)	(mm/ day)	2 weeks	Decrease	No bias
	Standard enteral formula	11/14		49 (CI 45, 51)							Decrease	
14417	Pea-fibre and fructooligosaccharide formula	11/14		42 (CI 28, 55)	0.203			Preoccupation with food (mean daily value)	(mm/ day)	2 weeks	Decrease	No bias
	Standard enteral formula	11/14		49 (CI 38, 60)							Decrease	
14416	Pea-fibre/FOS formula	11/14		61 (CI 48, 75)	0.435			Prospective consumption (mean daily value)	(mm/ day)	2 weeks	Decrease	No bias
	Standard enteral formula	11/14		65 (CI 54, 76)							Decrease	

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
14414	Pea-fibre and fructooligosaccharide formula	11/14		39 (CI 28, 51)	0.111			Satiety score (mean daily value)	(mm/ day)	2 weeks	Decrease	No bias
	Standard enteral formula	11/14		34 (CI 24, 44)							Decrease	

Results - Energy Intake, Eating motivation and Resistant Starch

Englyst et al. (Englyst *et al.*, 2007) have described a classification of carbohydrates in which their categorisation is based on 'availability' for digestion by endogenous enzymes in the small intestine. Within the 'unavailable' carbohydrate category are included starches which resist digestion in the small intestine for various reasons. These various types of resistant starch have been categorised into 4 main types RS1-RS4. RS1 is physically inaccessible to endogenous enzymes in the small intestine (e.g. being associated with the structural components of plants), RS2 is also inaccessible as starch granules (raw resistant starch). RS3 resists digestion through its chemical structure (retrograde resistant starch), and RS4 is synthetically modified starch which may be rendered inaccessible through etherisation, esterification or cross-bonding. Estimates of usual human intake have been achieved through the use of ileostomy subjects and via laboratory analysis of food samples. However, both approaches present challenges (Englyst *et al.*, 2007).

Energy intake and resistant starch

Summary of cohort results

No cohort studies provided data

Summary of trials results

Four studies provided data on the effects of starch type on measures of energy intake (De Roos *et al.*, 1995;Ells *et al.*, 2005;Heijnen *et al.*, 1996;Jenkins *et al.*, 1998). Of these, only one reported energy intake as a primary outcome (De Roos *et al.*, 1995). All were cross-over studies, with non-obese subjects, conducted in the Netherlands (2), the UK and Canada. Energy intakes were assessed by dietary history (Jenkins *et al.*, 1998), dietary recall (Heijnen *et al.*, 1996;De Roos *et al.*, 1995) and food diary (Ells *et al.*, 2005). One study used women only (Ells *et al.*, 2005) and one men only (De Roos *et al.*, 1995).

De Roos *et al.* (De Roos *et al.*, 1995) found that in healthy young men permitted to eat *ad libitum*, consumption of 30 g/day of resistant starch for 1 week had little influence on appetite and food intake. Two types of resistant starch were tested, (a high amylose starch (RS2) and an extruded/retrograded high-amylose starch (RS3)) against a glucose control. Energy intakes were similar during all 3 dietary phases. When consuming RS2 starch, the participants tended to have lower ratings of appetite than RS3, but overall there were minor differences between starch types only. All products were consumed for 1 week each in a cross-over design by stirring into yoghurt. The amounts of resistant starch provided here were estimated to be in the region of 6 times that consumed on average in the Netherlands. The energy content of the resistant starch was estimated on the assumption that it was completely indigestible and not taking fermentation into consideration.

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In the study by Ells *et al.* (Ells *et al.*, 2005) food records were collected before and throughout the 14 day starch consumption periods. Two types of starch were consumed in this randomised, double blind trial, a rapidly-digested and a slowly-digested starch. The 14 day adaptation period preceded a one day acute experimental study, but overall there were no differences in energy intake in the 10 healthy, lean females associated with type of starch consumed during the adaptation period.

The effect of resistant starch on energy intake was also assessed by Heijnen *et al.* (Heijnen *et al.*, 1996) using 57 healthy males and females who consumed supplements containing glucose or resistant starch (RS) from raw high-amylose cornstarch (RS2) or from retrograded high-amylose cornstarch (RS3). Each of the starch supplements provided 30g resistant starch per day. Each type of supplement was consumed in addition to the habitual diet for 3 weeks. On the final day of the 3-week intervention, energy intake was assessed using a 24 hour dietary recall, at which point, no differences between the starch types or between the starches and the glucose control were found. It should be noted that these energy intake estimates did not include any energy that might have been potentially available from the products of fermentation of the starches.

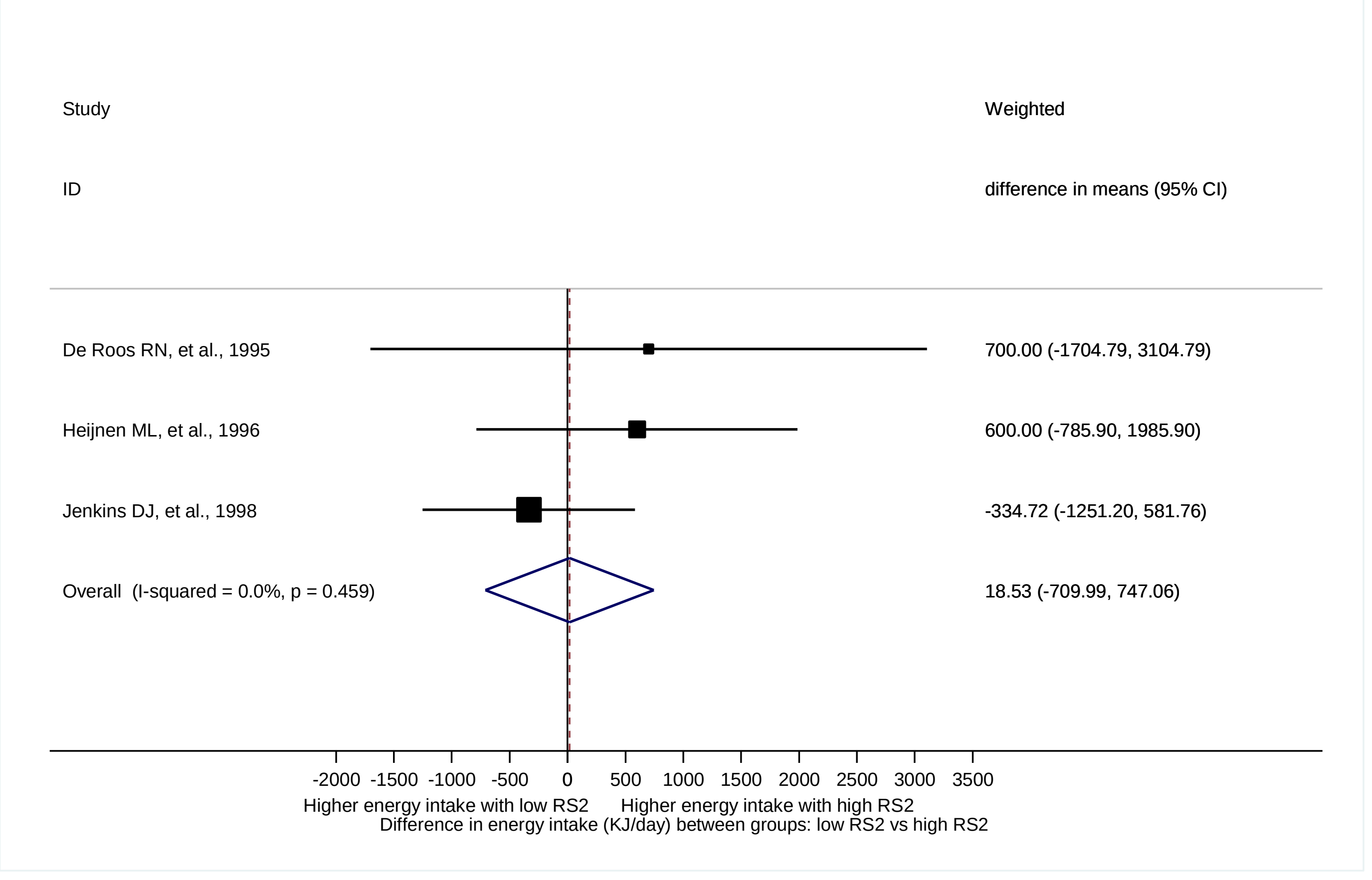
In the study by Jenkins *et al.* (Jenkins *et al.*, 1998), 24 healthy participants consumed low fibre, wheat bran-supplemented, RS2-supplemented or RS3-supplemented muffins and breakfast cereal for 2 weeks. The aim was to provide 30g/d of dietary fibre (AOAC method) in the form of wheat bran to compare against an equivalent amount of resistant starch, which was either in the form of granular resistant starch (RS2) or crystalline retrograded starch (RS3). Energy intake was assessed using a 7-day dietary history before and in the last week of each dietary phase. Significance of the differences in energy intake was not reported in the paper, however, these appear to be small. On day 10 of each 2-week phase, satiety was assessed using a 7-point bipolar scale (-3 extremely hungry, +3 extremely satiated).

Three studies providing dietary differences in resistant starch between groups were included in the meta-analyses. Results were divided into those which provided data on RS2 (raw resistant starch) or RS3 (retrograde resistant starch). Data from Ells *et al.* (Ells *et al.*, 2005) were not included in the meta-analysis as it was unclear whether the starch type was RS2 or RS3. The comparison product in each case was a glucose control (De Roos *et al.*, 1995;Heijnen *et al.*, 1996) or low fibre, non-supplemented test foods (Jenkins *et al.*, 1998). All studies included adults as participants. The first follow up reported at the end of the intervention was used. This varied from 1 to 3 weeks. Results for RS2 and RS3 compared with the control are reported in separate analyses.

Raw resistant starch (RS2)

The overall pooled estimate indicated that energy intake was 19kJ (95% CI, -710kJ to 747kJ) higher with consumption of a diet high in RS2 starch. This was not significantly different from zero (p=0.96). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 87%). Statistically, there was no evidence that a diet high in RS2 starch is associated with differences in energy intake.

Figure 6.10 Forest plot for raw resistant starch (RS2) and energy intake (kJ per day)



Retrograde resistant starch (RS3)

The overall pooled estimate indicated that energy intake was 103kJ (95% CI, -619kJ to 824kJ) lower with consumption of a diet high in RS3 starch. This was not significantly different from zero (p=0.78). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 0%). Statistically, there was no evidence that a diet high in RS3 starch is associated with differences in energy intake.

Figure 6.11 Forest plot for retrograde resistant starch (RS3) and energy intake (kJ per day)

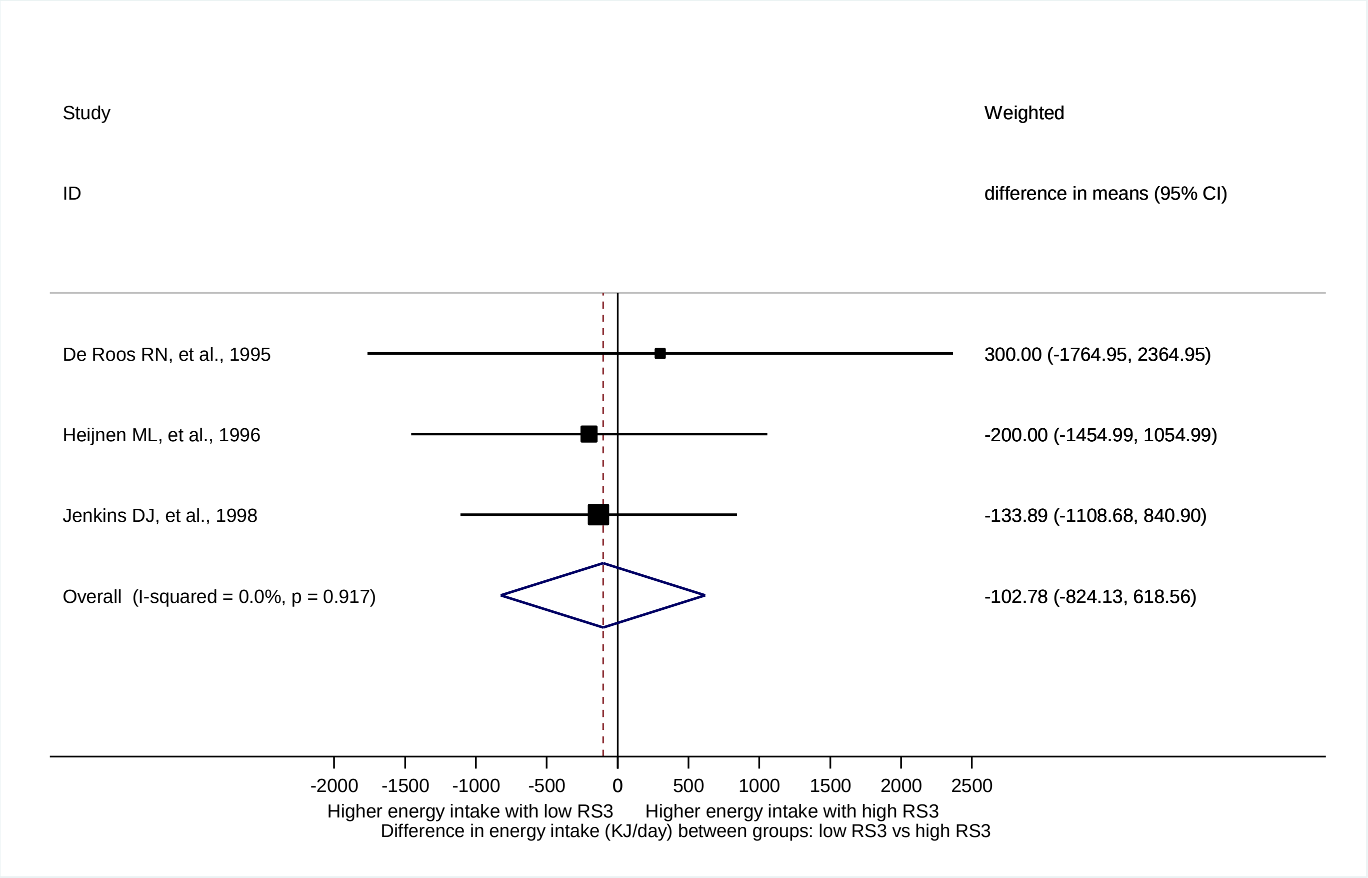


Table 6.16 Energy Intake – Fibre isolates, resistant starch: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*15046 (De Roos *et al.*, 1995)	Extruded/retrograded high-amylose starch (RS3)	24/24	13.3 (SD 3.7)	13.0 (SD 3.0)	NS	Energy intake	1x 24hr recall (MJ/day)	1 week	No change	unclear
	Glucose control	24/24	13.3 (SD 3.7)	12.7 (SD 4.2)					No change	
	High-amylose starch (RS2)	24/24	13.3 (SD 3.7)	13.4 (SD 4.3)	NS				No change	
14407 (Ells *et al.*, 2005)	Rapidly digestible starch	10/10	9018 (SE 1568)	10346 (SE 2173)	NS	Energy intake	7-day food diary throughout (kJ/day)	2 weeks	Not reported	No bias
	Slowly digestible starch	10/10	9018 (SE 1568)	9427 (SE 1923)					Not reported	
*14363 (Heijnen *et al.*, 1996)	Glucose	55/55		10.3 (SE 0.5)		Energy intake	1x 24hr recall (MJ/day)	3 weeks	No change	No bias
	Raw resistant starch (RS2)	57/57		10.9 (SE 0.5)	NS				No change	
	Retrograde resistant starch (RS3)	57/57		10.1 (SE 0.4)	NS				No change	
*14353 (Jenkins *et al.*, 1998)	low fibre control	24/24		2204 (SE 81)	Significance of differences not reported	Energy intake	7-day dietary history (kcal/day)	2 weeks	No change	unclear
	RS2	24/24		2124 (SE 77)					No change	
	RS3	24/24		2172 (SE 87)					No change	
	Wheat Bran	24/24		2260 (SE 84)					No change	

*This result was used in the meta-analyses of fibre isolates, resistant starch and energy intake (Figure 6.10 and 6.11)

Eating motivation and resistant starch

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Two trials compared the effects of starch-type on subjective ratings of appetite (De Roos *et al.*, 1995;Jenkins *et al.*, 1998). Due to an insufficient number of studies, it was not possible to combine these studies using meta-analysis.

De Roos *et al.* (De Roos *et al.*, 1995) found that in healthy young men permitted to eat *ad libitum*, consumption of 30 g/day of resistant starch for 1 week had little influence on appetite and food intake relative to a glucose control. Two types of resistant starch were tested, (a high amylose starch (RS2) and an extruded/retrograded high-amylose starch (RS3)) against a glucose control. When consuming RS2 starch, the participants tended to have lower ratings of appetite than RS3, but overall there were minor differences between starch types only. All products were consumed for 1 week each in a cross-over design by stirring into yoghurt. Subjective eating motivation was assessed using 150mm visual analogue scales throughout the day.

In the study by Jenkins *et al.* (Jenkins *et al.*, 1998), 24 healthy participants consumed low fibre, wheat bran-supplemented, RS2-supplemented or RS3-supplemented muffins and breakfast cereal for 2 weeks. The aim was to provide 30g/d of dietary fibre (AOAC method) in the form of wheat bran to compare against an equivalent amount of resistant starch, which was either in the form of granular resistant starch (RS2) or crystalline retrograded starch (RS3). On day 10 of each 2-week phase, satiety was assessed using a 7-point bipolar scale (-3 extremely hungry, +3 extremely satiated). Both of the resistant starch supplements generated higher satiety scores than the low fibre control ($p<0.05$), in this study.

These two trials provide some evidence that eating motivation may be reduced to some extent with the consumption of resistant starch-supplemented foods. It should be noted that the amounts of resistant starch used were large in comparison to estimates of resistant starch consumed in the UK (approx. 6g/d).

