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Comparative effects of tea and coffee drinking on body weight in adults: a systematic review and network meta-analysis of randomised trials

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Abstract

We aimed at quantifying the effects of different tea and coffee on weight loss in adults. We searched PubMed, Scopus, CENTRAL and grey literature sources to July 2024. The study excluded cross-over trials without washout period, those in critically ill patients, pregnant or breast-feeding women, multicomponent interventions and active control groups with tea or coffee. A random-effects network meta-analysis with a Bayesian framework was performed to calculate the mean difference (MD) and 95 % credible intervals (CrIs). The certainty of evidence was rated using the Grading of Recommendations Assessment, Development, and Evaluation approach, and risk of bias was assessed using Cochrane tool. Twenty-two randomised controlled trials with 1710 participants (average intervention duration = 10 weeks) were included. Green tea was effective for weight loss compared with placebo (MD: −1·23 kg, 95 % CrI: −2·45, −0·02; low certainty evidence) or water (MD: −1·61 kg, 95 % CrI: −2·90, −0·35; very low certainty evidence), while other beverages (coffee, decaffeinated coffee, green coffee, black tea and sour tea) were not. Green tea was effective for weight loss compared with water in sensitivity analysis of healthy individuals (MD: −3·31 kg, 95 % CrI: −5·83, −1·04). Based on very low to low certainty evidence, green tea drinking may result in a small weight loss in adults. This study mainly focused on weight loss effects of green tea and coffee, with limited data on other teas. Only five trials had longer intervention durations, suggesting future research on long-term effects. Most trials had high bias risk and low certainty, requiring more high-quality trials.

Keywords: **Adiposity: Weight loss: Tea: Coffee: Meta-analysis**

Coffee and tea are the two important dietary sources of caffeine, thus can increase consciousness and work productivity[1]. Both coffee[2] and tea[3] contain several beneficial components including polyphenols such as lignans and chlorogenic acid and epigallocatechin gallate, which are believed to be associated with a lower risk of site-specific cancers, CVD and premature death[4,5].

There is evidence that coffee and tea, especially green tea, have weight-loss effects. Caffeine can induce noradrenaline and dopamine release, thus stimulating neuronal activity in the brain and decreasing body weight[6]. Caffeine can also inhibit phosphodiesterase and suppresses the negative effects of adenosine on noradrenaline release, thus can induce fat oxidation[7]. Green tea decreases ghrelin secretion, nutrient absorption and adipogenesis, in contrast, increases adiponectin levels and substrate oxidation[8]. Intervention studies suggested that green tea supplementation, especially in the form of green tea extract, can result in a significant reduction in body weight in individuals with overweight or obesity[9]. Supplementations with caffeine[10] and green coffee extract[11] was also associated with a significant decrease in body weight in adults. A systematic review and meta-analysis concluded that green tea has no significant effect on prostate-specific antigen level[12]. Their geographical subgroup analysis revealed that green tea significantly reduced prostate specific antigen level in the USA population compared with non-USA populations.

However, the potential weight loss effects of other beverages, including coffee, decaffeinated coffee, sour tea and black tea, have not yet been evaluated. In addition, previous reviews have mainly focused on supplementation with green tea, green coffee

Abbreviations: CrI, credible interval; MD, mean difference.

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and caffeine as an herbal extract. Indeed, the potential weight loss effects of drinking tea or coffee, in the form of a beverage, have not been investigated in a systematic review. Therefore, we aimed to perform a systematic review and network meta-analysis of randomised trials to compare and rank the effects of drinking different tea and coffee on body weight in adults.

Materials and methods

The meta-analysis was conducted per instructions outlined in the Cochrane Handbook for Systematic Reviews of Interventions[13] and the Grading of Recommendations Assessment, Development, and Evaluation Handbook[14]. The protocol of the study was approved by the ethic committee of Tehran University of Medical Sciences (IR.TUMS.EMRI.REC.1401.075) and was registered with PROSPERO (CRD42022372417)[15].

Systematic search

PubMed, Scopus and CENTRAL were searched from inception until July 2024. Grey literature sources, including clinicaltrial.gov and ProQuest, were also searched to find potential additional trials. As per our *a priori* search strategy (online Supplementary Table 1), two authors (AMR and RN) independently screened the titles and abstracts. These reviewers independently read the full texts of all potentially relevant articles and screened the reference lists of relevant meta-analyses. There was no restriction on language, date, or publication status.

