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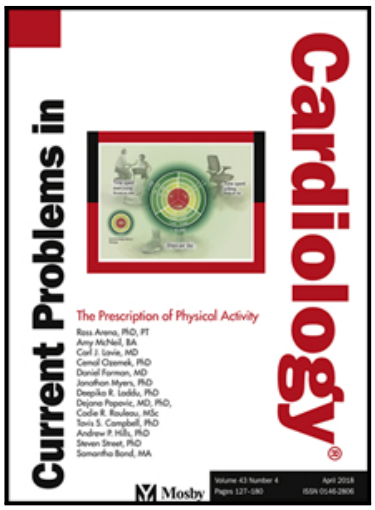

Effectiveness of the DASH Diet Versus Alternative Dietary Interventions for Hypertension Management: A Systematic Review and Meta-analysis

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PII: S0146-2806(26)00139-8
DOI: https://doi.org/10.1016/j.cpcardiol.2026.103397
Reference: YMCD 103397

To appear in: *Current Problems in Cardiology*

Please cite this article as: Juan José Valenzuela-Fuenzalida , Martin Trujillo-Riveros , Javiera Schwember Vega , Constanza Avalos- Diaz , Antonia Droguett , Josepha Hernández- Nilo , Mathias Orellana-Donoso , Alejandro Bruna-Mejias , Gloria Cifuentes-Suazo , Maria P Moya , Maria Piagkou , Vitor E Valenti , Juan Sanchis-Gimeno , Marko Konschake , Jessica Paola Loaiza-Giraldo , Effectiveness of the DASH Diet Versus Alternative Dietary Interventions for Hypertension Management: A Systematic Review and Meta-analysis, *Current Problems in Cardiology* (2026), doi: https://doi.org/10.1016/j.cpcardiol.2026.103397

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Effectiveness of the DASH Diet Versus Alternative Dietary Interventions for Hypertension Management: A Systematic Review and Meta-analysis

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Abstract

Background:

The Dietary Approaches to Stop Hypertension (DASH) diet is widely recommended for blood pressure control; however, its comparative effectiveness relative to other structured dietary interventions remains uncertain.

Objective:

To evaluate the comparative effectiveness of the DASH diet versus alternative dietary interventions on blood pressure and cardiometabolic outcomes in adults.

Methods:

A systematic review and meta-analysis of randomized controlled trials was conducted in accordance with PRISMA guidelines. Multiple databases were searched from inception to February 2026. Eligible studies included adults with elevated blood pressure or hypertension comparing the DASH diet with other dietary interventions or usual care. Continuous outcomes were pooled using random-effects models and expressed as mean differences (MD) or standardized mean differences (SMD). Risk of bias was assessed using the Cochrane RoB 2 tool, and certainty of evidence was evaluated using the GRADE approach.

Results:

A total of 22 randomized controlled trials were included in the qualitative synthesis, of which 10 were included in the meta-analysis. The DASH diet did not demonstrate a statistically significant advantage over comparator diets in reducing systolic blood pressure (MD = 1.30; 95% CI: −1.54 to 4.14) or diastolic blood pressure (MD = 0.21; 95% CI: −3.72 to 4.14), with substantial heterogeneity observed across studies. Significant effects were identified for selected cardiometabolic outcomes, including reductions in urinary sodium excretion (MD = −32.89; 95% CI: −62.76 to −3.01), LDL cholesterol (MD = −8.59; 95% CI: −14.64 to −2.54), and glycated hemoglobin (HbA1c) (MD = −0.49; 95% CI: −0.52 to −0.46), as well as an increase in urinary potassium excretion (MD = 11.76; 95% CI: 4.08 to 19.44). The certainty of evidence ranged from moderate to very low across outcomes.

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Conclusions:

The DASH diet was not superior to other dietary interventions in reducing blood pressure; however, it demonstrated consistent benefits in selected cardiometabolic parameters. Given the overall low certainty of evidence and substantial heterogeneity, these findings should be interpreted cautiously. Future research should focus on well-designed trials with standardized outcomes and longer follow-up to clarify comparative effectiveness.

Keywords:

DASH diet; hypertension; blood pressure; meta-analysis; cardiometabolic outcomes; randomized controlled trials.

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1. Introduction

Hypertension is a chronic condition characterized by persistently elevated blood pressure, defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg according to the World Health Organization [1]. It represents a leading contributor to premature morbidity and mortality worldwide, with an estimated 1.28–1.4 billion affected adults, and a disproportionate burden in low- and middle-income countries [1]. Global prevalence varies significantly across regions,

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reflecting disparities in socioeconomic status, healthcare access, and lifestyle-related risk factors [1,2].

The development and progression of hypertension are multifactorial, involving both non-modifiable and modifiable determinants. Established risk factors include aging, genetic predisposition, obesity, sedentary behavior, excessive sodium intake, alcohol consumption, and tobacco use [2]. From a pathophysiological perspective, hypertension is driven by complex interactions between neurohormonal and renal mechanisms. Central pathways include activation of the renin–angiotensin–aldosterone system, increased sympathetic nervous system activity, endothelial dysfunction, and impaired renal sodium handling, all of which contribute to increased peripheral vascular resistance and intravascular volume expansion [2,3].

Alterations in sodium homeostasis play a critical role in blood pressure regulation. Impaired natriuresis leads to sodium retention, increased extracellular fluid volume, and sustained elevations in blood pressure. This phenomenon may result from intrinsic renal tubular dysfunction or, more commonly, from chronic excessive dietary sodium intake [3]. Consequently, dietary interventions targeting sodium reduction have become a cornerstone in non-pharmacological management strategies for hypertension.

The Dietary Approaches to Stop Hypertension (DASH) diet is one of the most widely recommended dietary patterns for blood pressure control. It emphasizes high intake of fruits, vegetables, whole grains, and low-fat dairy products, along with reduced sodium consumption (approximately 2,300 mg/day or lower) [4]. Clinical and epidemiological evidence suggests that the DASH diet is associated with significant

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reductions in blood pressure and may confer additional cardiometabolic benefits, including improvements in lipid profile and glycemic control [4–6]. These effects extend beyond hypertensive populations and have been observed in individuals with metabolic syndrome, obesity, and type 2 diabetes [5,6]. Despite robust evidence supporting the DASH diet, uncertainty remains regarding its comparative effectiveness relative to other dietary interventions commonly used in hypertension management, such as low-carbohydrate, Mediterranean, or low-fat diets. Previous studies have primarily focused on the absolute effects of DASH rather than direct comparisons across dietary strategies, and heterogeneity in study design, populations, and outcome reporting further limits the interpretability of existing evidence. Therefore, we conducted a systematic review and meta-regression analysis to evaluate the comparative effectiveness of the DASH diet versus alternative dietary interventions on blood pressure and related cardiometabolic outcomes. This study aims to provide a more precise and clinically relevant synthesis of available evidence, addressing heterogeneity across studies and identifying potential moderators of treatment effect.

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2. Methods

2.1. Protocol and Registration

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This systematic review and meta-analysis were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [6]. The study protocol was prospectively registered in the International Prospective Register of Systematic Reviews under the registration number CRD420261385500. Any deviations from the original protocol were documented and justified in the final report.

2.2. Literature Search

A comprehensive and systematic literature search was conducted across multiple electronic databases, including MEDLINE (via PubMed), EMBASE, SCOPUS, Web of Science, and the Cochrane Central Register of Controlled Trials (CENTRAL), from database inception through February 2026. We included randomized controlled trials (RCTs) evaluating the effects of the Dietary Approaches to Stop Hypertension (DASH) diet compared with other dietary interventions or usual care in adults. No restrictions were applied regarding sample size or duration of follow-up. Studies published in English or Spanish were considered eligible. The search strategy combined controlled vocabulary (e.g., MeSH and Emtree terms) and free-text terms related to the intervention and condition of interest, including “DASH diet,” “dietary approaches to stop hypertension,” “hypertension,” “blood pressure,” “diet,” and “randomized controlled trial.” Boolean operators (“AND,” “OR”) were applied as appropriate to optimize sensitivity and specificity. Two reviewers independently screened the titles and abstracts of all retrieved records to identify potentially eligible studies. Full-text articles were assessed for inclusion if deemed relevant by either reviewer.

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Discrepancies were resolved through discussion and consensus; when disagreement persisted, a third reviewer adjudicated the decision.

2.3. Study Selection

The following inclusion criteria were applied: studies enrolling adult participants (≥18 years) with elevated blood pressure or diagnosed hypertension; interventions consisting of the Dietary Approaches to Stop Hypertension (DASH) diet; and reporting at least one relevant outcome related to blood pressure or cardiometabolic parameters, including systolic blood pressure (SBP), diastolic blood pressure (DBP), body weight, body mass index (BMI), lipid profile, glycemic markers (e.g., HbA1c), or urinary electrolyte excretion (sodium, potassium, or calcium). Eligible study designs included randomized controlled trials (RCTs) comparing the DASH diet with alternative dietary interventions, usual care, or no intervention. No restrictions were applied regarding intervention duration or follow-up length. Studies were excluded if they met any of the following criteria: non-randomized designs; observational studies; case reports or case series; narrative or systematic reviews; conference abstracts without sufficient data; non-human or in vitro studies; studies conducted in pediatric populations; or studies lacking an appropriate comparator group. Additionally, studies in which the intervention could not be clearly attributed to a DASH dietary pattern were excluded.

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2.4. Data Extraction and Risk of Bias Assessment

Two reviewers independently extracted data from all eligible studies using a standardized and pilot-tested data extraction form. Extracted information included: first author and year of publication; study design; sample size; participant characteristics; details of the intervention and comparator (including dietary composition and duration); outcomes of interest (including systolic and diastolic blood pressure, anthropometric measures, lipid profile, glycemic parameters, and urinary electrolytes); and effect estimates with corresponding measures of variability. The risk of bias of the included randomized controlled trials was independently assessed by the same reviewers using the Cochrane Risk of Bias 2 (RoB 2) tool [8]. This tool evaluates bias across five domains: (1) bias arising from the randomization process; (2) bias due to deviations from intended interventions; (3) bias due to missing outcome data; (4) bias in measurement of the outcome; and (5) bias in selection of the reported result. Each domain was judged as “low risk,” “some concerns,” or “high risk” of bias, leading to an overall risk of bias judgment for each study. Any disagreements between reviewers were resolved through discussion and consensus; when necessary, a third reviewer adjudicated the final decision.

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2.5. Data synthesis and analysis of scales

Data synthesis focused on outcomes that were consistently reported across included randomized controlled trials and that were clinically relevant to hypertension management and cardiometabolic risk. Outcomes were categorized a priori into primary and secondary endpoints based on their clinical importance and frequency of

reporting. Systolic blood pressure (SBP) and diastolic blood pressure (DBP), measured in mmHg, were defined as the primary outcomes. These parameters represent the most sensitive and clinically relevant indicators of antihypertensive efficacy. SBP, in particular, is a stronger predictor of cardiovascular risk, especially in older populations. Changes in SBP and DBP reflect modifications in intravascular volume and peripheral vascular resistance, which are key physiological targets of dietary interventions such as the DASH diet. Secondary outcomes included anthropometric measures, specifically body weight, body mass index (BMI, kg/m^2), and waist circumference. These variables provide complementary information on overall and central adiposity, which are closely associated with hypertension through mechanisms such as increased sympathetic activity, insulin resistance, and altered renal sodium handling. Urinary electrolytes, including sodium, potassium, and calcium excretion, were also analyzed as objective markers of dietary adherence and mechanistic mediators of blood pressure regulation. Urinary sodium and potassium reflect dietary intake and are directly linked to volume status and vascular tone. The sodium–potassium balance plays a central role in blood pressure homeostasis, with higher sodium intake associated with increased extracellular volume and elevated blood pressure, whereas potassium promotes vasodilation and natriuresis. Urinary calcium was included as an exploratory marker due to its potential involvement in vascular smooth muscle function and renal electrolyte regulation, although its relationship with blood pressure remains less consistent. Additional cardiometabolic outcomes included total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and glycated hemoglobin (HbA1c). These parameters were evaluated to assess the broader metabolic impact of dietary interventions

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beyond blood pressure reduction. Lipid profile components are established markers of cardiovascular risk, while HbA1c reflects intermediate-term glycemic control and residual cardiometabolic risk. For quantitative synthesis, continuous outcomes were pooled using mean differences (MD) when measurements were reported on the same scale, ensuring clinical interpretability of results. Standardized mean differences (SMD) were used only when substantial variability in measurement methods or units across studies precluded direct comparison.

