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Meta-analysis review

A meta-analysis of the effects of *Zingiber officinale* on metabolic indexes among patients with type 2 diabetes

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ABSTRACT

The metabolic effects of ginger (*Zingiber officinale*) on type 2 diabetes have been increasingly assessed in clinical trials, but the results remain inconsistent. In this updated meta-analysis, the Cochrane Library, Scopus, PubMed, Web of Science, and Google Scholar were searched from the inception to November 12, 2025, to find randomized controlled trials comparing the effect of ginger and placebo on the metabolic indexes of patients with type 2 diabetes. Pooling data from 13 articles with 837 participants indicated that treatment with ginger significantly decreased fasting blood sugar (FBS) (weighted mean difference (WMD) –16.22 mg per 100 mL, 95 % confidence interval (CI) (–25.49, –6.95), I^2 = 85.67 %), hemoglobin A1c (HbA1c) (WMD –0.49 %, 95 % CI (–0.86, –0.12), I^2 = 98.14 %), triglyceride level

(WMD –17.04 mg per 100 mL, 95 % CI (–28.61, –5.47), I^2 = 71.30 %), and low-density lipoprotein cholesterol (LDL-C) (WMD –5.5 mg per 100 mL, 95 % CI (–10.98, –0.01), I^2 = 83.99%). However, the beneficial effects of ginger on body mass index (BMI), homeostasis model assessment for insulin resistance (HOMA-IR), total cholesterol, high-density lipoprotein-cholesterol (HDL-C), and systolic and diastolic blood pressure did not meet the threshold of statistical significance. Ginger was more effective at a daily dose of less than 2000 mg daily (powdered rhizome of *Zingiber officinale* administered orally) and in males, individuals younger than 54 years, and individuals with a baseline HbA1c of more than 8 %.

Keywords: ginger (*Zingiber officinale*), type 2 diabetes, body mass index, fasting blood sugar, blood pressure, triglycerides

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INTRODUCTION

Data from the global burden of diseases indicated that in 2021, 506.0 million individuals suffered from type 2 diabetes, with 23.9 million new cases, 1.6 million deaths, and 75.3 million disability-adjusted life years (DALYs) (1). Furthermore, from 1990 to 2021, both absolute and relative burdens of type 2 diabetes increased considerably (1). In addition, the incidence of type 2 diabetes is estimated to markedly increase in the next few decades (2, 3). Particularly, a steep incremental pattern has been predicted among individuals under 20 years of age (2).

A meta-analysis of 34 studies reported that nearly 51 % of patients with diabetes employ complementary and alternative medicine, particularly herbal medicines, to treat their disease, suggesting the importance of complementary medicine in patients' care and its potential benefits when administered correctly (4).

Ginger supplementation was found to improve the metabolism of rats with type 2 diabetes, mitigate mitochondrial dysfunction, and ameliorate glucose uptake, endothelial dysfunction, and lipid metabolism (5–8). Ginger possesses several metabolically active chemical constituents, such as 6-gingerol, 10-gingerol, 6-shogaol, 8-gingerol, oleoresin, and 6-hydroshogaol, which are beneficial in the management of type 2 diabetes (9). Due to the

beneficial effects of ginger on carbohydrate and lipid metabolism and blood pressure (5–8, 10), clinical trials have increasingly measured the effects of ginger on metabolic indices in patients with type 2 diabetes. However, their results remained inconsistent (11–23).

Due to significant inconsistencies among the existing clinical trials regarding the effects of ginger on BMI, glycemic index, lipid profile, and blood pressure, this updated meta-analysis was conducted to investigate the effect of ginger on the metabolic indexes of patients with type 2 diabetes. This meta-analysis included considerably more studies compared to previous meta-analyses and solely focused on ginger itself, not its combination with moxibustion or other herbal medicines. In addition, compared to most previous meta-analyses, we included the latest trials and assessed various outcomes to determine the effects of ginger on different aspects of care. Moreover, this meta-analysis conducted various subgroup analyses to more effectively identify patients with type 2 diabetes who benefit more from ginger.

SEARCH METHODS AND CRITERIA

Search strategy

PubMed, Scopus, Web of Science, and the Cochrane Library were searched from their establishment to November 12, 2025, using the following search keywords: (“Zingiber officinale” OR "ginger") [title, abstract, keywords] AND ("cholesterol" OR "triglyceride" OR "low-density lipoprotein" OR "high-density lipoprotein" OR "very low-density lipoprotein" OR "low density lipoprotein" OR "high density lipoprotein" OR "very low density lipoprotein" OR "blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR "VLDL" OR "HDL" OR "LDL" OR "FBS" OR "fasting blood sugar" OR "FPG" OR "fasting plasma glucose" OR "HbA1c" OR "hemoglobin A1c" OR "HOMAIR" OR "HOMA-IR" OR "homeostasis model assessment insulin resistance" OR "BMI" OR "body mass index")) [title, abstract, keywords].

Furthermore, we searched the first ten pages of Google Scholar using the combination of the above-mentioned keywords, in addition to evaluating the references cited in the identified trials or recent reviews. The exact search strategy can be found in Supplementary, Section 1. The retrieved studies were then transferred to EndNote 8.0, followed by the removal of

duplicate records. This study was reported in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (24), and its protocol was registered in PROSPERO (CRD420251018270).

Inclusion and exclusion criteria

Inclusion criteria were: (*i*) study design: randomized controlled trial, (*ii*) comparing the effects of ginger with placebo on the outcomes, including FBS, HbA1c, HOMA-IR, diastolic blood pressure, systolic blood pressure, triglyceride, HDL-C, LDL-C, very low-density lipoprotein cholesterol (VLDL-C), total cholesterol and BMI, and (*iii*) all participants with type 2 diabetes.

Exclusion criteria were: (*i*) case series, case reports, observational studies, and review articles since these studies do not provide original, unbiased, placebo-controlled data, (*ii*) absence of a placebo group, (*iii*) none of the target outcomes were reported, (*iv*) non-English studies, and (*v*) when ginger was administered in combination with other medications

Data extraction and outcome measures

Two authors performed the search and evaluated the eligibility of the retrieved studies. All discrepancies were resolved through discussion. By screening the titles and abstracts, the authors primarily measured the relevance of the identified records and evaluated their compliance with the above-mentioned inclusion and exclusion criteria. Next, the full-text version of the remaining articles was assessed to check their eligibility for inclusion.

The following data were collected: study characteristics (trial registry, the first author's name, country of study, and publication year), population (sample size, age, sex, baseline HbA1c and baseline BMI), interventions (dose of ginger, type of placebo, length of treatment), and the outcomes (FBS, HbA1c, HOMA-IR, diastolic blood pressure, systolic blood pressure, triglyceride, HDL-C, LDL-C, VLDL-C, total cholesterol and BMI).