Study selection and eligibility criteria

Randomised controlled trials were selected if (1) had either parallel or cross-over design and lasted at least 2 weeks[16], (2) were conducted in participants aged ≥ 18 years, (3) compared the effect of different types of tea or coffee including green tea, black tea, sour tea, coffee, decaffeinated coffee or green coffee on body weight, or compared one of these beverages against a control group and (4) reported change in body weight (kg) during the intervention period in both intervention and control groups in each trial as an outcome, or reported sufficient information to estimate those values. An eligible control group was defined as a placebo, water, no intervention or intake of other tea or coffee.

Exclusion criteria

Exclusion criteria were (1) cross-over trials without a washout period, (2) trials conducted in critically ill patients (e.g. trials conducted in patients with beta thalassemia), (3) trials that were conducted in pregnant or breast-feeding women, (4) trials that implemented a multicomponent intervention in the intervention arm and (5) trials that had an active control group rather than any type of tea or coffee.

Screening and data extraction

Two reviewers (RN and AMR) independently extracted the author's name, study design (parallel or cross-over), year of publication, number of participants, baseline BMI, % female, mean age, intervention and comparator characteristics, duration and the dosage of intervention, dropouts, degree of adherence to the intervention and mean and corresponding SD of change from baseline weight in each study arm. Disagreements were resolved by consulting the first author (AJ).

Risk of bias (quality) assessment

Two authors (AJ and SS-B) independently assessed the risk of bias of the trials according to version 2.0 of the Cochrane tool for risk of bias assessment[13].

Data analysis

Mean differences (MD) and their 95 % credible intervals (CrIs) were considered as the effect size for reporting the results. To perform the analyses, the mean and SD of change in body weight (kg) from baseline in each study arm were calculated. If these values were not reported in the trials, we followed the Cochrane Handbook guidance to calculate these values using baseline and endpoint measures[13].

First, a random-effects pairwise meta-analysis with a Bayesian framework was performed to estimate direct estimates[17,18]. Then, a random-effects network meta-analysis with a Bayesian framework was conducted to calculate the network estimates[17,18]. The node-splitting approach was used to calculate indirect estimates and to evaluate incoherence between direct and indirect estimates. Ranking probabilities were calculated, and the surface under the cumulative ranking curves was obtained. Both pairwise and network meta-analyses were performed under the *gemtc* package of R version 3.4.3 (R Studio, Boston, MA).

A pre-specified sensitivity analysis was performed with trials conducted on participants with overweight or obesity. Two *post hoc* sensitivity analyses were also done with trials conducted in healthy and unhealthy participants. Due to the low number of trials with a low risk of bias and trials that implemented energy restriction alongside their intervention, we did not perform pre-specified sensitivity analyses with trials with a low risk of bias and energy restriction. To evaluate the potential for transitivity, the distribution of the potential effect modifiers across the available direct comparisons was assessed. Mean age, baseline BMI and percentage of female participants were considered as the potential effect modifiers (online Supplementary Figures 1–3). A comparison-adjusted funnel plot was created to assess the potential for publication bias (online Supplementary Fig. 4)[19].

Grading of the evidence

The certainty of the evidence was evaluated using the Grading of Recommendations Assessment, Development, and Evaluation approach developed for network meta-analyses[20]. The minimal clinically important difference threshold for weight loss in adults was considered as 5 % weight loss[21], equal to 4·5 kg[22].

Results

Literature search and study selection process

Figure 1 shows the systematic search and study selection process. After the exclusion of 931 duplicates and an additional