2.6. Rating the quality of evidence

The certainty of evidence for each outcome was assessed using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE Working Group) approach [9]. The quality of evidence was rated as high, moderate, low, or very low based on predefined domains, including risk of bias, inconsistency, indirectness, imprecision, and publication bias. For each outcome (including systolic and diastolic blood pressure, anthropometric measures, lipid profile, glycemic parameters, and urinary electrolytes), evidence profiles were generated, and judgments were made following GRADE guidance for randomized controlled trials. The GRADEpro Guideline Development Tool (GRADEpro GDT) was used to import pooled estimates from Review Manager (RevMan, version 5.4) and to generate Summary of Findings tables, which are presented in Supplementary Table 4.

3. Results

3.1. Study selection

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The electronic search retrieved a total of 478 records, of which 86 were considered potentially eligible for full-text review. The detailed study selection process is presented in the PRISMA flow diagram (Figure 1). No additional studies were identified through clinical trial registries or manual searches. A total of 22 randomized controlled trials met the eligibility criteria and were included in the qualitative synthesis. Of these, 10 studies were included in the quantitative meta-analysis, depending on outcome availability and completeness of reported data. The studies included in the meta-analysis were: [10-19]. Studies were excluded from the quantitative synthesis when outcome data were not reported in a format suitable for pooling or when outcomes of interest were not assessed. A detailed list of excluded studies and reasons for exclusion is provided in Supplementary Table S2.

3.2. Study characteristics

A summary of the included studies is presented in Table 1. The 22 eligible randomized controlled trials evaluated the effects of the DASH diet compared with control or alternative dietary interventions across a range of cardiovascular and metabolic outcomes. The studies included in the quantitative synthesis (n = 10) contributed data to one or more outcomes, including blood pressure, anthropometric measures, lipid profile, glycemic parameters, and urinary electrolytes. These studies were: [10- 19]. The included studies were published between 2001 and 2024 and were conducted across multiple countries, including the United States, Iran, China, Brazil, and Poland. Several studies were multicenter trials, increasing the geographic diversity of the populations analyzed. Overall, the studies included a total of 4,199 participants, with 1,776 assigned to the DASH diet group and 2,423 to control or alternative dietary

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interventions. The mean age of participants was 48.05 (SD ± 14.46) years in the DASH group and 49.18 (SD ± 15.08) years in the control group. The mean duration of follow-up was 8.17 weeks (range: 3–26 weeks).

3.3. Risk of bias assessment in individual studies

Risk of bias was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool across five domains (D1–D5). Overall, methodological quality varied across included trials (Figure 2). Most studies were judged as having *some concerns* in the randomization process (D1) and deviations from intended interventions (D2), primarily due to insufficient reporting of allocation concealment and lack of clarity regarding adherence to assigned interventions. Notably, four trials (Kucharska 2018, Lima 2013, Wright 2021, and Paula 2015) were classified as having high risk of bias in D2, which substantially influenced their overall risk of bias judgment. In contrast, the majority of studies demonstrated low risk of bias in outcome measurement (D4), suggesting that outcome assessment was generally robust and unlikely to introduce systematic error. Similarly, missing outcome data (D3) was largely assessed as low risk, although some studies presented *some concerns* due to incomplete reporting of attrition or handling of missing data. Selective reporting (D5) was frequently judged as *some concerns*, reflecting limited availability of pre-registered protocols or insufficient detail to confirm consistency between planned and reported outcomes. Overall, only one study (Juraschek 2020) was rated as low risk of bias across all domains, while four studies were classified as high risk of bias overall, driven mainly by issues in deviations from intended interventions (D2). The remaining studies were judged as having *some concerns*, indicating moderate methodological limitations.

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3.4. Synthesis of results

Quantitative synthesis was performed using Review Manager (RevMan, version 5.4; Cochrane Collaboration). Continuous outcomes were analyzed by extracting the number of participants, mean values, and corresponding standard deviations (SDs) for each study arm. When SDs were not reported, they were derived from available 95% confidence intervals (CIs) using Cochrane-recommended methods (SD = √n × [upper CI − lower CI] / 3.92), when sufficient data were available.

Pooled estimates were calculated using the inverse variance (IV) method. Mean differences (MDs) were used when outcomes were reported in the same units, and standardized mean differences (SMDs) were used only when different measurement scales were present. A random-effects model (DerSimonian–Laird method) was applied for all analyses due to expected clinical and methodological heterogeneity. Statistical heterogeneity was assessed using the I^2 statistic, with values >50% indicating substantial heterogeneity. In such cases, results were interpreted cautiously, emphasizing consistency and direction of effect. The direction of effect was defined a priori. Negative values favored the DASH diet for outcomes where lower values indicate improvement (e.g., blood pressure, BMI, lipids, HbA1c), while positive values favored the DASH diet for outcomes reflecting beneficial increases (e.g., urinary potassium). Random-effects meta-regression analyses were conducted to explore heterogeneity using pre-specified covariates (intervention duration, baseline BMI, geographic region, and sample size), fitted with restricted maximum likelihood (REML). Results were considered exploratory due to the limited number of studies.

Risk of bias was assessed using the Cochrane RoB 2 tool, and certainty of evidence was evaluated using the GRADE approach. Overall, results should be interpreted cautiously given heterogeneity and imprecision.

3.4.1. Systolic blood pressure (SBP)

The DASH diet was compared with alternative dietary interventions for systolic blood pressure (SBP). Evidence from the pooled analysis of five studies showed no statistically significant difference between groups (MD = 1.30; 95% CI: −1.54 to 4.14; p = 0.37) (Figure 3) [10,12,13,14,18]. Although some individual studies reported estimates favoring either the DASH or comparator diets, the direction of effect was not consistent across trials, and confidence intervals frequently overlapped the line of no effect. Substantial statistical heterogeneity was observed (I^2 = 89%; p < 0.00001). According to the GRADE approach, the overall certainty of evidence for this outcome was rated as very low (Supplementary Table S4). The pooled estimate suggests a small, non-significant difference in SBP between groups, which is unlikely to be clinically meaningful given the magnitude of effect and the high degree of heterogeneity.

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3.4.2. For diastolic blood pressure (DBP)

The effect of the DASH diet on diastolic blood pressure (DBP) was evaluated in four studies. The pooled analysis showed no

statistically significant difference between groups (MD = 0.21; 95% CI: −3.72 to 4.14; p = 0.92) (Figure 4) [12,13,14,18]. The direction

of effect varied across studies, with wide confidence intervals indicating substantial imprecision. High statistical heterogeneity was

observed (I^2 = 90%; p < 0.00001). Based on the GRADE approach, the certainty of evidence was very low (Supplementary Table S4).

These findings do not support a differential effect of the DASH diet on DBP compared with other dietary interventions.

3.4.3. Body Mass Index (BMI)

Five studies assessed the effect of the DASH diet on body mass index (BMI). The pooled estimate demonstrated no statistically significant difference between groups (MD = 1.30; 95% CI: −1.54 to 4.14; p = 0.37) (Figure 5) [12,13,14,17,18]. The direction of effect was inconsistent, and confidence intervals overlapped the null value across most studies. Substantial heterogeneity was identified (I^2 = 89%; p < 0.00001). According to GRADE, the certainty of evidence was very low (Supplementary Table S4). The observed effect size is small and unlikely to be clinically relevant.

3.4.4. Waist Circumference

Three studies evaluated waist circumference. The pooled analysis suggested a non-significant reduction favoring the DASH diet (MD = −3.17; 95% CI: −7.02 to 0.69; p = 0.11) (Figure 6) [14,17,19]. The direction of effect was consistent across studies,

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although confidence intervals crossed the line of no effect. No statistical heterogeneity was observed ($I^2 = 0\%$; $p = 0.63$). The certainty of evidence was rated as low according to GRADE (Supplementary Table S4). While the magnitude of reduction may be clinically relevant, the lack of statistical significance limits definitive conclusions.

3.4.5. Body weight

Two studies assessed body weight. The pooled estimate showed no statistically significant difference between groups (MD = 4.44; 95% CI: −4.09 to 12.98; $p = 0.31$) (Figure 7) [10,13]. The direction of effect was inconsistent, and extremely high heterogeneity was observed ($I^2 = 100\%$; $p < 0.00001$), indicating substantial variability across studies. According to GRADE, the certainty of evidence was very low (Supplementary Table S4). These findings are highly uncertain and should be interpreted with caution.

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3.4.6. Urinary sodium excretion

Three studies evaluated urinary sodium excretion. The pooled analysis demonstrated a statistically significant reduction with the DASH diet (MD = −32.89; 95% CI: −62.76 to −3.01; $p = 0.03$) (Figure 8) [15,16,19]. Although heterogeneity was substantial ($I^2 = 75\%$; $p = 0.02$), the direction of effect was consistent across studies. According to GRADE, the certainty of evidence was low (Supplementary Table S4). The magnitude

of effect supports the expected physiological impact of sodium restriction associated with the DASH dietary pattern.

3.4.7. Urinary potassium excretion

Two studies assessed urinary potassium excretion. The pooled analysis showed a statistically significant increase in potassium excretion with the DASH diet (MD = 11.76; 95% CI: 4.08 to 19.44; p = 0.003) (Figure 9) [16,19]. No heterogeneity was observed (I^2 = 0%; p = 0.76), indicating consistent findings across studies. The certainty of evidence was rated as moderate according to GRADE (Supplementary Table S4). This result reflects a consistent biological effect of increased dietary potassium intake.

3.4.8. Urinary calcium excretion

Two studies evaluated urinary calcium excretion. The pooled estimate showed no statistically significant difference between groups (SMD = −0.70; 95% CI: −2.02 to 0.62; p = 0.30) (Figure 10) [16,19]. Substantial heterogeneity was observed (I^2 = 89%; p = 0.002), and confidence intervals were wide. According to GRADE, the certainty of evidence was very low (Supplementary Table S4). These findings do not provide reliable evidence of an effect.

3.4.9. Total cholesterol

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Two studies assessed total cholesterol. The pooled analysis showed no statistically significant difference between groups (MD = −6.26; 95% CI: −16.76 to 4.24; p = 0.24) (Figure 11) [11,19]. No heterogeneity was observed (I^2 = 0%; p = 0.80). According to GRADE, the certainty of evidence was low (Supplementary Table S4). The magnitude of effect was modest and not clinically meaningful.

3.4.10. Low-density lipoprotein cholesterol (LDL-C)

Three studies evaluated LDL cholesterol. The pooled analysis demonstrated a statistically significant reduction favoring the DASH diet (MD = −8.59; 95% CI: −14.64 to −2.54; p = 0.005) (Figure 12) [11,17,19]. No heterogeneity was observed (I^2 = 0%; p = 0.92), indicating consistent findings. According to GRADE, the certainty of evidence was moderate (Supplementary Table S4). The magnitude of reduction is clinically relevant and supports a beneficial effect of the DASH diet on lipid profile.