Table 6.17 Eating motivation – Starch type: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Follow-up	p-value difference between groups	Outcome/Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
14347 (De Roos *et al.*, 1995)	Extruded/retrograded high-amylose starch	24/24	no difference	NS	Appetite for a meal Average over whole day	VAS 150mm	1 week	No change	unclear
	Glucose control	24/24						No change	
	High-amylose starch	24/24	lower	0.05				No change	
14373	Extruded/retrograded high-amylose starch	24/24	lower	<0.05	Appetite for a snack Average over whole day	VAS 150mm	1 week	No change	unclear
	Glucose control	24/24						No change	
	High-amylose starch	24/24	lower	<0.05				No change	
14355	Extruded/retrograded high-amylose starch	24/24	no difference	NS	Appetite for something savoury Average over whole day	VAS 150mm	1 week	No change	unclear
	Glucose control	24/24						No change	
	High-amylose starch	24/24	no difference	NS				No change	
14357	Extruded/retrograded high-amylose starch	24/24	no difference	NS	Appetite for something sweet Average over whole day	VAS 150mm	1 week	No change	unclear
	Glucose control	24/24						No change	
	High-amylose starch	24/24	no difference	NS				No change	
14372	Extruded/retrograded high-amylose starch	24/24	no difference		Average over whole day Fullness	VAS 150mm	1 week	No change	unclear
	Glucose control	24/24						No change	
	High-amylose starch	24/24	lower					No change	
14362	Extruded/retrograded high-amylose starch	24/24	lower	<0.05	Average over whole day Hunger ratings	VAS 150mm	1 week	No change	unclear
	Glucose control	24/24						No change	
	High-amylose starch	24/24	lower	<0.05				No change	
14356 (Jenkins *et al.*, 1998)	low fibre control	18/24	0.6 (SE 0.2)		Satiety score	7-point bipolar scale	10 days	No change	unclear
	RS2	18/24	1.4 (SE 0.2)	0.05				No change	
	RS3	18/24	1.2 (SE 0.3)	0.05				No change	
	Wheat Bran	18/24	1.1 (SE 0.2)	NS				No change	

Results - Energy Intake, Eating motivation and Mixed Soluble and Insoluble Fibre Isolates

Energy intake and mixed soluble and insoluble types

Summary of cohort results

No cohort studies provided data

Summary of trials results

Three trials provided data on the effects of mixed soluble and insoluble fibre isolates on energy intake (Hunninghake *et al.*, 1994;Jenkins *et al.*, 1999;Rigaud *et al.*, 1990).

All three studies were included in a meta-analysis.

Rigaud *et al.* compared cereal and citrus fibre tablets with a placebo (Rigaud *et al.*, 1990), Hunninghake *et al.* a fibre mix of guar gum, pectin, soy, corn bran, pea fibre with a matched placebo (Hunninghake *et al.*, 1994) and Jenkins *et al.* a low wheat fibre breakfast cereal with a coarse bran wheat fibre breakfast cereal (Jenkins *et al.*, 1999). The studies by Jenkins *et al.* and Hunninghake *et al.* were on non-obese subjects and had no energy restriction goal, but in Rigaud *et al.* subjects were included only if BMI>25kg/m^2. Both intervention groups followed an energy restricted diet (20-30% less energy than run-in diet) in this latter study. Accordingly, body weights decreased in the latter study, but were unchanged in the studies by Jenkins *et al.* and Hunninghake *et al.*

All studies included adults as participants and were conducted in France, USA and Canada. Definitions of different levels of soluble and insoluble fibre are reported in the trial characteristics table. The first follow up reported at the end of the intervention was used. This varied from 2 weeks to 26 weeks. The overall pooled estimate indicated that energy intake was 405kJ (95% CI, -207kJ to 1017kJ) lower with consumption of a high fibre diet. This was not significantly different from zero (p=0.20). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 64). Statistically, there was no evidence that a diet high in mixed soluble and insoluble fibre isolates is associated with a lower energy intake.

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Figure 6.12 Forest plot for mixed soluble and insoluble fibre isolates and energy intake (kJ per day)

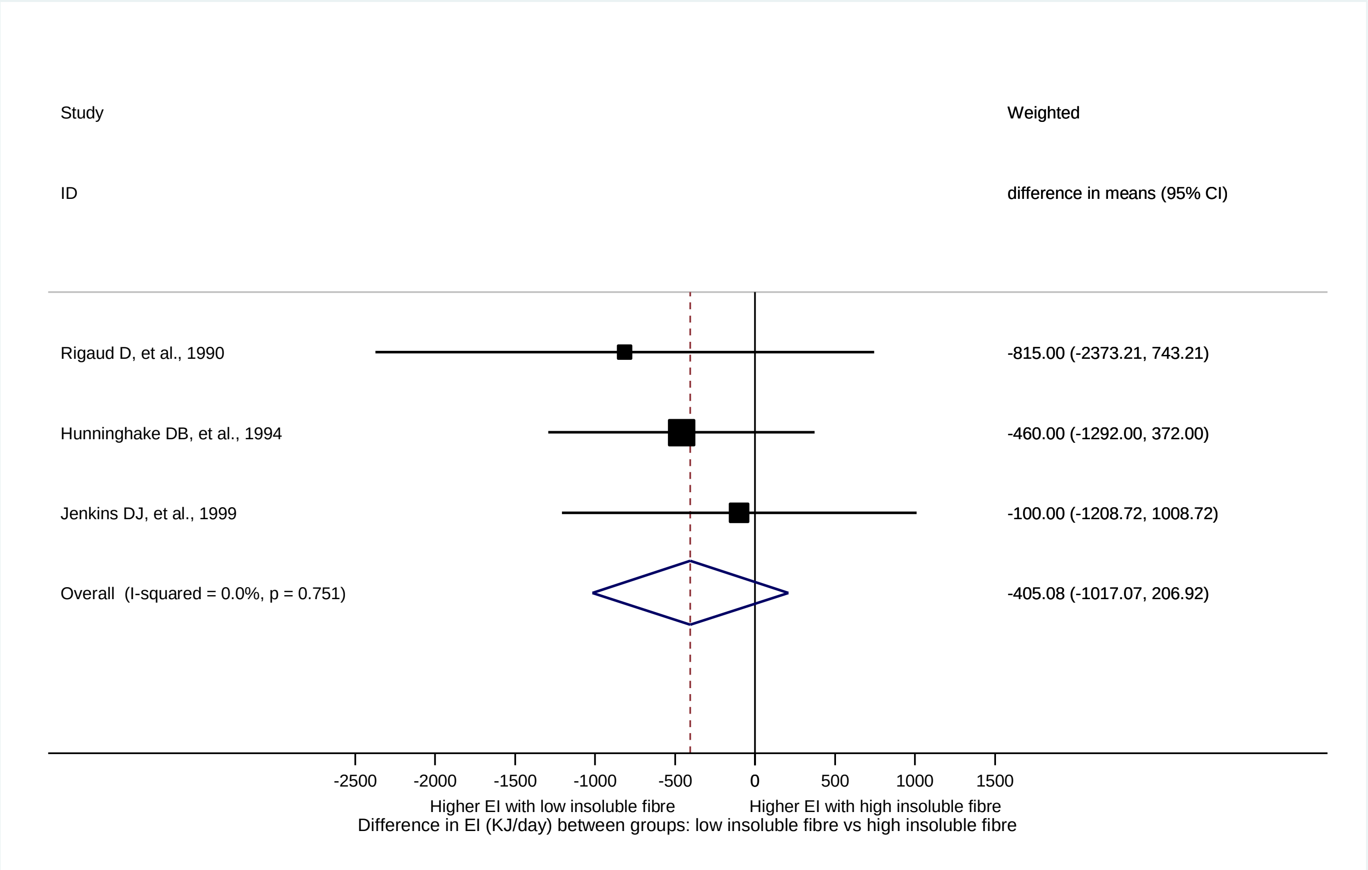

Table 6.18 Energy Intake – Fibre isolates, insoluble and mixed soluble-insoluble types: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*15308 (Hunninghake *et al.*, 1994)	Fibre (guar gum, pectin, soy, corn bran, pea fibre) 10g/d	40/53	7.65 (SE 0.31)	7.26 (SE 0.32)	NS	Energy intake	3-day food diary (MJ/day)	15 weeks	No change	No bias
	Fibre (guar gum, pectin, soy, corn bran, pea fibre) 20g/d	39/55	7.46 (SE 0.33)	6.81 (SE 0.31)	NS				No change	
	Placebo	48/53	7.97 (SE 0.36)	7.27 (SE 0.29)					No change	
*14396 (Jenkins *et al.*, 1999)	Coarse bran wheat fibre breakfast cereal	24/24		9.4 (SE 0.4)		Energy intake	7-day diet history (MJ/day)	2 weeks	No change	unclear
	Low-wheat fibre breakfast cereal	24/24		9.5 (SE 0.4)					No change	
	Medium particle sized wheat fibre breakfast cereal	24/24		9.7 (SE 0.5)	Not reported				No change	
*16897 (Rigaud *et al.*, 1990)	Fibre tablets	14/26	10605 (SE 508)	8354 (SE 462)	0.1	Energy intake	Computerised 7-day recall (kJ/day)	6 months	Decrease	No bias
	Placebo tablets	9/26	10718 (SE 538)	9169 (SE 647)					Decrease	

*This result was used in the meta-analysis of fibre isolates, insoluble and mixed soluble-insoluble types and energy intake (Figure 6.12)

Energy intake and mixed water-soluble fibre isolates

Summary of trials results

Three papers provided the results from 3 studies which reported data on the effects of mixed source water-soluble fibre isolates on energy intake. All studies were conducted in the USA. None set an energy restriction goal as part of the intervention.

One study used a cross-over design (Tinker *et al.*, 1991), and 2 the parallel group approach (Haskell *et al.*, 1992;Jensen *et al.*, 1997). Study size ranged from 62 and the average study size was 43 participants. Mean BMI in each trial was <26kg/m^2, except for the studies by Haskell *et al.* where it was not reported (Haskell *et al.*, 1992). All studies included only adults. The studies by Haskell *et al.* and Jensen *et al.* (Haskell *et al.*, 1992;Jensen *et al.*, 1997) were double blind.

Haskell *et al.* (Haskell *et al.*, 1992) compared a medium viscosity, water-soluble dietary fibre mixture of acacia gum, psyllium husk and guar gum (17g fibre/day) to a placebo in 62 subjects for 12 weeks. The fibre supplement was prepared as a powder in a carbohydrate base (approximately 15g of fructose per serving), and the control was the carbohydrate base only. This same research group later conducted a longer duration trial (6 months) with a similar protocol, but comparing 15 g/day of a water-soluble dietary fibre supplement (a mixture of psyllium, pectin, guar gum, and locust bean gum) with an inactive, low viscosity water-soluble dietary fibre control (acacia gum). The 58 trial participants who were mildly- to moderately hypercholesterolaemic consumed a self-selected, low-fat and low-cholesterol diet comparable to the National Cholesterol Education Program (NCEP) Step One diet throughout the trial (Jensen *et al.*, 1997).

Tinker et al compared the effects of 4 weeks of dietary supplementation with either prunes (providing 6g/d fibre) or the same amount of carbohydrate as fibre-free grape juice on energy intake (Tinker *et al.*, 1991). No impact of the additional fibre on energy intake was observed. However, the primary outcomes were cited as plasma cholesterol, bile acid concentration and faecal output rather than energy intake.

None of the 3 separate studies reported by Haskell *et al.* could be included in the meta-analysis as no energy intakes were provided in the paper (Haskell *et al.*, 1992). However, the authors reported in the text that there were no differences in energy intake between diet groups for each of these trials. This left only two trials, which was insufficient to conduct a meta-analysis. Neither of these studies observed a difference in energy intake with this particular type and level of dietary fibre supplementation.

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Table 6.19 Energy Intake – Fibre isolates, mixed soluble types: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
16099 (Haskell *et al.*, 1992) Study 1	Placebo	29/30			NS		Energy intake	FFQ	12 weeks	No change	No bias
	Mixed soluble fibre	29/32			NS	NS				No change	
16134 Study 3	Guar gum	14/16			NS		Energy intake	3-day food diary	4 weeks	No change	No bias
	Mixed soluble fibre	14/16			NS	NS				No change	
Study 2	Acacia Gum	21/22			NS	NS	Energy intake	3-day food diary	4 weeks	No change	No bias
	Placebo	21/22			NS					No change	
16144 Study 4	Study4 Placebo	11/12			NS		Energy intake	3-day food diary	4 weeks	No change	No bias
	Study4 Soluble fibre 10g	11/13			NS	NS				No change	
	Study4 Soluble fibre 15g	12/15			NS	NS				No change	
	Study4 Soluble fibre 5g	12/12			NS	NS				No change	
15567 (Jensen *et al.*, 1997)	Control (Acacia gum)	27/27	1902 (SD 708)	1878 (SD 742)			Energy intake	FFQ (kcal/day)	8 weeks	No change	No bias
	Soluble fibre	24/24	1842 (SD 627)	1748 (SD 586)		NS				No change	
15568	Control (Acacia gum)	27/27	1902 (SD 708)	1840 (SD 696)			Energy intake	FFQ (kcal/day)	24 weeks	No change	No bias
	Soluble fibre	24/24	1842 (SD 627)	1827 (SD 613)		NS				No change	
14429 (Tinker *et al.*, 1991)	Grape juice	41/41	10552 (SE 339)	10761 (SE 63)			Energy intake	Food diary on alternate days throughout (kJ/day)	4 weeks-average	Not reported	unclear
	Prunes	41/41	10552 (SE 339)	10791 (SE 297)		NS				Not reported	

Eating motivation and fibre isolates, insoluble and soluble fibre

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Four trials explored the effects of insoluble fibre isolates on subjective ratings of appetite (Astrup *et al.*, 1990;Gilhooly *et al.*, 2008;Rigaud *et al.*, 1990;Jenkins *et al.*, 1998) and one trial the effects of mixed soluble fibre supplements. Due to variation in study designs, the method of assessing eating motivation and the nature of each intervention, it was not possible to combine these studies using meta-analysis.

Methods of assessing subjective eating motivation varied across studies, although most commonly 100mm visual analogue scales were used with a variety of end descriptors.

Two studies used the cross-over design (Jenkins *et al.*, 1998;Astrup *et al.*, 1990), and two were double-blind (Rigaud *et al.*, 1990;Salas-Salvado *et al.*, 2008). The sample size ranged from 22 to 200 participants, and these were all adults with an average BMI in the overweight or obese range (except (Jenkins *et al.*, 1998)).

Studies were conducted in Canada, Denmark, France, Spain and USA.

Rigaud *et al.* compared cereal and citrus fibre tablets with placebo tablets (Rigaud *et al.*, 1990). Both intervention groups followed an energy restricted diet (20-30% less than run-in diet) and the aim was to test whether the addition of fibre tablets improved weight loss through modified compliance due to amelioration of appetite. Ratings of hunger decreased in the fibre tablet group, but tended to increase in the un-supplemented group over time. The figure provided in the paper suggests that there was a significant difference between groups at 6 months, with much less hunger experienced in the fibre tablet group. Gilhooly *et al.* also explored the potential of supplementary fibre in the form of an extra 20 g/day of dietary fibre from a high fibre cereal to improve adherence to an energy restriction regimen (30% restriction) (Gilhooly *et al.*, 2008). After 5 weeks, the fibre-supplemented subjects reported higher ratings of ‘satisfaction with the amount of food given’, but no difference in desire to eat and hunger ratings compared to the unsupplemented subjects. Under more extreme energy restriction conditions, Astrup *et al.* found that the addition of 30g/d of ‘plant fibre’ to a very low calorie diet (VLCD) reduced hunger significantly compared with a VLCD without fibre (fibre effect, $p< 0.01$) (Astrup *et al.*, 1990).

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In the study by Jenkins *et al.* (Jenkins *et al.*, 1998), 24 healthy participants consumed low fibre, wheat bran-supplemented, RS2-supplemented or RS3-supplemented muffins and breakfast cereal for 2 weeks. The aim was to provide 30g/d of dietary fibre (AOAC method) in the form of wheat bran to compare against an equivalent amount of resistant starch or a low fibre control. On day 10 of each 2-week phase, satiety was assessed using a 7-point bipolar scale (-3 extremely hungry, +3 extremely satiated). The wheat bran supplemented muffins and cereal generated a somewhat higher satiety score than the low fibre control, but the difference was not statistically significant.

Salas-Salvado *et al.* provided data on the effects of a mixed soluble fibre supplement of 3g Plantago ovata husk and 1g glucomannan added to a hypoenergetic diet (-2.5MJ/d) either once or twice daily (Salas-Salvado *et al.*, 2008) and compared with a placebo product (microcrystalline cellulose) which was similar in weight and presentation. Postprandial satiety was assessed for 3 days using a standard visual analogue scale. There was evidence of an increase in satiety ratings post-lunch for both the fibre supplement groups compared to placebo ($p<0.05$), but this effect was weaker for post-dinner ratings and there was no statistically significant difference between diet groups.

Within the context of an energy-restricted regimen, the addition of either mixed insoluble or soluble fibres described in these trials tends to mitigate against the reduction in satiety generally associated with a low energy diet.

Table 6.20 Eating motivation - Fibre isolates, insoluble types: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
*14493 (Astrup *et al.*, 1990)	VLCD with fibre	22/22		38			<0.01			Average over whole follow-up Hunger ratings	VAS 100mm,	2 weeks	Decrease	bias
	VLCD without fibre	22/22		44.5									Decrease	
14494	VLCD with fibre	22/22		54.4			NS			Average over whole follow-up Satiety	VAS 100mm	2 weeks	Decrease	bias
	VLCD without fibre	22/22		53.4									Decrease	
14477 (Gilhooly *et al.*, 2008)	No fibre supplementation minus insoluble fibre supplementation	No fibre: 17/17 Fibre: 16/17					NS	-0.6 (CI -13.5,12.3)		Average over whole follow-up Desire to eat	VAS 100mm	5 weeks	Decrease in both	bias
*14476	Insoluble fibre supplementation minus no fibre supplementation	No fibre: 17/17 Fibre: 16/17					NS	-1.8 (CI -14.8,11.1)		Average over whole follow-up Hunger ratings	VAS 100mm	5 weeks	Decrease in both	bias
14547	Insoluble fibre supplementation minus no fibre supplementation	No fibre: 17/17 Fibre: 16/17					0.08	9.4 (CI -1.0,19.7)		Average over whole follow-up Satisfaction with the amount of food given	VAS 100mm	5 weeks	Decrease in both	bias
*16874 (Rigaud *et al.*, 1990)	Fibre	14/26	139.8 (SE 8.2)		decrease	0.0008				Hunger ratings	VAS (cm)	6 months	Decrease	No bias
	Placebo	9/26	129.5 (SE 6.9)		increase	0.02							Decrease	
14356 (Jenkins *et al.*, 1998)	Low fibre control	18/24		0.6 (SE 0.2)						Satiety score	7-point bipolar scale	10 days	No change	unclear
	RS2	18/24		1.4 (SE 0.2)	0.05		0.05						No change	
	RS3	18/24		1.2 (SE 0.3)	0.05		0.05						No change	
	Wheat Bran control	18/24		1.1 (SE 0.2)	NS		NS						No change	
14515 (Salas-	Mixed soluble fibre 3 times a day	58/68			1.06 (SD 4.43)					Satiety post dinner	VAS 100mm	16 weeks	Decrease	No bias

Salvado *et al.*, 2008)	Mixed soluble fibre twice a day	53/66	2.54 (SD 4.81)						Decrease	
	Placebo	55/66	-7.87 (SD 4.57)						Decrease	
14791	Mixed soluble fibre 3 times a day minus Placebo	Inter-vention: 58/58 Placebo: 55/66		8.92 (CI -2.31, 20.16)	NS	Satiety post dinner	VAS 100mm	16 weeks	Decrease in both	No bias
14790	Mixed soluble fibre twice a day minus placebo	Inter-vention: 53/66 Placebo: 55/66		10.4 (CI -1.25, 22.05)		Satiety post dinner	VAS 100mm	16 weeks	Decrease in both	No bias
14514	Mixed soluble fibre twice a day	53/66	5.14 (SD 4.53)			Satiety post lunch	VAS 100mm	16 weeks	Decrease	No bias
	Placebo	55/66	-8.43 (SD 4.29)						Decrease	
	Mixed soluble fibre 3 times a day	58/68	1.07 (SD 4.17)						Decrease	
14789	Mixed soluble fibre 3 times a day minus Placebo	Inter-vention: 58/58 Placebo: 55/66		9.50 (CI -1.06, 20.07)	0.04	Satiety post lunch	VAS 100mm	16 weeks	Decrease in both	No bias
14788	Mixed soluble fibre twice a day minus placebo	58/68		13.57 (CI 2.61, 24.54)					Decrease in both	

Results - Energy Intake and Fibre Isolates, Psyllium

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Two studies provided data on the effects of psyllium fibre, which is a hydrophilic mucilloid derived from the husk of *Plantago ovate*, on energy intake. Dennison and Levine (Dennison and Levine, 1993) tested the effect of breakfast cereals with either wheat or psyllium fibre in children with mildly elevated blood lipids. Using a 3-month cross-over design, with a 2-week washout phase, the daily consumption of 6g fibre from psyllium when incorporated into a low fat, low cholesterol diet did not influence energy intake when compared to the wheat fibre diet (5g total fibre).