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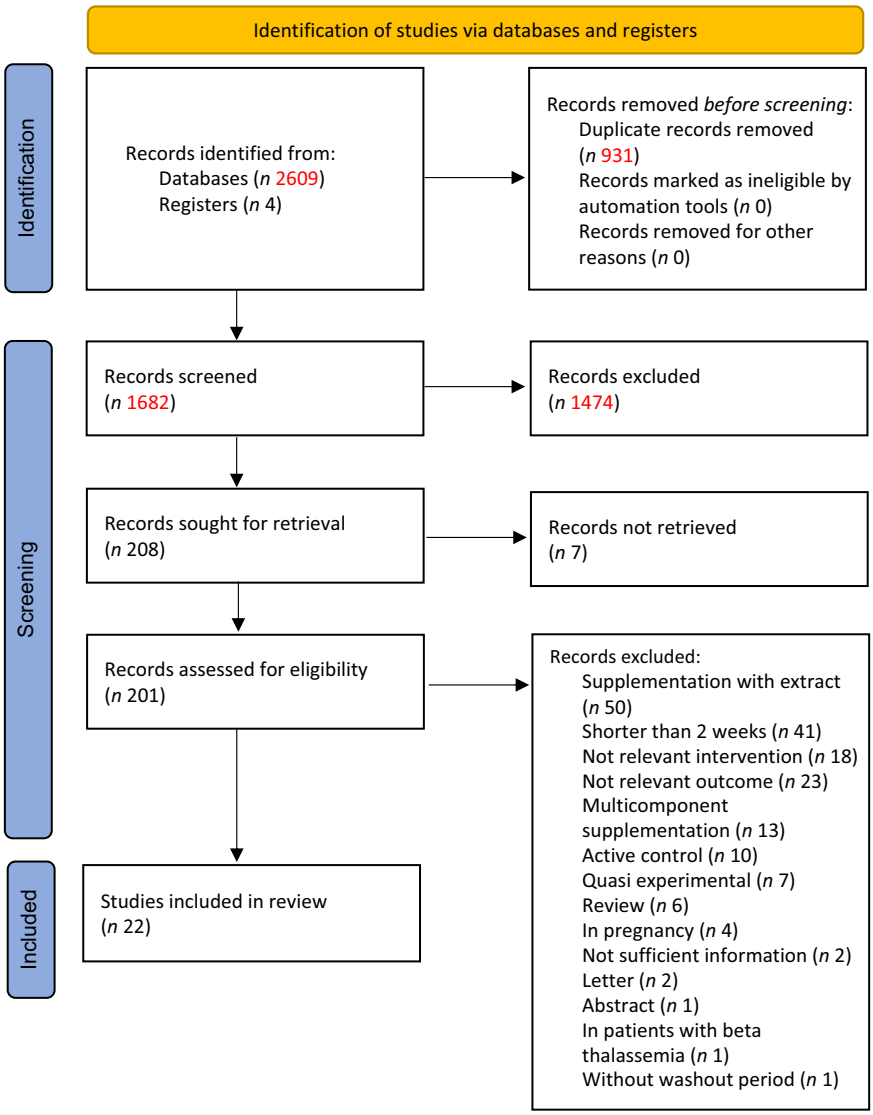

Fig. 1. Flow diagram.

1474 records that were not eligible according to our inclusion criteria, we read the full text of 201 records; of those, twenty-two trials were considered eligible for inclusion. Online Supplementary Table 2 presents the list of excluded studies based on the review of the full texts with reasons for exclusions.

Characteristics of the included trials

In total, twenty-two randomised trials with 1710 participants proved eligible for inclusion in the present meta-analysis[23–44] (Table 1). All but three trials[32,33,39] had a parallel design. Three trials had a cross-over design, in which the length of the washout period was 1 week[39], > 4 weeks[32] and 8 weeks[33]. Three trials were conducted in men[32,38,40], three in women[23,28,34] and the remainder in either sex. Nine trials were conducted in participants with overweight and/or obesity[23,24,26,28,31,35,37,38,44] and nine in healthy participants[23,29–32,39,40,42,44]. The intervention duration was 2 weeks in one trial[39], 4 weeks in three trials[23,32,34], 8 weeks in nine trials[26,28,29,33–35,40,43,44], 12 weeks in four trials[25,30,31,37] and longer than 12 weeks in the other five trials[24,27,38,41,42]. Four trials were rated to have a low risk of bias[24,29,38,44], five trials were rated to have some concerns[25,27,31,32,34] and the other twelve trials were rated to have a high risk of bias[23,26,28,30,33,35–37,39,40,42,43] (online Supplementary Table 3).

