Effect of reduced dietary sodium on blood pressure: a meta-analysis of randomized controlled trials

Authors' objectives
To ascertain whether restriction of dietary sodium lowers blood-pressure in hypertensive and normotensive individuals.

Searching
MEDLINE was searched from January 1966 to February 1994, and Current Contents from September 1993 to April 1994, for English language articles of human studies. The following MeSH were used: 'hypertension', 'blood pressure', 'vascular resistance', 'sodium and dietary', 'diet and sodium restricted', 'sodium chloride', 'clinical trial', and 'randomized controlled trial and prospective studies'. Bibliographies of review articles and personal files were also examined.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were included.

Specific interventions included in the review
Dietary sodium restriction, monitored by timed urinary sodium excretion. Articles reporting the adjuvant use of antihypertensive medication during the course of the study were excluded.

Participants included in the review
Normotensive and hypertensive individuals were included. The median age was 26 years (range: 10 to 65) for the normotensive participants, and 47 years (range: 8 to 73) for the hypertensive participants.

Outcomes assessed in the review
Systolic and diastolic blood-pressure, and urinary sodium excretion were assessed.

How were decisions on the relevance of primary studies made?
The titles and abstracts were assessed for simple relevance criteria by two independent observers, in order to exclude obviously irrelevant citations. The methods section of articles included after this stage were blinded for title, authors, journal, abstract and results, and were reviewed independently by two observers.

Assessment of study quality
Accepted articles were assessed for the method of randomisation, the degree of blinding, the percentage of enrolled participants who completed the trial, the number of blood-pressure and urinary electrolyte excretion measurements, and the percentage of sodium target achieved. Crossover studies were examined for a washout period, and consideration of an order effect, and parallel studies for success of randomisation. The authors do not state how the papers were assessed for validity, or how many of the authors performed the validity assessment.

Data extraction
The data extraction were carried out independently by two observers using a customised form. Any discrepancies in the data extraction were identified and resolved by consensus.

Methods of synthesis
How were the studies combined?
A quantitative synthesis was undertaken.
Both fixed-effect and random-effects estimates were calculated; analyses were weighted by variance.

Average baseline sodium excretion and difference of sodium changes were weighted by effective sample size. A correction factor for measurement error in urinary sodium was also used.

Subgroup analysis was undertaken to estimate the potential impact of salt reduction in the general population.

How were differences between studies investigated?
Homogeneity amongst the trials was examined using the chi-squared test.

Weighted least-squares linear regression methods were used to explore the sources of variation in blood-pressure effect among studies, and subgroup analyses were carried out to assess the impact of study design and quality.

Results of the review
Fifty-six RCTs (n=3,505) in 53 articles: 28 RCTs included hypertensive participants (n=1,131), while the remaining 28 RCTs examined normotensive participants (n=2,374).

The dietary intervention effect averaged 95 mmol/day (range: 71 to 119) in the 28 hypertensive trials and 125 mmol/day (range: 95 to 156) in the 28 normotensive trials. There was significant heterogeneity among trials in the effect of dietary sodium restriction on blood-pressure; this heterogeneity was not eliminated when taking study design and quality into account.

After adjustment for measurement error in urinary sodium excretion, regression analysis showed a decrease in blood-pressure of 3.7 mmHg (range: 2.35 to 5.05) for systolic (p<0.001) and 0.9 mmHg (range: -0.13 to 1.85) for diastolic (p=0.09), for a 100 mmol/day reduction in daily sodium excretion, in the hypertensive trials. For the same reduction in daily sodium excretion, the normotensive trials showed decreases of 1.0 mmHg (range: 0.51 to 1.56; p<0.001) and 0.1 mmHg (range: -0.32 to 0.51; p=0.64) in systolic and diastolic blood-pressure, respectively.

A statistically-significant intercept, representing a decrease in blood-pressure with no change in dietary sodium intake, was observed in the hypertensive trials for both systolic and diastolic blood-pressure.

Subgroup analysis demonstrated large decreases in blood-pressure in the trials of older hypertensive individuals. In the 14 trials of normotensive non-institutionalised patients whose meals were prepared for them, there was no evidence of a significant change in blood-pressure.

Publication bias was examined and found to be evident in favour of small trials reporting a reduction in blood-pressure.

Authors’ conclusions
Dietary sodium restriction for older hypertensive individuals might be considered, but the evidence in the normotensive population does not support current recommendations for universal dietary sodium restriction.

CRD commentary
A detailed meta-analysis is presented that updates the review by Cutler et al. (see Other Publications of Related Interest). However, data pooling may not be applicable due to the heterogeneity of the primary studies. Publication bias, as discussed by the authors, is present. The search strategy does not allow for non-English language articles.

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Other publications of related interest

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.