3.4.11. High-density lipoprotein cholesterol (HDL-C)

Three studies assessed HDL cholesterol. The pooled estimate showed no statistically significant difference between groups (MD = 0.62; 95% CI: −1.14 to 2.38; p = 0.49) (Figure 13) [11,17,19]. No heterogeneity was observed (I^2 = 0%; p = 0.69). According to GRADE, the certainty of evidence was low (Supplementary Table S4). These findings suggest no clear effect on HDL levels.

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3.4.12. Glycated hemoglobin (HbA1c)

Two studies evaluated glycated hemoglobin (HbA1c). The pooled analysis demonstrated a statistically significant reduction favoring the DASH diet (MD = −0.49; 95% CI: −0.52 to −0.46; $p < 0.00001$) (Figure 14) [10,11]. No heterogeneity was observed ($I^2 = 0\%$; $p = 0.97$), indicating highly consistent results. According to GRADE, the certainty of evidence was moderate (Supplementary Table S4). The magnitude of reduction suggests a clinically meaningful improvement in glycemic control.

3.5. Adverse effects

Adverse events were not systematically reported across the included randomized controlled trials. None of the studies predefined safety outcomes or provided structured reporting of adverse events, including serious adverse events or withdrawals due to intervention-related harm. Across the trials, the DASH dietary intervention was generally described as well tolerated, with several studies reporting good feasibility and adherence without evidence of clinically relevant harm. For example, behavioral and lifestyle interventions incorporating the DASH diet were considered acceptable and feasible, with no safety concerns identified. In one trial, no spontaneous complaints related to the intervention were reported, further supporting its tolerability. Similarly, trials assessing metabolic and physiological outcomes did not report adverse metabolic effects associated with sodium reduction or dietary modification. Importantly, the absence of reported adverse events should not be interpreted as evidence of absence of harm, as safety outcomes were not

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systematically assessed or consistently documented across studies. Therefore, the certainty of evidence regarding the safety of the DASH diet remains limited.

3.6. Meta-Regression

To explore potential sources of between-study heterogeneity, random-effects meta-regression analyses were performed using prespecified study-level moderators, including mean age, treatment duration (weeks), intervention frequency per week, daily energy intake (kcal), and proportion of women. Full results are presented in Table 2. For systolic blood pressure (SBP), treatment duration was the only statistically significant moderator (β = 0.30; 95% CI 0.10 to 0.50; p = 0.0030), indicating that longer interventions were associated with greater variability in SBP effect estimates across studies. No significant moderating effects were observed for age, proportion of women, intervention frequency, or energy intake. For diastolic blood pressure (DBP), none of the evaluated moderators were significantly associated with between-study heterogeneity. Across lipid outcomes (HDL-C and LDL-C), no statistically significant moderators were identified, suggesting that the examined study-level characteristics did not explain variability in effect estimates for these outcomes. For body mass index (BMI), no moderators reached statistical significance. Although age and intervention frequency showed borderline associations (p = 0.0920 and p = 0.0928, respectively), these findings did not meet conventional thresholds for statistical significance and should be interpreted cautiously. For urinary sodium excretion, age (β = 0.10; 95% CI 0.05 to 0.16; p = 0.0002) and intervention frequency (β = -0.13; 95% CI -0.23 to -0.03; p = 0.0129) were identified as statistically significant moderators, indicating that these

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variables may partially explain heterogeneity in sodium excretion outcomes. No significant effects were observed for treatment duration, proportion of women, or energy intake. Overall, meta-regression analyses identified limited and outcome-specific sources of heterogeneity. Given the ecological nature of meta-regression and the relatively small number of studies contributing to several models, these findings should be interpreted as exploratory and hypothesis-generating rather than confirmatory.

3.7. Sensitivity análisis

Sensitivity analyses were conducted to assess the robustness of the pooled estimates. A leave-one-out approach was applied by sequentially removing each study and recalculating pooled effect sizes for the primary outcomes (systolic and diastolic blood pressure). Overall, the direction and magnitude of the pooled effects remained largely unchanged after exclusion of individual studies, indicating that no single study exerted a disproportionate influence on the results. For outcomes with substantial heterogeneity, exclusion of individual studies resulted in modest reductions in I^2; however, pooled estimates remained non-significant and confidence intervals continued to cross the line of no effect.

For outcomes showing statistically significant effects (e.g., urinary potassium excretion, LDL cholesterol, and HbA1c), the direction and significance of the pooled estimates were preserved across sensitivity analyses. Sensitivity analyses were not performed for outcomes with fewer than two contributing studies. Overall, these

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findings support the stability of the results; however, conclusions should be interpreted with caution given the limited number of studies and the presence of heterogeneity in several analyses.

4. Discussion

This systematic review and meta-analysis synthesized evidence from randomized controlled trials comparing the DASH diet with alternative dietary interventions on blood pressure and cardiometabolic outcomes. Overall, our findings indicate that the DASH diet did not demonstrate consistent superiority over comparator diets in reducing systolic or diastolic blood pressure, with most pooled estimates showing non-significant differences and substantial heterogeneity. However, consistent effects were observed in selected metabolic parameters, including urinary electrolyte excretion, LDL cholesterol, and HbA1c.

Our results differ in magnitude from previous meta-analyses. For example, Askarpour et al. [20] reported significant reductions in systolic (−3.94 mmHg) and diastolic blood pressure (−2.44 mmHg), as well as improvements in anthropometric and lipid parameters. These differences are likely explained by methodological factors, particularly the inclusion of comparisons against usual care or non-structured diets, whereas the present analysis focused on direct comparisons between DASH and other structured dietary interventions, which likely attenuates between-group differences. A substantial proportion of the trials included in our analysis overlap with foundational DASH studies (e.g., Sacks et al., Karanja et al., Juraschek et al.), supporting the internal

consistency of the evidence base. However, many contemporary trials compare DASH with other active dietary strategies, reducing the likelihood of detecting large between-group differences.

Adherence appears to be a key determinant of effectiveness. A meta-analysis by Chen et al. [21] showed that higher adherence to the DASH pattern was associated with modest reductions in systolic (SMD −0.18) and diastolic blood pressure (SMD −0.13), although with substantial heterogeneity. Similarly, Siervo et al. [22] reported significant reductions in systolic (−6.74 mmHg) and diastolic blood pressure (−3.54 mmHg) in analyses that primarily compared DASH with usual diets. Taken together, these findings suggest that adherence and comparator selection are major drivers of observed effect sizes, potentially more relevant than the specific dietary model itself in controlled settings. The meta-regression analyses identified limited sources of heterogeneity across outcomes. Treatment duration was associated with variability in systolic blood pressure estimates, suggesting that longer interventions may influence the magnitude of between-study differences. In addition, age and intervention frequency were associated with variability in urinary sodium excretion, indicating that participant characteristics and intervention delivery may contribute to differences in physiological response. However, no consistent moderators were identified across most outcomes, including diastolic blood pressure, lipid parameters, and body mass index. These findings should be interpreted cautiously given the ecological nature of meta-regression and the relatively small number of studies contributing to several models. Beyond blood pressure, our results demonstrated consistent effects on urinary sodium and potassium excretion, supporting the expected physiological

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mechanisms of the DASH diet. In addition, moderate-certainty evidence showed reductions in LDL cholesterol and HbA1c, suggesting potential cardiometabolic benefits beyond blood pressure control.

4.1. Certainty of evidence and clinical implications

The application of the GRADE framework indicated that the certainty of evidence ranged from moderate to very low across outcomes, primarily due to substantial heterogeneity, imprecision, and variability in comparator dietary interventions. In particular, the lack of consistent superiority of the DASH diet over other structured dietary approaches for blood pressure outcomes reinforces the importance of contextual interpretation. From a clinical perspective, these findings suggest that while the DASH diet remains a well-supported dietary strategy, its relative advantage over other structured diets may be limited. Therefore, dietary recommendations should emphasize adherence, patient preferences, and feasibility, rather than prioritizing a single dietary model.

4.2. Limitations

Several limitations should be considered when interpreting these findings. First, substantial heterogeneity was observed across studies, likely driven by differences in comparator diets, intervention duration, and baseline participant characteristics. Although meta-regression analyses identified treatment duration, age, and intervention frequency as potential contributors to heterogeneity in selected

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outcomes, these findings were not consistent across all analyses and should be interpreted cautiously given the ecological nature of meta-regression and the limited number of studies. Second, several outcomes were informed by a small number of trials, reducing statistical power and increasing uncertainty. Third, most included studies evaluated surrogate endpoints rather than clinically relevant outcomes such as cardiovascular events or mortality, limiting the direct applicability of findings to long-term clinical decision-making.

4.3. Future directions

Future research should prioritize adequately powered randomized controlled trials directly comparing the DASH diet with other structured dietary interventions using standardized outcome measures and longer follow-up durations. Greater emphasis should be placed on clinically relevant endpoints, including cardiovascular events and mortality. Additionally, future studies should explore strategies to improve long-term adherence, as well as investigate the role of patient-level factors that may influence response to dietary interventions.

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5. Conclusions

In this systematic review and meta-analysis of randomized controlled trials, the DASH diet did not demonstrate superiority over alternative dietary interventions in reducing systolic or diastolic blood pressure. Most pooled estimates were non-significant and characterized by substantial heterogeneity and low certainty of evidence. However,

the DASH diet showed consistent and clinically relevant effects on selected cardiometabolic parameters, including reductions in urinary sodium excretion, LDL cholesterol, and glycated hemoglobin, as well as increased urinary potassium excretion, supporting its biological plausibility and metabolic benefits. These findings suggest that while the DASH diet remains a valid and evidence-based dietary strategy, its comparative advantage over other structured dietary interventions is uncertain. Therefore, clinical decision-making should prioritize patient adherence, feasibility, and individual preferences rather than assuming superiority of a single dietary pattern. Given the overall limitations of the available evidence, including heterogeneity and imprecision, further well-designed randomized controlled trials with standardized outcomes and longer follow-up are needed to clarify the comparative effectiveness of the DASH diet.

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7. References

1. World Health Organization. Hypertension [Internet]. Geneva: World Health Organization; 2025 [cited 2026 Apr 11]. Available from: WHO Hypertension Fact Sheet
2. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. Nat Rev Nephrol. 2020;16(4):223–237. doi:10.1038/s41581-019-0244-2
3. Hall JE, Granger JP, do Carmo JM, et al. Hypertension: physiology and pathophysiology. Compr Physiol. 2012;2(4):2393–2442. doi:10.1002/cphy.c110058

4. Chiu S, Bergeron N, Williams PT, Bray GA, Sutherland B, Krauss RM. Comparison of the DASH diet and a higher-fat DASH diet on blood pressure and lipids. J Am Coll Cardiol. 2016;67(5):513–523. doi:10.1016/j.jacc.2015.10.096
5. Saneei P, Salehi-Abargouei A, Esmaillzadeh A, Azadbakht L. Influence of Dietary Approaches to Stop Hypertension (DASH) diet on blood pressure: a systematic review and meta-analysis on randomized controlled trials. Nutr Metab Cardiovasc Dis. 2014;24(12):1253–1261. doi:10.1016/j.numecd.2014.06.008
6. Svetkey LP, Simons-Morton D, Vollmer WM, et al. Effects of dietary patterns on blood pressure: subgroup analysis of the DASH randomized clinical trial. Arch Intern Med. 1999;159(3):285–293. doi:10.1001/archinte.159.3.285
7. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P, Moher D. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. Int J Surg. 2021 Apr;88:105906. doi: 10.1016/j.ijsu.2021.105906. Epub 2021 Mar 29. PMID: 33789826.
8. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, Cates CJ, Cheng HY, Corbett MS, Eldridge SM, Emberson JR, Hernán MA, Hopewell S, Hróbjartsson A, Junqueira DR, Jüni P, Kirkham JJ, Lasserson T, Li T, McAleenan A, Reeves BC, Shepperd S, Shrier I, Stewart LA, Tilling K, White IR, Whiting PF, Higgins JPT. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019 Aug 28;366:l4898. doi: 10.1136/bmj.l4898. PMID: 31462531.
9. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ; GRADE Working Group. GRADE: an emerging consensus on rating quality of

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evidence and strength of recommendations. BMJ. 2008 Apr 26;336(7650):924-6. doi: 10.1136/bmj.39489.470347.AD. PMID: 18436948; PMCID: PMC2335261.

