Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies

Lisa Te Morenga,[1 2] Simonette Mallard,[1] Jim Mann[1 2 3]

EDITORIAL by Willett and Ludwig

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[1]Departments of Human Nutrition and Medicine, University of Otago, PO Box 56, Dunedin 9054, New Zealand
[2]Riddet Institute, University of Otago
[3]Edgar National Centre for Diabetes and Obesity Research, University of Otago
Correspondence to: J Mann
jim.mann@otago.ac.nz

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STUDY QUESTION

Does altering the intake of dietary sugars influence body weight in free living people consuming ad libitum diets (that is, with no strict control of food intake)?

SUMMARY ANSWER

Altering intake of sugars or sugar sweetened beverages is associated with changes in body weight, which seem to be mediated via changes in energy intake since isoenergetic exchange of sugars with other carbohydrates is not associated with weight change.

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

Sugar intake has been linked to obesity, but the association is tenuous. Based on formal systematic review and meta-analyses of randomised controlled trials, an increased or decreased intake of sugars resulted in parallel changes in body weight, with poor dietary compliance apparently explaining the absence of such an effect in some studies involving children.

Selection criteria for studies

We included randomised controlled trials and cohort studies reporting intake of sugars or sugar containing foods or beverages, and a measure of body fatness. Trials and studies were identified from OVID Medline, Embase, PubMed, Cumulative Index to Nursing and Allied Health Literature, Scopus, and Web of Science (up to December 2011).

Primary outcomes

For trials, we pooled weight change data using inverse variance models with random effects. Effect estimates from cohort studies were expressed as odds ratios for risk of obesity, or as β coefficients for change in adiposity per unit of sugars intake.

Main results and role of chance

Thirty of 7895 trials and 38 of 9445 cohort studies met the inclusion criteria. In trials of adults involving ad libitum diets, reduced intake of dietary sugars was associated with a decrease in body weight (0.80 kg, 95% confidence interval 0.39 to 1.21; P<0.001); increased sugars intake was associated with a comparable weight increase (0.75 kg, 0.30 to 1.19; P=0.001). Isoenergetic exchange of dietary sugars with other carbohydrates showed no change in body weight (0.04 kg, −0.04 to 0.13). Trials in children, which involved recommendations to reduce sugar sweetened foods and beverages, had low participant compliance with dietary advice; these trials showed no overall change in weight. However, in relation to intakes of sugar sweetened beverages after one year follow-up in prospective studies, the odds ratio for being overweight or obese increased by 55% (32% to 82%) among groups with the highest intakes compared with those with the lowest intakes. Trends were consistent and associations remained after sensitivity analyses.

Bias, confounding, and other reasons for caution

Limitations included those inherent to the primary research—notably inadequate data for dietary intake; and variation in duration, nature, and quality of dietary interventions. Four adult trials reported data only for completers, which could have overestimated the effect, but we saw no meaningful difference in the magnitude of effect between these trials and the other studies.

Blinding to treatment was not possible in most trials. However, judgment was not involved in recording body weight and measurement bias was therefore unlikely. Despite the small effect size and uncertainty regarding the extent to which a reduction in intake of sugars might be achieved by the general population, the findings have bearing on nutrition guidelines aimed at reducing risk of obesity.

Study funding/potential competing interests

The research was supported by the University of Otago, Riddet Institute, and World Health Organization. The authors declare no other competing interests.

Effect of intake of dietary sugars on measures of adiposity

Comparison	Pool of studies reviewed	Mean difference in weight (kg; 95% CI)	P
Reduced intake in adults	5 trials, ad libitum diets	0.80 (0.39 to 1.21)	<0.001
Increased intake in adults	10 trials, ad libitum diets	0.75 (0.3 to 1.19)	0.001
Trials <8 weeks' duration	8 trials	0.52 (0.14 to 0.89)	0.007
Trials >8 weeks' duration	2 trials	2.73 (1.68 to 3.78)	<0.001
Reduced intake in children	5 trials, ad libitum diets	0.09* (−0.14 to 0.32)	0.45
Increased intake in children	5 cohort studies	1.55† (1.32 to 1.82)	<0.001
Exchange of sugars with other carbohydrate	11 trials, isoenergetic diets	0.04 (−0.04 to 0.13)	0.3

*Standardised mean difference in body mass index.
†Odds ratio of being obese or overweight.

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

Lee Hooper,[1] Asmaa Abdelhamid,[1] Helen J Moore,[2] Wayne Douthwaite,[2] C Murray Skeaff,[3] Carolyn D Summerbell[2]

[1]Norwich Medical School, University of East Anglia, Norwich NR4 7TJ, UK
[2]Obesity Related Behaviours Group, School of Medicine and Health, Wolfson Research Institute, Durham University, Stockton on Tees, UK
[3]Department of Human Nutrition, University of Otago, Dunedin, New Zealand
Correspondence to: L Hooper
L.hooper@uea.ac.uk

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STUDY QUESTION

Does lower total fat intake lead to lower body weight in adults and children?