Risk of bias assessment

Two researchers individually measured the risk of bias for the identified trials, and all differences were solved *via* consultation. The revised Cochrane risk-of-bias tool for randomized trials (RoB2) was employed to investigate the risk of bias according to the randomization process, selection of the reported results, deviations from intended interventions,

missing outcome data and outcome measurement, and provides an overall risk of bias for studies, with each domain receiving one of the following ranks: low risk of bias, some concerns, and high risk of bias (25).

Data analysis

For all outcomes of interest, changes in mean standard deviation (SD) were extracted from the included studies. Due to significant methodological heterogeneity, a random-effects model (restricted maximum–likelihood) was adopted to pool data and calculate weighted mean difference (WMD) and 95 % confidence interval (CI). This meta-analysis was performed employing Stata version 14.0 (StataCorp, TX, USA). We employed the chi-square test and I^2 statistics to assess heterogeneity between trials, and I^2 more than 50 % was considered high statistical heterogeneity.

Subgroup analysis. – We performed subgroup analysis based on baseline characteristics, such as ginger dose, length of treatment, male percentage, age, country of study, baseline BMI, baseline HbA1c, sample size, and overall risk of bias, to identify the factors associated with the effects of ginger on HbA1c among different subgroups of individuals with type 2 diabetes and detect the source of heterogeneity.

Sensitivity analysis. – Employing the leave-one-out test, sensitivity analysis was done for HbA1c to measure the robustness of the findings.

The risk of publication bias and small study effects was evaluated for HbA1c using funnel plot and Egger's and Begg's tests.

RESULTS AND DISCUSSION

Of 2156 records identified initially, 231 records were deleted due to duplication, and 1837 records were removed after screening the titles and abstracts. After full-text screening of the remaining records, 13 articles with 837 participants were included in the present meta-analysis (11–23) (Fig. 1). Carvalho *et al*. (14) included more than 100 participants, but all other studies included fewer than 100 participants (11–13, 15–23). Treatment length varied from 8 to 12 weeks among the included randomized controlled trials, and ginger dose varied from 1200 mg per day to 3000 mg per day across studies. All studies administered ginger orally. The ginger

source was the powdered rhizome of *Zingiber officinale* in all studies, except for the study conducted by Elsaadany *et al*. (12), which used powdered *Zingiber officinale* root. The mean age of participants ranged from nearly 46 to 59 years, their mean baseline BMI ranged from 26.9 to 32.3 kg m^{-2}, and their mean baseline HbA1c ranged from 6.95 to 8.93 (Tables I and II).

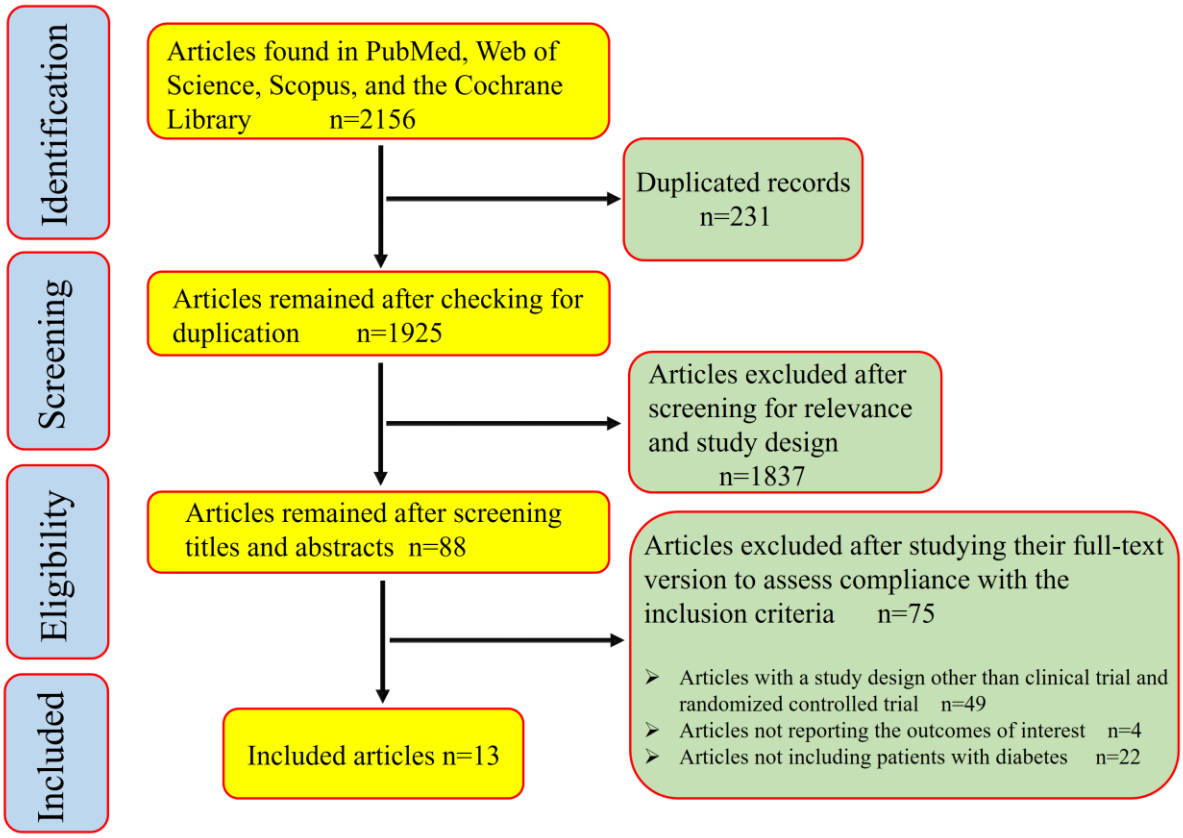

Fig. 1. Systematic search flowchart.