Network meta-analysis

Comparative effects of different beverages on body weight are presented in Fig. 2 and Table 2. In the main analysis incorporating all trials, green tea drinking was effective for weight loss compared with placebo (MD: −1·23 kg, 95 % CrI: −2·45, −0·02; low certainty evidence) and water (MD: −1·61 kg, 95 % CrI: −2·90, −0·35; very low certainty evidence). Other beverages, including black tea, sour tea, coffee, decaffeinated coffee and green coffee, were not effective for weight loss compared with either placebo or other beverages (very low- to

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Table 1. Characteristics of the trials included in the network meta-analysis of tea or coffee drinking on weight loss in adults

Author, year, Country	Participants	Age range, year	Mean age	% Female	Baseline BMI (kg/m^2)	Intervention (duration)	Control	Adherence	Drop out		Adverse events
Al-Naggar, 2022 Malaysia	Female university students with obesity (*n* 30)	20–25		100 %	Int: 31·1 Cont: 29·9	Green tea, 1·5 liter per day (4 weeks)	Placebo beverage	Not reported	Not reported		Not reported
Alperet, 2020 Singapore	Adults with overweight and insulin resistance (*n* 126)	35–69	47	42 %	Int: 27·4 Cont: 27·0	Instant regular coffee, 4 cups per day (24 weeks)	Placebo beverage	Good	14	11·1 %	5
Bak, 1989 Netherlands	Young adults with normal serum cholesterol (*n* 107)	> 18	26	44 %	Int: 22·5 Cont: 23·3	Boiled coffee, 4 to 6 cups per day (12 weeks)	No coffee	Good	Not reported		Not reported
Basu, 2013 USA	Adults with obesity and metabolic syndrome (*n* 35)	> 18		Not reported	Not reported	Green tea, 4 cups per day (8 weeks)	Water	90 %	Not reported		no significant side effects were reported
Bohn, 2014 Australia	Regular tea-drinking men and women with a BMI 20–35 kg/m^2 (*n* 111)	35–70	56	65 %	Int: 24·8 Cont: 25·0	Black tea, 3 cups per day (24 weeks)	Caffeine-matched placebo	Good	Not reported		Not reported
Cardoso, 2013 Brazil	Women with overweight or obesity (*n* 36)	20–40		100 %	Int: 28·4 Cont: 31·1	Green tea, 20 grams per day (8 weeks)	Placebo beverage	Not reported	Not reported		Not reported
Hochkogler, 2019 Austria	Healthy volunteers with a BMI 20–32 kg/m^2 (*n* 86)	> 18	24	51 %	Int: 23·5 Cont: 23·5	Coffee, 750 ml per day (8 weeks)	Water	Good (Non-complaints were excluded)	2	2 %	no clinically relevant adverse effects
Kajimoto, 2005 Japan	Healthy subjects with a BMI 22·5–30 kg/m^2 (*n* 195)	20–65	43	50 %	Int: 25·7 Cont: 25·7	Green tea catechin-containing bottle, 3 bottles per day (12 weeks)	Placebo drink	Good	2	1·1 %	4 cases of cold-like symptoms (control group, 15; low-dose group, 12;high-dose group, 7), cases of eczema (1 in each group), 7 cases of diarrhea or soft stools (control group, 1; low-dose group, 4; high-dose group, 2), and 1 case of lack of appetite (high-dose group
Kobayashi, 2016 Japan	Adults with overweight or obesity (*n* 124)	> 18	44	57 %	Int: 27·4 Cont: 27·4	Green tea beverages with a high content of catechins, 500 ml per day (12 weeks)	Placebo drink	> 90 %	2	1·6 %	14 cases of abdominal pain (6, 3, and 5 in the placebo, low-dose group, and high-dose groups, respectively) and 4 cases of diarrhea (2, 1, and 1 in the placebo, low-dose group, and high-dose groups, respectively)
Lecoultre, 2014 Switzerland (C > 4 weeks)	Healthy participants (*n* 10)	> 18	23	0	22·6	Coffee, 4 cups per day (4 weeks)	Decaffeinated coffee, 4 cups per day	Good	0		Not reported
Martínez-López, 2019 Spain (C)-8	Adults with hypercholesterolemia and normo-cholesterolemia with a BMI < 25 kg/m^2 (*n* 42)	18–45	30	61 %	23·1	Soluble green/roasted coffee, 6 grams per day (three servings of 2 g of the coffee blend dissolved in 200 ml	Water or an isotonic drink	Appropriate	4	9·5 %	Not reported