Vega-Lopez *et al.* (Vega-Lopez *et al.*, 2001) reported the results of a crossover trial with 24 men, and 44 women who were randomly assigned to a control or psyllium group for 30 days. Groups were provided with 5 psyllium or control cookies per day which contributed 12.0 or 1.6g fibre respectively. At the same time, participants were asked to follow a low fat (<30% energy) and low cholesterol diet, which was not energy restricted. Energy intakes (assessed by 7 day dietary records) varied by gender and menopausal status group, but were 3.6 – 5.9% lower during the psyllium consumption periods ($p<0.05$).

These two studies provide inconsistent evidence concerning the effect of psyllium on energy intake.

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Table 6.21 Energy Intake – Fibre isolates, psyllium: RCT data

Result ID/ Author	Subgroup detail	Intervention group	Completers/ Allocated	Follow-up	p-value difference between groups	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
Children study										
14406 (Dennison and Levine, 1993)		Control cereal	20/25	1660 (SE 60)		Energy intake	7 day food diary (kcal/day)	1 month	No change	No bias
		Psyllium cereal	20/25	1661 (SE 91)	NS				No change	
Adult study										
14377 (Vega-Lopez *et al.*, 2001)	Men	Control cookies	24/68	9874 (SD 1381)		Energy intake	7 day food diary, (kJ/day)	30 days-average	Not reported	unclear
	Men	Psyllium cookies	24/68	9322 (SD 1879)	0.05				Not reported	
14383	Pre-menopausal	Control cookies	23/68	8083 (SD 1347)		Energy intake	7 day food diary, (kJ/day)	30 days-average	Not reported	unclear
	Pre-menopausal	Psyllium cookies	23/68	7803 (SD 1623)	0.05				Not reported	
14548	Post-menopausal	Control cookies	21/68	8176 (SD 1628)		Energy intake	7 day food diary, (kJ/day)	30 days-average	Not reported	unclear
	Post-menopausal	Psyllium cookies	21/68	7841 (SD 1523)	0.05				Not reported	

Results - Energy Intake, Eating motivation and Fibre Isolates, Gums and Extracts

Energy intake and fibre isolates, gums and extracts

Summary of cohort results

No cohort studies provided data

Summary of trials results

Eleven studies reported data on the effects of a variety of fibre isolates that were soluble, generally viscous gums, including guar gum, acacia gum, arabinoxylan, algal polysaccharides and pectin. Of these trials, five reported energy intake as a primary outcome (Mattes, 2007;Pasman *et al.*, 1997a;Paxman *et al.*, 2008;Pelkman *et al.*, 2007;Tredger *et al.*, 1991).

Six studies used a cross-over design (Pasman *et al.*, 1997a;Mattes, 2007;Tredger *et al.*, 1991;Garcia *et al.*, 2006;Garcia *et al.*, 2007;Pelkman *et al.*, 2007;Paxman *et al.*, 2008;Panlasigui *et al.*, 2003) and 5 the parallel groups approach (Wood *et al.*, 2006;Wood *et al.*, 2007;Haskell *et al.*, 1992;Marett and Slavin, 2004;Schwab *et al.*, 2006). None advocated an energy restriction goal as part of the intervention. Seven studies were double-blind (Mattes, 2007;Pelkman *et al.*, 2007;Wood *et al.*, 2006;Wood *et al.*, 2007;Haskell *et al.*, 1992;Marett and Slavin, 2004;Schwab *et al.*, 2006) and 2 were single-blind (Garcia *et al.*, 2006;Garcia *et al.*, 2007;Paxman *et al.*, 2008). The remaining studies were open or reporting of blinding was unclear in the paper. The mean number of subjects per trial was 33 (median 30) and the study durations ranged from one week to 6 months (5 studies were of one week duration only).

Studies were conducted in Finland, Germany (2), the Philippines, the Netherlands, UK (2), and the USA (6). All studies included adults as participants. In most studies the mean BMI of participants was in the overweight range (25-30), however, in 2 studies average BMI was less than 25kg/m^2 (Paxman *et al.*, 2008;Panlasigui *et al.*, 2003). Two studies were on women (Pasman *et al.*, 1997a;Pelkman *et al.*, 2007) and three were on men only (Tredger *et al.*, 1991;Wood *et al.*, 2006;Wood *et al.*, 2007).

Energy intakes were mainly assessed using food diaries, but two studies used the dietary recall technique (Panlasigui *et al.*, 2003;Mattes, 2007) and Pelkman *et al.* (Pelkman *et al.*, 2007) reported energy as the average intake of 2 test days in which *ad libitum* monitored test meals were provided.

Seven studies providing dietary differences in specific fibre isolates between groups were included in the meta-analysis. All of these studies consistently showed lower intakes in the higher fibre (isolate) groups compared with the placebo or lower isolate groups, although these differences were not always statistically significant. Three studies were not included in the meta-analysis because no data were provided on average energy intakes in each intervention group (Haskell *et al.*, 1992;Marett and Slavin, 2004;Mattes, 2007) and one further study was excluded due to lack of measures of variance around the mean (Panlasigui *et al.*, 2003). In none of these studies was there a significant difference between the high and low fibre conditions for energy intake. Haskell *et al.* explored the effect of daily consumption of 15g acacia gum compared to a placebo powder (composition not reported) when added to the diets of 44 non-obese subjects (Haskell *et al.*, 1992). After 4 weeks, energy intake, assessed by food diaries was not different between study groups. Marett *et al.* (Marett and Slavin, 2004) assessed the effects of Larch or Tamarack-derived arabinogalactan (a non-viscous soluble fibre) added to food and drinks, compared with rice-starch supplemented products for 6 months, but found no differential effect on energy intake.

Mattes *et al.* tested the effects of a breakfast bar containing guar gum (3.9g/55g serving) and sodium alginate (1.1g/55g serving) and a total fibre content of 4.5g with a low fibre bar (total fibre 0.62g) in 24 lean and overweight participants for 7 days using a cross-over design (Mattes, 2007). Energy intake which was assessed using a computerised 3-day multiple pass technique was not different between diets. Panlasigui *et al.* (Panlasigui *et al.*, 2003) reported the effect of carageenan-supplemented test foods consumed over 8 weeks compared with the usual diet in 20 subjects. Energy intake (by recall) was not influenced by supplementation of the diet with this algal polysaccharide.

Of the seven studies included in the meta-analysis, 3 studies provided information from more than two groups. One study was analysed comparing placebo and pectin (Schwab *et al.*, 2006), one study compared placebo with a high fibre (alginate pectin) drink (Pelkman *et al.*, 2007) and the third study compared sugar-beet with guar gum (Tredger *et al.*, 1991). Definitions of different levels of gums and extracts are reported in the trial characteristics table. The first follow up reported at the end of the intervention was used and this varied from 1 to 12 weeks. The overall pooled estimate indicated that energy intake was 566 kJ (135 kcal) (95% CI, 202 kJ (48 kcal) to 931 kJ (223 kcal)) lower with consumption of a diet high in fibre isolates. This was significantly different from zero ($p<0.01$). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 60%). Statistically, there was evidence that diets high in the specific fibre isolates reported here are associated with a lower energy intake.

Figure 6.13 Forest plot for fibre isolates, gums and extracts and energy intake (kJ per day)

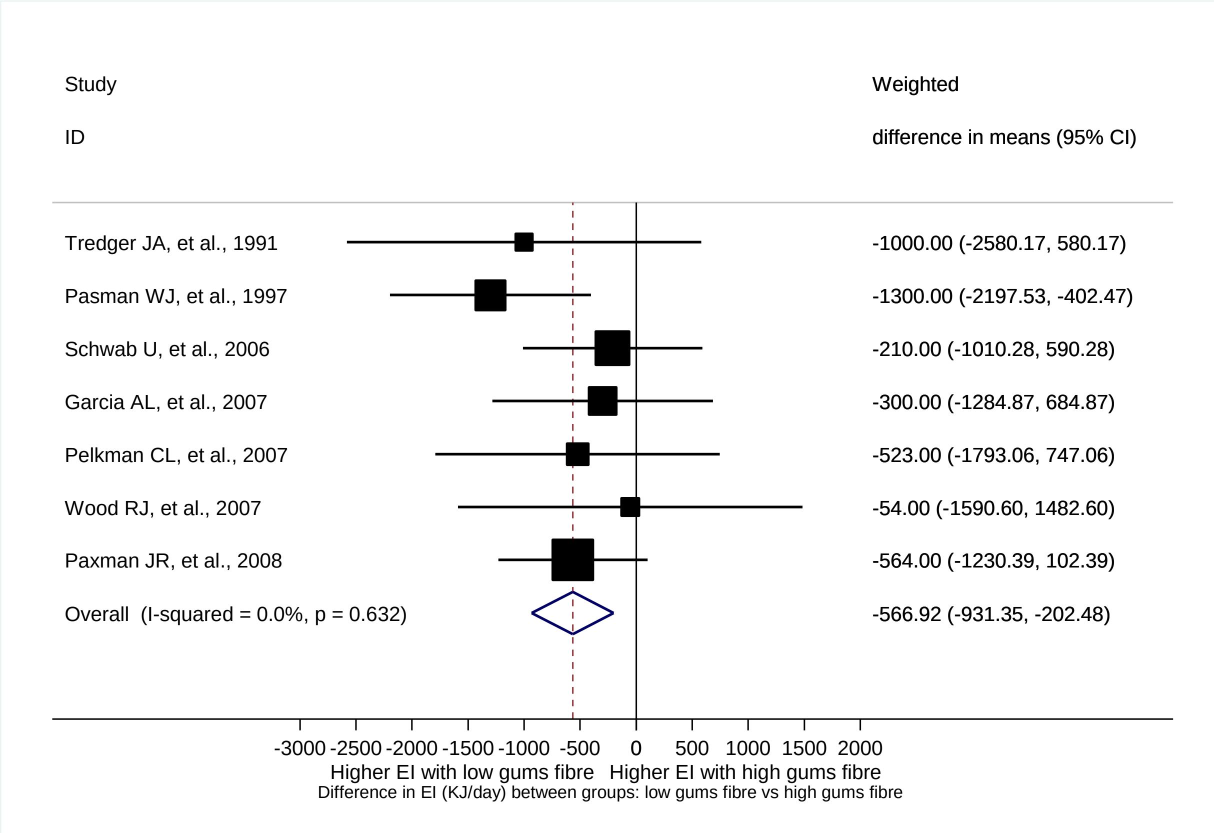

Table 6.22 Energy Intake – Fibre isolates, gums and extracts: RCT data

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*17399 (Garcia *et al.*, 2007)		Arabinoxylan	11/11	9.4 (CI 8, 10.9)	8.8 (CI 8.4, 10.2)		0.193		Energy intake exclusive of supplement	4-day food diary (MJ/day)	6 weeks	No change	unclear
		Placebo	11/11	9.5 (CI 9.0, 10)	9.1 (CI 8.7, 9.5)							No change	
16116 (Haskell *et al.*, 1992)		Study2 Acacia gum	21/22			NS	Not reported/ NS		Energy intake	3-day food diary	4 weeks	No change	No bias
		Study2 Placebo	21/22			NS						No change	
16666 (Marett and Slavin, 2004)		Larch arabinogalactan	18/18			NS	Not reported		Energy intake	3 day food diary	6 months	No change	No bias
		Placebo	17/17			NS						No change	
		Tamarack arabinogalactan	19/19			NS						No change	
14449 (Mattes, 2007)		Placebo bar minus breakfast bar + guar gum and sodium alginate	Cross-over: 20/25					No significant difference	Energy intake	3-day recall – computerised multiple pass (kcal/day)	5 days-average	Both not reported	unclear
15188 (Panlasigui *et al.*, 2003)		Carageenan-added test foods	20/20		1881				Energy intake	24hr recall every 10 days (kcal/day)	8 weeks-average	No change	unclear
		Usual diet	20/20		1685		NS					No change	
*16416 (Pasman *et al.*, 1997a)		Study 1 Control	17/17		6.7 (SE 0.39)				Energy intake	3-day unweighed food diary (MJ/day)	1 week	Not reported	unclear
		Study 1 Guar gum	17/17		5.4 (SE 0.24)		<0.05					Not reported	
*14486 (Paxman *et al.*, 2008)		Alginate	68/69		1830.1 (SD 472.2)		0.019		Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
		Control	68/69		1964.9 (SD 474.6)							Not reported	
14487	Men	Alginate	30/69		2001.8 (SD 501.1)				Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
	Men	Control	30/69		2174 (SD							Not	

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
					467.6)							reported	
14488	Women	Alginate	38/69		1694.5 (SD 405.1)				Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
	Women	Control	38/69		1799.8 (SD 416.1)							Not reported	
14489	BMI < 25	Alginate	44/69		1802.5 (SD 400.7)				Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
	BMI < 25	Control	44/69		1949.9 (SD 444.3)							Not reported	
14490	BMI 25+	Alginate	24/69		1880.7 (SD 587.6)				Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
	BMI 25+	Control	24/69		1992.4 (SD 534.7)							Not reported	
14491	Pre-breakfast preload	Alginate	41/69		1759.8 (SD 375.1)				Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
	Pre-breakfast preload	Control	41/69		1916.3 (SD 452.6)							Not reported	
14492	Pre-evening meal preload	Alginate	27/69		1936.9 (SD 581.8)				Energy intake	7 day food diary (kcal/day)	7 days-average	Not reported	bias
	Pre-evening meal preload	Control	27/69		2038.7 (SD 505.8)							Not reported	
*14465 (Pelkman *et al.*, 2007)		Higher fibre drink	29/35		2591 (SE 109)			NS	Total energy intake	Average intake of 2 test days *ad libitum* monitored test meals, (kcal/day)	7 days	Not reported	unclear
		Lower fibre drink	29/35		2594 (SE 109)			NS				Not reported	
		Placebo drink	29/35		2716 (SE 110)							Not reported	
		Higher fibre drink	29/35		678 (SE 37)			<0.05	Energy intake at dinner test meals	Average intake of 2 test days *ad libitum* monitored test meals, (kcal/day)	7 days	Not reported	unclear
		Lower fibre drink	29/35		689 (SE 37)			<0.05				Not reported	
		Placebo drink	29/35		764 (SE 37)							Not reported	
*16467 (Schwab *et al.*,		Pectin	22/22	7602 (SD 2113)	7768 (SD 1309)			No indication of statistical signifcanceof	Energy intake	4-day food diary (kJ/day)	8 weeks	No change	No bias
		Placebo	22/22	7642 (SD 1423)	7978 (SD							No change	

Result ID/ Author	Subgroup detail	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
2006)					1398)			differences provided					
		Polydextrose	22/22	7464 (SD 1980)	7978 (SD 2443)							No change	
*14452 (Tredger *et al.*, 1991)		Guar gum	12/15	10000 (SE 600)	11000 (SE 800)	NS		Unclear if groups significantly different	Energy intake	3-day food diary (kJ/day)	10 days	No change	unclear
		Sugar beet fibre	12/15	10700 (SE 500)	12000 (SE 100)	NS						No change	
		Wheat bran	12/15	10100 (SE 600)	11200 (SE 600)	NS						No change	
17221 (Wood *et al.*, 2007)		Low carbohydrate diet + placebo	15/15	9660 (SD 3184)	6991 (SD 2481)				Energy intake	7-day food diary (kJ/day)	1 week	Decrease	No bias
		Low carbohydrate diet + Soluble fibre	14/15	9857 (SD 2594)	7468 (SD 2063)		NS					Decrease	
17222		Low carbohydrate diet + placebo	15/15	9660 (SD 3184)	7017 (SD 2929)				Energy intake	7-day food diary (kJ/day)	6 weeks	Decrease	No bias
		Low carbohydrate diet + Soluble fibre	14/15	9857 (SD 2594)	6866 (SD 1544)		NS					Decrease	
*17223		Low carbohydrate diet + placebo	15/15	9660 (SD 3184)	6824 (SD 2314)				Energy intake	7-day food diary (kJ/day)	12 weeks	Decrease	No bias
		Low carbohydrate diet + Soluble fibre	14/15	9857 (SD 2594)	6770 (SD 1966)		NS					Decrease	

*This result was used in the meta-analysis of fibre isolates, gums and extracts and energy intake

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Eating motivation and fibre isolates, gums and extracts

Summary of cohort results

No cohort studies provided data

Summary of trials results

Six trials explored the effects of diets supplemented with soluble fibre isolates in the form of guar gum, pectin or glucommanan on subjective ratings of appetite (Heini *et al.*, 1998;Mattes, 2007;Pasman *et al.*, 1997a;Pelkman *et al.*, 2007;Schwab *et al.*, 2006;Vido *et al.*, 1993).

Due to variation in study designs, the method of assessing eating motivation and the nature of each intervention, it was not possible to combine these studies using meta-analysis.