Table I. Study characteristics, including setting, and baseline characteristics of participants

Age (year, mean)	Gender	Baseline BMI (kg m^{-2})	Baseline HbA1c	Length of treatment (weeks)	Number of participants in the ginger group	Number of participants in the placebo group	Ref.
50.44	Both	28.3	Not reported	8	40	41	20
50.44	Both	28.3	Not reported	8	40	41	21
52.3	Both	26.9	8.3	12	33	30	11
54.4	Both	28.72	Not reported	8	41	39	15
50.7	Both	29.5	7.4	10	23	22	23

58.64	Both	Not reported	8.4	12	47	56	14
52.8	Both	30.8	8.93	8	11	11	12
54.4	Both	28.72	Not reported	8	41	39	13
46.2	Both	32.3	8.04	8	40	40	16
59.84	Both	27.44	Not reported	8	20	21	22
46.15	Both	Not reported	7.34	12	22	19	19
54.01	Both	31.1	6.95	12	36	36	17
51.1	Both	29.5	6.95	8	28	30	18

155 BMI – body mass index, HbA1c – hemoglobin A1c

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Table II. Study characteristics, including interventions and outcomes

Ginger (*Zingiber officinale*) source	Ginger dose	Route of administering ginger	Ginger formulation for dosing	Significant effects	Participants number (sample size)	Type of placebo	Ref.
Powdered rhizome of *Zingiber officinale*	3000 mg/day	Oral route	Ginger capsules	Serum LDL-C was decreased significantly in the ginger group, with no significant difference between the two groups.	81	Cellulose microcrystalline capsules	20
Powdered rhizome of *Zingiber officinale*	3000 mg/day	Oral route	Ginger capsules	FBS, HbA1c, and HOMA-IR were significantly decreased in the ginger group compared to the placebo group.	81	Cellulose microcrystalline capsules	21
Powdered rhizome of ginger	1600 mg/day	Oral route	Ginger capsules	Ginger significantly reduced FBS, HbA1c, HOMA-IR, triglycerides, and total cholesterol compared with the placebo group.	63	Wheat flour capsules	11
Powdered rhizome of *Zingiber officinale*	3000 mg/day	Oral route	Ginger powder	Ginger significantly decreased total cholesterol and LDL-C and increased HDL-C levels compared with the control group. Ginger did not significantly change measures of glycemic control and anthropometry.	80	Black tea	15
Powdered rhizome of *Zingiber officinale*	2000 mg/day	Oral route	Ginger capsules	Compared to placebo, ginger significantly reduced FBS and HbA1c, but not triglycerides, total cholesterol, LDL-C, and HDL-C.	45	Wheat flour capsules	23
Powdered rhizome of *Zingiber officinale*	1200 mg/day	Oral route	Ginger capsules	The ginger group showed a greater reduction in FBS and total cholesterol compared to the control group.	103	Microcrystalline cellulose capsules	14

Powdered *Zingiber officinale* root	3000 mg/day	Oral route	Ginger capsules	Compared to placebo, ginger significantly reduced FBS.	22	Cellulose powder capsules	12
Powdered rhizome of *Zingiber officinale*	3000 mg/day	Oral route	Ginger powder	No significant differences were observed between the two groups in terms of blood pressure.	80	Black tea	13
Powdered rhizome of *Zingiber officinale*	1800 mg/day	Oral route	Ginger capsules	Ginger powder supplementation significantly reduced BMI, FBS, HbA1c, total cholesterol, LDL-C, triglycerides, and HOMA-IR.	80	Wheat flour capsules	16
Powdered rhizome of *Zingiber officinale*	2000 mg/day	Oral route	Ginger capsules	The serum levels of triglycerides, but not total cholesterol, LDL-C, HDL-C, decreased significantly in the ginger group compared to the placebo group.	41	Starch capsules	22
Powdered rhizome of *Zingiber officinale*	2000 mg/day	Oral route	Ginger capsules	Ginger significantly decreased the serum levels of FBS and HbA1c compared to placebo.	41	Lactose capsules	19
Powdered rhizome of *Zingiber officinale*	2000 mg/day	Oral route	Ginger capsules	Ginger significantly decreased systolic and diastolic blood pressure compared to placebo.	72	Starch capsules	17
Powdered rhizome of *Zingiber officinale*	2000 mg/day	Oral route	Ginger tablet	Ginger significantly decreased the serum levels of LDL-C and triglycerides, but not FBS, total cholesterol, HDL-C, and HbA1c, compared to placebo.	58	Corn starch tablet	18

BMI – body mass index; FBS – fasting blood sugar; HbA1c – hemoglobin A1c; HDL-C – high-density lipoprotein cholesterol; HOMA-IR – homeostatic model assessment for insulin resistance; LDL-C – low-density lipoprotein cholesterol

Risk of bias assessment

The included studies meticulously followed the principles of randomization, blinding, outcome assessment and reporting, and the risk of bias was generally low among the included studies. Only the studies reported by El Gayar *et al*. (16) and Azimi *et al*. (13, 15) showed a high risk of bias due to their single-blinded nature (Supplementary, Section 2).

Meta-analysis

Pooling the data from 8 randomized controlled trials (11, 13, 16–18, 20, 22, 23), the random-effects model indicated that although ginger decreased BMI among people with type 2 diabetes (WMD –0.25 kg m^{-2}, 95 % CI (–0.51, 0.01), I^2 = 81.18 %), the effect did not meet the threshold of statistical significance (Fig. 2). Heterogeneity remained high, which could originate from differences in patient characteristics, study design, *etc*. Due to this high heterogeneity, we adopted a random-effects model for analysis.

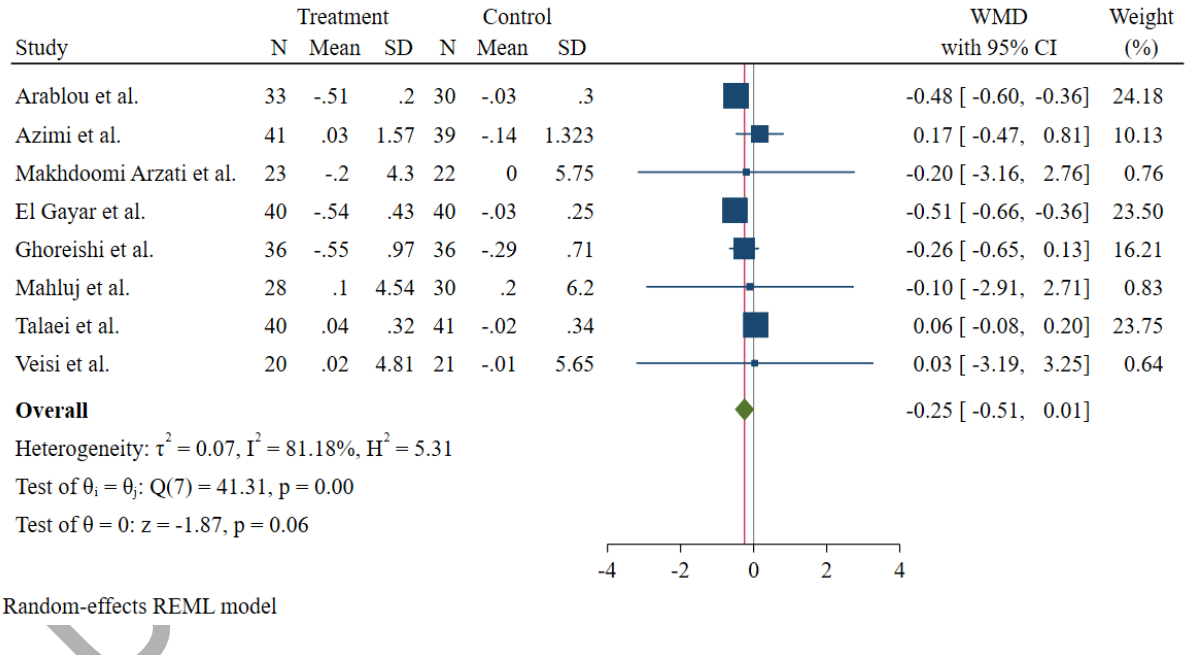


Fig. 2. Comparison of the effect of ginger and placebo on BMI.