10. Saslow LR, Jones LM, Sen A, Wolfson JA, Diez HL, O'Brien A, Leung CW, Bayandorian H, Daubenmier J, Missel AL, Richardson C. Comparing Very Low-Carbohydrate vs DASH Diets for Overweight or Obese Adults With Hypertension and Prediabetes or Type 2 Diabetes: A Randomized Trial. Ann Fam Med. 2023 May-Jun;21(3):256-263. doi: 10.1370/afm.2968. PMID: 37217318; PMCID: PMC10202504.
11. Belfort GP, de Padilha PC, Farias DR, da Silva LBG, Dos Santos K, Gomes ES, Lima TSV, Bornia RBRG, Rezende KBC, Saunders C. Effect of the Dietary Approaches to Stop Hypertension (DASH) diet on the development of preeclampsia and metabolic outcomes in pregnant women with pre-existing diabetes mellitus: a randomised, controlled, single-blind trial. J Nutr Sci. 2023 Jul 6;12:e73. doi: 10.1017/jns.2023.54. Erratum in: J Nutr Sci. 2023 Jul 28;12:e88. doi: 10.1017/jns.2023.77. PMID: 37457679; PMCID: PMC10345782.
12. Couch SC, Saelens BE, Khoury PR, Dart KB, Hinn K, Mitsnefes MM, Daniels SR, Urbina EM. Dietary Approaches to Stop Hypertension Dietary Intervention Improves Blood Pressure and Vascular Health in Youth With Elevated Blood Pressure. Hypertension. 2021 Jan;77(1):241-251. doi: 10.1161/HYPERTENSIONAHA.120.16156. Epub 2020 Nov 16. PMID: 33190559; PMCID: PMC7725858.
13. Juraschek SP, Miller ER 3rd, Chang AR, Anderson CAM, Hall JE, Appel LJ. Effects of Sodium Reduction on Energy, Metabolism, Weight, Thirst, and Urine Volume: Results From the DASH (Dietary Approaches to Stop Hypertension)-Sodium Trial. Hypertension. 2020 Mar;75(3):723-729. doi: 10.1161/HYPERTENSIONAHA.119.13932. Epub 2020 Jan 20. PMID: 31957521; PMCID: PMC7278848.

Journal Pre-proof

14. Kucharska A, Gajewska D, Kiedrowski M, Sińska B, Juszczyk G, Czerw A, Augustynowicz A, Bobiński K, Deptała A, Niegowska J. The impact of individualised nutritional therapy according to DASH diet on blood pressure, body mass, and selected biochemical parameters in overweight/obese patients with primary arterial hypertension: a prospective randomised study. Kardiol Pol. 2018;76(1):158-165. doi: 10.5603/KP.a2017.0184. Epub 2017 Oct 5. PMID: 28980293.

15. Lima ST, da Silva Nalin de Souza B, França AK, Salgado Filho N, Sichieri R. Dietary approach to hypertension based on low glycaemic index and principles of DASH (Dietary Approaches to Stop Hypertension): a randomised trial in a primary care service. Br J Nutr. 2013 Oct;110(8):1472-9. doi: 10.1017/S0007114513000718. Epub 2013 Apr 30. PMID: 23632203.

16. Mu L, Yu P, Xu H, Gong T, Chen D, Tang J, Zou Y, Rao H, Mei Y, Mu L. Effect of sodium reduction based on the DASH diet on blood pressure in hypertensive patients with type 2 diabetes. Nutr Hosp. 2022 Jun 24;39(3):537-546. English. doi: 10.20960/nh.04039. PMID: 35388704.

17. Sangouni AA, Hosseinzadeh M, Parastouei K. The effect of dietary approaches to stop hypertension (DASH) diet on fatty liver and cardiovascular risk factors in subjects with metabolic syndrome: a randomized controlled trial. BMC Endocr Disord. 2024 Jul 25;24(1):126. doi: 10.1186/s12902-024-01661-x. PMID: 39054440; PMCID: PMC11270781.

18. Wright KD, Klatt MD, Adams IR, Nguyen CM, Mion LC, Tan A, Monroe TB, Rose KM, Scharre DW. Mindfulness in Motion and Dietary Approaches to Stop Hypertension (DASH) in Hypertensive African Americans. J Am Geriatr Soc. 2021 Mar;69(3):773-778. doi: 10.1111/jgs.16947. Epub 2020 Nov 23. PMID: 33227157; PMCID: PMC8329944.

Journal Pre-proof

19. Paula TP, Viana LV, Neto AT, Leitão CB, Gross JL, Azevedo MJ. Effects of the DASH Diet and Walking on Blood Pressure in Patients With Type 2 Diabetes and Uncontrolled Hypertension: A Randomized Controlled Trial. J Clin Hypertens (Greenwich). 2015 Nov;17(11):895-901. doi: 10.1111/jch.12597. Epub 2015 Jun 4. PMID: 26041459; PMCID: PMC8031764.
20. Lari A, Sohouli MH, Fatahi S, Cerqueira HS, Santos HO, Pourrajab B, Rezaei M, Saneie S, Rahideh ST. The effects of the Dietary Approaches to Stop Hypertension (DASH) diet on metabolic risk factors in patients with chronic disease: A systematic review and meta-analysis of randomized controlled trials. Nutr Metab Cardiovasc Dis. 2021 Sep 22;31(10):2766-2778. doi: 10.1016/j.numecd.2021.05.030. Epub 2021 Jun 10. PMID: 34353704.
21. Chen H, Dhana K, Huang Y, Huang L, Tao Y, Liu X, Melo van Lent D, Zheng Y, Ascherio A, Willett W, Yuan C. Association of the Mediterranean Dietary Approaches to Stop Hypertension Intervention for Neurodegenerative Delay (MIND) Diet With the Risk of Dementia. JAMA Psychiatry. 2023 Jun 1;80(6):630-638. doi: 10.1001/jamapsychiatry.2023.0800. PMID: 37133875; PMCID: PMC10157510.
22. Saneei P, Salehi-Abargouei A, Esmaillzadeh A, Azadbakht L. Influence of Dietary Approaches to Stop Hypertension (DASH) diet on blood pressure: a systematic review and meta-analysis on randomized controlled trials. Nutr Metab Cardiovasc Dis. 2014 Dec;24(12):1253-61. doi: 10.1016/j.numecd.2014.06.008. Epub 2014 Jun 27. PMID: 25149893.

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Anexes

Figure 1

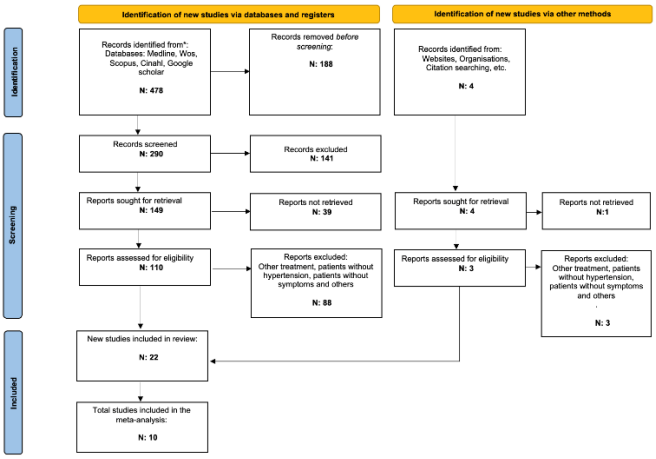

Figure 2. Risk of bias (traffic light plot)

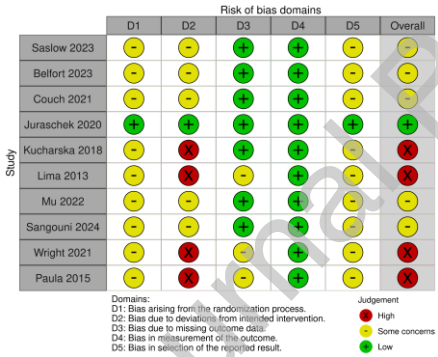

Figure 3. Systolic blood pressure (SBP)

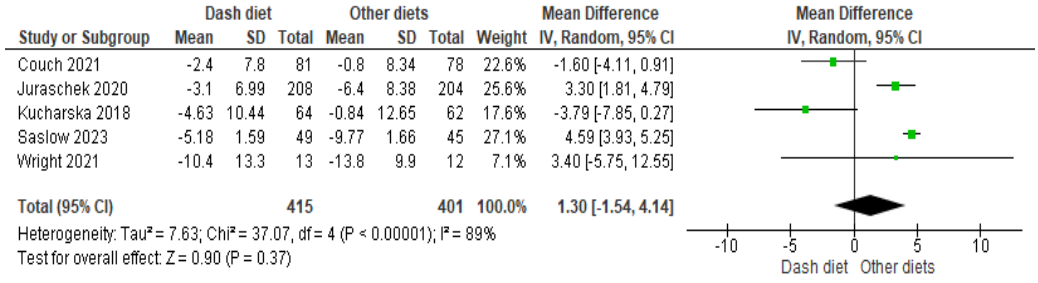

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Figure 4. Diastolic blood pressure (DBP)

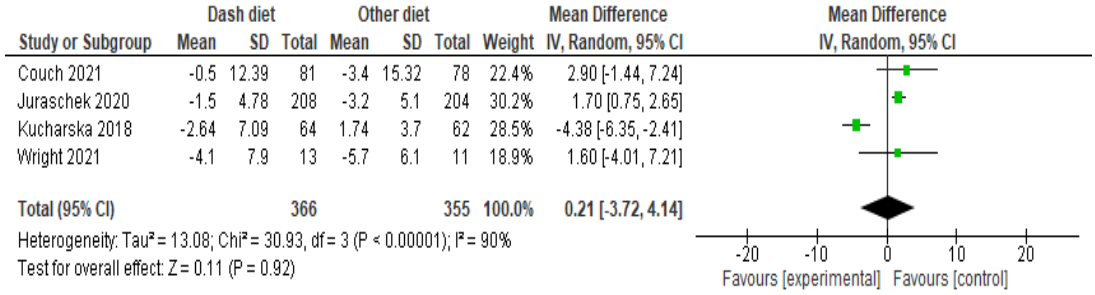

Figure 5. Body mass index (BMI)