Five trials used adults, and one trial included only children aged 11 years old on average (Vido *et al.*, 1993). Three trials used a parallel groups design (Salas-Salvado *et al.*, 2008;Schwab *et al.*, 2006;Vido *et al.*, 1993), but the other 3 used a cross-over design. Studies were conducted in the Neatherlands (2), USA (3), Finland, Italy and Spain. Five trials were double blind (Vido *et al.*, 1993;Schwab *et al.*, 2006;Pelkman *et al.*, 2007;Mattes, 2007;Heini *et al.*, 1998) and one was open (Pasman *et al.*, 1997a).

Heini *et al.* found no significant effect of fibre (guar gum) addition to a hypoenergetic formula diet on either fasting (data not shown), or post-breakfast satiety ratings after one week of intervention using a cross-over design (Heini *et al.*, 1998). Mattes *et al.* tested the effects of a breakfast bar containing guar gum (3.9g/55g serving) and sodium alginate (1.1g/55g serving) and a total fibre content of 4.5g with a low fibre bar (total fibre 0.62g) in 24 lean and overweight participants for 7 days using a cross-over design (Mattes, 2007). Desire to eat, which was assessed using standard visual analogue scales, was not different between diets. Similarly, two studies that compared a placebo with pectin (Schwab *et al.*, 2006), or a high fibre drink with alginate and pectin (Pelkman *et al.*, 2007) did not observe an effect on ratings of appetite and satiety.

In the double blind, placebo-controlled trial by Vido *et al.* children aged <15 years were randomised to receive either glucomannan (2g/day) or a placebo product (Vido *et al.*, 1993) for 2 weeks whilst consuming their usual diet. The methods concerning the assessment of satiety are not well documented, but the number of children reporting ‘more satiety’ after meals was 14 in the fibre group and 11 in the placebo group (p>0.05).

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Pasman *et al.* reported the results of two studies in one paper (Pasman *et al.*, 1997a). Obese women were provided with supplements of either guar gum (20g fibre, twice daily) to add to orange juice, or orange juice alone. In study 1, the women consumed their usual diet, and in study 2 a hypoenergetic diet (either 4 or 6 MJ/d) was followed. Eating motivation was assessed using visual analogue scales on the final 3 days of each intervention. Mean energy intakes were generally low in study 1 (5.4 MJ/day), but a significant reduction in energy intake was observed with guar gum supplementation (assessed using food diaries). However, this was not reflected in any differences in measures of appetite. In study 2, however, the authors reported that with energy intake fixed at 4 MJ/day ratings of hunger were lower, and satiety higher with guar gum than with orange juice alone.

Collectively, these trials provide inconsistent evidence of the effects of fibre isolates in the form of gums on subjective ratings of eating motivation.

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Table 6.23 Eating motivation - Fibre isolates, gums and extracts: RCT data

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
Children study											
16930 (Vido *et al.*, 1993)	Glucomannan supplement	30/30		14	Not reported		'More satiety after meals'	Scale (no. participants)	2 months	Decrease	unclear
	Placebo	30/30		11						Decrease	
Adult studies											
14426 (Heini *et al.*, 1998)	Hypoenergetic formula diet	25/25	65 (SD 18.4)	54.3 (SD 14.3)			Post breakfast Satiety	Hunger/fullness category scale (Haber *et al.* 1977) 0-100	1 week	Decrease	No bias
	Hypoenergetic formula diet and guar gum	25/25	64.6 (SD 18.3)	56.9 (SD 16.8)	NS					Decrease	
14446 (Mattes, 2007)	Placebo bar minus breakfast bar + fibre	Cross-over: 21/25				No significant diff	Desire to eat	(mm)	5 days-average	Not reported in both	unclear
	Placebo bar minus breakfast bar + fibre	Cross-over: 21/25								Not reported in both	
	Placebo bar minus breakfast bar + fibre	Cross-over: 21/25								Not reported in both	
	Placebo bar minus breakfast bar + fibre	Cross-over: 21/25								Not reported in both	
16418 (Pasman *et al.*, 1997a) Study 1	Study 1 Control	17/17					Average over 3 monitored days Satiety	VAS 100mm	1 week	Not reported	unclear
	Study 1 Guar gum	17/17			0.11					Not reported	
16417 Study 1	Study 1 Control	17/17					Average over 3 monitored days Hunger ratings	VAS 100mm	1 week	Not reported	unclear
	Study 1 Guar gum	17/17			>0.9					Not reported	
16423 Study 2	Hypocaloric diet (4MJ/d)	14/14			0.35	Individual time points, hunger lower with fibre p<0.05 on 4 MJ/d diet	Average over 3 monitored days Hunger ratings	VAS 100mm	1 week	Not reported	bias
	Hypocaloric diet (4MJ/d) and guar gum	14/14								Not reported	
	Hypocaloric diet (6MJ/d)	14/14				No effect of fibre on 6MJ/d diet				Not reported	
	Hypocaloric diet (6MJ/d) and guar gum	14/14			0.61					Not reported	
16424 Study 2	Hypocaloric diet (4MJ/d)	14/14				Individual time points, satiety higher with fibre p<0.05 on 4 MJ/d diet	Average over 3 monitored days Satiety	VAS 100mm	1 week	Not reported	bias
	Hypocaloric diet (4MJ/d) and guar gum	14/14			0.18					Not reported	
	Hypocaloric diet (6MJ/d)	14/14				No effect of fibre on 6MJ/d diet				Not reported	
	Hypocaloric diet (6MJ/d)	14/14			NS					Not reported	

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Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	and guar gum										
	Guar gum - High compliance	10/10	3.0 (SD 2.1)	3.2 (SD 3.2)	NS					Increase	
	Guar Gum - Low compliance	10/10	4.0 (SD 4.1)	6.1 (SD 4.1)	NS					Increase	
16429 (Pelkman *et al.*, 2007)	Higher fibre drink	29/35			NS		Appetite	VAS 100mm	7 days	Not reported	unclear
	Lower fibre drink	29/35			NS					Not reported	
	Placebo drink	29/35								Not reported	
16427	Higher fibre drink	29/35			NS		Fullness	VAS 100mm	7 days	Not reported	unclear
	Lower fibre drink	29/35			NS					Not reported	
	Placebo drink	29/35								Not reported	
14466	Higher fibre drink	29/35			NS		Hunger ratings	VAS 100mm	7 days	Not reported	unclear
	Lower fibre drink	29/35			NS					Not reported	
	Placebo drink	29/35								Not reported	
16428	Higher fibre drink	29/35			NS		Prospective consumption	VAS 100mm	7 days	Not reported	unclear
	Lower fibre drink	29/35			NS					Not reported	
	Placebo drink	29/35								Not reported	
16543 (Schwab *et al.*, 2006)	Pectin	22/22			NS		Desire to eat	VAS	12 weeks	Decrease	No bias
	Placebo	22/22								Decrease	
	Polydextrose	22/22			NS					Decrease	
16542	Pectin	22/22			NS		Fullness	VAS	12 weeks	Decrease	No bias
	Placebo	22/22								Decrease	
	Polydextrose	22/22			NS					Decrease	
16534	Pectin	22/22			NS		Hunger ratings	VAS	12 weeks	Decrease	No bias
	Placebo	22/22								Decrease	
	Polydextrose	22/22			NS					Decrease	
16541	Pectin	22/22			NS		Satiety	VAS	12 weeks	Decrease	No bias
	Placebo	22/22								Decrease	

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Difference between groups at follow-up	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	Polydextrose	22/22			NS					Decrease	

Results - Energy Intake and Cereal Brans (other than oat bran)

Summary of cohort results

No cohort studies provided data

Summary of trials results

Five studies providing dietary differences in cereal brans, other than oat bran between groups provided data. Of these trials, two reported energy intake as a primary outcome (Sanders and Reddy, 1992;Tredger *et al.*, 1991) and all were included in a meta-analysis. Four of the five studies provided information from more than two groups and the groups with the highest wheat bran and lowest fibre were compared. Definitions of different levels of non-oat bran and controls are reported in the trial characteristics table and the table below. Against a low fibre control product, five studies explored effects of wheat bran, and 2 studies reported data on rice bran and cocoa bran. Two studies did not have a control or low fibre group and in these cases wheat bran was compared with sugar beet (Tredger *et al.*, 1991) and 15g of rice bran (Sanders and Reddy, 1992). None of the studies were energy restriction trials.

All studies were cross-over trials. One was single-blind (Sanders and Reddy, 1992), 2 were open (Vuksan *et al.*, 1999;Jenkins *et al.*, 1999) and the other 2 trials did not provide this information. Studies were conducted in Canada (2), the USA and the UK (2).

All studies included non-obese adults as participants.

The first follow up reported at the end of the intervention was used. This varied from 1 week to 3 weeks. The pooled estimate indicated that energy intake was 56 kJ (95% CI, -499 kJ to 612 kJ) higher with consumption of a diet lower in non-oat bran fibre. This was not significantly different from zero (p=0.84). Heterogeneity denoted by I^2 was 26% (95% CI, 0 to 70%). Statistically, there was no evidence that a diet high in non-oat bran fibre is associated with a different energy intake.

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Figure 6.14 Forest plot for cereal brans (other than oat bran) and energy intake (kJ per day)

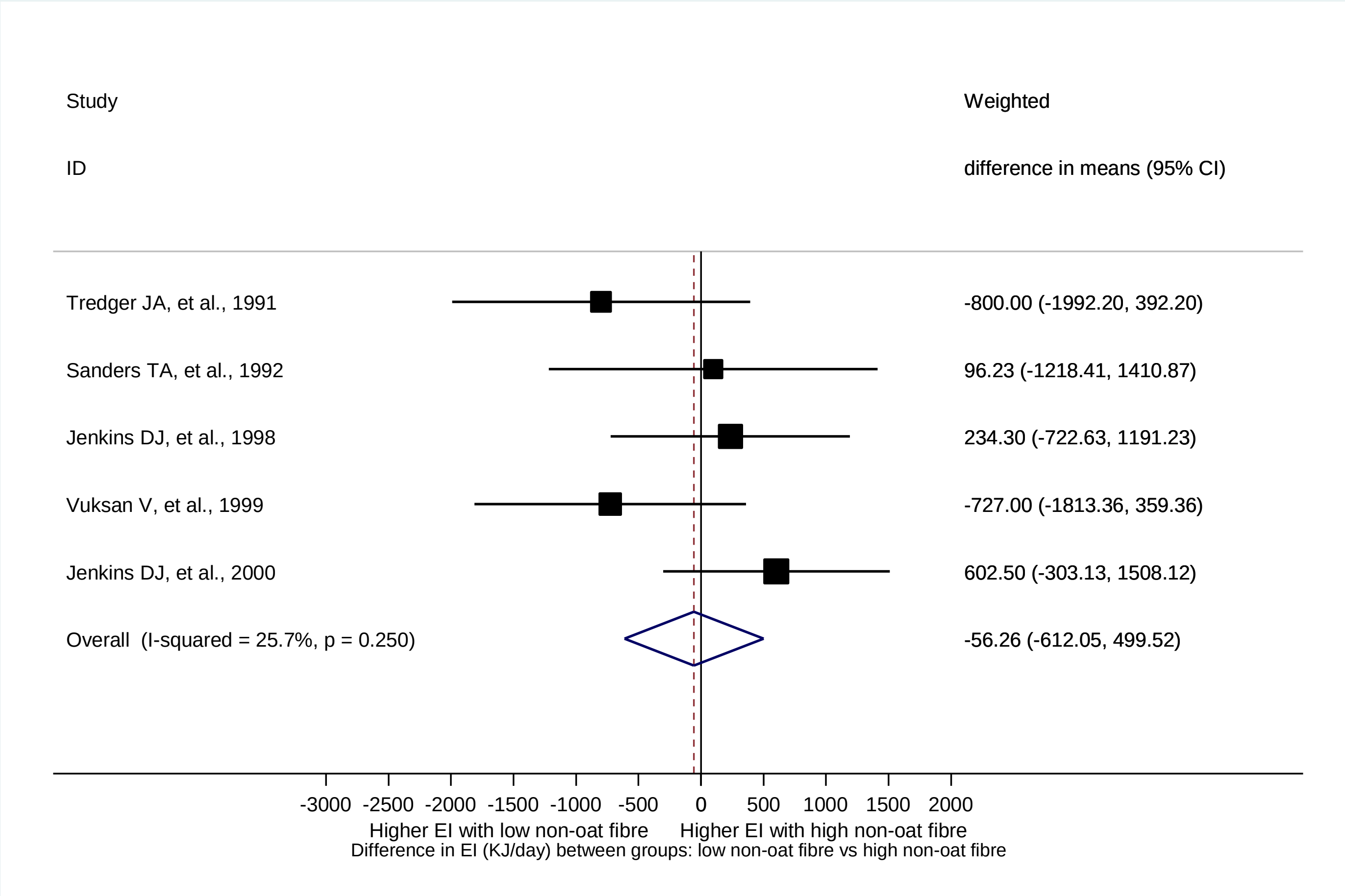

Table 6.24 Energy Intake – Bran (non oat): RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	Outcome/ Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*14343 (Jenkins *et al.*, 2000)	Cocoa-bran breakfast cereal (25g fibre/d)	25/25		2164 (SE 90)		.09		Energy intake	7-day dietary history (kcal/day)	2 weeks	No change	unclear
	Low-fibre breakfast cereal (5.6g fibre/d)	25/25		2020 (SE 64)							No change	
*14353 (Jenkins *et al.*, 1998)	low fibre control (22g fibre day)	24/24		2204 (SE 81)		Significance of differences not reported		Energy intake	7-day dietary history (kcal/day)	1 week	No change	unclear
	RS2	24/24		2124 (SE 77)							No change	
	RS3	24/24		2172 (SE 87)							No change	
	Wheat Bran (30g fibre/day)	24/24		2260 (SE 84)							No change	
*14397 (Sanders and Reddy, 1992)	Rice bran (15g)	18/18		2188 (SE 104)		NS		Energy intake	Duplicate portions (kcal/day)	3 weeks	No change	unclear
	Rice bran (30g)	18/18		2271 (SE 124)		NS					No change	
	Wheat bran (15g)	18/18		2211 (SE 122)							No change	
*14452 (Tredger *et al.*, 1991)	Guar gum	12/15	10000 (SE 600)	11000 (SE 800)	NS		Unclear if groups significantly different	Energy intake	3-day food diary (kJ/day)	10 days	No change	unclear
	Sugar beet fibre (20g fibre/day)	12/15	10700 (SE 500)	12000 (SE 100)	NS						No change	
	Wheat bran (20g fibre /day)	12/15	10100 (SE 600)	11200 (SE 600)	NS						No change	
*14481 (Vuksan *et al.*, 1999)	Low fibre breakfast cereal (1.7g fibre /day)	22/24		9008 (SE 364)				Energy intake	7-day dietary history (kJ/day)	2 weeks	No change	unclear
	Reduced starch wheat flakes	24/24		8878 (SE 389)		NS					No change	
	Wheat bran (21g fibre/day)	23/24		8281 (SE 418)							No change	

*This result was used in the meta-analysis of cereal brans (other than oat bran) and energy intake

Results - Energy Intake, Eating motivation and Fibre Isolates, Beta-Glucans

Beta-glucan is a viscous soluble polysaccharide that occurs in the endosperm cell walls of grains. It is composed of glucose molecules with mixed β-(1→4) and β-(1→3) bonds. Oats and barley are recognised as particularly rich sources. Considerable variation in the amount of beta-glucans in oats and oat products exists, which is due to varietal and processing influences. Commercial rolled oats may contain in the region of 3-5% beta-glucan and oat bran between 6-10% (Wursch and Pi-Sunyer, 1997). Studies by Keenan *et al.*, Smith *et al.* and Sundberg *et al.* (Smith *et al.*, 2008;Sundberg, 2008;Keenan *et al.*, 2007) explored beta-glucans derived from barley, whereas the other studies investigated oats or oat-derived beta-glucans. The comparison was between oats and corn in 3 studies (Reynolds *et al.*, 2000;Kohl *et al.*, 2009;Johnston, 1998), and with wheat and corn in 2 studies (Davy *et al.*, 2002b;Chen *et al.*, 2006;He *et al.*, 2004).

Energy intake and fibre isolates, beta-glucans

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Eighteen papers, from 16 studies provided data on the relationship between beta-glucan consumption and energy intake. Two studies reported energy intake data in 2 papers each respectively (Davy *et al.*, 2002a;Davy *et al.*, 2002b) and (He *et al.*, 2004;Chen *et al.*, 2006). Nine of these studies were conducted in the USA, and the remainder in Northern Europe, Canada and Australia.

One study was conducted on children (Maki *et al.*, 2003), but all others used adults as participants.

Most studies assessed energy intake using the food diary approach, however, one study used the 24-hour recall technique (He *et al.*, 2004;Chen *et al.*, 2006) and two used a food frequency questionnaire (Kerckhoffs *et al.*, 2003;Theuwissen and Mensink, 2007).

Two studies used female participants (Robitaille *et al.*, 2005;Abrahamsson *et al.*, 1994) and four used males only (Whyte *et al.*, 1992;Maki *et al.*, 2007a;Davy *et al.*, 2002b;Davy *et al.*, 2002a). Three studies (from 4 papers) were large, with more than 100 participants (He *et al.*, 2004;Chen *et al.*, 2006;Johnston, 1998;Keenan *et al.*, 2007) but the study by Kohl *et al.* was particularly small, with just 17 subjects (Kohl *et al.*, 2009). However, this study administered beta-glucan in the form of capsules which permitted the design to be a randomised, double-blind, placebo-controlled cross-over study, which was a strength. However, data from this study were not included in the meta-analysis as no measures of variance around the mean energy intakes were provided.

Twelve of the 16 studies providing dietary differences in beta-glucans between groups were included in the meta-analysis. Two studies were excluded from the meta-analysis due to lack of measures of variation around the energy intake estimates (Kohl *et al.*, 2009;Johnston, 1998). These latter studies reported no significant difference with beta-glucan capsule or oat consumption respectively. One study was excluded where participants were children (Maki *et al.*, 2003) and one further study could not be included because no energy intake estimates were provided (the paper reported in the text that there were no differences in energy intake between study groups which compared barley beta-glucans and placebo) (Keenan *et al.*, 2007). The study by Maki *et al.* (Maki *et al.*, 2003) which determined the effect of control or ready-to-eat cereal with 3g/d beta-glucan from oats for 4 weeks in children (aged 6-14 years), reported significantly lower estimates of energy intake in the oat compared to the control group. Energy intake was lower by 9.7% ($P<0.05$) during the beta-glucan cereal phase.