Pooling the data from 10 randomized controlled trials (11, 12, 14–19, 21, 23), the random-effects model revealed that treatment with ginger significantly decreased FBS (WMD –16.22 mg per 100 mL, 95 % CI (–25.49, –6.95), I^2 = 85.67 %) (Fig. 3) and HbA1c (WMD –0.49 %, 95 % CI (–0.86, –0.12), I^2 = 98.14 %) (Fig. 4). However, data from 6 randomized controlled

trials (11, 14, 16–18, 21) did not show a significant decrease in HOMA-IR compared to placebo (WMD –0.36, 95 % CI (–0.75, 0.02), I^2 = 72.96 %) (Fig. 5). For all these glycemic indices, a high level of heterogeneity was observed among the included studies; thus, the results should be interpreted cautiously. In addition to adopting a random-effects model, we conducted subgroup analyses for HbA1c to identify the potential sources of heterogeneity.

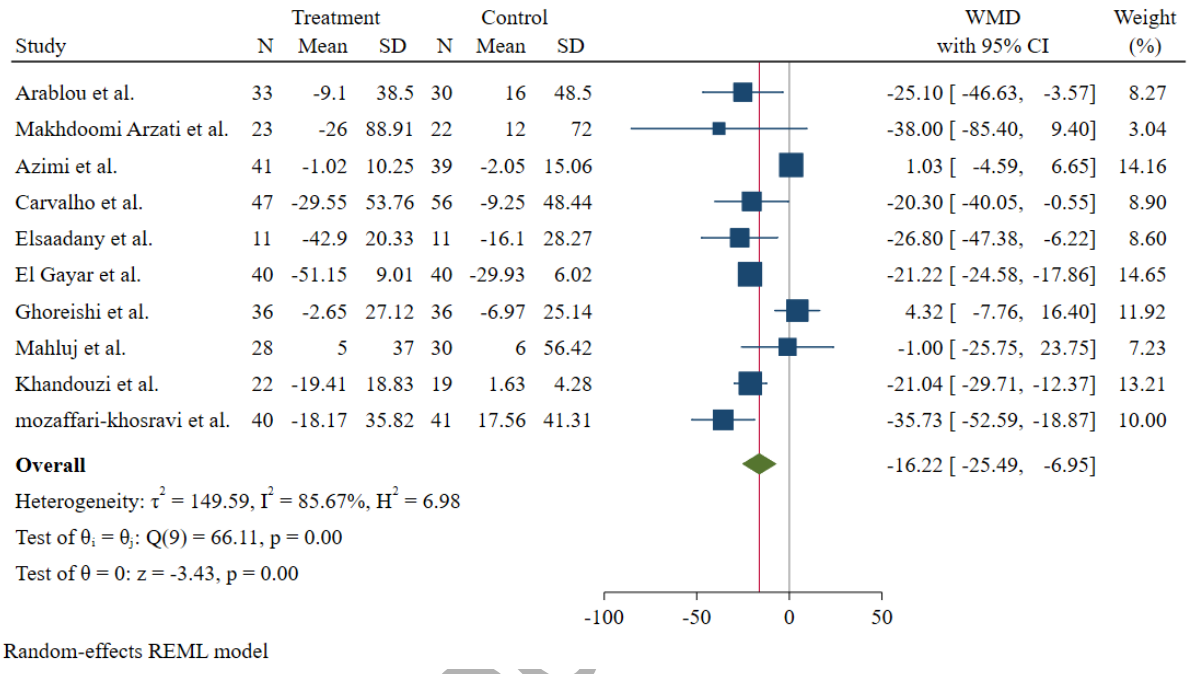


Fig. 3. Comparison of the effect of ginger and placebo on FBS.

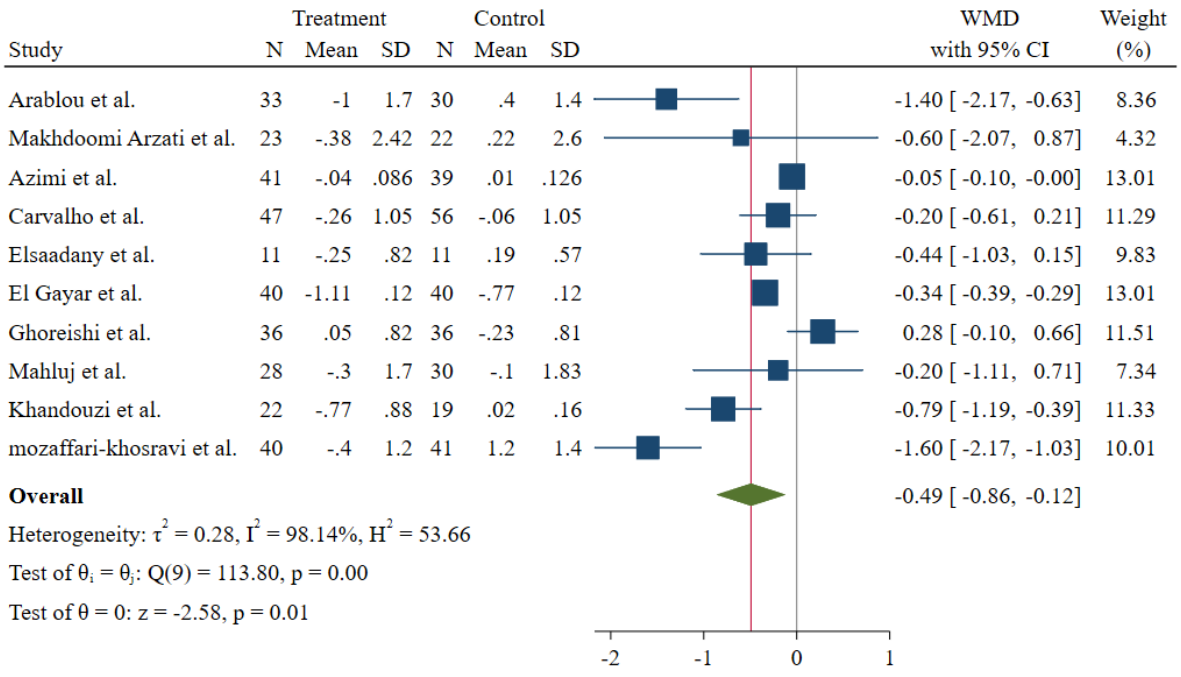


Fig. 4. Comparison of the effect of ginger and placebo on HbA1c.