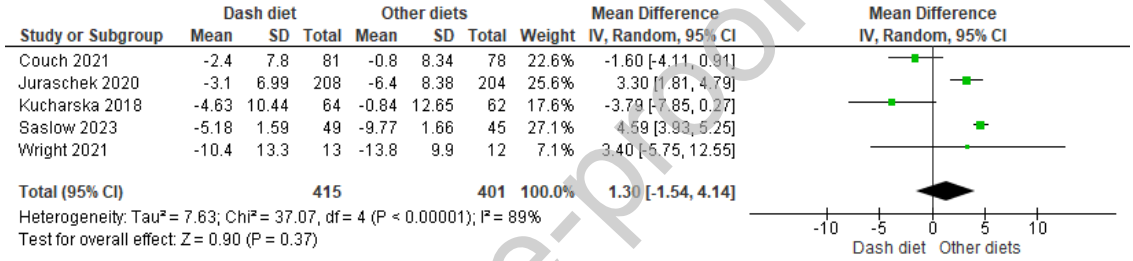

Figure 6. Waist circumference

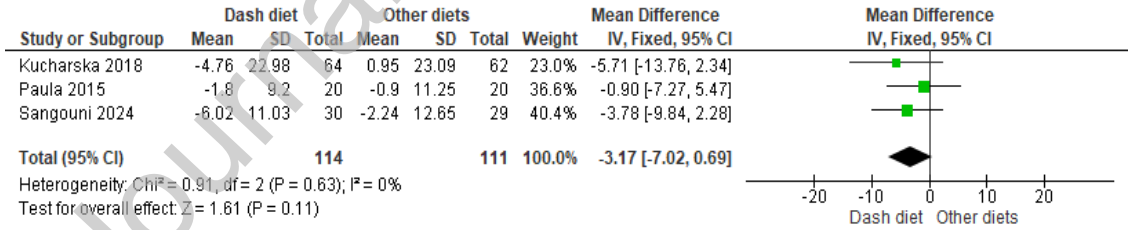

Figure 7. Body weight

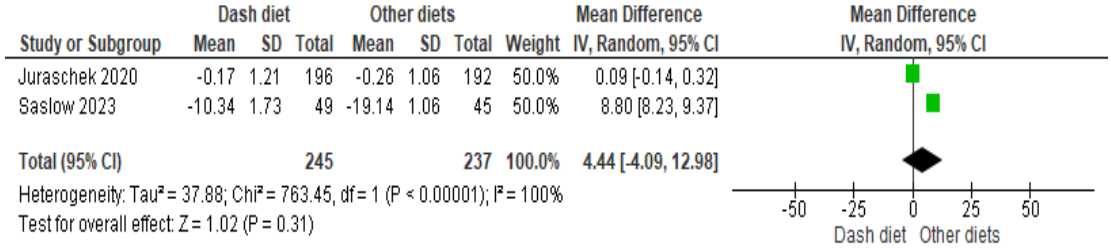

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Figure 8. Urinary sodium excretion

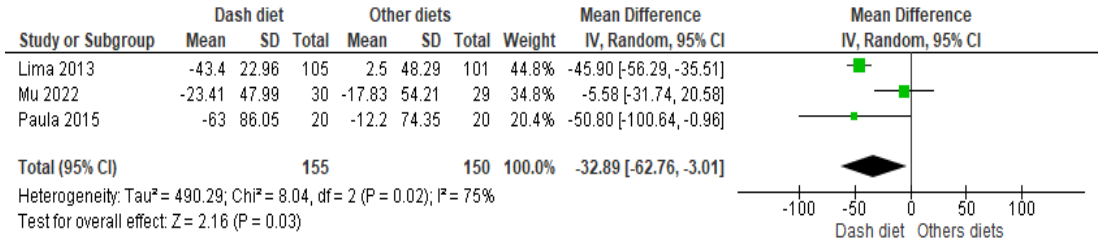

Figure 9. Urinary potassium excretion

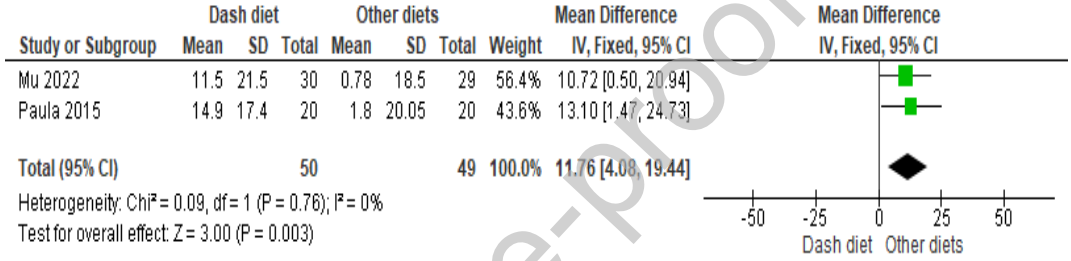

Figure 10. Urinary calcium excretion

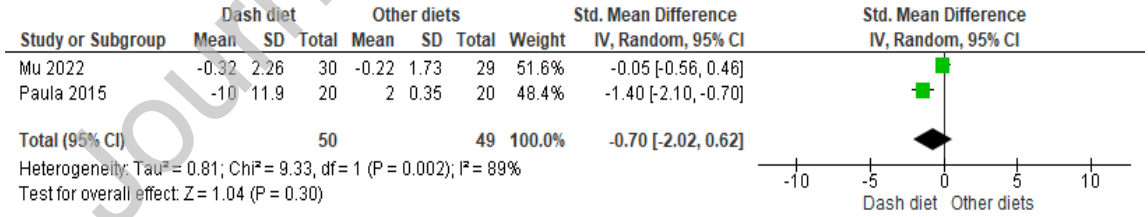

Figure 11. Total cholesterol

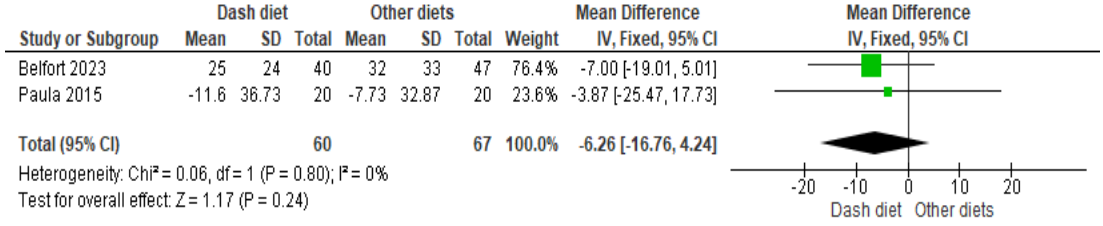

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Figure 12. Low-density lipoprotein cholesterol (LDL-C)

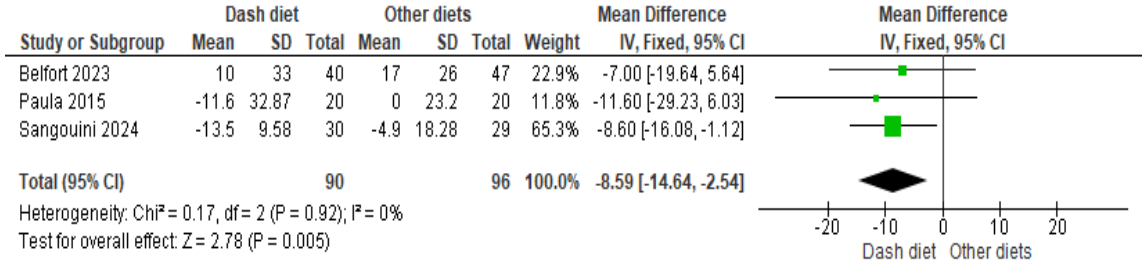

Figure 13. High-density lipoprotein cholesterol (HDL-C)

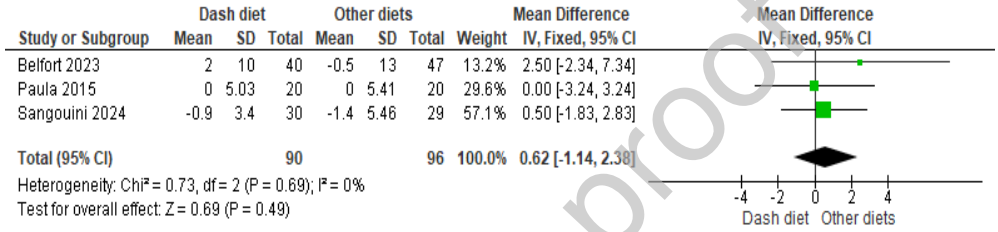

Figure 14. Glycated hemoglobin (HbA1c)

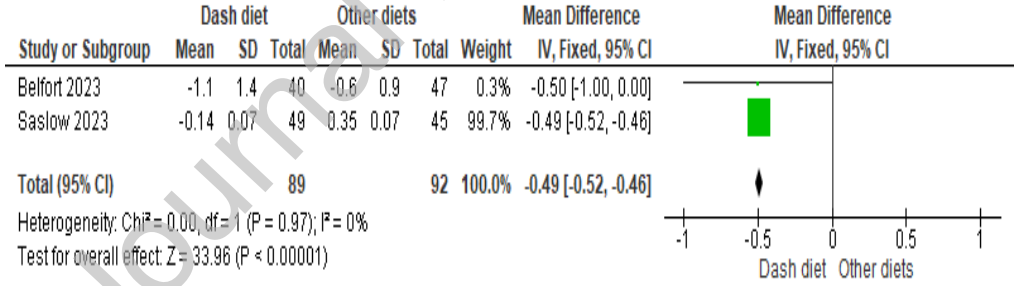

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Table 1. Characteristics of the included studies.

Author	Country	Population		Intervention		Outcomes	Follow-up	Results
		Sample size (n)	Patients mean (SD)	Intervention	ıaracteristics/Dose			

Paula et al., 2015	Brazil	CG:20 EG:20	CG: 62.5 (8.8) EG: 61.8 (8.1)	CG: Standard diet without increased physical activity EG: DASH diet with increased physical activity	CG: The diet was individually prescribed: total daily energy, 25 kcal to 30 kcal of body weight, 50% to 60% of energy as carbohydrates, 10% to 20% as proteins, and 25% to 30% as total fat. Patients were advised to consume their usual type of bread, and soy oil was provided for 4 weeks. EG: Total energy 25 kcal to 30 kcal of body weight, 55% of energy as carbohydrates, 18% as proteins, and 27% as total fat. The consumption of fruits, vegetables, low-fat dairy foods, whole grains, lean meat, nuts, seeds, and beans was	24-hour systolic blood pressure 24-hour diastolic blood pressure Daytime systolic blood pressure Nighttime systolic blood pressure Daytime diastolic blood pressure Nighttime diastolic blood pressure Body mass index (BMI)	4 weeks	24-hour systolic blood pressure p=0.001 24-hour diastolic blood pressure p=0.013 Daytime systolic blood pressure p=0.001 Nighttime systolic blood pressure p=0.041 Daytime diastolic blood pressure p=0.003 Nighttime diastolic

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		encouraged. The intake of salt, fats, and sweets was discouraged. Whole bread and soya oil were provided during the study. Patients were asked to increase physical activity by walking at least 15 to 20 minutes per day, 5 days per week, in addition to their baseline activities. A pedometer was provided to be used during the 4-week intervention period	Waist circumference Fat mass Urinary sodium Urinary potassium Urinary calcium Total cholesterol LDL cholesterol HDL cholesterol	blood pressure p=0.207 Body mass index (BMI) p=0.102 Waist circumference p=0.152 Fat mass p=0.902 Urinary sodium p=0.017 Urinary potassium p=0.012 Urinary calcium p=0.707 Total cholesterol p=0.566 LDL cholesterol p=0.144	

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								HDL cholesterol p=0.910
Arab et al., 2021	Irán	CG: 51 EG: 51	CG: (33-47)* EG: (35-61)*	CG: Standard diet EG: DASH diet	CG: Standard diet: No dietary menu was provided to women in the control group. Rather, the control group received usual dietary advice consistent with the Healthy	Frequency (attacks/month) Duration (days/month) Severity (visual analogue	Not reported	Frequency (attacks/month) p=0.025 Duration (days/month) p=0.053 Severity (visu