A full description of the 12 trials included in the meta-analysis is included in the trials characteristics table. Wheat products or wheat fibre was the comparison group for most of the studies. The first follow up reported at the end of the intervention was used. This varied from 2 weeks to 12 weeks. The overall pooled estimate indicated that energy intake was 48kJ (95% CI, -265kJ to 362kJ) higher with consumption of a diet high in beta-glucans. This was not significantly different from zero ($p=0.76$). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 47%). Statistically, there was no evidence that a diet high in beta-glucans derived from oats or barley is associated with a different energy intake. It should be noted however, that the comparison groups were often high in fibre derived from wheat, and this may have impacted on our finding of a lack of effect on energy intake with higher beta-glucan diets.

Figure 6.15 Forest plot for fibre isolates, beta-glucans and energy intake (kJ per day)

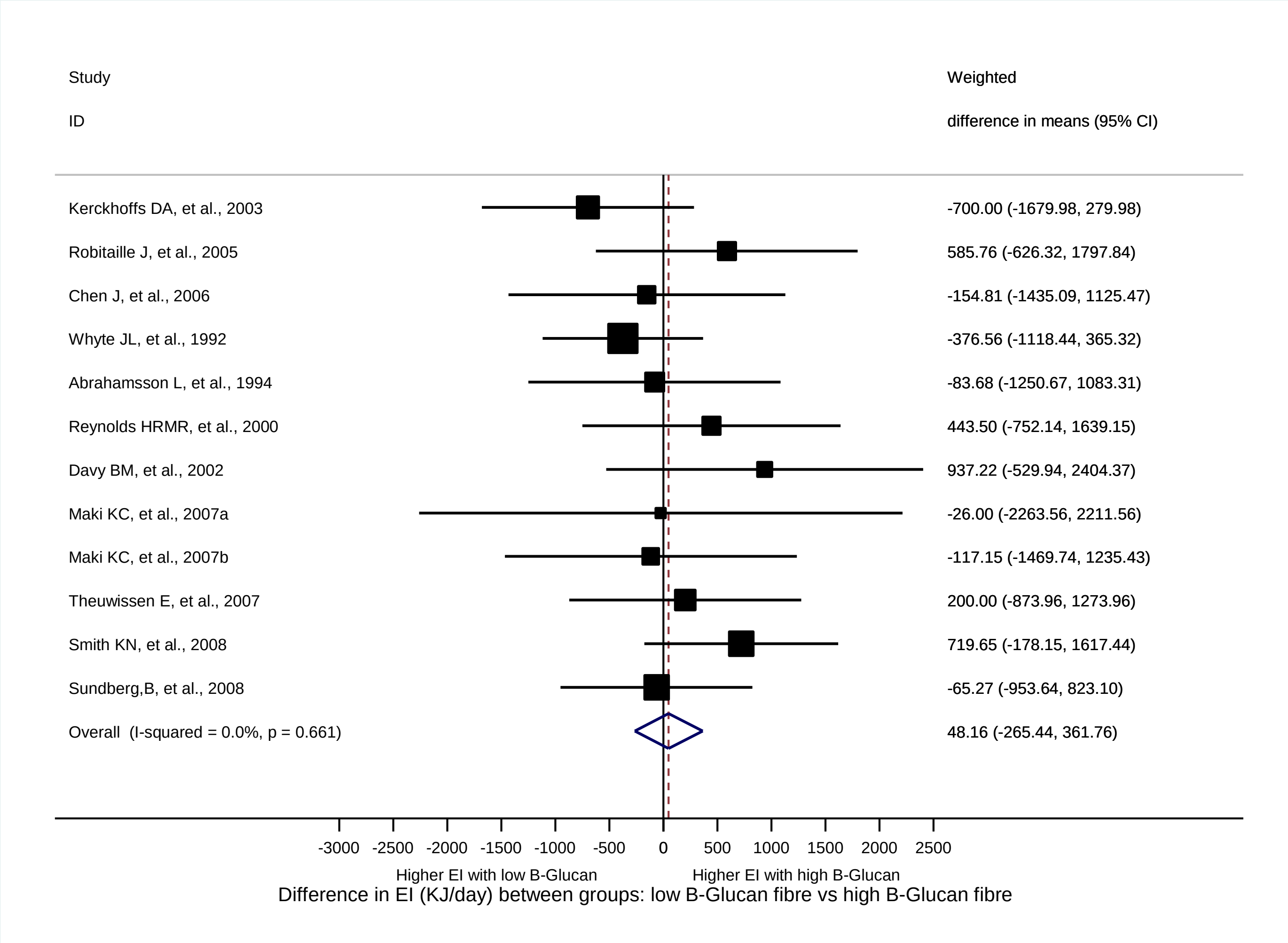

Table 6.25 Energy Intake – Dietary fibre, beta-glucans: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups in Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
Children study													
14411 (Maki *et al.*, 2003)	Beta-glucan cereal	18/29		1790.8 (SE 114)			0.05		Energy intake	3-day food record (kcal/day)	3 weeks	No change	No bias
	Control cereal	18/29		2016.6 (SE 112)								No change	
Adult studies													
*14470 (Abrahamsson *et al.*, 1994)	Oat bran buns	12/15	2110 (SD 426)	2440 (SD 341)			Not reported		Energy intake	7-day food diary (kcal/day)	4 weeks	No change	unclear
	Wheat bran buns	12/16	2110 (SD 426)	2460 (SD 356)								No change	
17169 (Chen *et al.*, 2006)	High fibre	54/54	2143 (SD 941)		75 (SD 776)		NS		Energy intake	24-hr recall (kcal/day)	12 weeks	No change	No bias
	Low fibre	56/56	2034 (SD 811)		112 (SD 757)							Small increase	
*17177	High fibre minus low fibre	ITT analysis: High fibre:56/56 Low fibre: 54/54						-37 (CI -343, 269)	Energy intake	24-hr recall (kcal/day)	12 weeks	-0.7 kg	No bias
*15429 (Davy *et al.*, 2002a)	Wheat cereal	18/18	2246 (SE 130)	2375 (SE 125)			NS		Energy intake	4-day food diary (kcal/day)	12 weeks	Increase	bias
	Whole-grain oat cereal	18/18	2538 (SE 134)	2599 (SE 128)								Increase	
14726 (He *et al.*, 2004)	Oat bran and oatmeal	54/54	2143 (SD 941)		75 (SD 776)		NS		Energy intake	Recall (kcal/day)	12 weeks	No change	No bias
	Refined wheat and corn	56/56	2034 (SD 811)		112 (SD 757)							Increase	
16678 (Johnston, 1998)	Control cereal	60/62	2007.7	2024.9		NS	Not reported		Energy intake	3-day food diary (kcal/day)	6 weeks	No change	unclear
	Whole grain oat cereal	60/62	1923.6	1935.2		NS						No change	
16335 (Keenan *et al.*, 2007)	High-dose, low molecular weight barley beta glucan	30/30				NS	Not reported		Energy intake	3-day food diary	6 weeks	No change	No bias
	High-dose, high molecular weight barley beta glucan	32/32				NS					6 weeks	No change	
	Low-dose, high molecular weight barley beta glucan	32/32				NS					6 weeks	No change	
	Low-dose, low molecular weight barley beta glucan	31/31				NS					6 weeks	No change	
	Placebo	30/30				NS					6 weeks	No change	

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups in Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*14375 (Kerckhoffs *et al.*, 2003)	Beta glucan foods	25/25	8.8 (SE 0.3)	8.6 (SE 0.3)				NS	Energy intake	Average intake from baseline to follow-up FFQ, (MJ/day)	4 weeks	Decrease	bias
	Control foods	23/23	9.1 (SE 0.3)	9.3 (SE 0.4)								Decrease	
14505 (Kohl *et al.*, 2009)	Beta-D-Glycans capsules	12/12		8616			0.19		Energy intake	6x3-day food diary (kJ/day)	4 weeks	Not reported	No bias
	Placebo capsule	12/12		8692								Not reported	
*14478 (Maki *et al.*, 2007a)	Oat based cereals	27/33	2365 (SD 740)	2564 (SE 761)			0.849		Energy intake	3-day food diary	2 weeks	n/a	unclear
	Wheat based cereals	27/33	2365 (SD 740)	2590 (SE 851)								n/a	
*15056 (Maki *et al.*, 2007b)	Oat beta-glucan cereal	26/26	1858 (SE 787)		66 (SE 122)		0.868		Energy intake	3-day food diary (kcal/day)	12 weeks	No change	No bias
	Wheat cereal	34/34	1937 (SE 739)		94 (SE 111)							No change	
*14513 (Reynolds *et al.*, 2000)	Corn cereal	21/21	1727 (SE 91)	1844 (SE 87)					Energy intake	4-day food diary (kcal/day)	4 weeks-average	No change	unclear
	Oat cereal	22/22	1890 (SE 116)	1950 (SE 117)			NS					No change	
*14405 (Robitaille *et al.*, 2005)	Low fat	16/18	2229 (SD 576)	1825 (SD 411)		0.41		NS	Energy intake	3-day food diary (kcal/day)	4 weeks	Decrease	unclear
	Low fat + oat bran	18/19	2072 (SD 423)	1965 (SD 425)		0.35						No change	
*16565 (Smith *et al.*, 2008)	High molecular weight Betaglucan	45/45			-1 (SE 85)	NS	0.12		Energy intake	3-day food diary (kcal/day)	6 weeks	No change	No bias
	Low molecular weight Betaglucan	45/45			-173 (SE 69)	0.05						Increase	
*15708 (Sundberg, 2008)	Barley fibre flakes	43/48		1942.61 (SD 478.24)			NS		Energy intake	3-day food diary (kcal/day)	4 weeks	No change	No bias
	Wheat flakes	43/48		1958.21 (SD 525.28)								No change	
*16288 (Theuwissen and Mensink, 2007)	Beta-glucan muesli	40/43		8.3 (SD 2.5)			NS		Energy intake	FFQ (MJ/day)	4 weeks	Decrease	No bias
	Control muesli	40/43		8.1 (SD 2.4)								Decrease	
*14400 (Whyte *et al.*, 1992)	Oat dietary period	21/23		1860 (SD 312)			Not reported		Energy intake	Every 3rd day - food diary (kcal/day)	4 weeks-average	No change	unclear
	Wheat dietary period	21/23		1950 (SD 273)								No change	

*This result was used in the meta-analysis of fibre isolates, beta-glucans and energy intake

Eating motivation and fibre isolates, beta-glucans

Summary of cohort results

No cohort studies provided data

Summary of trials results

Two trials provided data concerning beta-glucan consumption and subjective reports of appetite. One trial compared the effects of a diet high in oats (rich in beta-glucans) compared to a control diet (Saltzman *et al.*, 2001) and one trial compared the effect of high or low molecular weight beta-glucan supplements on appetite for breakfast, lunch or dinner (Smith *et al.*, 2008). Both studies were 6 weeks in duration. The former study found no significant difference in frequency of reporting hunger or satiety by study group, but the study by Smith *et al.* reported some reduction in hunger at lunch time (but not at other times of the day) with consumption of a high molecular weight barley-derived beta-glucan supplement compared to the low molecular weight product.

Due to an insufficient number of studies, it was not possible to combine these studies using meta-analysis.

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Table 6.26 Eating motivation - fibre isolates, beta-glucans: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Outcome/ Assessment method	Result-specific follow-up	Weight Change	Outcome Assessment Bias
16151 (Saltzman *et al.*, 2001)	Control	11/20	3.6 (SE 0.4)	2 (SE 0.3)				Frequency of feelings of satiety	6 weeks	Decrease	unclear
	Oat diet	8/21	2.9 (SE 0.6)	2.5 (SE 0.6)			NS			Decrease	
16168	Control	11/20	2.3 (SE 0.5)	3.6 (SE 0.4)				Hunger report frequency	6 weeks	Decrease	unclear
	Oat diet	8/21	2.1 (SE 0.5)	2.5 (SE 0.5)			0.1			Decrease	
16566 (Smith *et al.*, 2008)	High molecular weight barley beta-glucan	45/45				NS		Category scale 1=no desire to eat 9=unbearable hunger Breakfast time	6 weeks	No change	No bias
	Low molecular weight barley beta-glucan	45/45				NS				Increase	
16594	High molecular weight barley beta-glucan	45/45				NS		Category scale 1=no desire to eat 9=unbearable hunger Dinner time	6 weeks	No change	No bias
	Low molecular weight barley beta-glucan	45/45				NS				Increase	
16593	High molecular weight barley beta-glucan	45/45			0.9 (SE 0.3)	0.05	0.02	Category scale 1=no desire to eat 9=unbearable hunger Lunch time	6 weeks	No change	No bias
	Low molecular weight barley beta-glucan	45/45			0.03 (SE 0.21)	NS				Increase	

Results - Energy Intake, Eating motivation and Breakfast Cereals

Energy intake and breakfast cereals

Summary of cohort results

No cohort studies provided data

Summary of trials results

Six studies explored the effects of breakfast cereal intake on energy intake (Kirk *et al.*, 1997;Kleemola *et al.*, 1999;Mattes, 2002;Rodriguez-Rodriguez *et al.*, 2008;Waller *et al.*, 2004;Zaveri and Drummond, 2009). Of these trials, two reported energy intake as a primary outcome (Zaveri and Drummond, 2009;Waller *et al.*, 2004). All were included in a meta-analysis.

Energy intakes were assessed using food diaries, other than Waller *et al.* (Waller *et al.*, 2004) which used dietary recalls. Studies were conducted in America, Finland, Scotland (2), Spain and the USA. None were single- or double-blind in design.

Participants were all adults, and mean BMI was <30kg/m^2 in 5 trials, but 35kg/m^2 in one study (Waller *et al.*, 2004). One study included only women (Rodriguez-Rodriguez *et al.*, 2008), and one study only men (Zaveri and Drummond, 2009). The average number of participants in the 6 trials was 93 (median 62).

Descriptions of the different types of breakfast cereal intervention are reported in the trial characteristics table (table 6.3). These studies assessed the effect of incorporating ready-to-eat breakfast cereals (or cereal bar) into the diet compared with a ‘no change’ protocol. The cereal amounts advocated were generally 1 or 2 servings per day (30 – 60g) with milk. In all of these studies the anticipation was that the cereal products would replace either a whole meal (breakfast or lunch or both) (Mattes, 2002;Kirk *et al.*, 1997;Kleemola *et al.*, 1999) or be a substitute for snacks (Waller *et al.*, 2004;Zaveri and Drummond, 2009). In one study the control group were asked to increase their fruit and vegetable intake (Rodriguez-Rodriguez *et al.*, 2008).

One study was a cross-over trial (Kleemola *et al.*, 1999) and the others employed the parallel group design.

One study included an energy restriction goal as part of the intervention (Rodriguez-Rodriguez *et al.*, 2008) but the others permitted energy intake to vary. Mattes *et al.* (Mattes, 2002) explored whether ready-to-eat (RTE) breakfast cereal used as a portion-controlled, meal replacement influences energy intake. The intervention groups in this study were randomly allocated to consume a serving of a single brand of breakfast cereal plus skimmed milk and a portion of fruit, or a variety of breakfast cereals, for breakfast and as a replacement for lunch or dinner over a 14-day period (Mattes, 2002). Ready-to-eat breakfast cereals were provided to both intervention groups. Participants in the breakfast cereal diet groups only were then encouraged to follow a volumetric diet from weeks 3 to 6 with an energy restriction goal of 500kcal/day. As the control group did not use a non-cereal meal replacement product, any differences in energy intake may be attributable to the meal-replacement protocol rather than breakfast cereals *per se.*

One study provided information from more than two groups (Mattes, 2002) and the control was compared with the group which received a variety of cereals (not a single cereal type). One study tested the effect of a cereal bar rather than cereal to be consumed with milk (Zaveri and Drummond, 2009).

The first follow up reported at the end of the intervention was used. This varied from 2 weeks to 12 weeks. Heterogeneity denoted by I^2 was more than 80% and therefore a pooled estimate has little meaning and is not included in the plot. One study only, found a statistically significant effect on energy intake with the replacement of 2 meals per day with high carbohydrate RTE breakfast cereal (Mattes, 2002). The other studies showed no clear pattern of effect, with large confidence intervals around the mean energy intake difference. These studies suggest that replacing meals or snacks with cereal products has limited impact on energy intake, at least over the relatively short time frame of the studies included here.