Table 1. (*Continued*)

Author, year, Country	Participants	Age range, year	Mean age	% Female	Baseline BMI (kg/m^2)	Intervention (duration)	Control	Adherence	Drop out		Adverse events
						of hot water, three times a day) (8 weeks)					
Mortazavi, 2018 Iran	Women with metabolic syndrome (*n* 70)	40–70	57	100 %	Int: 31·8 Cont: 30·6	Green tea, Three 200 cc per day (8 weeks)	Lukewarm water	Not reported	5	7·1 %	0
Mousavi, 2012 Iran	Patients with type 2 diabetes and overweight or obesity (*n* 63)	35–65	55	52 %	Int: 27·4 Cont: 28·1	Green tea, 4 cups per day (8 weeks)	No green tea	Not reported	2	3·1 %	Not reported
Mozaffari, 2013 Iran	Patients with type 2 diabetes (*n* 60)	> 35	53	85 %	Int: 28·2 Cont: 28·3	Sour tea, 2 cups per day (4 weeks)	Black tea	92–95 %	7	11·7 %	0
Naderi Nabi, 2017 Iran	Individuals with obesity (*n* 84)	18–50	47	63 %	Int: 29·9 Cont: 29·7	Green tea, 2 cups per day (12 weeks)	Mineral water	Not reported	15	15 %	No remarkable adverse effect
Ohnaka, 2012 Japan	Men with a mild-to-moderate elevation of fasting plasma glucose and overweight (*n* 45)	40–65	53	0	27·5	Caffeinated instant coffee, decaffeinated instant coffee, 5 cups per day (16 weeks)	No coffee	Good	4	8·2 %	Not reported
Revuelta, 2014 UK (C)-1	Healthy subjects (*n* 20)	> 18		65 %	Int: 23·9 Cont: 23·9	Coffee, 2–4 cups per day (2 weeks)	Green coffee	> 92 %	2	10 %	1 dizziness, 1 nauseous
Senger, 2012 Brazil	Elderly subjects with metabolic syndrome (*n* 45)	> 60		84 %	Int: 30·5 Cont: 30·4	Green tea, 3 cups per day (8 weeks)	No green tea	Not reported	0		Not reported
Superko, 1991 USA	Healthy non-smoking men (*n* 189)	> 18	46	0	26·5	Caffeinated coffee, decaffeinated coffee, cups per day, 700–1200 ml per day (8 weeks)	No coffee	Not reported	5	2·7 %	
Toolsee, 2013 Mauritis	Patients with pre-diabetes (*n* 123)	35–65	48	49 %	Int: 24·5 Cont: 24·5	Green tea, 3 cups per day, (16 weeks)	Water	Good	32	20·6 %	0
van Dusseldorp, 1991 Netherlands	Healthy subjects (*n* 64)	17–57	39	48 %	Int: 23·5 Cont: 22	Unfiltered and filtered coffee, (14 weeks)	No coffee	91 %	2	3 %	Not reported
Wedik, 2011 USA	Healthy subjects with overweight (*n* 45)	> 18	40	64 %	29·5	Instant caffeinated coffee, decaffeinated coffee, 5 cups per day (8 weeks)	No coffee	Good	4	8·9 %	4 (consisted of a urinary tract infection and gastroesophageal reflux among participants assigned to decaffeinated coffee, and a hypoglycemic event and cold sores among participants assigned to caffeinated coffee.)

Cont, control; Int, intervention.