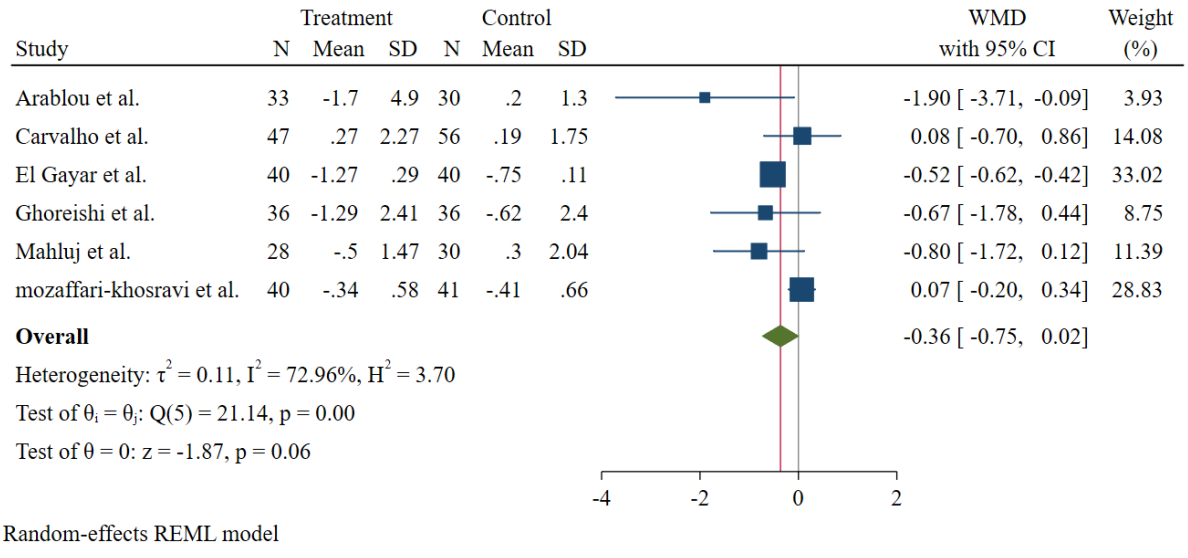
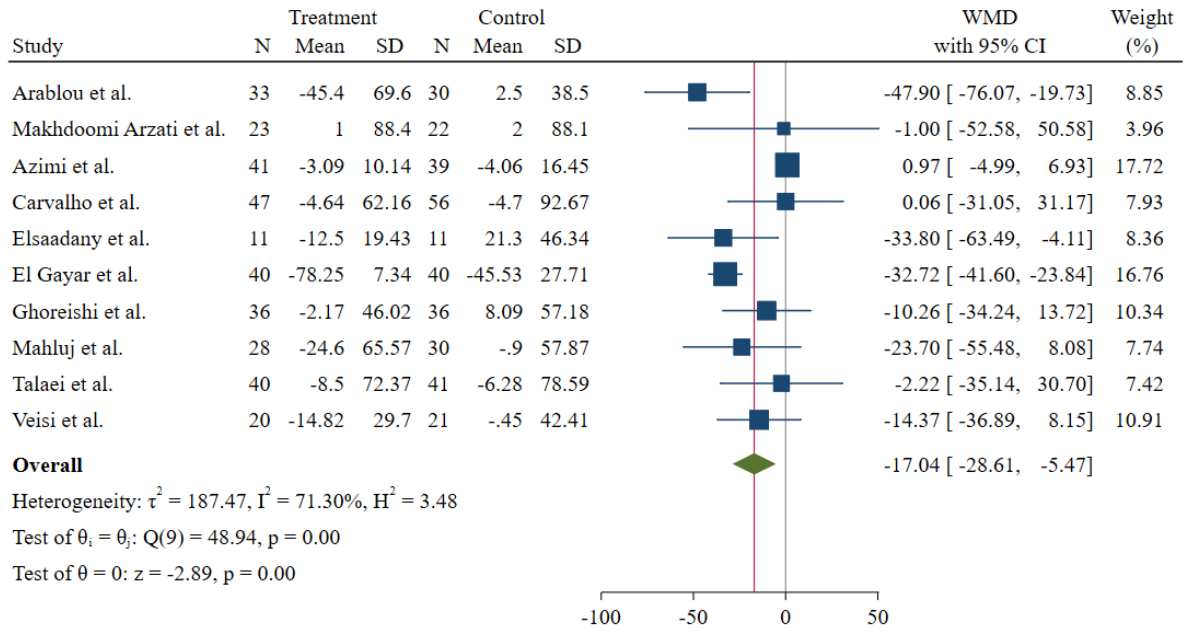


Fig. 5. Comparison of the effect of ginger and placebo on HOMAIR.

From the pooled data of 10 studies (11, 12, 14–18, 20, 22, 23), the random-effects model indicated that compared to treatment with placebo, treatment with ginger significantly

198 decreased triglyceride level (WMD –17.04 mg per 100 mL, 95 % CI (–28.61, –5.47), I^2 =
199 71.30 %) (Fig. 6) and LDL-C (WMD –5.5 mg per 100 mL, 95 % CI (–10.98, –0.01), I^2 =
200 83.99 %) (Fig. 7), but did not significantly change HDL-C (WMD 2.75 mg per 100 mL, 95 %
201 CI (–0.54, 6.04), I^2 = 97.28 %) (Fig. 8) and total cholesterol levels (WMD –4.90 mg per 100
202 mL, 95 % CI (–12.70, 2.89), I^2 = 84.49 %) (Fig. 9). For all components of the lipid profile, a
203 high level of heterogeneity was observed among the included studies; therefore, further
204 analyses were conducted to address the high heterogeneity.



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206 Fig. 6. Comparison of the effect of ginger and placebo on triglyceride.

