



# BMJ Open Effects of diet on obesity-related anthropometric characteristics in adults: a protocol for an umbrella review of meta-analyses of randomised controlled trials

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## ABSTRACT

**Introduction** There have been many meta-analyses of randomised controlled trials on the influence of different diets on obesity-related anthropometric characteristics in adults. However, whether diet interventions can effectively decrease obesity-related anthropometric characteristics remains unclear. The objective of this study is to summarise and synthesise the evidence on the effects of diet on obesity-related anthropometric characteristics in adults by an umbrella review of meta-analyses of randomised controlled trials.

**Methods and analysis** We will first retrieve English articles only published before 15 December 2021 by searching PubMed, Embase and Web of Science. Only articles that are meta-analyses of randomised controlled trials will be included. Three researchers will independently screen the titles and abstracts of retrieved articles and check the data extracted from each eligible meta-analysis. In each meta-analysis, we will consider calculating the effect size of the mean difference of the effect of each diet on obesity-related anthropometric characteristics in adults using a random-effect model or a fixed-effect model according to heterogeneity. Study heterogeneity (Cochrane's Q and I<sup>2</sup> statistics) and small-study effects (Egger's test or Begg's test) will be considered. Evidence of each effect size will be graded according to the NutriGrade scoring system. We will use AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews V.2) to assess the methodological quality of each meta-analysis.

**Ethics and dissemination** This umbrella review will provide information on the effects of different diets on obesity-related anthropometric characteristics in adults. Ethical approval is not necessary for this study. We will publish the completed umbrella review and related data online.

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## INTRODUCTION

The problem of obesity and overweight has become extremely serious either in adults or in children, and in 2016 more than half of adults in the world were overweight or obese, putting a huge burden on global

## Strengths and limitations of this study

- The included outcomes contain as comprehensive a range of obesity-related anthropometric characteristics as possible.
- A substantial number of original research papers and participants are included.
- This paper covers types of food as comprehensively as possible.
- We will try to address the heterogeneity of included systematic reviews.
- This umbrella review will be limited by including only full texts in English language.

economics.<sup>1–5</sup> What is more concerning is that the number of individuals with obesity and overweight continues to rise.<sup>2–7</sup> Many studies have documented an association between obesity and various chronic diseases such as cancer, type 2 diabetes, cardiovascular disease, hypertension, stroke, dyslipidaemia and reproductive disorder.<sup>2–6 8–10</sup> People usually use a multifactorial stepwise approach consisting of behavioural therapy, lifestyle and dietary interventions, and medical pharmacotherapy to manage obesity. However, interventions that are mostly based on educational, behavioural or pharmacological measures are not very effective in preventing and treating obesity.<sup>11 12</sup> Overweight/obesity is often caused by a long-term energy imbalance between intake and expenditure, leading to weight gain.<sup>13</sup> Diet characterised by a low intake of high-energy-dense foods and a high intake of low-energy-dense foods can counteract such an imbalance.<sup>13</sup> Diet is a major modifiable determinant of obesity, and diet quality has been defined as the degree to which a diet reduces the risk of non-communicable diseases.<sup>14 15</sup> Therefore,

dietary intervention is the cornerstone of addressing the obesity epidemic.

Diet can produce changes in anthropometric parameters and body composition of overweight and obese patients.<sup>16</sup> Some studies found that whole grains, fruits, nuts, beans and fish are associated with a reduced risk of obesity, while refined grains, red meat and sugary beverages are associated with an increased risk.<sup>13 17 18</sup> After extensive research, intervention studies have shown short-term effects between optimal intake of food and treatment of obesity. However, there is little information on the role of specific food groups and their optimal intake in preventing obesity. Also, there has been no study that focused on any existing evidence on the effect of dietary factors (single food and beverages, alcohol, macronutrients and micronutrients) on obesity-related anthropometric characteristics, including body mass index (BMI), waist circumference (WC), body fat, hip circumference (HC) and waist to hip ratio (WHR). Thus, it is critical to develop and evaluate the validity of dietary differences and assess diet quality in a population, as well as test their ability to predict weight and adiposity. A clear public health plan that assesses the strength, precision and influence of potential bias needs to be established.<sup>19–21</sup>