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		Eating Plate recommendations to improve their food choices. EG: Dieta DASH: Weekly DASH eating plan using 7-day menu cycles to provide 15–20 % of women's total daily energy requirements from proteins, 25–30 % from fats and 55–60 % from carbohydrates. The DASH diet was designed to contain higher amounts of vegetables, fruits, whole grains, low-fat dairy, nuts and beans and lower amounts of red meat, sweets, refined grains, saturated fats and cholesterol compared with the control	scale) Quality of life (HIT-6 score) Depression Anxiety Stress	al analogue scale) p=0.001 Quality of life (HIT-6 score) p=0.868 Depression p=0.011 Anxiety p=0.155 Stress p=0.007

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					diet. Also, the DASH diet was designed to provide higher amounts of Ca, Mg and K and lower (< 2400 mg/d) amounts of Na.			
Belfort et al., 2023	Brazil	CG: 47 EG: 40	CG: 32 (26-35) EG: 32 (27-37)	CG: Standard diet EG: DASH diet	CG: The standard diet was the diet already recommended in routine prenatal nutritional care at the study site, which is consistent with American Diabetes Association guidelines. The dietary plan was divided into five to six meals a day at regular times. The women received the diet and a food substitution list, according to food groups (fruits,	Glycated hemoglobin Glutathione peroxidase Total cholesterol LDL HDL Triglycerides C-reactive protein (CRP) Systolic blood pressure Diastolic blood	Not reported	Glycated hemoglobin p=0.12 Glutathione peroxidase p=0.09 Total cholesterol p=0.48 LDL p=0.43 HDL p=0.71 Triglycerides p=0.40 C-reactive protein

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			bread, dairy products, meats, cereals, legumes, fats and vegetables). This plan was based on foods with standard fat content, except for milk, which could be full-fat or semi-skimmed (1–2 % fat). As for cereals and bread, no requirement for wholegrain options was made. In addition, the women also received general nutritional guidelines as part of the standard prenatal nutritional care given at the study site. EG: The total energy value of each diet was calculated individually to promote adequate	press ure	(CRP) p=0.09 Systolic blood press ure p=0.65 Diastolic blood press ure p=0.36

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gestational weight gain. The proportion of macronutrients was similar for the two groups, ranging from 45 to 55 % carbohydrates, 15 to 20 % proteins and 25 to 30 % lipids. The energy distribution per meal for both groups was as follows: breakfast 10–15 %, mid-morning snack 5–10 %, lunch 20–30 %, afternoon snack 10–15 %, dinner 20–30 % and supper 5–10 %. All the women with low calcium intake (<900 mg/d) were prescribed 500 mg calcium carbonate supplementation per day from the 20th gestational week onwards

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					Sodium intake was limited to 2400 mg/d and both groups were advised against consuming sucrose.			
Castilla-Ojo et al., 2023	USA	CG: 28 EG: 27	CG: 52.0 (7.7) EG: 52.7 (10.9)	CG: Standard diet EG:DASH diet	CG: The control diet was designed with potassium, magnesium, and calcium levels at the 25th percentile of U.S. consumption, and was consequently low in fruit, vegetables, and dairy products. Meanwhile, the macronutrient profile and fiber content for the control diet were kept at average U.S.	Serum urate with assigned diet Serum urate with losartan Serum urate with assigned diet and losartan	4 weeks	Serum urate with assigned diet p=0.77 Serum urate with losartan p=0.011 Serum urate with assigned diet and losartan p=0.15

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					consumption on levels. EG: The DASH diet was comparatively higher in fruits and vegetables, emphasizing low-fat dairy products, whole grains, fish, nuts, and poultry, with decreased levels of cholesterol and total and saturated fats. Sodium content, ~3 g of sodium per day, was the same in both the control and DASH diets.			
Lima et al., 2013	Brazil	CG: 35 EG: 36	CG: 54.3 (9.2) EG: 55.1 (8.7)	CG: Standard diet with a focus on sodium reduction. EG: DASH diet combined with low-glycemic index foods and monthly nutritional counseling.	CG: Standard diet with a focus on sodium reduction. The intervention included general recommen	Systolic blood pressure Diastolic blood pressure Urinary	6 months	Systolic pressure: CG: -4.7 mm Hg, EG: -14.4 mm Hg ($p < 0.01$)

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		dations to reduce salt in daily meals without other changes to diet or physical activity. EG: DASH diet combined with low-glycemic-index foods. Total daily energy: 25–30 kcal per kg of body weight. Diet composition: 55% carbohydrates, 18% protein, and 27% total fat. Consumption of fruits, vegetables, low-fat dairy products, whole grains, lean meats, nuts, seeds, and legumes was encouraged. Salt, saturated fat, and	sodium		Diastolic pressure: CG: -4.3 mm Hg, EG: -9.7 mm Hg ($p < 0.05$) Urinary sodium: EG reduction of 43.4 mEq/24 h ($p < 0.05$)

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					sweets were discouraged. Monthly Nutritional Counseling: Participants received counseling sessions each month to reinforce adherence to the diet and monitor progress.			
Jurascheket al., 2017	USA	CG: 204 EG: 208	CG: 49.1 (10.4) EG: 47.4 (9.6)	CG: Standard diet EG1: Low-sodium DASH diet EG2: versus high-sodium DASH diet	CG: The control diet is typical of what many Americans eat, i.e., intakes of potassium, magnesium, and calcium at the 25th percentile and the average macronutrient profile of the U.S. population. EG: The DASH diet emphasized fruits, vegetables, and low-fat dairy foods with reduced intake of saturated	Systolic blood pressure at high sodium levels Systolic blood pressure at low sodium levels	Over 4 weeks separated by 5-day breaks.	Systolic blood pressure at high sodium levels p=0.004 Systolic blood pressure at low sodium levels p=0.001

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					fat, total fat, and cholesterol. The DASH diet included whole grains, poultry, fish, and nuts, and was reduced in red meat, sweets, and sugar-containing beverages. On either diet, participants were fed each of three sodium levels (50, 100, and 150 mmol/d at 2100 kcal) in random order for 4 weeks separated by 5-day breaks.			
Saslow et al., 2023	USA	CG1: 23 CG2: 22 EG1: 25 EG2: 24	CG1: 60.09 (6.03) CG2: 55.18 (10.48) EG1: 58.40 (8.11) EG2: 60.21 (6.19)	CG1: Very low carbohydrate diet. CG2: Very low carbohydrate + behavioral support.. EG1: DASH diet. EG2: DASH diet + behavioral support.	CG1: Ketogenic dietary pattern — very low carbohydrate, moderate protein, higher fat. CG2: Same VLC diet plus self-regulation support: self-monitoring,	Systolic blood pressure HbA1c Weight (lb)	Not reported	Systolic blood pressure p=0.002 HbA1c p=0.06 Weight (lb) p=0.001

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				goal setting, personalized feedback, mindful eating, positive emotion regulation, social support, and cooking guidance.	
				EG1: DASH pattern rich in fruits, vegetables, whole grains, and low-fat dairy; restricts saturated and total fat; lower in sodium. EG2: Same DASH pattern plus identical behavioral support as CG2.	

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Wright et al., 2021	USA	CG: 12 EG1: 13 EG2: 13	CG: 70.8 (5.5) EG1: 74.0 (5.9) EG2: 71.9 (3.9)	CG: True control (no intervention) EG1: MIM DASH (mindfullness-integrated DASH intervention) EG2: Attention control (non-hypertensive education)	CG: No information or intervention between baseline and study measurements. EG1: Mindfulness-integrated DASH dietary intervention (MIM DASH). EG2: Attention control consisting of non-hypertension-related health education, designed to control for attention effects.	Systolic blood pressure Diastolic blood pressure DASH-Q Mindful affect Perceived Stress	Not reported	MIM DASH vs Attention control: Systolic blood pressure p=0.12 Diastolic blood pressure p=0.60 DASH-Q p=0.57 Mindful affect p=0.81 Perceived stress p=0.68 MIM DASH vs True Control Systolic blood pressure p=0.29 Diastolic blood pressure p=0.62 DASH-Q

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									p=0.59 Mindful affect p=0.82 Perceived Stress p=0.69
Zou et al., 2023	China	CG: 29 EG: 30	CG: 68.03 (3.82) EG: 70.00 (4.24) Older patients with hypertension and type 2 diabetes.	CG: Chinese modified DASH diet plus normal sodium salt (CM-NSSG). EG: Chinese modified DASH diet plus low sodium salt (CM.LSSG).	CG: Chinese-adapted DASH dietary pattern with regular/normal sodium intake. EG: Chinese-adapted DASH dietary pattern with restricted low-sodium salt intake.	-	Not reported	Not reported	Not reported
Mu et al., 2022	China	CG: 29 EG: 30	CG: 68.03 ± 3.82 EG: 70.00 ± 4.24 Hypertensive patients with type 2 diabetes.	CG: Modified DASH diet + common salt EG: Modified DASH diet + low-sodium salt, 8-week dietary intervention	CG: Common salt group (consuming common salt + the modified DASH diet, n = 31)		Urinary sodium Urinary potassium Sodium/	8 weeks	Changes of urine test results Sodium p=0,027

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		EG: Low-sodium salt group (consuming 52% sodium-restricted formula salt + the modified DASH diet, n = 30) Salt intake in both groups was controlled at 5 g/day per person, in accordance with the WHO recommended salt standard. After completing a baseline survey and medical examination, an 8-week dietary intervention was implemented, with weeks 1 and 2 representing the dietary orientation phase, weeks 3 and 4 the centralized feeding phase (meals centralized in the hospital cafeteria),	Potassium ratio Chlorine Calcium Magnesium Phosphorus Albumin Creatinine UACR	Potassium p=0,306 Sodium/ Potassium ratio p=0,227 Chlorine p=0,035 Calcium p=0,612 Magnesium p=0,236 Phosphorus p=0,269 Albumin p=0,053 Creatinine p=0,013 UACR p=0,005

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		and weeks 5 to 8 the home healthcare phase. All participants were instructed not to change their previous exercise habits or medication use during the intervention. Participants were monitored at the hospital once a week to collect data on ambulatory blood pressure (ABP), salt intake, and medication use. Additionally, for trial safety, a medical examination was performed at 4 weeks and at the end of the intervention (the same as at baseline). Specific requirements for the modified DASH diet included

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		adding brown rice, corn, soybeans, kidney beans, and other grains to rice; consuming less than 120 g/day of lean meat, poultry, fish, and other meats, with less red meat and more white meat, primarily skinless chicken and fish; drinking one bottle of low-fat, high-calcium milk daily; eating more low-sugar leafy green vegetables, around 500 g per day; eating a moderate amount of fruit (after meals) and nuts (a handful); and limiting daily intake of less than 30 grams of vegetable oil and less than 5 grams of salt.