SUMMARY ANSWER

High quality, consistent evidence shows that a reduction in total fat intake leads to small but statistically significant and clinically meaningful reductions in body weight in adults, with supporting evidence for a similar effect in children and young people.

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

The ideal proportion of total fat in the human diet is unclear. This systematic review provides a large and consistent body of evidence that lowering total fat intake, as a proportion of energy intake, results in lower body weight in the long term, lower body mass index, and lower waist circumference in adults, with a dose-response relation. Evidence in children and young people is more limited but supports a similar relation.

Selection criteria for studies

We searched Medline, Embase, CINAHL, and the Cochrane Central Register of Controlled Trials to June 2010. We included randomised controlled trials and cohort studies of adults or children and young people that compared lower total fat intake with usual total fat intake and assessed the effects on measures of body fatness (body weight, body mass index, and waist circumference) after at least six months (randomised controlled trials) or one year (cohorts). Trials intending to reduce weight in participants or confounded by additional medical or lifestyle interventions were excluded.

Primary outcome

Body weight.

Main results and role of chance

33 randomised controlled trials (73 589 participants) and 10 cohort studies in adults were included, from North America, Europe, or New Zealand. Meta-analysis of data from the trials suggested that diets lower in total fat are associated with lower relative body weight (on average by 1.6 kg, 95% confidence interval −2.0 to −1.2 kg, I^2=75%, 57 735 participants), body mass index (−0.51 kg/m^2, 95% confidence interval −0.76 to −0.26, nine trials, I^2=77%), and waist circumference (by 0.3 cm, −0.58 to −0.02, 15 671 women, one trial). Lower weight gain in the low fat arm than control arm was consistent across the trials, but the size of the effect varied. Metaregression suggested a dose-response relation, such that each 1% decrease of energy from total fat resulted in a reduction in weight of 0.2 kg, compared with not altering total fat intake, in populations with intakes from 28% to 43% of energy from total fat and in studies with a duration of six months to over eight years. Lower baseline fat intake but not study duration was also associated with greater relative weight loss. The statistically significant effect of a low fat diet on weight was not lost in sensitivity analyses (including removing trials that expended greater time and attention on low fat groups). There was no suggestion of negative effects on other cardiovascular risk factors (lipid levels or blood pressure).

Bias, confounding and other reasons for caution:

GRADE assessment suggested that the quality of evidence for the relation between total fat intake and body weight in adults was high. Only one randomised controlled trial and three cohort studies were found in children and young people, but these confirmed a positive relation between total fat intake and weight gain.

Study funding/potential competing interests

This study was funded by the World Health Organization and University of East Anglia. The funders had no vested interests in the findings of this research.

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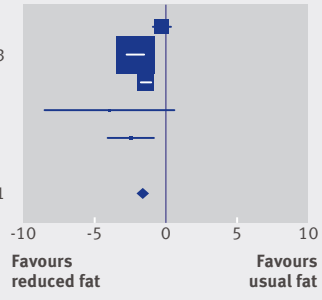
- Research: Dietary fat intake and prevention of cardiovascular disease (*BMJ* 2001;322:757)
- Head to head: Are the causes of obesity primarily environmental? Yes (*BMJ* 2012;345:e5843)
- Head to head: Are the causes of obesity primarily environmental? No (*BMJ* 2012;345:e5844)
- Analysis: Taxing unhealthy food and drinks to improve health (*BMJ* 2012;344:e2931)

Effect of low fat diet versus usual fat diet on body weight (kg), by subgroups*

Study	Total: Reduced fat	Total: Usual fat	Mean difference, IV, random (95% CI)	Weight (%)	Mean difference, IV, random (95% CI)
Subtotal of 6 RCTs (difference of <5%)	2115	2519		19.7	-0.19 (-0.88 to 0.50)
Subtotal of 13 RCTs (difference of 5% to <10%)	17 588	26 853		52.3	-2.08 (-2.77 to -1.39)
Subtotal of 4 RCTs (difference of 10% to <15%)	4306	4005		22.9	-1.34 (-1.70 to -0.98)
Subtotal of 3 RCTs (difference of ≥15%)	150	169		2.0	-3.89 (-8.76 to 0.99)
1 RCT (unknown difference in % energy from fat)	15	15		3.1	-2.43 (-4.20 to -0.66)
Total (95% CI)	24 174	33 561		100.0	-1.57 (-1.97 to -1.16)