Therefore, we plan to establish a clear public health plan that provides potential new insights that can be used in future research on developing preventive nutrition strategies and a convenient tool to screen for those at risk of undernutrition or overnutrition. In this umbrella review of meta-analyses, we aimed to conduct an umbrella review of meta-analyses of randomised controlled trials (RCT) to comprehensively summarise and synthesise the evidence on the effects of diet on obesity-related anthropometric characteristics in adults. Furthermore, we aimed to assess methodological quality using validated tools to identify the optimal intake of these food groups to reduce the risk of each outcome separately.

## METHODS AND ANALYSIS

### Protocol registration and reporting of findings

We have registered the article with the International Prospective Register of Systematic Reviews (<https://www.crd.york.ac.uk/prospero/>) on 23 January 2021. We referred to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols 2015 checklist<sup>22</sup> (see online supplemental table 1). We will provide any amendments to the protocol as supplementary materials in the publication of the final results.

### Patient and public involvement

The study is an umbrella review focusing on the effects of diet on obesity-related anthropometric characteristics. We did not set any restrictions to region or sex of the included population. There is no patient or public involvement in this study.

### Study design

We divide the process into two steps. The first step is to screen out the included literature according to the

inclusion criteria and exclusion criteria. A detailed flow chart of article selection is shown in online supplemental figure 1. The second step is to make a forest plot showing the effect of different diets on different parameters. We will score the included literature. If there are several included articles describing the effects of the same food on the same obesity-related parameters, we will select the one with the highest score and present them in a forest plot.

### Eligibility criteria

#### Types of participants

The general human population will be considered, regardless of sex, race and region.

#### Types of exposure (intervention)

The intervention is the different types of diet. Based on previously published literature,<sup>13 23 24</sup> we will divide diets into the following: dietary patterns, including ketogenic diet, Mediterranean diet, etc; food groups, foods and beverages, including whole grain, fruit, nut, legume, dairy products, eggs, meat, fish, fats (eg, butter), oil, tea, garlic, gum, refined grains, sugar-sweetened beverages, etc; and macronutrients, micronutrients (vitamins, minerals) and fibre.

#### Types of comparator

Foods that were different from the intervention group will be considered as the control group.

#### Types of outcome

The main outcome is the pooled mean difference in WC (in centimetres), pooled mean difference in BMI (in kilograms per square metre), pooled mean difference in fat mass (body fat; in kilograms) or pooled mean difference in HC (in centimetres). The secondary outcome is pooled mean difference in weight change (in kilograms), pooled mean difference in lean mass (in kilograms), pooled mean difference in free fat mass (in kilograms) or pooled mean difference in WHR.

### Inclusion criteria

We considered including meta-analyses of RCT because the results of RCT are more convincing than the results of other types of studies.<sup>25</sup> We aimed to study the influence of diet on obesity-related parameters in adults. Because body weight, WC and other anthropometric parameters in adults are not as susceptible to growth and development, the results on the influence of diet on these anthropometric parameters could be more reliable. To better and more accurately evaluate the impact of these foods on obesity-related parameters, we will only consider including articles where the outcomes contain at least two of the following items: WC, BMI, fat mass (body fat) and HC. Meanwhile, to better compare the influence of different foods on obesity-related parameters, we will unify the units of these weight parameters as follows: WC in centimetres, BMI in kilograms per square metre, fat mass in kilograms and HC in centimetres. At the same

time, to quantitatively study the effects of these foods on obesity-related parameters, we will consider including articles that reported pooled mean difference in obesity-related parameters between the intervention and the control group.