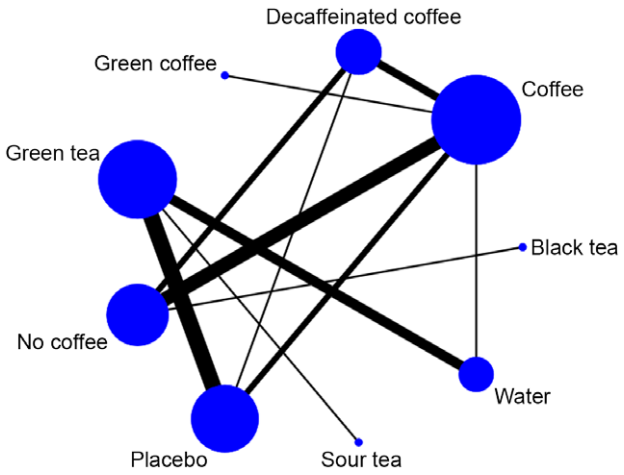

Fig. 2. Network diagram for weight loss. The size of the nodes is proportional to the total number of participants allocated to each beverage, and the thickness of the lines is proportional to the number of studies evaluating each direct comparison.

low certainty evidence). Based on surface under the cumulative ranking curves values, green tea was the most effective beverage for weight loss (75 %) (Table 3).

Sensitivity analyses

In a pre-specified sensitivity analysis with trials conducted on participants with overweight and/or obesity, none of the beverages were effective for weight loss (online Supplementary Table 4). We also performed two *post hoc* sensitivity analyses on healthy and unhealthy participants. In the analyses of healthy individuals, green tea drinking was effective for weight loss compared with no coffee drinking (MD: −2·67 kg, 95 % CrI: −5·25, −0·26) or water (MD: −3·31 kg, 95 % CrI: −5·83, −1·04) (Table 4). No significant effect was seen in the analysis of unhealthy individuals (online Supplementary Table 5).

Grading the evidence

The certainty of the evidence for direct, indirect and network estimates is presented in online Supplementary Tables 6–8. The certainty of the evidence was rated low for the effects of green tea *v.* placebo, coffee *v.* sour tea, coffee *v.* placebo, sour tea *v.* decaffeinated coffee and water *v.* placebo (online Supplementary Table 8). The certainty of the evidence was rated very low for other comparisons. The magnitude of the impacts for all comparisons was lower than the minimal clinically important difference threshold (4·5 kg), suggesting that tea or coffee drinking may result in a small weight loss in adults.

Discussion

In this network meta-analysis incorporating data from twenty-two randomised trials, we compared the weight loss effects of drinking tea and coffee in adults. The results suggest that green tea drinking may result in a small weight loss in adults compared with either placebo or water with very low to low certainty of evidence. A sensitivity analysis in participants with overweight and/or obesity

Table 2. Comparative effects of different beverages on body weight (Mean difference (kg) and 95 % credible interval)*

Treatments	Green tea																			
	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval
Black tea	−0·27	−3·40, 2·87	Black tea																	
Sour tea	−0·01	−4·10, 4·12	−0·28	−5·43, 4·9	Sour tea															
Coffee	−0·59	−2·21, 1·01	−0·85	−3·57, 1·85	−0·58	−5·01, 3·81	Coffee													
Green coffee	−0·59	−4·09, 2·91	−0·86	−4·96, 3·28	−0·58	−5·97, 4·79	0·01	−3·10, 3·11	Green coffee											
No coffee	−0·78	−2·67, 1·10	−1·05	−3·55, 1·46	−0·77	−5·31, 3·73	−0·19	−1·23, 0·84	−0·2	−3·46, 3·07	No coffee									
Decaffeinated coffee	−1·03	−2·94, 0·92	−1·31	−4·10, 1·58	−1·02	−5·56, 3·51	−0·45	−1·64, 0·83	−0·45	−3·75, 2·92	−0·56	−1·56, 1·12	Decaffeinated coffee							
Placebo	**−1·23**	**−2·45, −0·02**	−1·5	−4·47, 1·50	−1·22	−3·04, 5·52	−0·64	−1·92, 0·66	−0·64	−4·01, 2·72	−0·45	−2·05, 1·17	−0·19	−1·86, 1·41	Placebo					
Water	**−1·61**	**−2·90, −0·35**	−1·88	−5·10, 1·32	−1·60	−5·94, 2·68	−1·02	−2·78, 0·73	−1·02	−4·60, 2·53	−0·83	−2·86, 1·19	−0·57	−2·69, 1·46	−0·38	−1·99, 1·21	Water			

* The results indicate the effects of other columns in comparison to the first column. For example, the effect of green tea *v.* black tea is −0·27 kg (−3·40, 2·87). Statistically significant results are indicated in bold text.

