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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^2 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.

PROSPERO registration number CRD42021232826.

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.

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 economics.[1–5] What is more concerning is that the number of individuals with obesity and overweight continues to rise.[2–7] 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.[2–6 8–10] 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.[11 12] Overweight/obesity is often caused by a long-term energy imbalance between intake and expenditure, leading to weight gain.[13] 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.[13] 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.[14 15] 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.[16] 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.[13 17 18] 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.[19–21]

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[22] (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,[13 23 24] 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.[25] 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,[23 24 26] 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),[27] 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[28] grading for obesity-related parameters for each diet to assess certainty in the findings. The NutriGrade[28] 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 ≥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.[29] For Cochrane'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 ≤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).[30] 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*[31] 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[32] thought soy showed no overall statistically significant effect on weight, WC or fat mass. However, Mu and colleagues[33] 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[34] found that magnesium supplementation did not affect body weight, BMI and WC, while Askari *et al*[35] found a significant reduction in BMI following magnesium supplementation and Rafiee *et al*[36] 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.[37] 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.[38 39] 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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Competing interests None declared.

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Figure 1: Flow chart illustrating the preliminary literature search and study selection of systematic reviews (published prior to 17 January 2021)

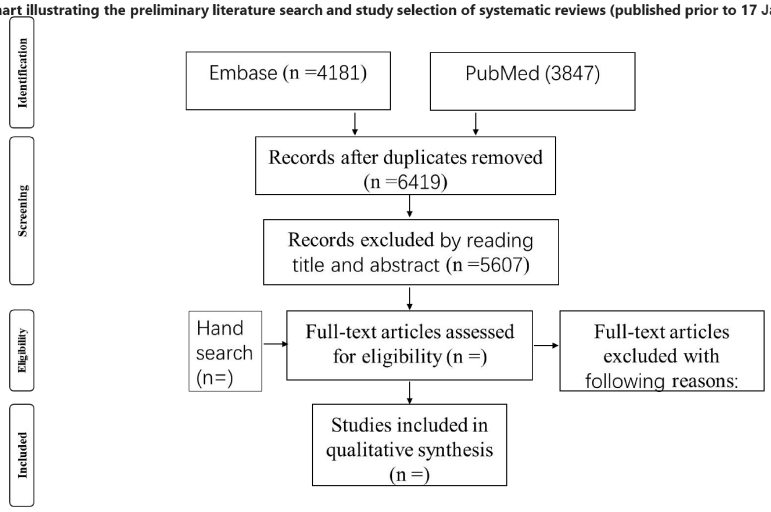

Table 1| **PRISMA-P (preferred reporting items for systematic review and meta-analysis protocols) 2015 checklist: recommended items to address in a systematic review protocol**

Section and topic	Item No	Checklist item	Information reported	
ADMINISTRATIVE INFORMATION			**Yes**	**No**
Title:				
Identification	1a	Identify the report as a protocol of a systematic review	X	
Update	1b	If the protocol is for an update of a previous systematic review, identify as such		N/A a new protocol
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	X	
Authors:				
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	X	
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	X	
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments		N/A a new protocol

Support:				
Sources	5a	Indicate sources of financial or other support for the review	X	
Sponsor	5b	Provide name for the review funder and/or sponsor		There are no funders
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol		There are no funders
INTRODUCTION				
Rationale	6	Describe the rationale for the review in the context of what is already known	X	
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	X	
METHODS				
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	X	
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	X	
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	X	
Study records:				
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	X	
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	X	
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	X	
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any	X	

		pre-planned data assumptions and simplifications		
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	X	
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	X	
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	X	
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	X	
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	X	
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	X	
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	X	
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	X	

Table 2:search strategy for PUBMED

#1	anthropometry OR 'fat mass' OR bmi OR 'body mass index' OR 'waist circumference' OR 'waist circumferences' OR 'body fat' OR 'waist-to-hip ratio' OR 'waist hip ratio' OR weight OR anthropometric OR 'index, body mass' OR 'body fatness'
#2	'diet' OR diets OR dietary OR oil OR food OR foods OR fish OR fishes OR meat OR meats OR fruit OR berries OR berry OR legume OR pods OR 'pods, legume' OR vegetable OR vegetables OR beverages OR beverage OR soy OR sugars OR sugar OR egg OR eggs OR macronutrient OR macronutrients OR micronutrients OR micronutrient OR whole grain OR refined grain OR cereal OR pasta OR rice OR potato OR bean OR dairy OR dairies OR milk OR yogurt OR cheese OR fish OR seafood OR meat OR processed meat OR sugar sweetened beverage
#3	metanalys*[tw] OR meta-analys*[tw]
#4	"randomized controlled trial" OR "clinical trial" OR RCT OR "Clinical Trials" OR "controlled trial" OR "Intervention Study" OR "Intervention Studies" OR randomized OR "randomized controlled trial" or random

#5	#1 AND #2 AND #3 AND #4

Table 3: search strategy for EMBASE

#1	anthropometry OR 'fat mass' OR bmi OR 'body mass index' OR 'waist circumference' OR 'waist circumferences' OR 'body fat' OR 'waist-to-hip ratio' OR 'waist hip ratio' OR weight OR anthropometric OR 'index, body mass' OR 'body fatness'
#2	'diet' OR diets OR dietary OR oil OR food OR foods OR fish OR fishes OR meat OR meats OR fruit OR berries OR berry OR legume OR pods OR 'pods, legume' OR vegetable OR vegetables OR beverages OR beverage OR soy OR sugars OR sugar OR egg OR eggs OR macronutrient OR macronutrients OR micronutrients OR micronutrient OR 'whole grain' OR 'refined grain' OR cereal OR pasta OR rice OR potato OR bean OR dairy OR dairies OR milk OR yogurt OR cheese OR fish OR seafood OR meat OR 'processed meat' OR 'sugar sweetened beverage'
#3	('meta analys*' OR 'metanalys*'):ti,ab,kw
#4	"randomized controlled trial" OR "clinical trial" OR RCT OR "Clinical Trials" OR "controlled trial" OR "Intervention Study" OR "Intervention Studies" OR randomized OR "randomized controlled trial" or random
#5	#1 AND #2 AND #3 AND #4