Figure 6.16 Forest plot for breakfast cereals and energy intake (kJ per day)

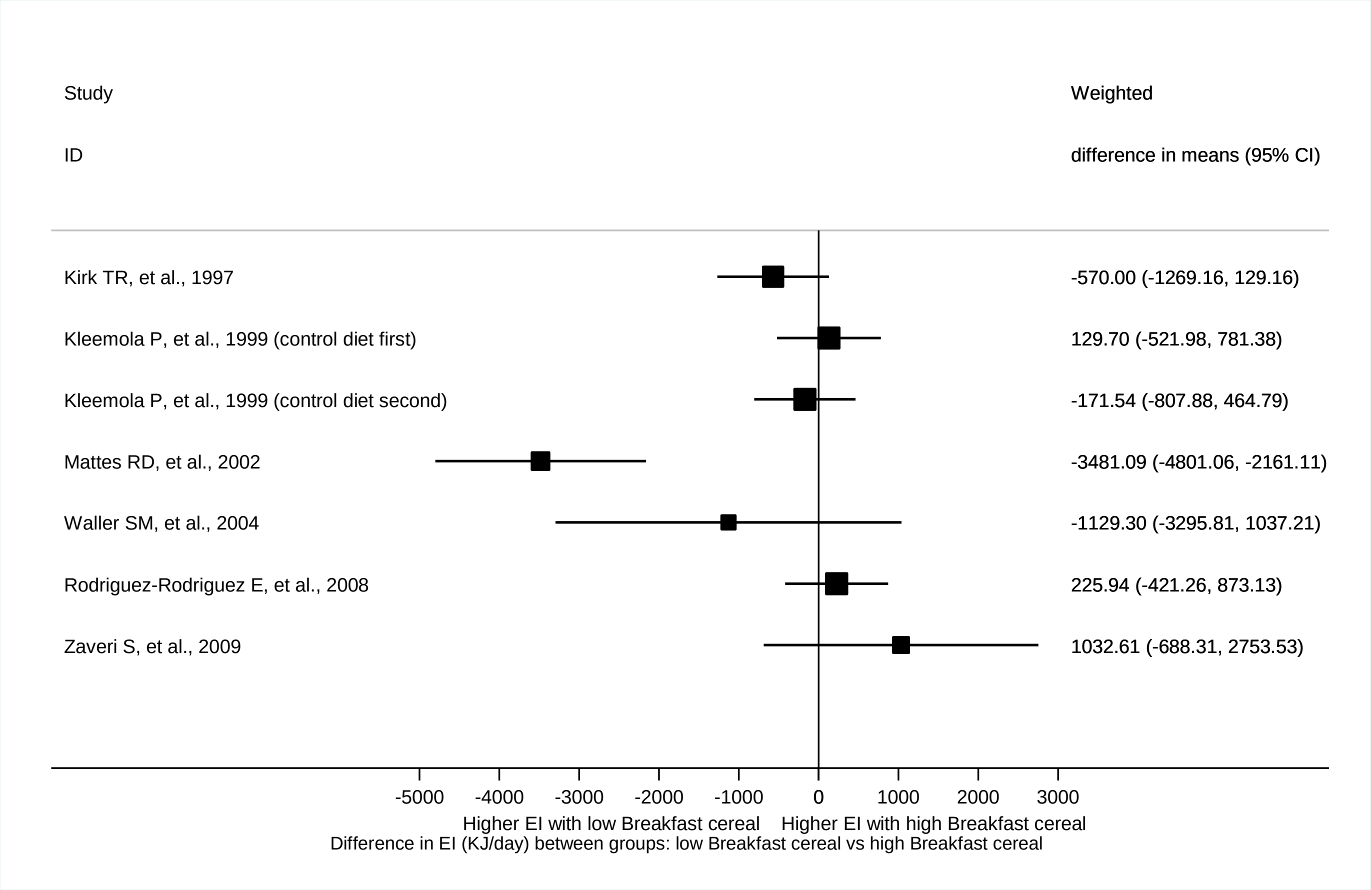

Table 6.27 Energy Intake – Breakfast cereals: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*14369 (Kirk *et al.*, 1997)	Breakfast cereals (RTE)	26/26	7.82 (SD 1.26)	7.87 (SD 1.23)					Energy intake	7-day food diary (MJ/day)	4 weeks	No change	bias
	Control	22/22	8.01 (SD 1.23)	8.44 (SD 1.34)			NS					No change	
14370	Breakfast cereals (RTE)	26/26	7.82 (SD 1.26)	7.92 (SD 1.22)					Energy intake	7-day food diary (MJ/day)	12 weeks	No change	bias
	Control	22/22	8.01 (SD 1.23)	7.75 (SD 1.22)			NS					No change	
*15228 (Kleemola *et al.*, 1999)	Group 1- Cereal diet first	104/ allocated not reported	2184 (SD 627)	2094 (SD 565)	-90	0.11		NS	Energy intake	3-day food diary (kcal/day)	6 weeks	No change	bias
	Group 2- Control diet first	105/ allocated not reported	2056 (SD 626)	2063 (SD 581)	7							No change	
*15241	Group 1- Control diet second	104/ allocated not reported	1979 (SD 596)	2004 (SD 534)	25				Energy intake	3-day food diary (kcal/day)	6 weeks	No change	bias
	Group 2- Cereal diet second	105/ allocated not reported	1923 (SD 551)	1963 (SD 584)	40	0.79		NS				No change	
*14379 (Mattes, 2002)	Control group	26/36			+215 (SE 122) (SD			Not reported	Energy intake	24 hour diary, (kcal/day)	2 weeks	No change	unclear
	Single breakfast cereal diet	28/33			-640 (SE 109)							Decrease	
	Variety breakfast cereal diet	28/37			-617 (SE 105)							Decrease	
14935 (Rodriguez-Rodriguez *et al.*, 2008)	Increased cereal diet	25/25	2408 (SD 534)	1558 (SD 265)		<0.01			Energy intake	3-day food diary (kcal/day)	2 weeks	Decrease	bias
	Increased fruit & veg diet	24/24	2145 (SD 580)	1567 (SD 238)		<0.01						Decrease	
*14936	Increased cereal diet	25/25	2408 (SD 534)	1612 (SD 283)		<0.01	NS		Energy intake	3-day food diary (kcal/day)	6 weeks	Decrease	bias
	Increased fruit & veg diet	24/24	2145 (SD 580)	1558 (SD 275)		<0.01						Decrease	
*14391 (Waller *et al.*,	Cereal group	17/32			-293.13 (SD 628.63)		0.146		Energy intake	3x24hr recall (kcal/day)	4 weeks	Decrease	unclear

2004)	Control	23/30			-23.22 (SD 889.6)							No change	
16920 (Zaveri and Drummond, 2009)	Cereal bar	13/14	1983.3 (SD 553.5)	1794.7 (SD 346)		NS			Energy intake	4-day food diary (kcal/day)	6 weeks	No change	unclear
	Control	12/13	1849.6 (SD 341.1)	1719.7 (SD 753.3)		NS	NS					No change	
*16921	Cereal bar	13/14	1983.3 (SD 553.5)	2044.4 (SD 523.1)		NS			Energy intake	4-day food diary (kcal/day)	12 weeks	No change	unclear
	Control	12/13	1849.6 (SD 341.1)	1797.6 (SD 546.7)		NS	NS					No change	

*This result was used in the meta-analysis of breakfast cereals and energy intake

Eating motivation and breakfast cereals

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Two trials provided data on breakfast cereal consumption (Mattes, 2002) or cereal bar consumption (Zaveri and Drummond, 2009) and eating motivation.

Due to an insufficient number of studies, it was not possible to combine these studies using meta-analysis.

In the study by Zaveri and Drummond (Zaveri and Drummond, 2009) the effect of cereal bar consumption (2 per day) was compared to a control group (no additional snack) on energy intake and other aspects of eating behaviour in 30 healthy men over 12 weeks. Energy intake was assessed using food diaries, and visual analogue scales were used to assess hunger ratings. There was no difference in daily energy intake or average hunger ratings between the groups, which suggests that energy compensation took place. Eating frequencies of the control and cereal bar groups were similar, which suggests that the provided cereal bars had been substituted for other habitual snacks.

Mattes *et al.* (Mattes, 2002) explored whether ready-to-eat breakfast cereal used as a portion-controlled, meal replacement influences energy intake, subjective ratings of appetite and ultimately body weight regulation in 103 mixed gender, overweight and obese volunteers. For 2 weeks, participants consumed breakfast cereals as replacement for 2 meals (the 3rd was unrestricted) per day in either a single or multi-variety condition. These 2 groups were compared to a control group who received no dietary instruction. No differences between groups were reported for ratings of fullness, prospective consumption or hunger as assessed using 9-point category scales.

These two studies do not provide evidence to suggest that incorporation of breakfast cereals or cereal bars into the diet as a replacement for other foods preferentially influences eating motivation.

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Table 6.28 Eating motivation - Breakfast cereals

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	Outcome/Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
14387 (Mattes, 2002)	Single breakfast cereal diet minus control group	Single breakfast: 31/33 Control: 34/36					No difference	Average over whole day Fullness	9 point category scale	2 weeks	No change	unclear
14388	Variety breakfast cereal diet minus control group	Variety breakfast: 31/37 Control: 34/36					No difference	Average over whole day Fullness	9 point category scale	2 weeks	No change	unclear
14389	Variety breakfast cereal diet minus single breakfast cereal diet	Variety breakfast: 31/37 Single breakfast: 31/33					No difference	Average over whole day Fullness	9 point category scale	2 weeks	Decrease	unclear
14384	Single breakfast cereal diet minus control group	Single breakfast: 31/33 Control: 34/36					No difference	Average over whole day Hunger ratings	9 point category scale	2 weeks	No change	unclear
14385	Variety breakfast cereal diet minus control group	Variety breakfast: 31/37 Control: 34/36					No difference	Average over whole day Hunger ratings	9 point category scale	2 weeks	No change	unclear
14386	Variety breakfast cereal diet minus single breakfast cereal diet	Variety breakfast: 31/37 Single breakfast: 31/33					No difference	Average over whole day Hunger ratings	9 point category scale	2 weeks	Decrease	unclear
14390	Single breakfast cereal diet minus control group	Single breakfast: 31/33 Control: 34/36					No difference	Average over whole day Prospective consumption	9 point category scale	2 weeks	No change	unclear
14392	Variety breakfast cereal diet minus control group	Variety breakfast: 31/37 Control: 34/36					No difference	Average over whole day Prospective consumption	9 point category scale	2 weeks	No change	unclear
14393	Variety breakfast cereal diet minus single breakfast cereal diet	Variety breakfast: 31/37 Single breakfast: 31/33					No difference	Average over whole day Prospective consumption	9 point category scale	2 weeks	Decrease	unclear
16922 (Zaveri and Drummond, 2009)	Cereal bar	13/14	4.4 (SD 1.7)	4.5 (SD 2.3)	NS	NS		Hunger ratings	VAS 100mm	6 weeks	No change	unclear
	Control	12/13	4.1 (SD 1.4)	4.2 (SD 1.7)	NS							
16923	Cereal bar	13/14	4.4 (SD 1.7)	5.2 (SD 1.8)	NS	NS		Hunger ratings	VAS 100mm	12 weeks	No change	unclear
	Control	12/13	4.1 (SD 1.4)	4.5 (SD 1.6)	0.05						No change	

Results - Energy Intake and Confectionery

Summary of cohort results

No cohort studies provided data

Summary of trials results

One trial compared the impact on energy intake of consumption of either peanuts or confectionery as snack foods (Claesson *et al.*, 2009). This Swedish, parallel group trial followed 26 non-obese subjects over a 2-week period during which either candy (not chocolate or liquorice) or salted peanuts were consumed (20 kcal/kg/day for each group). There was a marked difference in carbohydrate energy between the diet groups during the 2nd week (candy diet group consumed 65% energy from carbohydrate, and the peanut group 32%). Energy intake as assessed by food diaries, was marginally higher in the nut group, but the difference between groups was not statistically significant (P=0.6).

Table 6.29 Energy Intake – Confectionery: RCT data

Result ID/ Author	Inter-vention group	Completers/ Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
14482 (Claesson *et al.*, 2009)	Peanuts	13/13	9.244 (SD 2.5)	13.214 (SD 2.7)		Energy intake	3-day food diary (MJ/day)	2 weeks	No change	bias
	Sweets	12/13	9.131 (SD 3.1)	12.690 (SD 2.7)	0.6				Increase	

Results - Energy Intake and Legumes

Summary of cohort results

No cohort studies provided data

Summary of trials results

Two Australian cross-over trials provided data concerning the impact of high legume diets, compared to wheat-based diets on energy intake (Nestel *et al.*, 2004;Pittaway *et al.*, 2007). In the study by Pittaway *et al* (Pittaway *et al.*, 2007), the chickpea diet and the comparison, high fibre wheat diet had an equivalent total fibre content and were consumed for 5 weeks by 31 subjects. A range of chickpea-based or wheat-based foods were provided for the subjects to assist compliance. No significant difference in energy intake, as assessed using food diaries was observed. Similarly, Nestel *et al.* provided a range of chickpea-based or wheat-based foods for the 21 subjects in this trial. After 6 weeks on each intervention group, however, energy intake as assessed using a food frequency questionnaire was not differentially affected by these diets.

Another study that followed-up participants for 16 weeks after randomisation to either lupin kernel (a member of the legume family) flour bread or wheat control bread reported no difference between groups at the end of the intervention (Lee *et al.*, 2009).

Table 6.30 Energy Intake – Legumes: RCT data

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
(Lee *et al.*, 2009)	Control bread	37/48	9367 (SD 2.23)	8.88 (SD 2.13)	0.28	Diet history question-naire (mJ/day)	16 week	No change	unclear
	Lupin flour bread	37/40	9.28 (SD 2.09)	8.23 (SD 2.06)				No change	
15328 (Nestel *et al.*, 2004)	Chickpea based foods	19/21	7989 (SD 3717)	7424 (SD 2938)	NS	FFQ (kJ/day)	6 weeks	Not reported	unclear
	Wheat based foods	19/21	7989 (SD 3717)	7524 (SD 3947)				Not reported	
14459 (Pittaway *et al.*, 2007)	Chickpea diet	27/31		8.89 (CI 8.35, 9.42)	NS	4-day food diary (MJ/ day)	5 weeks	Not reported	unclear
	Wheat diet	27/31		9.08 (CI 8.48, 9.69)				Not reported	

Results - Energy Intake, Eating motivation and Wholegrain

Energy intake and wholegrain

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Four papers from three studies providing dietary differences in wholegrain foods between groups were identified (Andersson *et al.*, 2007;Howard *et al.*, 2006;Tinker *et al.*, 2008;Turpeinen *et al.*, 2000). Papers from Howard *et al.* and Tinker *et al.* are both from the Women's Health Initiative Dietary Modification Trial (Andersson *et al.*, 2007;Howard *et al.*, 2006;Tinker *et al.*, 2008;Turpeinen *et al.*, 2000). The results from Tinker *et al.* are included in the meta-analysis.

All three studies were included in the meta-analysis. The Women's Health Initiative Dietary Modification Trial is a parallel group design, but the other studies included here are cross-over trials of mixed gender. All studies included adults as participants. None included an energy restriction goal as part of the intervention. Energy intakes were assessed using a food frequency questionnaire in the Women's Health Initiative Trial, and the other two studies employed the food diary approach.

Definitions of different wholegrain diets are reported in the trial characteristics table. The first follow up reported at the end of the intervention was used. This varied from 3 weeks to 6 years. The overall pooled estimate indicated that energy intake was 360 kJ (95% CI, 79 kJ to 642 kJ) lower with consumption of a diet high in wholegrain foods. This was significantly different from zero (p=0.01). Heterogeneity denoted by I^2 was 0% (95% CI, 0 to 88%).

It should be noted that one study (Tinker *et al.*, 2008) contributed more to the pooled estimate than the other studies (75%) which had far fewer participants. The absolute difference in wholegrain intakes between the intervention groups on this study was extremely small (daily wholegrain servings increased from 1.1 to 1.4 in the intervention group). Other dietary changes in this trial may equally be responsible for the lower energy intakes reported (reduced fat intake in particular). Statistically, there was some evidence that a diet high in wholegrain foods is associated with a lower energy intake, but this result is primarily driven by one large study of women.

Nb. the results of this meta-analysis should be viewed in conjunction with that of the beta-glucan studies as some of those studies were also 'wholegrain'.

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Figure 6.17 Forest plot for wholegrain and energy intake (kJ per day)

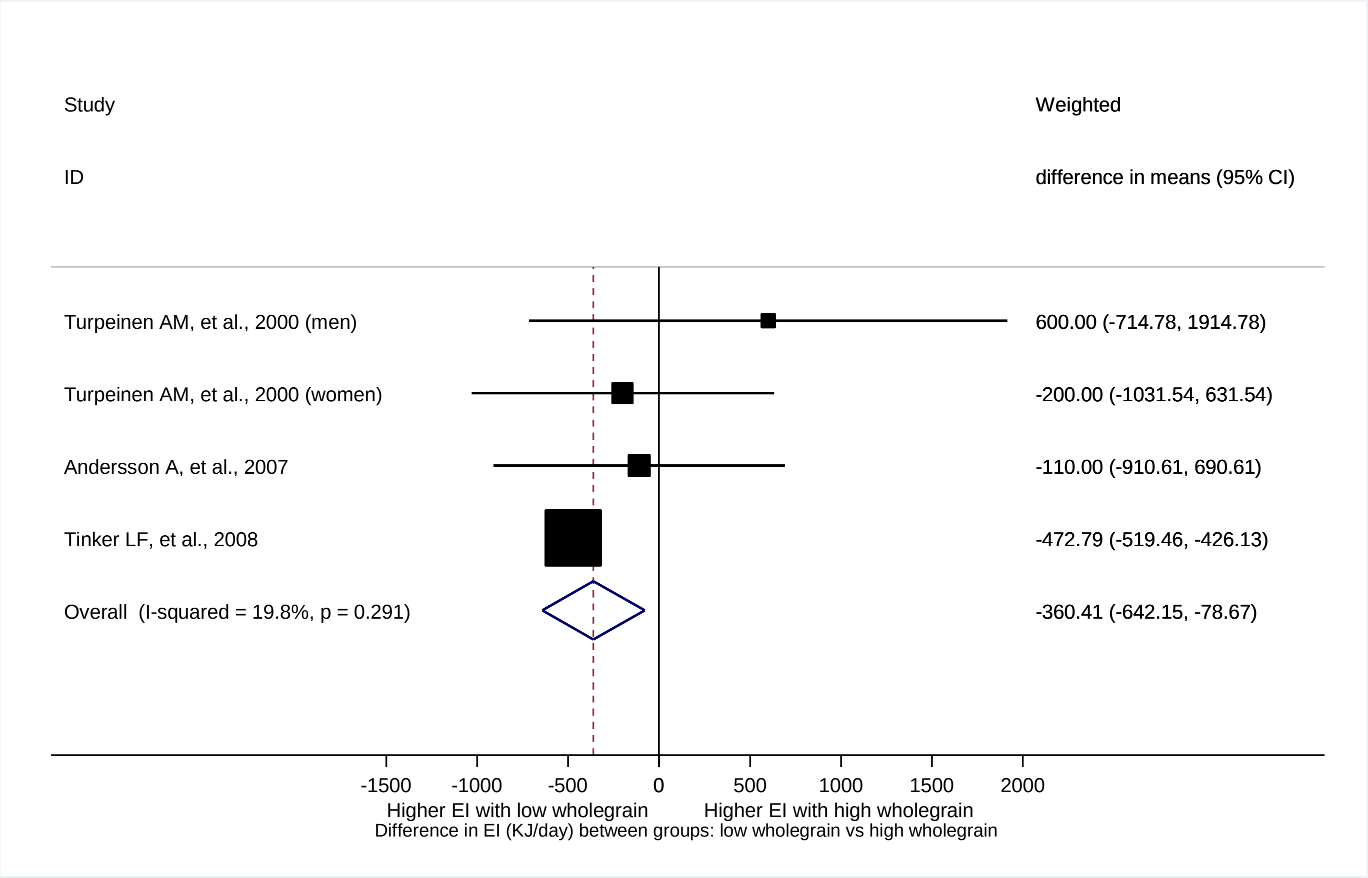

Table 6.31 Energy Intake – Wholegrain: RCT data

Result ID#/ Reference	Subgroup detail	Intervention group	Completers/ Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
*14067 (Andersson *et al.*, 2007)		Refined grain products	28/30	8005 (SD 1420)	9065 (SD 1475)		Energy intake	3-day food diary (kJ/day)	6 weeks	Increase	unclear
		Wholegrain products	27/30	8600 (SD 1645)	8955 (SD 1580)	0.73				Increase	
16257 (Howard *et al.*, 2006)		Control	22958/29294	1789.4 (SD 703.0)	1593.8 (SD 644.0)		Energy intake	FFQ (kcal/day)	1 year	No change	No bias
		Low fat	14885/19541	1790.2 (SD 710.1)	1500.5 (SD 544.2)	<0.001				Decrease	
16258		Control	22958/29294	1789.4 (SD 703.0)	1546.2 (SD 639.5)		Energy intake	FFQ (kcal/day)	6 years	No change	No bias
		Low fat	14885/19541	1790.2 (SD 710.1)	1431.8 (SD 551.7)	<0.001				Decrease	
15378 (Tinker *et al.*, 2008)		Control	25182/29294	1788 (SD 699)	1594 (SD 640)		Energy intake	FFQ (kcal/day)	1 year	No change	unclear
		Low fat diet	17117/19541	1790 (SD 709)	1502 (SD 541)	0.001				Decrease	
*15390		Control	21759/29294	1788 (SD 699)	1548 (SD 635)		Energy intake	FFQ (kcal/day)	6 years	No change	unclear
		Low fat diet	14117/19541	1790 (SD 709)	1435 (SD 549)	0.001				Decrease	
*14430 (Turpeinen *et al.*, 2000)	Men	Low fibre wheat bread	18/43		9400 (SE 600)		Energy intake	4-day food diary (kJ/day)	3 weeks	No change	unclear
	Men	Wholemeal rye bread	18/43		8800 (SE 300)	NS				No change	
*14431	Women	Low fibre wheat bread	21/43		6800 (SE 300)		Energy intake	4-day food diary (kJ/day)	3 weeks	No change	unclear
	Women	Wholemeal rye bread	21/43		7000 (SE 300)	NS				No change	

*This result was used in the meta-analysis of wholegrain and energy intake

Eating motivation and wholegrain (whole oats)

Summary of cohort results

No cohort studies provided data.