Heterogeneity: τ^2=0.57; χ^2=104.03, df=26, P<0.001, I^2=75%
Test for overall effect: Z=7.57, P<0.001
Test for subgroup differences: χ^2=17.40, df=4, P=0.002, I^2=77.0%



* Based on difference in percentage of energy from fat between control and reduced fat groups

Time lag to benefit after screening for breast and colorectal cancer: meta-analysis of survival data from the United States, Sweden, United Kingdom, and Denmark

Sei J Lee,[1] W John Boscardin,[2] Irena Stijacic-Cenzer,[1] Jessamyn Conell-Price,[3] Sarah O'Brien,[4] Louise C Walter[1]

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[1]Division of Geriatrics, University of California (San Francisco), San Francisco Veterans Affairs Medical Center, San Francisco, CA 94121, USA
[2]Department of Epidemiology and Biostatistics, University of California (San Francisco), USA
[3]Joint Medical Program, University of California (San Francisco and Berkeley), San Francisco, USA
[4]AIDS Education and Training Evaluation Center, University of California (San Francisco), USA
Correspondence to: S J Lee
sei.lee@ucsf.edu

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- Research: Effect of evidence based risk information on "informed choice" in colorectal cancer screening (*BMJ* 2011;342:d3193)
- Research methods and reporting: Comparative effectiveness research in cancer screening programmes (*BMJ* 2012;344:e2864)
- Head to head: Should we use total mortality rather than cancer specific mortality to judge cancer screening programmes? Yes (*BMJ* 2011;343:d6395)
- Head to head: Should we use total mortality rather than cancer specific mortality to judge cancer screening programmes? No (*BMJ* 2011;343:d6397)

STUDY QUESTION

After screening for breast or colorectal cancer, how much time is needed before reductions in cancer mortality are seen?

SUMMARY ANSWER

One cancer death was prevented for 1000 people screened at around 10 years after screening (both for mammography and fecal occult blood testing).

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

Cancer screening exposes patients to an immediate risk of complications, yet prevents cancer mortality in the future; the time lag to benefit after screening mammography and fecal occult blood testing is unclear. This paper indicates that such screening prevents one cancer death per 1000 patients screened at 10 years, suggesting that these tests should be targeted toward patients with a life expectancy of more than 10 years.

Selection criteria for studies

Population based, randomized trials of screening mammography or fecal occult blood testing (conducted in the United States, Sweden, United Kingdom, and Denmark), identified by reviews from the Cochrane Collaboration and US Preventive Services Task Force as high quality.

Primary outcome(s)

Time to death from breast or colorectal cancer in screened and control populations.

Main results and role of chance

To prevent one cancer death for 1000 patients screened, the time lag to benefit was 10.3 years (95% confidence interval 6.0 to 16.4) for fecal occult blood testing and 10.7 years (4.4 to 21.6) for screening mammography. To prevent one cancer death for 5000 patients screened, the time lag to benefit was 4.8 years (2.0 to 9.7) and 3.0 years (1.1 to 6.3), respectively. To prevent one cancer death for 500 patients screened, the time lag to benefit was 14.6 years (9.6 to 21.2) and 15.9 years (9.4 to 25.2), respectively.

Bias, confounding, and other reasons for caution

Firstly, our results are based on trials conducted many years ago. Recent advances in screening mammography and fecal occult blood testing may lead to different estimates of time lag to benefit. Secondly, our results are based on trials that examined the effect of a series of screenings. Since the mortality benefit of one screening must be less than multiple rounds of screening, these results might overestimate the time lag to benefit associated with a single screening test. Thirdly, cancer symptoms usually precede death from cancer, suggesting that our results may underestimate the time lag to benefit for avoiding cancer symptoms.

Study funding/potential competing interests

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Summary estimates of the time lag to benefit for cancer screening

	Absolute risk reduction		
	1 cancer death prevented per 5000 people screened	1 cancer death prevented per 1000 people screened	1 cancer death prevented per 500 people screened
Screening for colorectal cancer	4.8 (2.0 to 9.7)	10.3 (6.0 to 16.4)	14.6 (9.6 to 21.2)
Screening for breast cancer	3.0 (1.1 to 6.3)	10.7 (4.4 to 21.6)	15.9 (9.4 to 25.2)

Data are years (95% CI).

Intermittent self catheterisation with hydrophilic, gel reservoir, and non-coated catheters: a systematic review and cost effectiveness analysis

Sarah L Bermingham,[1] Sarah Hodgkinson,[1] Sue Wright,[2] Ellie Hayter,[3] Julian Spinks,[4] Carol Pellowe[5]

[1]Royal College of Physicians, National Clinical Guideline Centre, London NW1 4LE, UK
[2]Peninsula Community Health, Sedgemoor Centre, St Austell PL25 5AS, UK
[3]Sussex Community NHS Trust, Horsham Hospital, Horsham RH12 2DR, UK
[4]Court View Surgery, Strood ME2 2HA, UK
[5]Department of Adult Nursing, Florence Nightingale School of Nursing and Midwifery, King's College London, London SE1 8WA
Correspondence to: S L Bermingham
s.l.bermingham@gmail.com

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STUDY QUESTION

What is the most effective and cost effective type of catheter for patients performing intermittent self catheterisation in the community?

