

Review Article

Dietary Sodium Reduction Counselling and Blood Pressure Control in Hypertensive Outpatients: A Randomized Controlled Trial

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Abstract

Background: Excess dietary sodium is a major, modifiable driver of elevated blood pressure, and counselling is central to achieving reduction in outpatient care. **Objective:** To synthesise trial evidence on whether sodium-reduction counselling lowers blood pressure in hypertensive outpatients. **Methods:** Narrative review of randomized trials, systematic reviews/meta-analyses, and mechanistic studies from PubMed, Cochrane Library, and Europe PMC. **Findings:** Sodium restriction, alone or within DASH-based counselling, produces meaningful systolic reductions, with behavioural counselling achieving smaller but durable effects than efficacy trials. **Conclusions:** Individualised dietary counselling is an evidence-supported, underused adjunct to pharmacotherapy for hypertension control.

Keywords: dietary sodium; hypertension; blood pressure; dietary counselling; DASH diet

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Objective: To synthesise trial evidence on whether sodium-reduction counselling lowers blood pressure in hypertensive outpatients. **Methods:** Narrative review of randomized trials, systematic reviews/meta-analyses, and mechanistic studies from PubMed, Cochrane Library, and Europe PMC. **Findings:** Sodium restriction, alone or within DASH-based counselling, produces meaningful systolic reductions [2], with behavioural counselling achieving smaller but durable effects than efficacy trials.

Conclusions: Individualised dietary counselling is an evidence-supported, underused adjunct to pharmacotherapy for hypertension control.

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Introduction

Hypertension remains the leading modifiable risk factor for cardiovascular death worldwide, and dietary sodium intake is among its most consistently reproducible determinants [3]. Average global sodium consumption far exceeds physiological requirement and recommended upper limits, with intake patterns shaped largely by processed and restaurant food rather than discretionary salt use [4,5]. Randomized feeding trials established more than two decades ago that experimentally lowering sodium intake reduces blood pressure in a graded, dose-dependent fashion, and that combining sodium reduction with an otherwise healthy dietary pattern produces additive benefit [6,2]. Translating these efficacy findings into everyday outpatient practice, however, depends on counselling: clinicians and dietitians must convert population-level trial evidence into individualised behaviour change that patients can sustain amid competing dietary, cultural, and economic pressures.

Current hypertension guidelines endorse dietary sodium restriction as first-line non-pharmacological therapy, alongside the DASH dietary pattern, weight management, and physical activity [7]. Yet the magnitude of blood pressure reduction achieved with real-world counselling interventions is typically smaller than that observed in tightly controlled feeding studies, raising questions about implementation fidelity, adherence, and the counselling strategies most likely to succeed in routine outpatient hypertension management. Outpatient settings present particular challenges for sodium-reduction counselling: consultation time is limited, dietary assessment tools vary in accuracy, and patients must navigate a food supply in which sodium is often hidden in processed and restaurant items rather than added at the table, limiting the value of advice focused solely on discretionary salt use. This review synthesises the trial evidence linking dietary sodium reduction counselling to blood pressure control in hypertensive outpatients, spanning mechanistic rationale, controlled feeding trials, behavioural counselling trials, and population-level salt-substitution strategies.

Methods

This article is a narrative review of published literature rather than a report of a new clinical trial. We searched PubMed, the Cochrane Library, and Europe PMC through 2026 using combinations of the terms "dietary sodium," "salt reduction," "blood pressure," "hypertension," "DASH diet," "dietary counselling," and "randomized controlled trial." Priority was given to landmark randomized controlled trials, Cochrane systematic reviews, and dose-response meta-analyses examining sodium intake and blood pressure, supplemented with outpatient counselling and mobile-health intervention trials specifically targeting hypertensive populations, and with foundational guideline and epidemiological documents providing context. Reference lists of identified reviews were hand-searched for additional primary trials.

As a narrative rather than systematic synthesis, no formal risk-of-bias scoring or new meta-analytic pooling was performed; findings are integrated qualitatively, and numeric comparisons presented in the figures are illustrative aggregates drawn from the cited published reports rather than a new pooled analysis.