Summary of trials results

One trial reported no differential effect of 6 weeks on an oat-based diet compared to the control diet in any aspect of eating motivation (Saltzman *et al.*, 2001).

Table 6.32 Satiety – Whole grains: RCT data

Result ID/ Author	Intervention group	Completers / Allocated	Baseline	Follow-up	p-value difference between groups	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
16151 (Saltzman *et al.*, 2001)	Control	11/20	3.6 (SE 0.4)	2 (SE 0.3)		Frequency of feelings of satiety	Questionnaire (score/5)	6 weeks	Decrease	unclear
	Oat diet	8/21	2.9 (SE 0.6)	2.5 (SE 0.6)	NS				Decrease	
16168	Control	11/20	2.3 (SE 0.5)	3.6 (SE 0.4)		Hunger report frequency	Questionnaire (score/5)	6 weeks	Decrease	unclear
	Oat diet	8/21	2.1 (SE 0.5)	2.5 (SE 0.5)	0.1				Decrease	

Results - Energy Intake, Eating motivation and Glycaemic Index or Load

The glycaemic index (GI) is a relative measure of the plasma glucose response induced by a specific food, as compared to the response induced by the same amount of carbohydrate from a reference source, such as white bread or pure glucose (Liu *et al.*, 2000). The glycaemic load (GL) is the product of a specific food's GI and its carbohydrate content (Liu *et al.*, 2000), therefore taking into account both the quality and quantity of carbohydrate consumed. This may be interpreted as a measure of diet-induced insulin demand (Stevens *et al.*, 2002). The glycaemic index (and thus also GL) is determined not only by the nature of the carbohydrate component of a food or diet, but also by the types and amounts of protein, fat and dietary fibre, as well food processing and storage (Venn and Green, 2007). Unless tightly controlled in an experimental situation, in most cases high and low GI/GL diets differ in many ways other than the carbohydrate fraction, including dietary fibre content, energy density and sensory quality.

Energy intake and glycaemic index or load

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Sixteen trials provided data on the effects of high or low GI diets on energy intake. Of these studies, five reported energy intake as a primary outcome (Henry *et al.*, 2007;Paxman *et al.*, 2008;Alfenas and Mattes, 2005;Sloth *et al.*, 2004;Warren *et al.*, 2003).

The majority of studies assessed energy intake by the completion of food diaries, but three studies assessed energy intake by providing food and re-weighing or monitoring food not eaten (Alfenas and Mattes, 2005;Henry *et al.*, 2007;Dumesnil *et al.*, 2001). Three studies used the dietary recall method to assess energy intake (Ebbeling *et al.*, 2007;Warren *et al.*, 2003;Clapp, 1998). Two studies were conducted on children (Warren *et al.*, 2003;Henry *et al.*, 2007).   Six studies each were conducted in the USA and the UK, and the other 4 studies in Denmark, Canada, Australia and France.

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Most trials recruited participants within the overweight or obese range, except those by (Alfenas and Mattes, 2005) and (Clapp, 1998). Sample sizes ranged from 12 to 129 participants, with a median sample size of 39. Seven studies used a cross-over design (Henry *et al.*, 2007;Warren *et al.*, 2003;Alfenas and Mattes, 2005;Paxman *et al.*, 2008;Brynes *et al.*, 2003;Dumesnil *et al.*, 2001;Clapp, 1998). Studies with a small sample size may be underpowered to detect a meaningful difference in energy intake using a parallel group design e.g. (Philippou *et al.*, 2008;Ebbeling *et al.*, 2005).

Alfenas and Mattes (Alfenas and Mattes, 2005) and Dumesnil *et al.* (Dumesnil *et al.*, 2001) assessed energy intake by providing all food and monitoring intake over a relatively short period of time; an approach which might potentially be the most sensitive to the effects of dietary manipulation. The former study is one of the few studies in this body of literature that also matched higher and lower GI diets for macronutrient composition and energy density. However, Alfenas and Mattes, using non-obese subjects found no effect of dietary GI on energy intake, whereas Dumesnil *et al.* reported a significant reduction in energy intake with a low GI, low fat, high protein diet in 12 obese males. Since this study manipulated both GI and protein level, it is not possible to differentiate the effect of GI from that of protein on energy intake. It was not possible to include the study by Alfenas and Mattes (Alfenas and Mattes, 2005) in the meta-analysis as mean energy intakes were not provided (text states no difference in energy intake).

Data from Ebbeling *et al.* (Ebbeling *et al.*, 2007) was presented in figure form only, which prohibited accurate data extraction. This paper indicated a decrease in energy intake in both intervention groups, but no statistically significant difference between them and therefore no differential effect of GI on energy intake under these *ad libitum* conditions.

Two studies of children, both of which were conducted in the UK, (Warren *et al.*, 2003;Henry *et al.*, 2007) were also not included in the meta-analysis. In Warren *et al.* the effects of 3 breakfast types (low GI, low GI+sucrose and high GI) were investigated in children using a cross-over study design. Glycaemic index of the low GI breakfasts was estimated as 55, and ranged between 75-100 in the high GI conditions. Energy intake at lunch time, which was assessed by provision of monitored buffet-style lunches, was found to be significantly lower after the low GI breakfasts compared to the high GI condition (by 119-145 kcal). In the study by Henry *et al.* (Henry *et al.*, 2007), children aged 8-11 years were provided with 300 kcal, low- or high-GI breakfasts in a randomised cross-over study design over a 10 week period. Each group was given low-GI and high-GI breakfasts on two non-consecutive days per week for 10 weeks per breakfast type. Energy intake was assessed using *ad libitum* buffet lunches and daily energy intakes by 24 hour recall and 3 day food diaries. While there was some evidence of lower energy intakes at lunch after the low-GI breakfasts, the difference between breakfast types was not statistically significant (p=0.406).

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Results from Philippou *et al.* (Philippou *et al.*, 2009b) which tested the effects of high or low dietary GI diets on weight maintenance during 4-months following a period of intensive weight loss were not included in the meta-analysis. Energy intakes at 2 and 4-months did not differ between diet groups, but energy intake relative to estimated requirements was reported to be significantly lower in the low-GI group compared to the high-GI group at 4 months (p=0.032) (data not included in tables below). Studies that are not included in the meta-analysis do not provide consistent evidence of an effect of dietary GI on energy intake.

Eleven studies providing dietary differences in GI between groups were included in the meta-analysis. One study reported energy intake expressed as kcal per kg of lean body mass and was transformed to give kJ/day (Clapp, 1998). All studies included adults as participants. Definitions of different levels of GI are reported in the trial characteristics table. The first follow up reported at the end of the intervention was used. This varied from 3 days to 12 months. Heterogeneity denoted by I^2 was 90% and therefore the pooled estimate, which has little meaning, was omitted from the meta-analysis. Other than the study by Phillipou *et al.*, studies generally reported somewhat higher energy intakes with higher GI diets, although individually only in two studies, was this difference significantly different from zero. With no pooled estimate of risk, it was inappropriate to create a funnel plot to assess the extent of publication bias.

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Figure 6.18 Forest plot for glycaemic index or load diets and energy intake (kJ per day)

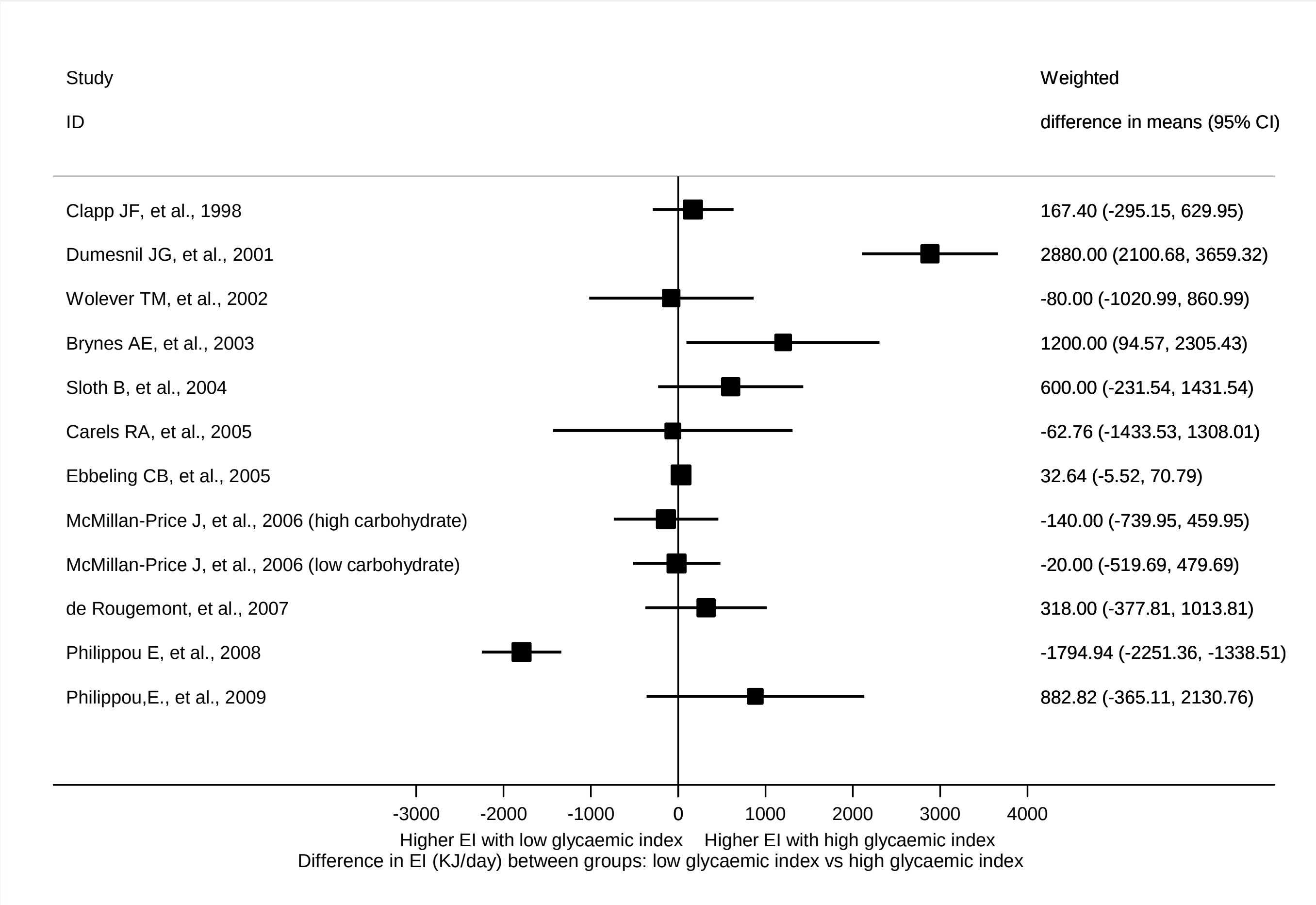

Table 6.33 Energy Intake – Glycaemic index/load: RCT data

Result ID#/ Reference	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value within group Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
Children study														
14653 (Henry *et al.*, 2007)	High GI breakfast	25/38		3132 (SD 829)						Energy intake from *ad libitum* meal	Observation, (kJ/meal)	10 weeks	Small increase	unclear
	Low GI breakfast	25/38		3057 (SD 875)			0.406						Small increase	
14654	High GI breakfast	25/38		8749 (SD 1398)						Energy intake	24 hour diary (kJ/meal)	10 weeks	Small increase	unclear
	Low GI breakfast	25/38		8495 (SD 1550)			0.449						Small increase	
14655	High GI breakfast	15/38		7511 (SD 1778)						Energy intake	1-day food diary, Study day (kJ/day)	10 weeks	Small increase	unclear
	Low GI breakfast	15/38		6889 (SD 1406)			NS						Small increase	
14656	High GI breakfast	15/38		6501 (SD 1652)						Energy intake	1-day food diary, Non-study day (kJ/day)	10 weeks	Small increase	unclear
	Low GI breakfast	15/38		6411 (SD 731)			NS						Small increase	
14657	High GI breakfast	15/38		6654 (SD 2381)						Energy intake	1-day food diary, Weekend day (kJ/day)	10 weeks	Small increase	unclear
	Low GI breakfast	15/38		6297 (SD 2307)			NS						Small increase	
14352 (Warren *et al.*, 2003)	Low GI + sucrose breakfast minus low GI breakfast	Cross-over: 37/38						27 (SE 9)		Lunch energy intake	Buffet meal (kcal/meal)	3 days	Not reported in both	bias
14354	High GI breakfast minus low GI breakfast	Cross-over: 37/38						145 (SE 9)		Lunch energy intake	Buffet meal (kcal/meal)	3 days	Not reported in both	bias
14358	High GI breakfast minus low GI + sucrose	Cross-over:						119 (SE 8.8)		Lunch energy	Buffet meal (kcal/meal)	3 days	Not reported	bias

Result ID#/ Reference	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value within group Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
	breakfast	37/38								intake			in both	
Adult studies														
14464 (Alfenas and Mattes, 2005)	High GI minus Low GI	Crossover: 39/39						No significant diff		Energy intake	Metabolic ward records (kcal/day)	8 days	Not reported	unclear
*14395 (Brynes *et al.*, 2003)	High GI	17/22		9.02 (SE 0.34)						Energy intake	7d food diary (kJ/day)	3 weeks	No change	unclear
	High MUFA	17/22		10.9 (SE 0.51)				Sig. diff from all 3 high carbohydrate groups, P<0.05					No change	
	Low GI	17/22		7.82 (SE 0.45)									Decrease	
	Sucrose	17/22		9.9 (SE 0.51)									Increase	
*14907 (Carels *et al.*, 2005)	Weight loss program	~19/~26	2272 (SD 454)	1659 (SD 433)			Not reported			Energy intake	4-day food diary (kcal/day)	1 year	Decrease	unclear
	Weight loss program + low GI education	~19/~26	2580 (SD 607)	1674 (SD 586)									Decrease	
*14551 (Clapp, 1998)	High GI - cafeteria diet	14/14		41 (SE 1)			Unclear			Energy intake	Recall (kcal/kg lean body mass)	7 days	No change	unclear
	Low GI - aboriginal diet	14/14		40 (SE 1)									Decrease	
14484 (de Rougemont *et al.*, 2007)	High GI	19/20	8937 (SE 259)	8699 (SE 251)						Energy intake	5-day dietary survey (kJ/day)	3 weeks	No change	bias
	Low GI	19/20	8536 (SE 272)	8210 (SE 201)			NS						Decrease	
*14485	High GI	19/20	8937 (SE 259)	8607 (SE 255)						Energy intake	5-day dietary survey (kJ/day)	5 weeks	No change	bias
	Low GI	19/20	8536 (SE 272)	8289 (SE 247)			NS						Decrease	
*14348 (Dumesnil *et al.*,	Conventional healthy diet	12/12		11695 (SD 1163)						Energy intake	Metabolic ward records – food	6 days	No change	unclear

Result ID#/ Reference	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value within group Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
2001)											provided ad libitum and monitored (kJ/day)			
	Low GI, low fat, high protein	12/12		8815 (SD 738)			0.05						Decrease	
15423 (Ebbeling *et al.*, 2007)	Low fat diet	ITT: 37/37			decrease					Energy intake	3x 24 hr recall	6 months	Decrease	unclear
	Low GL diet	ITT: 36/36			decrease		NS						Decrease	
15441	Low fat diet	ITT: 37/37			decrease					Energy intake	3x 24 hr recall	1 year	Decrease	unclear
	Low GL diet	ITT: 36/36			decrease		NS						Decrease	
15442	Low fat diet	ITT: 37/37			decrease					Energy intake	3x 24 hr recall	18 months	Decrease	unclear
	Low GL diet	ITT: 36/36			decrease		NS						Decrease	
15473 (Ebbeling *et al.*, 2005)	Low fat diet	12/17	1802 (SE 116)	1409 (SE 46)	-2.1 (CI -9.2, 5.5)					Energy intake	7-day food diary (kcal/day)	6 months-average	Decrease	unclear
	Low GI diet	11/17	1860 (SE 72)	1391 (SE 79)	-9.9 (CI -13, -2.2)		NS						Decrease	
*15474	Low fat diet	12/17	1802 (SE 116)	1472 (SE 85)	-2.1 (CI -9.2, 5.5)					Energy intake	7-day food diary (kcal/day)	1 year	Decrease	unclear
	Low GI diet	11/17	1860 (SE 72)	1494 (SE 82)	-9.9 (CI -13, -2.2)		NS						Decrease	
*16231 (McMillan-Price *et al.*, 2006)	High CHO, high GI diet	32/32	9630 (SE 470)	6010 (SE 240)			NS			Energy intake	3-day food diary (kJ/day)	12 weeks	Decrease	unclear
	High CHO, low GI diet	32/32	9030 (SE 460)	6150 (SE 190)									Decrease	
	High protein, high GI diet	32/32	9220 (SE 450)	5950 (SE 170)			NS						Decrease	
	High protein, low GI diet	33/33	8890 (SE 470)	5970 (SE 190)			NS						Decrease	
*16852 (Philippou *et al.*, 2008)	High GI	7/9	2052	1308	-596 (CI -625, -516)	<0.05				Energy intake	7-day food diary (kcal/day)	12 weeks	Decrease	unclear
	Low GI	6/9	2034	1773	-167 (CI -	<0.05	<0.01						Decrease	