SUMMARY ANSWER

Use of hydrophilic and gel reservoir catheters resulted in slightly fewer incidences of symptomatic urinary tract infection (UTI) than non-coated catheters, but their higher costs meant multiple use non-coated catheters were the most cost effective option.

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

A wide variety of materials and techniques are used to perform intermittent self catheterisation, and their relative effectiveness and cost effectiveness have not been systematically investigated. This review found little difference in clinical effectiveness and a large difference in cost effectiveness between single use, coated catheters and multiple use, non-coated catheters. However, because of limitations and gaps in the evidence base and the designation of non-coated catheters as single use devices, we recommend a precautionary principle should be adopted and that patients should be offered a choice between hydrophilic and gel reservoir catheters.

Selection criteria and design

For intermittent self catheterisation, patients may use catheters with a hydrophilic polymer surface coating, packaged with lubricant (gel reservoir), or non-coated. Hydrophilic and gel reservoir catheters must always be discarded after each use, whereas non-coated catheters may either be discarded after use (sterile catheterisation) or washed and reused for up to a week (clean catheterisation). We searched Medline, Embase, the Cochrane Library, and Cinahl to identify randomised controlled trials and randomised crossover trials of methods of long term intermittent self catheterisation (>28 days) in community or primary care settings. Results were pooled according to outcome and meta-analyses conducted where appropriate. A probabilistic Markov model was developed to establish the most cost effective method of intermittent self catheterisation from a UK NHS and personal social services perspective.

Primary outcome(s)

We considered cases of symptomatic UTI, patient preference or comfort, bacteraemia, mortality, and number of catheters used. Cost effectiveness was expressed as costs, quality adjusted life years (QALYs), and incremental cost per QALY gained.

Main results and role of chance

Eight studies were included in the analysis: five compared hydrophilic and non-coated catheters, one compared gel reservoir and non-coated catheters, and two compared clean non-coated with sterile non-coated catheterisation. People using gel reservoir and hydrophilic catheters reported fewer incidences of one or more UTIs compared with those using sterile non-coated catheters (gel reservoir, 149 fewer per 1000 (95% CI −7 to 198), P=0.04; hydrophilic, 153 fewer per 1000 (−8 to 268), P=0.04). However, confidence intervals were wide and overlapping. There was no difference when outcomes were reported as mean monthly UTIs and total UTIs at one year (see table). There was no difference in the incidence of UTI for people using clean versus sterile non-coated catheters (12 fewer per 1000 (−134 to 146), P=0.86).

Gel reservoir catheters cost £54 350 per QALY gained and do not represent a cost effective use of NHS resources. At a threshold of £20 000 for cost effectiveness, there is a high (89.2%) probability that clean non-coated catheterisation is the most cost effective type of intermittent self catheterisation.

Bias, confounding, and other reasons for caution

The trials in our analysis were small and did not reflect the diversity of people who practise intermittent self catheterisation. Although robust to sensitivity analyses, the strength and generalisability of our findings are limited. In addition, non-coated catheters are labelled as single use items. Given concerns over patient safety and legal consequences, more robust evidence is required before recommending clean non-coated catheterisation as a first option for intermittent self catheterisation.

Study funding/potential competing interests

The study was funded by the National Institute for Health and Clinical Excellence (NICE).

Effects of different catheter types for intermittent self catheterisation on incidence of symptomatic urinary tract infection (UTI)

No of studies, patients	Mean (95% CI) effect size	Outcome quality
Hydrophilic *v* sterile non-coated catheters		
1 trial, 62 patients	0.01 (−0.11 to 0.09) fewer mean monthly UTIs	Moderate
1 trial, 56 patients	0.18 (−0.50 to 0.86) fewer total UTIs at one year	Moderate
2 trials, 188 patients	20% (1% to 35%) fewer incidences of ≥1 UTIs	Low
Gel reservoir *v* sterile non-coated catheters		
1 trial, 18 patients	66% (3% to 89%) fewer incidences of ≥1 UTIs	Very low
Clean non-coated (one used per day) *v* sterile non-coated catheters		
1 trial, 46 patients	67% (−55% to 517%) more incidences of ≥1 UTIs	Moderate
Clean non-coated (one used per week) *v* sterile non-coated catheters		
1 trial, 80 patients	8% (−14% to 27%) fewer incidences of ≥1 UTIs	Moderate