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Table 3. Beverages relative ranking for weight loss

Food group	SUCRA values (%)
Green tea	75
Black tea	74
Sour tea	61
Coffee	57
Green coffee	52
No coffee	47
Decaffeinated coffee	37
Placebo	49
Water	19

SUCRA, surface under the cumulative ranking curves.

indicated null findings, suggesting that tea or coffee drinking was not effective for weight loss in this population. We found a larger effect of green tea on weight loss in healthy individuals; however, the results should be interpreted with caution due to the low number of trials that included healthy participants.

Previous pairwise meta-analyses addressed the potential weight loss effects of tea and coffee in different populations. The results indicated that supplementation with green tea, mainly in the form of green tea extract, reduced body weight by 0·40 kg in patients with type 2 diabetes[45], by 2·80 kg in women with polycystic ovary syndrome[46] and by 1·07 kg and 2·53 kg in adults with overweight and obesity, respectively[9]. A similar finding was seen for green coffee, where supplementation with green coffee extract reduced body weight by 1·23 kg in adults[11]. Another meta-analysis of randomised trials suggested that supplementation with caffeine may reduce body weight in adults[10].

Most of the trials included in the previous meta-analyses assessed the weight loss effects of green tea or green coffee extracts. Indeed, the potential weight loss effects of drinking different tea or coffee in a real-world setting have not been ascertained. Drinking tea and coffee is an essential part of social life. People drink coffee and tea in various ceremonies. Tea can bring the family together and provide a platform for sharing and caring. Coffee is generally consumed outside of the home and has some social and emotional roles[47].

In contrast to the main analysis, our sensitivity analysis indicated that green tea drinking was not effective for weight loss in participants with overweight and/or obesity. A previous meta-analysis of randomised trials demonstrated that supplementation with green tea extract resulted in a larger reduction in body weight in participants with obesity (MD: −2·53 kg) as compared to participants who were overweight (MD: −1·07 kg) and normal weight (MD: −0·28 kg)[9]. The inconsistent findings in our network meta-analysis may be due to the low number of trials (*n* 9) included in that sensitivity analysis of participants with overweight and obesity.

This is also the case for the sensitivity analysis of healthy individuals, where only nine trials were available. In addition, of the nine trials included in the sensitivity analysis of healthy individuals, three trials implemented a energy-restricted diet or exercise program in their intervention program. Therefore, the larger reduction in body weight due to green tea drinking that was found in healthy participants should be interpreted with caution.

Table 4. Comparative effects of different beverages on body weight in healthy individuals (Mean difference (kg) and 95 % credible interval)

	Green tea													
Treatments	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval	Mean difference (kg)	95 % credible interval
Coffee	−2·61	−4·98, 0·42	Coffee											
Green coffee	−2·61	−6·51, 1·13	−0·01	−3·05, 3·04	Green coffee									
No coffee	**−2·67**	**−5·25, −0·26**	−0·07	−1·23, 1·10	−0·06	−3·32, 3·20	No coffee							
Decaffeinated coffee	−2·31	−4·71, 0·12	−0·29	−1·86, 1·05	0·31	−3·00, 3·78	0·36	−1·12, 2·06	Decaffeinated coffee					
Placebo	−1·40	−2·88, 0·09	−1·20	−3·34, 0·70	1·22	−2·35, 4·97	1·27	−0·86, 3·63	0·91	−1·21, 3·03	Placebo			
Water	**−3·31**	**−5·83, −1·04**	−0·69	−2·93, 1·44	−0·69	−4·47, 3·01	−0·62	−3·13, 1·77	−0·99	−3·66, 1·37	1·91	−4·49, 0·39	Water	

Boldface used for the significancy of the values.

The absence of a significant effect in unhealthy individuals might be attributed to several factors. First, the metabolic and physiological differences in these populations could influence the efficacy of tea and coffee on weight loss. Individuals with metabolic conditions often have altered metabolism, insulin resistance and hormonal imbalances[48], which might reduce the impact of tea and coffee constituents on weight reduction. Additionally, the interventions' duration and dosage might not have been sufficient to elicit a significant weight loss effect in these populations. Variability in the baseline characteristics of participants, such as diet, physical activity levels and adherence to the intervention, could also contribute to the null findings. Moreover, the small number of trials and the potential presence of confounding factors further complicate the interpretation of these results.