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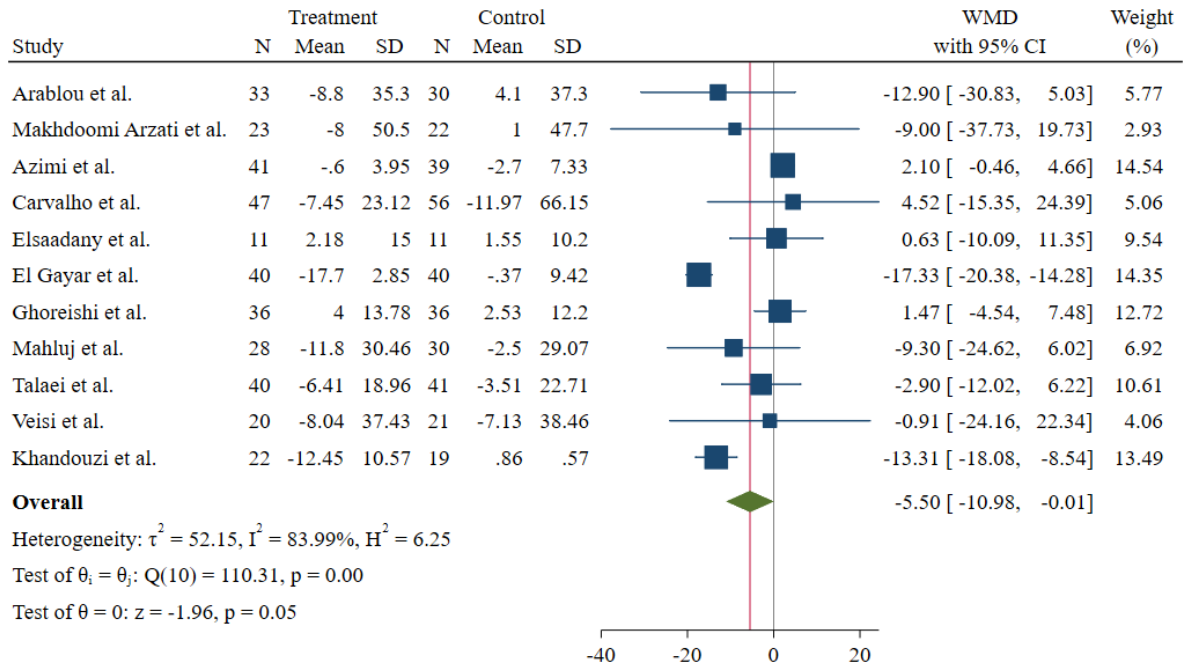

Fig. 7. Comparison of the effect of ginger and placebo on LDL-C.

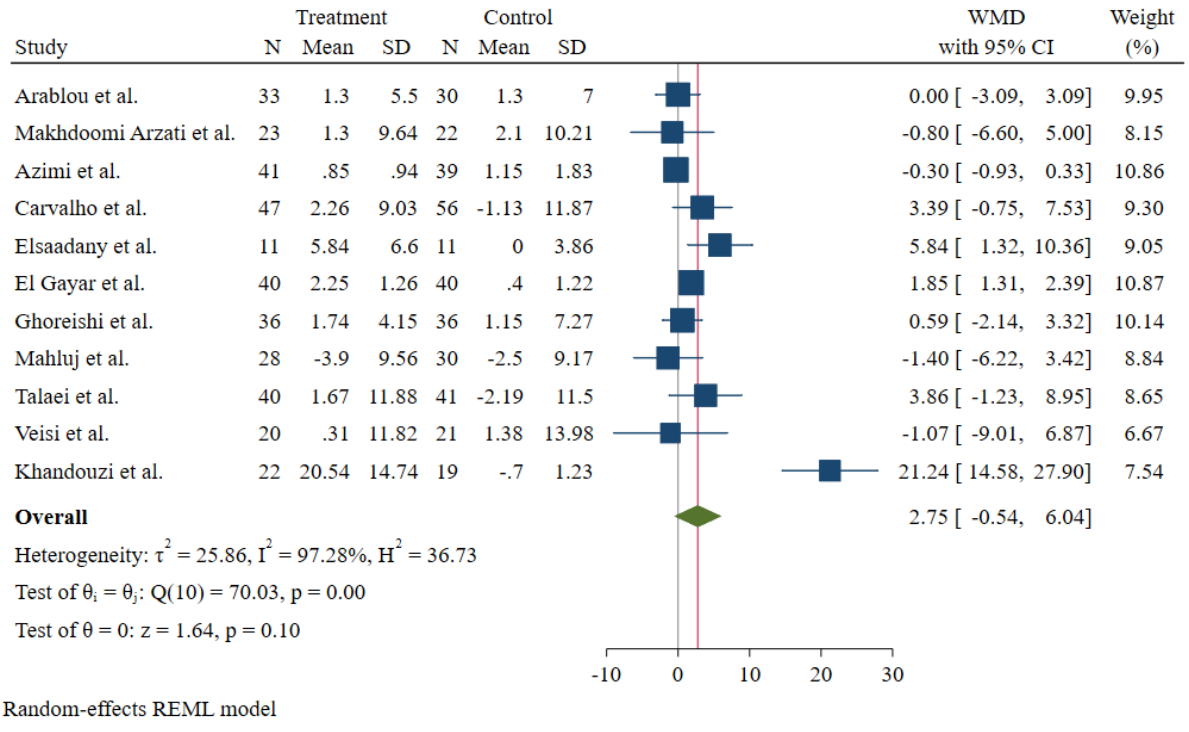

Fig. 8. Comparison of the effect of ginger and placebo on HDL-C.