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Kucharska et al., 2018	Poland	CG: 62 EG: 69	CG: 58.11 ± 8.52 EG: 61.34 ± 7.9 Patients with well-controlled, pharmacologically treated primary hypertension (outpatient hypertension clinic, Warsaw)	CG: Standard recommendations only (no nutritional intervention) EG: DASH diet with individualized nutritional counseling	CCG: No additional nutritional intervention beyond routine standard care. EG: Individualized 3-month diet plan per participant	Systolic blood pressure (SBP) Diastolic blood pressure (DBP) Body weight Waist circumference Serum glucose Insulin levels HOMA-IR Leptin levels BMI Relative body fat percentage Absolute body fat weight (kg)	3 months	Systolic blood pressure (SBP) p=0.237 Diastolic blood pressure (DBP) p=0.913 Body weight p=0.361 Waist circumference p=0.251 Serum glucose p=0.730 Insulin concentrations p=0.522 HOMA p=0.512 Leptin concentrations

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		ant. Group lecture (4–6 patients) on hypertension risk factors and DASH principles with emphasis on weight reduction. Each patie	p=0.054 BMI p=0.851 Relative body fat percentage (%) p=0.208 Absolute body fat mass (kg) p=0.253

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					ring.			
Kim et al., 2023	USA	CG: 218 EG: 395	Age (>30 y) CG: 192 EG: 383 Adult patients ≥22 years of age.	CG: DASH diet, with SBP <160 mmHg and DBP 80 to 95 mmHg. EG: DASH-Sodium diet, with SBP 120 to 159 mmHg and DBP 80 to 95 mmHg.	CG: Multicenter study in adults ≥22 years with SBP <160 mmHg and DBP 80–95 mmHg. Participants randomize	Hypertension Diastolic blood pressure Systolic blood pressure 24-h urine creatinine Weight	8 weeks	Not reported

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		d to DASH diet, fruit and vegetable diet, or control diet for 8 weeks.
		EG: Multicenter study in adults ≥22 years with SBP 120–15

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9 mm Hg and DBP 80–95 mm Hg. Within each dietary intervention, participants received high, intermediate, and low sodium

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					intake in random order for 4 weeks each.			
Couch et al., 2021	USA	CG: 78 EG: 81	CG: 14.7 (2.0) EG: 14.7 (2.0)	CG: Routine Care (RC) intervention by a booklet with National High Blood Pressure Education Program's pediatric dietary recommendations EG: Dash-4-Teens intervention	CG: The booklet encouraged consumption of fruits and vegetables and eating a DASH dietary pattern. A table of the DASH food plan was included with serving recommendations for a 2000 calorie diet. The booklet also included tips for weight reduction although no specific	Systolic blood pressure mm Hg Systolic blood pressure z-score Diastolic blood pressure mm Hg Diastolic blood z-score Flow mediated dilati	18 weeks	Systolic blood pressure mm Hg p=0.20 Systolic blood pressure z-score p=0.09 Diastolic blood pressure mm Hg p=0.14 Diastolic bloo

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		calorie recommendations were made for weight loss. Charts were provided for foods high and low in sodium and fat. Participant education promoted dietary sodium reduction to a level of 2400 mg per day.	on (FMID) (% Max) Flow mediated dilation (FMID) AUC BMI z-score Physical activity (METs/day) Energy intake, kcal/day DASH score Fruit servings/day Vegetables servings/day Low fat Dairy, servings/day Total fat, %kcal/day Saturated fat,	d pressure z-score p=0.19 Flow mediated dilation (FMID) (% Max) p=0.03 Flow mediated dilation (FMID) AUC p=0.003 BMI z-score p=0.84 Physical activity (METs/day) p=0.48 Energy intake, kcal/day p=0.49 DASH score p=0.01 Fruit servi
		EG: Female; Age 11-13 calories 1600, pasta (1 oz) 5/day, vegetable (1/2 cup) 4/day, fruit (1/2 cup) 3/day, low-fat dairy (1 cup) 3/day, lean meat, poultry, & fish (1 oz) 5/day, dry beans, nuts, seeds & eggs (1/4 cup) 1/day, fats and oils (1 tsp.) 2/day, sweets & desserts (1 tbsp. sugar) 1/day. Age 14-18 calories 1800, pasta					

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		(1 oz) 6/day, vegetable (1/2 cup) 5/day, fruit (1/2 cup) 3/day, low-fat dairy (1 cup) 3/day, lean meat, poultry, & fish (1 oz) 6/day, dry beans, nuts, seeds & eggs (1/4 cup) 1/day, fats and oils (1 tsp.) 2/day, sweets & desserts (1 tbsp. sugar) 1/day	%kcal/day Calcium mg/day Potassium mg/day Magnesium mg/day Sodium mg/day	servings/day p=0.06 Vegetables, servings/day p=0.77 Low fat Dairy, servings/day p=0.01 Total fat, %kcal/day p=0.0003 Saturated fat, %kcal/day p=0.0001 Calcium mg/day p=0.16 Potassium mg/day p=0.23 Magnesium mg/day p=0.50 Sodium
		Male; Age 11-13 calories 1800, pasta (1 oz) 6/day, vegetable (1/2 cup) 5/day, fruit (1/2 cup) 3/day, low-fat dairy (1 cup) 3/day, lean meat, poultry, & fish (1 oz) 6/day, dry beans, nuts, seeds & eggs (1/4 cup) 1/day, fats and oils (1 tsp.) 2/day, sweets & desserts (1 tbsp. sugar) 1/day. Age 14-18 calories 2200, pasta			

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					(1 oz) 8/day, vegetable (1/2 cup) 6/day, fruit (1/2 cup) 4/day, low-fat dairy (1 cup) 3/day, lean meat, poultry, & fish (1 oz) 7/day, dry beans, nuts, seeds & eggs (1/4 cup) 1/day, fats and oils (1 tsp.) 3/day, sweets & desserts (1 tbsp. sugar) 2/day			mg/day p=0.19
Karanja et al., 2007	USA	CG: 174 EG: 180	CG: EG: Adult patients (22 years of age or older) with prehypertension or stage 1 hypertension. (SBP 120-159 mmHg and DBP 80-95 mmHg) We excluded individuals taking blood pressure medication; those with a history of heart disease, kidney failure, hyperlipidemia, or diabetes mellitus; those on	CG: Standard diet with three sodium levels (upper, intermediate, and lower) EG: DASH diet with three sodium levels (upper, intermediate, and lower)	CG: A standard diet similar to that consumed by many Americans, it included 3.6 servings per day of fruits and vegetables and 0.5 servings per day of dairy products (2100 kcal). EG: The DASH diet emphasizes fruits and vegetables (9.6 servings per day, 2100 kcal) and low-fat dairy products	Salt Acceptability (DASH): Intermediate vs. Higher Lower vs. Intermediate Lower vs. Higher Salt Acceptability (Control): Intermediate vs. Higher Lower vs. Inter	30 days	Salt Acceptability (DASH): Intermediate vs higher p= 0.6564 Lower vs intermediate p= 0.1555 Lower vs higher p=0.3297 Salt Acceptability (Control): Intermedi

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special diets; and those consuming more than 14 alcoholic drinks per week.	(2.7 servings per day, 2100 kcal), which are the key food groups that define the DASH diet. In addition, compared to the control diet, the DASH diet contains higher amounts of whole grains (4.1 vs. 0 portions per day), fish (0.5 vs. 0.2 portions per day) and nuts and seeds (0.6 vs. 0 portions per day), and lower portions of fats (2.5 vs. 5.8 portions per day), red meat (0.5 vs. 1.5 portions per day) and sweets (0.5 vs. 3.2 portions per day) per 2100 kcal.	Willingness to Continue This Diet (DASH): Intermediate vs. Higher: Lower vs. Higher Willingness to Continue This Diet (Control): Intermediate vs. Higher: Lower vs. Higher Overall Diet Acceptability (DASH): Intermediate vs. Higher: Lower vs. Inter	mediate vs higher p= 0.5798 Lower vs intermediate p= 0.0236 Lower vs higher p=0.0049 Willingness to continue this type of diet (DASH): Intermediate vs higher p= 0.2396 Lower vs intermediate p= 0.4826 Lower vs higher p= 0.6377 Willingness to continue this type of diet (Control): Intermediate	

			medi ate Lowe r vs. High er	vs high er p= 0.16 90
		Overall Diet Acceptability (Control):	Inter medi ate vs. High er	Lowe r vs inter medi ate p=0. 0347
			Lowe r vs. Inter medi ate	Lowe r vs high er p=0. 4607
			Lowe r vs. High er	Overall acceptability of the diet (DASH):
		Acceptability indices not adjusted for sodium level at the end of the sodium period (both diets)	Inter medi ate vs high er	p=0. 3666
			Lowe r	Lowe r vs inter medi ate
			Inter medi ate High er	p=0. 9556
				Lowe r vs high er p=0. 3989
				Overall acceptability of the diet (Control):
				Inter medi ate vs high er p=0. 6373

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Jurascheket al., 2020	USA	CG: 204 EG: 208	CG: 49.1 (10.4) EG: 47.4 (9.6) Adult patients with systolic blood pressure (SBP) 120-159 mmHg and diastolic blood pressure (DBP) 80-95 mmHg, without antihypertensive medications, were randomly assigned to a DASH or control diet.	CG: Standard Diet EG: DASH Diet In their assigned diet, participants randomly consumed one of three sodium levels for 4 weeks	CG: Typical diet of many Americans. EG: The DASH diet focused on fruits, vegetables, and low-fat dairy, and reduced the intake of saturated fat, total fat, and cholesterol. It included whole grains, poultry, fish, and nuts, and reduced the intake of red meat, sweets, and sugary drinks.	Weight (DASH) Weight (Control) Urine volume (DASH) Urine volume (Control) Energy intake (DASH) Energy intake (Control) Systolic blood pressure (DASH) Systolic blood pressure (Control) Diastolic blood pressure (DASH)	4 weeks	Weight (DASH) p= 0.048 Weight (Control) p=0.001 Urine volume (DASH) p=0.76 Urine volume (Control) p=0.007 Energy intake (DASH) p=0.68 Energy intake (Control) p=0.36 Systolic blood pressure (DASH) p=<0.001

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Diastolic blood pressure (Control) Urine solute excretion: Sodium, mg/day (DASH) Sodium, mg/day (Control) Potassium, mg/day (DASH) Potassium, mg/day (Control) Urea nitrogen, mg/day (DASH) Urea nitrogen, mg/day (Control)

Systolic blood pressure (Control) p=<0.001 Diastolic blood pressure (DASH) p=<0.001 Diastolic blood pressure (Control) p=<0.001 Urine solute excretion: Sodium, mg/day (DASH) p=<0.001 Sodium, mg/day (Control) p=<0.001 Potassium, mg/day (DASH)

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								p=0.001 Potassium, mg/day (Control) p=0.19 Urea nitrogen, mg/day (DASH) p=0.38 Urea nitrogen, mg/day (Control) p=0.06
Jehn et al., 2008	USA	CG: EG1: 187 EG2: 146	CG: EG1: 44.0 (9.3) EG2: 46.9 (11.5) Adult patients aged 22 years or older with prehypertension or stage 1 hypertension. With SBP < 160 mmHg and DBP 80-95 mmHg.	CG: Standard diet. EG1: DASH diet in Black patients. EG2: DASH diet in non-Black patients (primarily non-Hispanic Whites).	CG: During a 3-week pre-inclusion period, participants consumed a standard diet (2100 kcal; sodium, 3450 mg/day; potassium, 1700 mg/day; calcium, 450 mg/day; total fat, 36% of energy; protein, 15% of energy;	Hypertensive, % SBP, mm Hg DBP, mm Hg Heart Rate, beats/min 24-h SBP Daytime SBP Nighttime SBP	3-week run-in period and 14 weeks of feeding	Hypertensive, % p=0.84 SBP, mm Hg p=0.93 DBP, mm Hg p=0.65 Heart Rate, beats/min p=0.009 24-h SBP

and carbohydrates, 49% of energy). EG: Over 14 weeks, participants agreed to eat only the foods provided to them and nothing else. The nutrient composition of the diets was confirmed by chemical analysis. Caloric intake was adjusted to maintain a stable weight.	(day-night) SBP 24-h DBP Daytime DBP Nighttime DBP (day-night) DBP 24-h HR Daytime HR Nighttime HR (day-night) HR Non dipping SBP, mm Hg Non dipping DBP, mm Hg Non dipping SBP or DBP, mm Hg Non dipping HR,	p=0.99 Daytime SBP p=0.26 Nighttime SBP p=0.11 (day-night) SBP p=0.001 24-h DBP p=0.82 Daytime DBP p=0.89 Nighttime DBP p=0.01 (day-night) DBP p=0.05 24-h HR p=0.002 Daytime HR p=0.09 Nighttime HR p=<0.001							