### Exclusion criteria

We will not include articles on the effects of diet on obesity-related parameters among pregnant and lactating women given that pregnant and lactating women are highly influenced by other factors. We will not include conferences, abstracts, correspondence, etc. If an article has incomplete data, we will exclude the article if complete data cannot be obtained after contacting the author. We will not include articles that examine the effects of diet on obesity-related parameters among people with infectious diseases, severe acute and chronic diseases, etc. We will also exclude articles where we could not identify the effect of the intervention food on obesity-related parameters. To quantitatively study the effects of diet on obesity-related parameters, we will not include systematic reviews without meta-analysis.

### Information source and search strategy

We will only retrieve English articles published before 15 December 2021 by searching PubMed and Embase. We did not set any restrictions when searching. We will only include articles that are meta-analyses of RCT. There have been several umbrella reviews that summarised the role of diet in type 2 diabetes incidence,<sup>23 24 26</sup> and by referring to their search terms we determined the following keywords: diet or beverages or soy or sugar or egg or macronutrient or micronutrient. More details are shown in online supplemental tables 2 and 3. We will import the search results into the EndNote V.X9 software and use it to remove duplicate articles. We will also include grey literature. If necessary, we will contact the corresponding authors of the included systematic reviews to collect missing data on the main endpoints or to ask regarding unclear information.

### Data extraction

Two researchers will separately check the data extracted from each eligible meta-analysis. If there is a disagreement, a third researcher will join the analysis. We will extract the following data from the included meta-analyses: first author and year of publication, number of included studies, intervention diet, control diet, number of included studies, number of subjects included in the intervention group, number of subjects included in the control group, duration of intervention, study population, outcomes of interest and pooled effect size of the mean difference of outcomes of interest, along with 95% CI, p values, heterogeneity (I index), publication bias (Egger's test and Begg's test values) and the quality of the studies included in each meta-analysis. For primary studies included in the meta-analyses, we will extract the following data: first author and year of publication,

number of included studies, intervention diet, control diet, number of included studies, number of subjects included in the intervention group, number of subjects included in the control group, duration of intervention, study population, outcomes of interest, baseline of outcomes of interest and the final results after the intervention. All data will be recorded in Excel according to previously designed content.

### Assessment of methodological quality and of certainty in the findings

We will assess the quality of included systematic reviews using AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews V.2),<sup>27</sup> which includes 16 items (7 critical domains and 9 non-critical domains). According to the tool, two reviewers will classify the results of the included systematic reviews as high, moderate, low and critically low. If the study has no or one non-critical weakness, we will appraise it as high; if more than one non-critical weakness, we will appraise it as moderate; if one critical flaw with or without non-critical weakness, we will appraise it as low; and if more than one critical flaw with or without non-critical weakness, we will appraise it as critically low.

In addition, we will carry out NutriGrade<sup>28</sup> grading for obesity-related parameters for each diet to assess certainty in the findings. The NutriGrade<sup>28</sup> scoring system comprises seven items with a total score of 10 for systematic reviews and meta-analyses of RCT. The following are the seven items: (1) risk of bias, study quality and study limitations (3 points); (2) precision (1 point); (3) heterogeneity (1 point); (4) directness of evidence (1 point); (5) publication bias (1 point); (6) funding bias (1 point); and (7) study design (2 points). Studies with a total score of  $\geq 8$ , 6–7.99, 4–5.99 and 0–3.99 points are graded as having high, moderate, low and very low confidence in the effect estimate, respectively.

### Data analysis

First, we will recalculate the summary effect and 95% CI using a random-effect model by DerSimonian and Laird after adjusting for most confounders in the published meta-analyses. If the same outcome is presented by sex or race in the published meta-analysis, we will first combine the effect size using fixed-effect methods before conducting the overall meta-analysis. Second, we will use  $I^2$  statistics or Cochran's Q test to determine the magnitude of heterogeneity.<sup>29</sup> For Cochran's Q test, we will consider the result as significant heterogeneity when  $p < 0.1$ ; for  $I^2$  statistics, we will classify the result as significant heterogeneity when the  $I^2$  value is  $\leq 50\%$ . Third, we will estimate publication bias and small-study effect by Egger's test (as confirmed by a p value of  $< 0.1$ ) or Begg's test (as confirmed by a p value of  $< 0.1$ ).<sup>30</sup> If the published meta-analysis has missing information, we will not recalculate the meta-analysis and will only extract the effect size. In addition, a series of subgroup analyses, such as classification by disease, sex and race, will be performed. We will also show our results according to food groups,