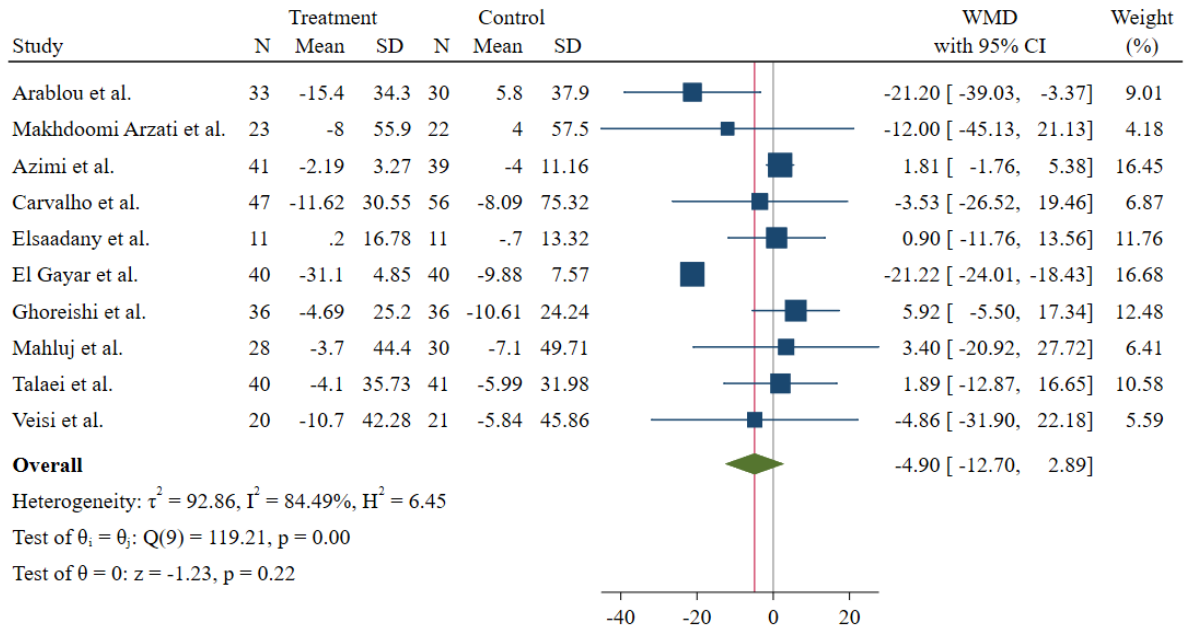

Fig. 9. Comparison of the effect of ginger and placebo on total cholesterol.

From the pooled data of 4 studies (13, 14, 17, 23), this meta-analysis indicated that although treatment with ginger decreased both systolic (WMD –2.27 mm Hg, 95 % CI (–4.95, 0.41), I^2 = 28.51 %) (Fig. 10) and diastolic blood pressure (WMD –2.43 mm Hg, 95 % CI (–5.30, 0.45), I^2 = 73.50 %) (Fig. 11), the confidence interval was wide and the effect did not meet the threshold of statistical significance, possibly because of the small number of included studies. Furthermore, high heterogeneity was observed for diastolic blood pressure, suggesting a considerable between-study variability.

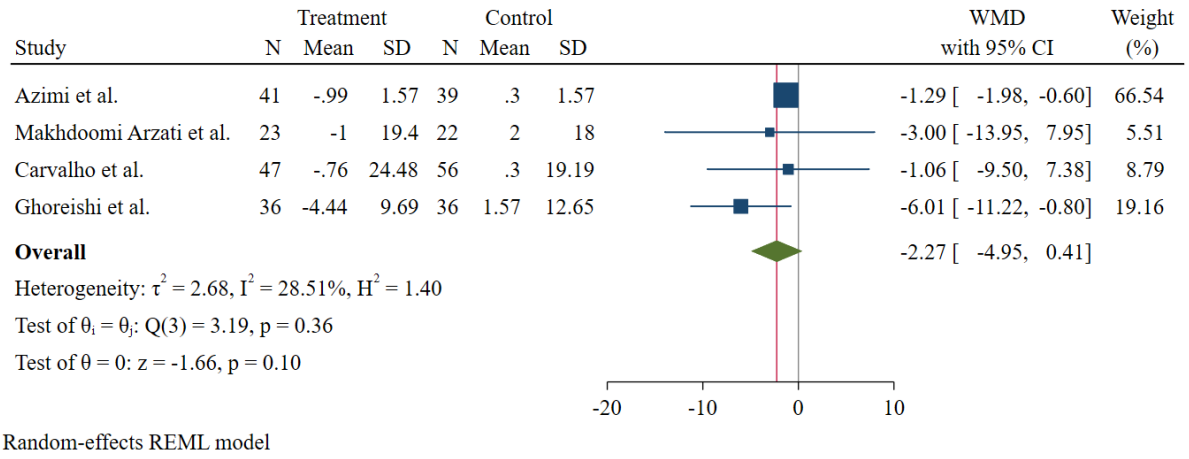

Fig. 10. Comparison of the effect of ginger and placebo on systolic blood pressure.

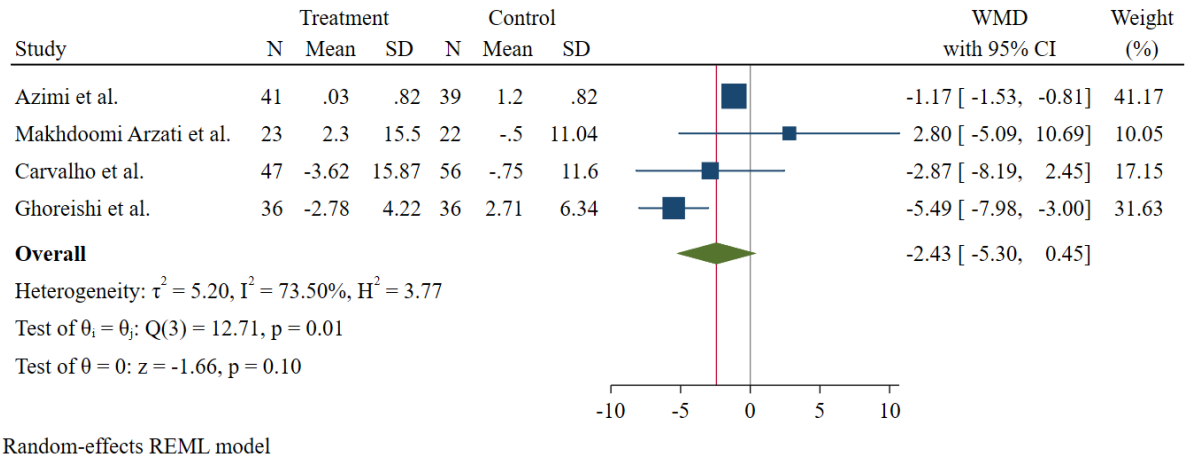

Fig. 11. Comparison of the effect of ginger and placebo on diastolic blood pressure.

Consistent with our findings, a recent meta-analysis of 10 studies by Ebrahimzadeh *et al.* (26) indicated that treatment with ginger can significantly lower FBS and HbA1c among subjects with type 2 diabetes. However, unlike our study, they reported that ginger can significantly decrease systolic and diastolic blood pressure, but does not affect lipid profile in individuals with type 2 diabetes. They also reported that ginger can lower HbA1c only in patients aged less than 50 years (26). We found that ginger significantly lowered HbA1c in all subgroups of age, but it was more effective among those younger than 54 years. Consistent with our findings, a meta-analysis of 24 studies on the general population reported that

238 treatment with ginger can significantly improve dyslipidemia and suppress inflammation,
239 which can reduce the risk of cardiovascular diseases in the long term (27).

240 *(S)*-[6]-gingerol in ginger was shown to upregulate AMP-activated protein kinase
241 (AMPK) phosphorylation and peroxisome proliferator-activated receptor-gamma co-activator
242 (PGC-1α) expression in rat skeletal muscle cells, thereby enhancing mitochondrial biogenesis
243 and ameliorating insulin resistance (28). Since ginger can mitigate mitochondrial dysfunction,
244 a main feature of metabolic syndrome, diabetes and dyslipidemia, it is believed to markedly
245 improve different components of metabolic impairment in patients (29). Besides, it was found
246 that gingerols in ginger can improve the expression of insulin-regulated glucose transporter 4
247 (GLUT4) in myotubes, thereby promoting glucose uptake (30). Several mechanisms have also
248 been implicated in the body mass-lowering property of ginger, including enhanced
249 thermogenesis, increased lipolysis, decreased lipogenesis and suppression of appetite (31).