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Hummel et al., 2013	USA	CG: - EG :13	CG: - EG:72 ± 10 Patients with treated hypertension and heart failure with compensated early ejection fraction Hypertension 14 (100%) Coronary artery disease 5 (36%) Diabetes mellitus 6 (43%) Chronic kidney disease 14 (100%) NYHA class II/III 2 (14%)/12 (86%) Prior heart failure hospitalization 10 (71%) On chronic loop diuretic therapy 11 (79%)	CG: Not applicable (single-arm pre-post design) EG: DASH diet	CG: Not applicable — no separate control group. EG: Target daily sodium intake of 50 mmol (1150 mg)/2100 kcal and energy intake to maintain lean body mass while meeting the nutritional goals of the DASH diet.	Left Ventricle mass index (g/m 2.7) Relative wall thickness Left atrial diameter (mm) Left Ventricle end-diastolic volume (ml) Stroke volume (ml) Ejection fraction (%) Cardiac output (l/min) Systemic vascular resistance (dynes s/cm 5)	21 days	Left Ventricle mass index (g/m 2.7) p=0.80 Relative wall thickness p=0.84 Left atrial diameter (mm) p=0.19 Left Ventricle end-diastolic volume (ml) p=0.77 Stroke volume (ml) p=0.02 Ejection fraction (%) p=0.03 Cardiac output (l/min)

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									p=0.19 Systemic vascular resistance (dynes/cm5) p=0.03
Belanger et al., 2022	USA	CG 204 EG: 207	CG: 49.1 (10.4) EG: 47.4 (9.6) Patients with a mean systolic blood pressure of 120 to 159 mmHg and a mean diastolic blood pressure of 80 to 95 mmHg without history of heart disease, renal insufficiency, poorly controlled hyperlipidemia, diabetes, the use of antihypertensive medications or insulin, or intake of >14 alcoholic drinks per week.	CG: Typical american diet EG: DASH diet	CG: The control diet was designed to reflect a dietary pattern and nutrient composition that is typical of what many people eat in the United States EG: The DASH dietary pattern emphasizes potassium rich fruits and vegetables and low-fat dairy products; it includes whole grains,	High-sensitivity cardiac troponin I (ng/L) NT-proBNP (pg/mL) hs-CRP (mg/L)	12 week	No	reported p value for this outcome

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poultry, fish, and nuts; and it is reduced in red meat, sweets, and sugar-containing beverages. Accordingly, it was rich in potassium, magnesium, calcium, and fiber, and reduced in total fat, saturated fat, and cholesterol; it was also slightly increased in protein. On their assigned diet, there were 3 periods, each lasting 4 weeks, in which participants ate 3 levels of sodium intake in random order using a crossover design. The 3 sodium levels were characterized as high (1.6mg/kcal), intermediate (1.1mg/kcal), and low (0.5mg/kca

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					l). At the end of each period, ≈4, 8, and 12 weeks after randomization, fasting blood specimens. Given the random order of sodium assignments, about a third of the participants were consuming each of the 3 sodium levels during each period.			
Sanei et at., 2013	Iran	Total: 60 randomized 49 completed 60 post-pubertal adolescent girls with s were randomly assigned. Ultimately, 49 adolescents completed	CG and EG: 14±2 60 post-pubertal adolescent girls aged 11 to 18 years with metabolic syndrome. They were excluded from the study if they had cardiovascular disease, kidney or liver disease, or were taking any medication that affects nutrient metabolism, blood lipids, or blood pressure, or any vitamin	CG: UDA (usual dietary advice) EG: DASH diet	CG: General oral advice and written information on healthy food choices based on the MyPlate program. EG: High amounts of whole grains, fruits, vegetables, and low-fat dairy. Limited saturated fat, cholesterol, refined grains, sweets, and red	Weight BMI Waist circumference Systolic blood pressure Diastolic blood pressure Total cholesterol HDL-C LDL-C	6 weeks	Not reported

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			the trial.	and mineral supplements.		meat. Higher calcium, potassium, and magnesium than the UDA group.	Insulin	
Sangouni et al., 2024	Iran	CG: 29 EG: 30	CG: 29 subjects (15 men and 14 women) EG: 30 subjects (15 men and 15 women) 60 subjects with metabolic syndrome (MetS). One subject was excluded from the study for missing follow-up appointments.	CG: Standard healthy diet EG: DASH diet	CG: Participants received a standard healthy diet. The diet was designed to provide balanced nutrition, without additional specifications regarding nutrients, specific eating patterns, or changes in physical activity. EG: Participants received the DASH diet, which is characterized by being rich in	Fasting glucose Lipid profile (LDL-HDL) Blood pressure Body mass index (BMI) Waist circumference	12 weeks	Fasting glucose (p=0.015) LDL (p=0.023) HDL (p=0.001) Systolic blood pressure (p=0.003) Diastolic blood pressure (p=0.048) BMI (p=0.102) Waist

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					fruits, vegetables, whole grains, and low-fat dairy products, as well as lean proteins, nuts, seeds, and legumes. The DASH diet limits the consumption of salt, saturated fats, and sweets. Macronutrient ratios were adjusted according to each participant's weight and needs, ensuring that the diet maintained an adequate energy balance.			circumference (p=0.152)
Sacks et al., 2001	USA	CG: 204 EG: 208	CG: 49 ± 10 years old EG: 47 ± 10 years old 412 participants, 50% women and 50% African American	CG: Typical U.S. diet (high sodium, ~150 mmol/day) EG: DASH diet with three levels of sodium	CG: Diet high in sodium, approximately 150 mmol of sodium per day (equivalent to 3.5 g of sodium or 8.7 g of sodium chloride)	Systolic blood pressure (24 hrs) Diastolic blood pressure	30 days per sodium level	Reduced systolic BP by 7.1 mm Hg (without hypertension) and 11.5

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		EG: Diet rich in fruits, vegetables, and low-fat dairy products, including whole grains, poultry, fish, and nuts, and with limited amounts of red meat, sweets, and sugary drinks. Three sodium levels: High (150 mmol/day). Intermediate (100 mmol/day), which coincides with the upper limit of national recommendations. Low (50 mmol/day), designed to investigate whether a further reduction in sodium could lower blood pressure even more. Each participant went through these three sodium levels sequentially,	(24 hrs) Urinary sodium and potassium levels Blood pressure: - Systolic pressure (24 hours, day and night) - Diastolic (24 hours, day and night) Urine biomarkers: - Urinary sodium excretion - Urinary potassium	mm Hg (with hypertension) with DASH diet at low sodium level (p<0.001) DASH diet combined with low sodium had greater BP reduction than control diet alone (p<0.001)

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					completing a total of 90 days of intervention in the study. This DASH intervention was carefully adjusted to maintain participants' weight constant throughout the study.	excretion	
Jurascheket al., 2017	USA	CG: 57 EG: 60	CG: 58.8 (10.5) EG: 59.2 (8.4)	CG: Control diet without counseling EG: DASH-plus with counseling	CG: The control group 53% of stipend dollars were used to purchase foods consistent with the DASH diet (e.g. fruits, vegetables, lean meats, and low-fat dairy), while 47% of the dollars were spent on non-DASH foods (e.g. processed foods or sweetened beverages). EG: DASH-Plus group received a single, in-person session with the study	Mean uric acid control Mean uric acid DASH-Plus intervention Mean uric acid DASH-Plus vs control Systolic blood pressure control Systolic bloo	Mean uric acid control p=0.58 Mean uric acid DASH-Plus intervention p= 0.65 Mean uric acid DASH-Plus vs control p=0.98 Systolic blood press

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		coach who delivered a 1-hr module on the adoption of the DASH diet. In addition, the $30/week allowance for the DASH-Plus group were limited to high potassium foods (fruits, vegetables, nuts, or dried beans). The potassium target was 17,000 mg/week. Every week the coach called participants in the DASH-Plus group to provide education and recommendations specific to the participant's needs, preferences, and local context.	d pressure DASH-plus Urine sodium control Urine sodium DASH-plus Systolic blood pressure overall Urine sodium overall			ure control p=0.09 Systolic blood pressure DASH-plus p=0.03 Diastolic blood pressure control p=0.07 Diastolic blood pressure DASH-plus p=0.02 Urine sodium control p= 0.05 Urine sodium DASH-plus p=0.40 Systolic

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					blood pressure overall p=0.002 Diastolic blood pressure overall p=0.001 Urine sodium overall p=0.047

CG Control group; **EG** Experimental group; **SD** Standard deviation; **BMI** Body mass index; **SBP** Systolic blood pressure; **DBP** Diastolic blood pressure; **LDL-C** Low-density lipoprotein cholesterol; **HDL-C** High-density lipoprotein cholesterol; **HbA1c** Glycated hemoglobin; **CRP** C-reactive protein; **UACR** Urinary albumin-to-creatinine ratio; **HOMA** Homeostatic Model Assessment; **METs** Metabolic equivalents; **AUC** Area under the curve; **FMID** Flow-mediated dilation; **HIT-6** Headache Impact Test-6; **DASH** Dietary Approaches to Stop Hypertension; **VLC** Very low-carbohydrate; **NYHA** New York Heart Association; **NT-proBNP** N-terminal pro–B-type natriuretic peptide.

Table 2. Metaregression.

Outcome	Moderator	B	95%LLCI	95% ULCI	p-value
SBP	Age	0.01	-0.05	0.08	0.6412
SBP	Proportion of women	3.60	-11.07	18.28	0.6304
SBP	Weeks of treatment	0.30	0.10	0.50	0.0030
SBP	Frequency per week	0.17	-0.26	0.60	0.4383
SBP	kcal	0.00	0.00	0.00	0.9881
DBP	Age	-0.08	-0.25	0.10	0.3879
DBP	Proportion of women	17.16	-12.37	46.70	0.2547
DBP	Weeks of treatment	0.05	-0.52	0.62	0.8628
DBP	Frequency per week	0.58	-0.93	2.08	0.4508

DBP	kcal	0.00	-0.01	0.01	0.8206
HDL	Age	-0.01	-0.03	0.02	0.5763
HDL	Proportion of women	-0.39	-1.92	1.15	0.6231
HDL	Weeks of treatment	0.02	-0.04	0.07	0.5761
HDL	Frequency per week	0.05	-0.78	0.87	0.9142
HDL	kcal	0.00	0.00	0.00	0.6407
LDL	Age	-0.01	-0.03	0.02	0.6021
LDL	Proportion of women	0.71	-2.27	0.85	0.3731
LDL	Weeks of treatment	0.01	-0.04	0.07	0.5971
LDL	Frequency per week	0.39	-0.46	1.23	0.3687
LDL	kcal	0.00	0.00	0.00	0.3554
BMI	Age	0.03	0.00	0.07	0.0920
BMI	Proportion of women	-0.50	-2.28	1.28	0.5800
BMI	Weeks of treatment	-0.04	-0.15	0.08	0.5614
BMI	Frequency per week	0.69	-0.11	1.49	0.0928
BMI	kcal	0.00	0.00	0.01	0.3411
Urinary sodium	Age	0.10	0.05	0.16	0.0002
Urinary sodium	Proportion of women	1.52	-7.16	10.20	0.7315
Urinary sodium	Weeks of treatment	-0.04	-0.09	0.01	0.1285
Urinary sodium	Frequency per week	-0.13	-0.23	-0.03	0.0129
Urinary sodium	kcal	0.00	-0.01	0.00	0.5237

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.