The potential weight loss effects of green tea and coffee may be partly due to the high caffeine content in these beverages. A typical brewed green tea beverage, consisting of 2·5 g tea leaves in 250 ml of hot water, contains 20–50 mg caffeine[49,50], compared with 235 mg caffeine in 12 fluid oz. of coffee shop brewed coffee and ~ 50 mg caffeine in 250 ml of brewed black tea[1]. Caffeine can induce noradrenaline and dopamine release, thus can stimulate neuronal activity in the brain, leading to a decrease in body weight[6]. However, considering the null effects of coffee and black tea on body weight, it seems that other components found in green tea may explain the weight loss effects of green tea. Green tea polyphenols can decrease the absorption of lipids and proteins in the intestine and thus can reduce calorie intake[51]. In addition, green tea polyphenols can activate AMP-activated protein kinase in the liver, skeletal muscle, and adipose tissues and thereby can induce substrate oxidation[51].

Different types of tea, including black tea and especially green tea, contain several healthful polyphenols entitled catechins, including epicatechin, epicatechin gallate, epigallocatechin and epigallocatechin gallate[51]. Green tea is a rich dietary source of cathechins, in a way that about 30–42 % of the dry weight of brewed green tea consists of catechins, of which, epigallocatechin gallate is the principal constituent[51]. Every 250 ml of green tea beverage contains 240–320 mg of catechins, most of which (60–65 %) is epigallocatechin gallate[49,50]. The primary polyphenols in black tea are thearubigins, catechins and theaflavins[51]. The polyphenols found in tea, especially green tea, can reduce digestion and absorption of carbohydrates, lipids and proteins and can affect gut microbiota and possibly the gut–brain–liver axis[51]. Epigallocatechin gallate can activate AMP-activated protein kinase, thus can reduce fatty acid synthesis and deposition of fats in muscle and liver[51].

Although our findings suggest that drinking black tea and different types of coffee was ineffective for weight loss, several healthful components exist in these beverages. Black tea and coffee are among the richest dietary sources of various polyphenols that have antioxidant, anti-inflammatory and cardioprotective properties[52]. Epidemiologic studies suggest that drinking coffee may be associated with a lower risk of all-cause and cause-specific mortality, CVD, site-specific cancers and several metabolic and neurological disorders[4].

Strengths and limitations

The present network meta-analysis is the first work to compare and rank the comparative effects of different tea and coffee on weight loss in adults. Previous pairwise meta-analyses have mainly assessed the effects of green tea or green coffee extracts on body weight, and the potential weight loss effects of different beverages have not been ascertained. We compared and ranked the weight loss effects of these beverages and rated the certainty of evidence using the Grading of Recommendations Assessment, Development, and Evaluation approach. We compared the magnitude of the impacts with the minimal clinically important difference threshold for weight loss, indicating that green tea drinking may result in a small reduction in body weight compared with water or placebo. There are also some limitations that should be considered. First, most of the trials included in the present network meta-analysis investigated the weight loss effects of green tea and coffee. Indeed, limited data are available about green coffee, black tea and sour tea. Second, only five trials had an intervention duration longer than 12 weeks, thus the potential weight loss effects of tea and coffee drinking, especially green tea drinking, in the long term should be investigated in future research. Third, it is important to discuss the potential impact of the risk of bias on the results of this meta-analysis. Most of the trials were rated to have a high risk of bias or some concerns. These biases could potentially affect the reliability and validity of the findings. To mitigate these concerns, we conducted sensitivity analyses excluding studies with high risk of bias; however, the overall certainty of evidence remains very low to low. Future studies with more rigorous designs are needed to confirm these findings and provide more definitive conclusions regarding the weight loss effects of tea and coffee.

Conclusions

Based on very low to low certainty evidence obtained from short-term trials, green tea drinking may result in a small reduction in body weight compared with water or a placebo. These findings should be confirmed in trials with better methodological quality and longer intervention duration, especially in adults with overweight and/or obesity.

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There are no conflicts of interest.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the ethics committee of the Tehran University of Medical Sciences (Ethic code: IR.TUMS.EMRI.REC.1401.075).

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Supplementary material

For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S0007114524001867

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