such as whole grains, refined grains, fruit, nut, legume, dairy products, eggs, meat, fish, fats, oil, tea, garlic, gum and sugar-sweetened beverages. Finally, we will use AMSTAR-2 to assess the methodological quality in tabular form for each review. NutriGrade will be used to evaluate the quality of evidence, which will be presented in tabular form. All statistical analyses will be conducted using Review Manager (RevMan, V.5.3 for Macintosh; The Cochrane Collaboration) and the PASW V.20.0 statistical package for Macintosh (SPSS).

## DISCUSSION

By an umbrella review of meta-analyses of RCT, Dinu *et al*<sup>31</sup> published an article on the effects of popular diets on anthropometric and cardiometabolic parameters. However, they only sorted out the effects of dietary patterns on BMI and weight, as well as other cardiometabolic parameters. Akhlaghi and colleagues<sup>32</sup> thought soy showed no overall statistically significant effect on weight, WC or fat mass. However, Mu and colleagues<sup>33</sup> held that soy products significantly reduced body weight, BMI, body fat per cent and WC in overweight or obese Asian populations, and more significant effects were observed in non-menopausal women. Asbaghi and colleagues<sup>34</sup> found that magnesium supplementation did not affect body weight, BMI and WC, while Askari *et al*<sup>35</sup> found a significant reduction in BMI following magnesium supplementation and Rafiee *et al*<sup>36</sup> found that magnesium supplementation was associated with lower WC only in obese subjects.

Generally, interventional studies that investigate the relationship between food intake and obesity-related anthropometric characteristics are often performed by supplementing or changing a regular diet; however, baseline consumption of foods (type and amount) can remain different.<sup>37</sup> The obesity index of people in developed countries is generally higher than developing countries, while the control of food intake by obese individuals is poorer than those with ideal body weight.<sup>38 39</sup> Thus, subject-friendly diets can be formulated for different population groups based on whole food components. We aim to investigate the characteristics of dietary nutrition in both weight loss and habitual diets to analyse the effects of diet on obesity-related anthropometric characteristics in adults. Further research is required using longitudinal studies and field trials to confirm these findings.

Our umbrella review has many strengths. First, we have included different types of diets in the umbrella review, with the results being more practical and generalised. Second, the anthropometric indicators related to obesity are comprehensive. Third, a series of subgroup analyses will be conducted to determine the factors affecting the results and to reduce heterogeneity. Finally, publication bias (Egger's test and Begg's test values) and the quality of studies will be assessed in each included meta-analysis.

## ETHICS AND DISSEMINATION

This is an umbrella review. We will not conduct any experiments on humans or animals so we will not consider an ethical review. We will publish the results of this umbrella review in a peer-reviewed journal.

**Contributors** All authors contributed to the design of this protocol. SF, QZ, LY, ZL and QC initiated the project. The protocol was drafted by SF and was refined by QZ. Statistical advice was provided by QC. SF was responsible for drafting the manuscript. All authors contributed to the manuscript and read and approved the final manuscript.