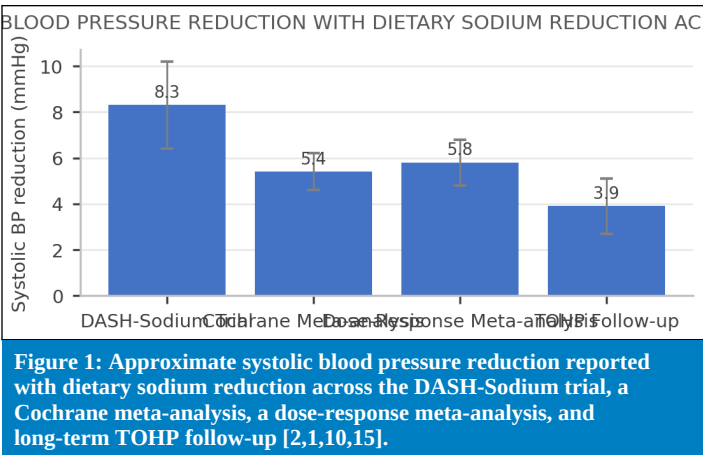
Epidemiological and Mechanistic Rationale

Sodium raises blood pressure principally through expansion of extracellular fluid volume and increased cardiac output, with secondary contributions from enhanced sympathetic nervous system activity, altered vascular endothelial function, and disrupted renal pressure-natriuresis relationships [8]. Individual blood pressure sensitivity to sodium varies substantially, with older age, Black race, obesity, diabetes, and chronic kidney disease all associated with heightened salt sensitivity, meaning identical dietary reductions can produce heterogeneous clinical benefit across hypertensive outpatient populations [7]. Beyond haemodynamic effects, chronically high sodium intake independently promotes vascular stiffening, left ventricular hypertrophy, and endothelial dysfunction through pathways that are only partially blood-pressure-mediated, strengthening the rationale for sodium reduction even among patients whose blood pressure appears adequately controlled on medication [3]. Potassium intake modifies this relationship: potassium-rich, sodium-reduced dietary patterns, exemplified by DASH, lower blood pressure more than sodium reduction alone by counteracting sodium-driven volume expansion and improving vascular tone [6]. These convergent mechanisms provide strong biological plausibility for dietary counselling that simultaneously targets sodium restriction and potassium-rich food substitution in hypertensive outpatients, rather than sodium reduction pursued in isolation.

Evidence from Randomized Controlled Trials of

Sodium Reduction

Table 1: Representative randomized controlled trials and meta-analyses of dietary sodium reduction and blood pressure.			
Study	Design/Duration	Population	Key Finding
Appel et al. 1997 (DASH) [6]	RCT, 8 weeks	Adults with high-normal BP or stage 1 hypertension	Combined diet pattern lowered SBP/DBP versus control diet
Sacks et al. 2001 (DASH-Sodium) [2]	RCT, 3 sodium levels x 2 diets, 30 days each	Adults with pre-/stage 1 hypertension	Lower sodium reduced SBP at every level; largest effect with low-sodium DASH
He et al. 2013 (Cochrane) [1]	Meta-analysis of RCTs, >4 weeks	Hypertensive and normotensive adults	Modest sustained sodium reduction lowers BP, more in hypertensives
Huang et al. 2020 [10]	Dose-response meta-analysis of RCTs	Mixed BP status adults	Approximately linear dose-response between sodium reduction and SBP lowering
Cook et al. 2007 (TOHP) [15]	Observational follow-up of RCTs, 10-15 years	Prehypertensive adults	Original sodium-reduction group had lower long-term cardiovascular event rates