250 Since hyperglycemia, high blood pressure, dyslipidemia and obesity are all risk factors
251 for atherosclerotic cardiovascular diseases and ginger could significantly improve
252 hyperglycemia and dyslipidemia and lead to a non-significant decrease in BMI and blood
253 pressure, the long-term use of ginger is expected to benefit those with type 2 diabetes and
254 atherosclerotic cardiovascular diseases (32, 33).

255 Unfortunately, due to the lack or scarcity of data from clinical trials, we could not assess
256 the effects of ginger on some microvascular and macrovascular complications of diabetes, such
257 as myocardial infarction, diabetic nephropathy and diabetic retinopathy. Experimental studies
258 in this regard have shown that ginger represents a promising complementary medicine in the
259 treatment and prevention of these complications of diabetes (34). For instance, in the study
260 conducted by Dongare *et al*. (34), treatment with ginger extract for 24 weeks (75 mg per kg per
261 day) reduced blood sugar levels and decreased the diameter of the retinal vessels and vascular
262 basement membrane thickness. These changes were associated with a marked anti-
263 inflammatory response and suppression of angiogenesis. Similarly, a systematic review of
264 animal studies indicated that ginger can suppress inflammation, oxidative stress, and apoptosis,
265 decrease creatinine levels, and protect against kidney injury in diabetic kidney disease (35, 36).
266 Furthermore, ginger was previously shown to mitigate endothelial inflammation, prevent
267 cardiac remodeling, and ameliorate myocardial infarction (13, 37, 38). Interestingly, ginger was
268 also found to ameliorate painful diabetic neuropathy in the mouse model, potentially by

regulating the expression of ion channels involved in nociception, such as transient receptor potential cation channel subfamily V member 1 (TRPV1) (39). Collectively, these findings suggest that ginger acts through a network of molecular mechanisms, targeting diabetes and its complications from multiple points.

Subgroup analysis

The subgroup analyses for the effect of ginger on HbA1c showed the more effective lowering of HbA1c in studies with a sample size of less than 50 and in studies with a low risk of bias. Besides, ginger more effectively lowered HbA1c in male participants, individuals younger than 54 years, and individuals with a baseline HbA1c higher than 8 % (Supplementary, Section 3). Moreover, ginger dose less than 2000 mg per day was shown more effective than a dose of > 2000 mg per day, considering that ginger was used orally (as capsules, tablets, or solution) in all studies. Except for one clinical trial that used powered *Zingiber officinale* root (12), all other trials administered powdered rhizome of *Zingiber officinale*. In addition, the length of treatment (more than 10 weeks and less than 10 weeks) did not affect the efficacy of ginger. Therefore, future randomized controlled trials are encouraged to investigate the effects of ginger on specific subgroups of patients who are more likely to benefit from treatment. Although it should be considered that each subgroup analysis can analyze the effect of only one variable, a multivariable meta-regression analysis of a large number of articles is needed to account for the effects of confounding factors.

Sensitivity analysis

The leave-one-out test indicated that removing individual studies could not affect the overall effect of ginger on HbA1c, and the results remained stable (CI: –0.97, –0.04) (Supplementary, Section 4).

Publication bias

Since the funnel plot for the effect of ginger on HbA1c showed degrees of asymmetry, we conducted Begg's test and Egger's test to assess the small-study effect. Begg's test and Egger's test both revealed no significant risk of publication bias ($p = 0.858$ and $p = 0.253$, resp.) (Supplementary, Section 5).

This updated meta-analysis included more studies (13 clinical trials) compared to previous meta-analyses. For instance, recent meta-analyses on the same topic conducted by

Ebrahimzadeh *et al*. (26) and Schumacher *et al*. (40) included only 10 and 5 clinical trials, resp. Schumacher *et al*. (40) reported that ginger did not significantly affect FBS or HbA1c, while Ebrahimzadeh *et al*. (26) reported that ginger can lower FBS or HbA1c but does not significantly affect lipid profile. However, we found that ginger not only lowers FBS or HbA1c levels but also decreases triglyceride and LDL-C levels. Besides, our findings regarding the effects of ginger on blood pressure did not confirm the results of Ebrahimzadeh *et al*. (26). These discrepancies illuminate the need for an updated meta-analysis. Furthermore, this meta-analysis reported BMI and HOMA-IR, which were not measured in these previous meta-analyses. In addition, the current study conducted subgroup analyses based on several characteristics, which were not addressed in the previous meta-analyses (40, 41).

Limitations

There are some limitations of our study. First, we detected degrees of methodological difference across studies, which could increase the risk of methodological heterogeneity. Secondly, previous clinical trials had a small sample size, and most studies were from a single country, which may limit the generalizability of our findings. Multi-center randomized clinical trials are necessary to validate the findings of this meta-analysis. Third, a significant statistical heterogeneity was observed for most outcomes. However, we employed a random-effects model and conducted subgroup analyses to identify the variables causing heterogeneity. Our findings identified ginger dose, gender, age, and baseline HbA1c as potential sources of heterogeneity in this study.

CONCLUSIONS

This meta-analysis indicated that ginger can significantly improve the glycemic index and lipid profile of patients with type 2 diabetes. Since type 2 diabetes is a complex disease and its management must concomitantly address different aspects, such as hyperglycemia, hypertension, dyslipidemia, and body mass control, ginger, with its beneficial effects on different metabolic aspects, can safely help many patients with type 2 diabetes as a complementary medicine.

Acronyms, abbreviations, symbols. – AMPK – AMP-activated protein kinase, BMI – body mass index, CI – confidence interval, DALYs – disability-adjusted life years, FBS – fasting blood sugar,

GLUT4 – glucose transporter 4, HbA1c – hemoglobin A1c, HDL-C – high-density lipoprotein-cholesterol, HOMA-IR – homeostasis model assessment for insulin resistance, LDC-C – low-density lipoprotein cholesterol, PGC-1α – peroxisome proliferator-activated receptor-gamma coactivator, PRISMA – Preferred Reporting Items for Systematic Reviews and Meta-Analyses, SD – standard deviation, TRPV1 – transient receptor potential cation channel subfamily V member 1, VLDL-C – very low-density lipoprotein cholesterol, WMD – weighted mean difference.

Supplementary Material is available by the corresponding author on a reasonable request.

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