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## REFERENCES

- Hassabou NF, Farag AF. Anticancer effects induced by artichoke extract in oral squamous carcinoma cell lines. *J Egypt Natl Canc Inst* 2020;32:17.
- Poirier P, Giles TD, Bray GA, *et al*. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss: an update of the 1997 American heart association scientific statement on obesity and heart disease from the obesity Committee of the Council on nutrition, physical activity, and metabolism. *Circulation* 2006;113:898–918.
- Upadhyay J, Farr O, Perakakis N, *et al*. Obesity as a disease. *Med Clin North Am* 2018;102:13–33.
- Zhao W, Zhai Y, Hu J, *et al*. Economic burden of obesity-related chronic diseases in mainland China. *Obes Rev* 2008;9 Suppl 1:62–7.
- Zheng R, Liu C, Wang C, *et al*. Natural course of metabolically healthy overweight/obese subjects and the impact of weight change. *Nutrients* 2016;8. doi:10.3390/nu8070430. [Epub ahead of print: 15 Jul 2016].
- Chu D-T, Minh Nguyen NT, Dinh TC, *et al*. An update on physical health and economic consequences of overweight and obesity. *Diabetes Metab Syndr* 2018;12:1095–100.
- Finkelstein EA, Khavjou OA, Thompson H, *et al*. Obesity and severe obesity forecasts through 2030. *Am J Prev Med* 2012;42:563–70.
- Andolfi C, Fisichella PM. Epidemiology of obesity and associated comorbidities. *J Laparoendosc Adv Surg Tech A* 2018;28:919–24.
- Kinlen D, Cody D, O'Shea D. Complications of obesity. *QJM* 2018;111:437–43.
- Mechanick JL, Apovian C, Brethauer S, *et al*. Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures - 2019 update: cosponsored by american association of clinical endocrinologists/american college of endocrinology, the obesity society, american society for metabolic & bariatric surgery, obesity medicine