The foundational DASH-Sodium trial randomized participants to three sodium levels within either a control

diet or the DASH dietary pattern, showing that reducing sodium lowered systolic blood pressure at every sodium level and that effects were larger among individuals with hypertension, with the combined low-sodium DASH arm producing the greatest reduction [2]. Subgroup analyses confirmed consistent benefit across sex, ethnicity, and baseline blood pressure category, though effects were most pronounced in Black participants and older adults [9]. Cochrane's systematic review and meta-analysis of longer-term randomized trials confirmed that modest, sustained sodium reduction lowers blood pressure in both hypertensive and normotensive adults, with larger effects in hypertensive participants [1]. A subsequent dose-response meta-analysis demonstrated an approximately linear relationship between the magnitude of sodium reduction and systolic blood pressure lowering across trial durations, reinforcing that greater reduction yields proportionally greater benefit without an apparent lower threshold, consistent with an earlier pooled meta-analysis of modest salt reduction and an independent dose-response synthesis of experimental studies [10,11,12]. Earlier overviews of randomized sodium-reduction trials, and a broader systematic review of health outcomes beyond blood pressure, reached concordant conclusions [13,14]. Long-term follow-up of the Trials of Hypertension Prevention cohorts found that participants originally randomized to sodium reduction had lower cardiovascular event rates more than a decade later, suggesting durable benefit beyond the measured blood pressure effect [15]. Table 1 summarises these representative trials, and Figure 1 illustrates the approximate magnitude of systolic blood pressure reduction reported across them.

Dietary Counselling Interventions in Hypertensive Outpatients

Table 2: Randomized trials of dietary sodium counselling interventions in hypertensive outpatients.

Study	Intervention	Setting	Key Finding
Appel et al. 2003 (PREMIER) [16]	Advice-only vs established lifestyle vs established+DASH	Outpatient, 6 months	Comprehensive counselling produced greater BP reduction and hypertension resolution
Elmer et al. 2006 [17]	Same arms as PREMIER, extended follow-up	Outpatient, 18 months	Benefits of comprehensive counselling substantially maintained
TONE 1998 [18]	Individualised sodium-reduction counselling	Older hypertensive outpatients	Enabled medication withdrawal without BP relapse in many patients
Rodrigues et al. 2023 [19]	Structured sodium-restriction education tool	Outpatient hypertension clinic	Improved perceived ability to overcome dietary barriers
Dorsch et al. 2020 (LowSalt4Life) [22]	Just-in-time mobile app counselling	Outpatient, pilot RCT	Modest reduction in sodium intake versus control
Eyles et al. 2023 (Salt Alternatives) [23]	Sodium-tracking app plus reduced-sodium salt	Outpatient, RCT	Salt substitute, more than app alone, drove sodium reduction

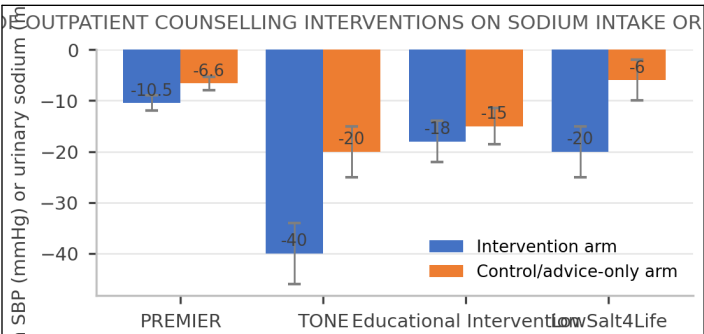


Figure 2: Approximate effects of outpatient counselling interventions on blood pressure or 24-hour urinary sodium excretion, intervention versus control, across PREMIER, TONE, a structured educational intervention, and the LowSalt4Life pilot trial [16,18,19,22].

Translating feeding-trial efficacy into outpatient practice requires structured behavioural counselling, and several trials have tested this directly. The PREMIER trial randomized hypertensive and prehypertensive adults to