Result ID#/ Reference	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value within group Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
					312, -123)									
15181 (Philippou *et al.*, 2009b)	High GI	completers not reported /19		1375 (SD 360)						Energy intake	3-day food diary (kcal/day)	2 months	No change	unclear
	Low GI	completers not reported /23		1307 (SD 299)			0.6						No change	
15182	High GI	completers not reported /19		1604 (SD 344)						Energy intake	3-day food diary (kcal/day)	4 months	No change	unclear
	Low GI	completers not reported /23		1447 (SD 380)			0.2						No change	
*14658 (Philippou *et al.*, 2009a)	High GI	completers not reported /28			-236 (SD 632)					Energy intake	3-day food diary (kcal/day)	6 months	Decrease	unclear
	Low GI	completers not reported /28			-447 (SD 499)	0.3	NS						Decrease	
17638 (Sichieri *et al.*, 2007)	High GI/GL diet	53/102	16.2 (SD 12.9)	12.1 (SD 7.8)						Energy intake (MJ/d)	FFQ	3 month	No change	unclear
	Low GI1/GL diet	60/101	14.3 (SD 9.3)	10.3 (SD 5.9)									No change	
17639	High GI/GL diet	50/102	16.2 (SD 12.9)	11.8 (SD 6.4)						Energy intake (MJ/d)	FFQ	6 months	No change	unclear
	Low GI/GL diet	55/101	14.3 (SD 9.3)	9.6 (SD 6.1)									No change	
17640	High GI/GL diet	46/101	16.2 (SD 12.9)	14.7 (SD 10.9)				0.97 (time x diet interaction)		Energy intake (MJ/d)	FFQ	12 months	No change	unclear
	Low GI/GL diet	44/102	14.3 (SD 9.3)	12.9 (SD 9.4)									No change	
17641	High GI/GL diet	60/101	16.2 (SD 12.9)	14.0 (SD 9.1)						Energy intake (MJ/d)	FFQ	18 months	No change	unclear

Result ID#/ Reference	Intervention group	Completers/ Allocated	Baseline	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value within group Δ from baseline	Outcome/ Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assess-ment Bias
	Low GI/GL diet	63/102	14.3 (SD 9.3)	11.2 (SD 7.0)									No change	
*15024 (Sloth *et al.*, 2004)	High GI diet	22/26	9.8 (SE 0.4)	9.8 (SE 0.3)				NS		Energy intake (MJ/d)	Weighed food diary completed daily (MJ/day)	10 weeks	Decrease	unclear
	Low GI diet	23/29	9.5 (SE 0.3)	9.2 (SE 0.3)									Decrease	
15025	High GI diet	22/26	9.8 (SE 0.4)	9.5 (SE 0.3)				NS		Energy intake (MJ/d)	Weighed food diary completed daily (MJ/day)	5 weeks	Decrease	unclear
	Low GI diet	23/29	9.5 (SE 0.3)	8.7 (SE 0.3)									Decrease	
*15939 (Wolever and Mehling, 2002)	High carbohydrate, high GI	11/11	7.32 (SE 0.28)	7.17 (SE 0.39)		NS			Diet* time interaction, p=0.03	Energy intake	3-day food diary (MJ/day)	8 weeks	Decrease	unclear
	High carbohydrate, low GI	13/13	7.78 (SE 0.5)	7.09 (SE 0.28)		NS							Decrease	
	Low carbohydrate, high MUFA	11/11	6.99 (SE 0.49)	7.86 (SE 0.55)		NS							Increase	

*This result was used in the meta-analysis of glycaemic index or load diets and energy intake

Eating motivation and glycaemic index or load

Summary of cohort results

No cohort studies provided data.

Summary of trials results

Ten trials provided data on the effects of high compared to low GI or GL diets on subjective reports of appetite. Due to variation in study designs, the method of assessing eating motivation and the nature of each intervention, it was not possible to combine these studies using meta-analysis.

Four studies were conducted in the USA, 2 in the UK, 2 in France and one in Denmark and Brazil. The sample size ranged from 9 to 203, but most had 30-50 participants. Average BMI of the trial participants was in the overweight or obese range for 5 trials (de Rougemont *et al.*, 2007;Sichieri *et al.*, 2007;Das *et al.*, 2007;Sloth *et al.*, 2004;Philippou *et al.*, 2009b). One study was conducted on children aged 9-13 years (Warren *et al.*, 2003), all others were on adults. Three studies included only women (Sloth *et al.*, 2004;Sichieri *et al.*, 2007;Bellisle *et al.*, 2007) and the others were mixed gender.

None of the studies were able to blind the participants to the nature of the intervention.

Three studies provided some evidence that GI of the diet may impact on subjective reports of hunger or satiety. In Pereira *et al.* (Pereira *et al.*, 2004) lower ratings of hunger were reported in response to the question ‘How hungry have you been over the past 24 hours?’ in the low carbohydrate, low GI group compared to the high carbohydrate, low fat group. A similar but non-significant reduction in reported hunger was observed when asked before each lunch ‘How hungry are you right now?’. Under energy-restricted conditions, overweight or obese young adults appear to have experienced less hunger when consuming a lower carbohydrate, low GI diet compared to a more traditional high carbohydrate, lower fat weight loss diet.

Bellisle *et al.* (Bellisle *et al.*, 2007) compared a standard Weight Watchers energy restriction plan, with and without advice to preferentially adhere to low GI foods. Over a period of 12 weeks, a generally lower intensity of hunger and desire to eat was reported in the group advised to follow the Weight Watchers plan + GI advice (p=0.001). Data are presented in figures only, but there was some indication that the differences between weight loss plans tended to occur in the afternoons.

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The UK-based study conducted by Warren *et al.*(Warren *et al.*, 2003) on preadolescent children found that higher GI breakfasts tended to generate the highest lunchtime hunger scores, when compared with low GI breakfasts with or without added sucrose. However, the statistical significance of the differences between diet groups was not clear in the paper.

Seven studies did not find an effect of dietary GI on subjective ratings of appetite. These included (Alfenas and Mattes, 2005;de Rougemont *et al.*, 2007;Pereira *et al.*, 2004;Philippou *et al.*, 2009b;Sichieri *et al.*, 2007;Sloth *et al.*, 2004). Philippou *et al.* (Philippou *et al.*, 2009b) found no difference in appetite between high and low GI groups (assessed using VAS) in a 4-month weight maintenance study with 42 obese men and women who had previously lost at least 5% of their body weight.

Herrmann *et al.* (Herrmann *et al.*, 2001) fed 8 males in a randomised cross-over design, diets which were high or low total fat (30 or 20%), and either high or low GI (>65 or >45). All food was provided to ensure diets were isocaloric, and after 7 days, a ‘test’ day was conducted during which appetite was assessed around a lunch meal (representative of the diet group) using VAS. Data from ratings of hunger, fullness, prospective consumption and desire to eat were pooled (due to reported similarities). Data are not provided in the paper, but the authors stated that satiety did not differ after the 4 test lunches.

Using a parallel group design, Sichieri *et al.* (Sichieri *et al.*, 2007) compared high and low GI diets with a small energy restriction goal over 18 months in 203 healthy overweight Brazilian women. A large difference in GI units (approx. 40 vs. 79) was reported throughout the trial, however, this did not differentially influence energy intakes, with no statistically significant difference between the groups at any time point. Hunger ratings (assessed by sum of Likert scale ratings completed before main meals) were somewhat lower in the low GI diet group, however, there was no significant main effect of diet, or diet by time interaction (p=0.64). Similarly, despite a large difference in GI between diet groups, the CALERIE study by Das *et al.* (Das *et al.*, 2007) did not find a differential effect on reports of hunger and satiety in this energy restriction trial using 34 healthy overweight adults.

The studies included here do not provide convincing and consistent evidence that manipulations of dietary GI, when administered for at least 3 days, influence eating motivation.

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Table 6.34 Eating motivation - Glycaemic index: RCT data

Result ID/ Authors	Intervention group	Completers/ Allocated	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
Children study													
14359 (Warren *et al.*, 2003)	High GI breakfast	37/37	higher			Unclear/ NS			Hunger/satiety ratings	7-point equilateral rating scale	3 days		unclear
	Low GI + sucrose breakfast	37/37	lower			NS						n/a	
	Low GI breakfast	37/37	lower			NS							
Adult studies													
14463 (Alfenas and Mattes, 2005)	High GI minus Low GI	Crossover: 39/39						0.54	Desire to eat	VAS (mm)	8 days	Not reported	unclear
14462	High GI minus Low GI	Crossover: 39/39						0.75	Fullness	VAS (mm)	8 days	Not reported	unclear
14461	High GI minus Low GI	Crossover: 39/39						0.52	Hunger ratings	VAS (mm)	8 days	Not reported	unclear
16426 (Bellisle *et al.*, 2007)	Low GI minus control	Low GI: 35/51 Control: 30/45					GI lower	0.01	Desire to eat	VAS 100mm	12 weeks-average	Decrease	unclear
16058	Low GI minus control	Low GI: 35/51 Control: 30/45					GI lower	0.01	Hunger ratings	VAS 100mm	12 weeks-average	Decrease	unclear
15253 (Das *et al.*, 2007)	Energy restricted high GL diet	15/17		increase	0.05				Desire to eat non-study foods	VAS 100mm	3 months	Decrease	No bias
	Energy restricted low GL diet	14/17			NS	NS						Decrease	
15255	Energy restricted high GL diet	15/17			0.05				Satisfaction with the amount of food given	VAS 100mm	3 months	Decrease	No bias
	Energy restricted low GL diet	14/17			NS	NS						Decrease	
14483 (de Rougemont *et al.*, 2007)	High GI	11/20	lower						Post breakfast Satiety	VAS 100mm	5 weeks	No change	bias
	Low GI	9/20	higher			0.09						Decrease	
14346 (Herrmann *et al.*, 2001)	High GI, low fat	9/9	Data not provided			NS			Hunger, Fullness, Prospective consumption, Desire to eat ratings – pooled and averaged		8 days	No change	unclear
	High GI, moderate	9/9				NS						No	

Result ID/ Authors	Intervention group	Completers/ Allocated	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	fat											change	
	Low GI, low fat	9/9				NS						No change	
	Low GI, moderate fat	9/9				NS						No change	
17034 (Pereira *et al.*, 2004)	Hypoenergetic low fat diet	17/23	4.2 (SD 0.3)						Hunger ratings (over past 24hr)	10 category question	67 days	Decrease	unclear
	Hypoenergetic low GL diet	22/23	3.3 (SD 0.28)			0.04						Decrease	
17035	Hypoenergetic low fat diet	17/23	4.5 (SD 0.38)						Midday hunger	VAS	67 days	Decrease	unclear
	Hypoenergetic low GL diet	22/23	3.6 (SD 0.33)			0.1						Decrease	
15185 (Philippou *et al.*, 2009b)	High GI	completers not reported/19							Fullness	VAS 100mm	2 months	No change	unclear
	Low GI	completers not reported/23				0.7						No change	
15186	High GI	completers not reported/19							Fullness	VAS 100mm	4 months	No change	unclear
	Low GI	completers not reported/23				0.8						No change	
15183	High GI	completers not reported/19							Hunger ratings (ave over day)	VAS 100mm	2 months	No change	unclear
	Low GI	completers not reported/23				0.4						No change	
15184	High GI	completers not reported/19							Hunger ratings (ave over day)	VAS 100mm	4 months	No change	unclear
	Low GI	completers not reported/23				0.8						No change	
15778 (Sichieri *et al.*, 2007)	High GI/GL diet	78/102		0.09 (SD 3.5)				NS	Hunger ratings Sum of pre-meal ratings	Likert scale	1 month	No change	unclear
	Low GI/GL diet	89/101		-0.07 (SD 3.8)				No main effect				No change	

Result ID/ Authors	Intervention group	Completers/ Allocated	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
15779	High GI/GL diet	56/102		-1.16 (SD 1.4)				of diet or dietXtime interaction	Hunger ratings Sum of pre-meal ratings	Likert scale	2 months	No change	unclear
	Low GI/GL diet	68/101		-0.26 (SD 4.1)								No change	
15780	Low GI/GL diet	60/101		-0.47 (SD 4.4)					Hunger ratings Sum of pre-meal ratings	Likert scale	3 months	No change	unclear
	High GI/GL diet	53/102		0.04 (SD 4.3)								No change	
15781	Low GI/GL diet	55/101		-1.05 (SD 5.2)				NS	Hunger ratings Sum of pre-meal ratings	Likert scale	6 months	No change	unclear
	High GI/GL diet	50/102		-1.6 (SD 5.0)				No main effect of diet or dietXtime interaction				No change	
15782	High GI/GL diet	49/102		-0.92 (SD 4.3)					Hunger ratings Sum of pre-meal ratings	Likert scale	9 months	No change	unclear
	Low GI/GL diet	47/101		-1.04 (SD 5.7)								No change	
15783	Low GI/GL diet	44/101		-1.21 (SD 5.7)					Hunger ratings Sum of pre-meal ratings	Likert scale	1 year	No change	unclear
	High GI/GL diet	46/102		-0.87 (SD 5.1)								No change	
15784	High GI/GL diet	44/102		-0.52 (SD 4.9)					Hunger ratings Sum of pre-meal ratings	Likert scale	15 months	No change	unclear
	Low GI/GL diet	49/101		-1 (SD 5.5)								No change	
15785	High GI/GL diet	60/102		-0.98 (SD 4.3)					Hunger ratings Sum of pre-meal ratings	Likert scale	18 months	No change	unclear
	Low GI/GL diet	63/101		-1.31 (SD 6.3)							18 months	No change	
15026 (Sloth *et al.*, 2004)	High GI diet	22/26							Fullness	VAS (end of day summary)	10 weeks-average	Decrease	unclear
	Low GI diet	23/29				NS						Decrease	
15027	High GI diet	22/26							Hunger ratings	VAS (end of day summary)	10 weeks-average	Decrease	unclear

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Result ID/ Authors	Intervention group	Completers/ Allocated	Follow-up	Within group Δ from baseline	p-value within group Δ from baseline	p-value difference between groups	Difference between groups at follow-up	p-value difference between groups	Outcome/Assessment method	Result/ Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
	Low GI diet	23/29				NS						Decrease	

Results - Energy Intake and Sweetened Beverages

Summary of cohort results

Two cohort studies of individuals who were children or adolescents at study baseline provided data concerning the association between sweetened beverage consumption and subsequent energy intake (Kvaavik *et al.*, 2005;Fiorito *et al.*, 2009). Both reported energy intake as a primary outcome (Fiorito *et al.*, 2009;Kvaavik *et al.*, 2005). The study by Kvaavik and colleagues, was a longitudinal study with 422 adolescent girls and boys with 18-20 years of follow-up. Dietary information was collected in 1981/1979, 1991 and 1999. Male, consistently high consumers of sugar-sweetened, carbonated soft drinks in both 1991 and 1999 reported higher intakes of energy (12.2 vs. 10.2 MJ day, p=0.005) in 1999 than did long-term low consumers. However, this association was not observed in women. In the Pennsylvania Study of Health and Development of Young Girls (Fiorito *et al.*, 2009), no association between intakes of mixed sugar and non-calorically sweetened beverages and subsequent energy intakes was observed.

Please interpret observational data with caution: With observational studies there is substantial potential for biases.

Summary of trials results

One trial provided data on the impact of consuming aspartame-sweetened beverages compared to sucrose-sweetened beverages on energy intake in adults (Reid *et al.*, 2007). In this study, energy intake was reported as a primary outcome, alongside nutrient intake, mood and BMI (Reid *et al.*, 2007). Over a period of 4 weeks, 133 normal weight women were randomly allocated to consume 4x250ml drinks daily which were either aspartame (67 kJ/day) or sucrose-sweetened (1800 kJ/day). Energy intake was elevated by about 1000kJ/day in the women consuming the sucrose-sweetened beverages (p<0.001). See also section on sugars for trials that manipulated the sugars content of diets via provision of both solid and liquid foods and beverages.

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Table 6.35 Energy Intake – Sweetened Beverages: Cohort studies in children

Result ID/ Reference/ Cohort Name	Country, Ethnicity, Inclusion criteria	Age range (mean) %Male	(Cases)/Total	Follow Up (% loss)	Diet Assessment	Exposure	Outcome/ Assessment Details	Sub-group detail	Contrast (mean)	Units	Mean Outcome (SD)	P
14234 (Fiorito *et al.*, 2009) Pennsylvania Study of Health and Development of Young girls	USA, Primarily White, Age 5-18y	(5) %M 0	170	10 years (15)	Dietary recall	Mixed sugar and non-caloric sweetener beverages	Energy intake Recall		1:<1 2: ≥1 to <2 3:>2	Servs /day		No significant difference was observed between the intake categories
14523 (Kvaavik *et al.*, 2005) Oslo Youth Study	Norway, Ethnicity unknown	(13) %M 49	1086	19 years (15.7)	Questionnaire (general)	sugar-sweetened, carbonated soft drinks	Energy intake (MJ/d) FFQ	Boys	1: Long-term low consumer (<2 in 1991 and <3 in 1999) 2: Inconsistent consumer (changing consumption frequency) 3: Long-term high consumer (>3 in 1991 and 4 in 1999)	times/ week	EI (MJ/d) 1: 10.2 (3.4) 2: 10.5 (3.2) 3: 12.2 (3.3)	
14526 (Kvaavik *et al.*, 2005) Oslo Youth Study	Norway, Ethnicity unknown	(13) %M 49	1086	19 years (15.7)	Questionnaire (general)	sugar-sweetened, carbonated soft drinks	Energy intake (MJ/d) FFQ	Girls	1: Long-term low consumer (<2 in 1991 and <3 in 1999) 2: Inconsistent consumer (changing consumption frequency) 3: Long-term high consumer (>3 in 1991 and 4 in 1999)	times/ week	EI (MJ/d) 1: 8.1 (2.6) 2: 8.7 (3.2) 3: 8.7 (2.7)	

Table 6.36 Energy Intake – Sweetened beverages: RCT data

Result ID/ Author	Intervention group	Completers/ Allocated	Baseline	Follow-up	P difference between groups	Outcome/Assessment method	Result/Outcome details	Result-specific follow-up	Weight Change	Outcome Assessment Bias
14424 (Reid *et al.*, 2007)	Aspartame	65/65	7799.63 (SD 1915.92)	7407.37 (SD 1955.5)	<0.001	Energy intake	7-day food diary (kJ/day)	4 weeks	Decrease	unclear
	Sucrose	68/68	7929.13 (SD 1809.33)	8722.44 (SD 1770.68)					Increase	

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