- association, and american society of anesthesiologists - executive summary. *Endocr Pract* 2019;25:1–75.
- 11 Plachta-Danielzik S, Kehden B, Landsberg B, *et al.* Attributable risks for childhood overweight: evidence for limited effectiveness of prevention. *Pediatrics* 2012;130:e865–71.
  - 12 Kopelman P, Jebb SA, Butland B. Executive summary: Foresight 'Tackling Obesity: Future Choices' project. *Obes Rev* 2007;8 Suppl 1:vi–ix.
  - 13 Schlesinger S, Neuenschwander M, Schwedhelm C, *et al.* Food groups and risk of overweight, obesity, and weight gain: a systematic review and dose-response meta-analysis of prospective studies. *Adv Nutr* 2019;10:205–18.
  - 14 Bälter K, Möller E, Fondell E. The effect of dietary guidelines on cancer risk and mortality. *Curr Opin Oncol* 2012;24:90–102.
  - 15 Hruby A, Manson JE, Qi L, *et al.* Determinants and consequences of obesity. *Am J Public Health* 2016;106:1656–62.
  - 16 Rodríguez-López CP, González-Torres MC, Aguilar-Salinas CA, *et al.* Dash diet as a proposal for improvement in cellular immunity and its association with metabolic parameters in persons with overweight and obesity. *Nutrients* 2021;13. doi:10.3390/nu13103540. [Epub ahead of print: 09 Oct 2021].
  - 17 Cui L, Chen T, Li Z, *et al.* Association between dietary related factors and central obesity among married women: China health and nutrition survey. *Appetite* 2022;168:105785.
  - 18 Di Daniele N. The role of preventive nutrition in chronic non-communicable diseases. *Nutrients* 2019;11. doi:10.3390/nu11051074. [Epub ahead of print: 15 May 2019].
  - 19 Zeng X, Zhang Y, Kwong JSW, *et al.* The methodological quality assessment tools for preclinical and clinical studies, systematic review and meta-analysis, and clinical practice guideline: a systematic review. *J Evid Based Med* 2015;8:2–10.
  - 20 Aromataris E, Fernandez R, Godfrey CM, *et al.* Summarizing systematic reviews: methodological development, conduct and reporting of an umbrella review approach. *Int J Evid Based Healthc* 2015;13:132–40.
  - 21 Pussegoda K, Turner L, Garritty C, *et al.* Systematic review adherence to methodological or reporting quality. *Syst Rev* 2017;6:131.
  - 22 Shamseer L, Moher D, Clarke M, *et al.* Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;350:g7647.
  - 23 Neuenschwander M, Ballon A, Weber KS, *et al.* Role of diet in type 2 diabetes incidence: umbrella review of meta-analyses of prospective observational studies. *BMJ* 2019;366:l2368.
  - 24 Dinu M, Pagliai G, Angelino D, *et al.* Effects of popular diets on anthropometric and cardiometabolic parameters: an umbrella review of meta-analyses of randomized controlled trials. *Adv Nutr* 2020;11:815–33.
  - 25 Akobeng AK. Understanding randomised controlled trials. *Arch Dis Child* 2005;90:840–4.
  - 26 Toi PL, Anothaisintawee T, Chaikledkaew U, *et al.* Preventive role of diet interventions and dietary factors in type 2 diabetes mellitus: an umbrella review. *Nutrients* 2020;12. doi:10.3390/nu12092722. [Epub ahead of print: 06 Sep 2020].
  - 27 Shea BJ, Reeves BC, Wells G, *et al.* AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ* 2017;358:j4008.
  - 28 Schwingshackl L, Knüppel S, Schwedhelm C, *et al.* Perspective: NutriGrade: a scoring system to assess and judge the Meta-Evidence of randomized controlled trials and cohort studies in nutrition research. *Adv Nutr* 2016;7:994–1004.
  - 29 Chen M, Tang T-C, He T-H, *et al.* Management of haemorrhoids: protocol of an umbrella review of systematic reviews and meta-analyses. *BMJ Open* 2020;10:e035287.
  - 30 Egger M, Davey Smith G, Schneider M, *et al.* Bias in meta-analysis detected by a simple, graphical test. *BMJ* 1997;315:629–34.
  - 31 Dinu M, Pagliai G, Angelino D, *et al.* Effects of popular diets on anthropometric and cardiometabolic parameters: an umbrella review of meta-analyses of randomized controlled trials. *Adv Nutr* 2020;11:815–33.
  - 32 Akhlaghi M, Zare M, Nouripour F. Effect of soy and soy isoflavones on obesity-related anthropometric measures: a systematic review and meta-analysis of randomized controlled clinical trials. *Adv Nutr* 2017;8:705–17.
  - 33 Mu Y, Kou T, Wei B, *et al.* Soy products ameliorate obesity-related anthropometric indicators in overweight or obese Asian and non-menopausal women: a meta-analysis of randomized controlled trials. *Nutrients* 2019;11. doi:10.3390/nu11112790. [Epub ahead of print: 15 Nov 2019].
  - 34 Asbaghi O, Hosseini R, Boozari B, *et al.* The effects of magnesium supplementation on blood pressure and obesity measure among type 2 diabetes patient: a systematic review and meta-analysis of randomized controlled trials. *Biol Trace Elem Res* 2021;199:413–24.
  - 35 Askari M, Mozaffari H, Jafari A, *et al.* The effects of magnesium supplementation on obesity measures in adults: a systematic review and dose-response meta-analysis of randomized controlled trials. *Crit Rev Food Sci Nutr* 2021;61:2921–37.
  - 36 Rafiee M, Ghavami A, Rashidian A, *et al.* The effect of magnesium supplementation on anthropometric indices: a systematic review and dose-response meta-analysis of clinical trials. *Br J Nutr* 2021;125:644–656.
  - 37 Baxter NT, Schmidt AW, Venkataraman A, *et al.* Dynamics of human gut microbiota and short-chain fatty acids in response to dietary interventions with three fermentable fibers. *mBio* 2019;10. doi:10.1128/mBio.02566-18. [Epub ahead of print: 29 01 2019].
  - 38 Campos-Uscanga Y, Gutiérrez-Ospina G, Morales-Romero J, *et al.* Self-Regulation of eating and physical activity is lower in obese female college students as compared to their normal weight counterparts. *Eat Weight Disord* 2017;22:311–9.
  - 39 Batterink L, Yokum S, Stice E. Body mass correlates inversely with inhibitory control in response to food among adolescent girls: an fMRI study. *Neuroimage* 2010;52:1696–703.