advice-only, established lifestyle recommendations, or established recommendations plus the DASH diet, finding that comprehensive counselling produced significantly greater blood pressure reduction and hypertension resolution than advice alone [16], with benefits substantially preserved at eighteen months [17]. The Trial of Nonpharmacologic Interventions in the Elderly demonstrated that individualised sodium-reduction counselling allowed many older hypertensive patients to discontinue antihypertensive medication without blood pressure relapse [18]. More recent outpatient-focused work has tested structured educational tools: a randomized trial using a validated sodium-restriction questionnaire found that structured education improved patients' self-reported ability to identify and overcome dietary barriers, even though objective sodium intake reductions were similar across arms [19], while a pragmatically designed outpatient counselling protocol sought to test whether routine dietetic referral, rather than an intensive research intervention, could meaningfully lower sodium intake in hypertensive clinic populations [20], building on an earlier systematic review concluding that dietary salt advice produces only small, inconsistently sustained long-term reductions in usual clinical settings [21]. Digital counselling adjuncts have shown mixed but promising results: a pilot just-in-time mobile application achieved modest reductions in sodium intake among hypertensive adults [22], whereas a larger trial combining a sodium-tracking smartphone application with reduced-sodium salt found that the salt substitute, more than the app itself, drove measurable change [23]. Table 2 compares these counselling-based interventions, and Figure 2 depicts their approximate effects on sodium intake or blood pressure relative to control.

Salt Substitution and Population-Level Strategies

Beyond individual counselling, potassium-enriched salt substitutes offer a scalable strategy less dependent on

sustained behaviour change. The large cluster-randomized Salt Substitute and Stroke Study in China demonstrated that replacing regular salt with a reduced-sodium, potassium-enriched substitute significantly reduced stroke, major cardiovascular events, and death in a rural population with elevated baseline cardiovascular risk [24]. Earlier outcome-trial meta-analyses similarly linked modest population-level salt reduction to reduced cardiovascular events, reinforcing that blood-pressure-mediated benefit translates into hard clinical outcomes [25], and a large multinational cohort found urinary sodium excretion associated with cardiovascular events in a pattern broadly consistent with this causal interpretation [26]. Cochrane's updated synthesis of low- versus high-sodium diet trials confirmed consistent blood pressure and modest neurohormonal effects across settings, though effect sizes varied with baseline sodium intake and trial duration [27]. Globally, average sodium intake remains roughly double the World Health Organization's recommended ceiling in most regions, with the highest intakes concentrated in East Asia and Central/Eastern Europe, underscoring that individual outpatient counselling operates within a food environment that itself requires policy-level reformulation and labelling interventions to durably shift population intake [4,5].

Clinical and Public Health Implications

Collectively, this evidence supports embedding dietary sodium counselling into routine outpatient hypertension management rather than treating it as an optional adjunct to pharmacotherapy. Effective counselling models share common features: individualised assessment of baseline intake and dietary sources, concrete substitution strategies rather than generic advice to "reduce salt," potassium-rich food promotion consistent with the DASH pattern, and structured follow-up to reinforce adherence [16,8]. Given that older, salt-sensitive, and

higher-baseline-blood-pressure patients derive disproportionate benefit, risk-stratified referral to dietitian-led counselling, rather than uniform low-intensity advice, is likely to be the most efficient use of limited outpatient nutrition-counselling resources [9,18]. Digital tools and reduced-sodium salt substitutes appear promising adjuncts but have not consistently outperformed conventional counselling, suggesting they should complement rather than replace structured dietitian contact [22,23]. Health systems should also address the upstream food environment, since counselling effectiveness is constrained by the sodium content of commercially available food that patients cannot easily avoid through willpower alone [3,5]. Practical outpatient measures might include routine spot-urine or dietary-recall screening to identify high-sodium consumers, brief motivational counselling scripts embedded into nurse-led or pharmacist-led visits, and shared decision-making that weighs sodium reduction alongside pharmacological titration rather than as a sequential afterthought once medication has failed.

Conclusion

Randomized trial and meta-analytic evidence robustly supports dietary sodium reduction as an effective, dose-responsive intervention for blood pressure control, with the largest, most consistent effects demonstrated when sodium restriction is embedded within structured dietary counselling rather than pursued as an isolated instruction. Outpatient hypertension management should therefore prioritise individualised, sustained dietary counselling—ideally dietitian-led and combined with DASH-consistent potassium-rich substitution—as a core, guideline-endorsed component of blood pressure control, complemented where appropriate by digital adherence tools, reduced-sodium salt substitutes, and population-level food-environment policy.

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