Hypertension is a highly prevalent disorder association with significant population-attributable risk for cardiovascular and renal morbidity and mortality. Given the high lifetime risk of hypertension and associated complications, a public health approach to prevention is logical. The DASH-Sodium trial represents a landmark study on nutrition and blood pressure (BP) regulation in a middle-aged population (~48±10 years) comprised of overweight-obese (body mass index [BMI] ~30±5 kg/m²), disproportionately minority (~60%, mainly African American) volunteers with BP averaging in the high normal range at ~134±10/86±5 mm Hg.¹ The findings from this carefully controlled feeding study, if applied to the general population, have the potential to reduce BP and delay and possibly prevent the development of hypertension and associated complications.

Based on a post hoc analysis on the reproducibility of salt sensitivity in the DASH-Sodium trial, Obarzanek and colleagues² conclude that salt sensitivity is not a highly reproducible finding. The authors interpret the low-order reproducibility of BP responses to changes of dietary sodium (r=0.27, r²=0.07) as further support for universal Na⁺ restriction in the entire population. They extend this reasoning to a recommendation for limiting sodium intake in food processing.

Obarzanek et al, acknowledge that this is a post hoc analysis of the DASH-Sodium data for which the study was not designed. In this regard, there are 3 significant limitations.

- Only 2 pairs of BP readings (4 total) were obtained during the run-in (high sodium) dietary phase. This is a limited amount of vitally important BP data for assessing the intra-individual reproducibility of salt sensitivity status and informing public health policy. Given the intra-individual variability of BP, even in a clinical setting, the standard error of the mean estimate (SEM) of systolic BP will be relatively large. For example, an intra-individual standard deviation of ±6 mm Hg with 4 readings would produce a SEM ±3 mm Hg (95% confidence interval ±6 mm Hg). Greater numbers of BP measurements were obtained for the controlled feeding portions of the study, which reduces the concern. However, the BP data obtained during the run-in period were used in all subjects and weighted equally to the other study periods in assessing the reproducibility of salt sensitivity.

- Group, not intra-individual, changes in dietary Na⁺ were used in the calculation, whereas the reproducibility of intra-individual changes in blood pressure resulting from the diet was the focus of this report. Although assessing Na⁺ intake for an individual requires multiple urine collections on a regular diet, the estimate on a controlled feeding study should be relatively accurate from a limited amount of urine data. Adjusting the reproducibility of the intra-individual BP response for the relative and absolute intra-individual differences in Na⁺ balance between the periods of comparison may have enhanced the estimates on the reproducibility of salt sensitivity.³

- Reproducibility of blood pressure responses to the same dietary intervention was not tested. The authors assumed that the response to a modest Na⁺ restriction (either run-in [high] or high-Na⁺ minus moderate) and more intense Na⁺ restriction (either run-in or high-Na⁺ minus low) should be correlated for an individual. The scientific foundation for this assumption is not established in this paper, and it may or may not be true.

Based on the limitations in design of the DASH-Sodium trial, it is difficult to reach strong conclusions about the intra-individual reproducibility of salt sensitivity and the clinical and public health implications from this report alone. Although this is an original paper, an important objective seems to be a serious attempt to guide public health policy and action. In this regard, the authors reviewed other relevant papers in the literature that are consistent with their conclusion that BP responses to changes of dietary sodium show low-order reproducibility.

Although concerns about intra-individual variation of blood pressure can be addressed by frequent measurements over several days with subjects on 2 distinctly different levels of sodium intake, this approach is impractical in the usual clinical setting for most patients. Moreover, the authors are recommending moderate Na⁺ restriction in the range of 65 to 100 mmol/d, for which short- to intermediate-term safety data are available from clinical trials. The claims of long-term safety based on cross-cultural ecological assessments are
attractive but challenging given multiple other major differences in dietary composition, physical activity patterns, and body habits between less- and more-acculturated people.

Extending the recommendation to limit sodium intake to 65 mmol/d in all hypertensive patients is attractive, given their significantly increased risk for cardiovascular and renal disease and greater likelihood of a significant and favorable blood pressure response to the intervention. Thus, the inconvenience and low potential for risk from moderate sodium restriction are more than counterbalanced by the probable benefit for the majority of hypertensives. The benefit-to-risk ratio is likely to remain highly favorable for individuals with high normal blood pressure readings who are at increased risk for cardiovascular and renal disease and for the progression of blood pressure to higher values. Within the population of individuals with high-normal blood pressure, more recently expanded to prehypertension, the blood pressure and cardiovascular benefits of salt restriction are likely to be greater for overweight and obese, middle-aged and older individuals and for ethnic minorities, especially those of African descent, who tend to be more salt-sensitive than younger whites and at greater risk for cardiovascular and renal complications. In fact, both the original DASH trial and the DASH-Sodium intervention were heavily “weighted” toward the groups that are more likely to have a favorable blood pressure response to dietary salt restriction. For these groups, the recommendation to implement a moderate (65 mmol/d) Na\(^+\) restriction without regard to the individual blood pressure response is reasonable based on the available scientific evidence.

The recommendation for universal Na\(^+\) restriction in the entire population to reduce the high incidence of hypertension also has a substantial foundation. The DASH 1500 mg sodium diet emerges as an attractive option for reaching this goal, with its high content of fruits and vegetables, whole grains, nuts, and low-fat dairy products, which should have health benefits for virtually everyone. In contrast to an isolated strategy of reducing sodium in processed foods, the DASH intervention is closer in composition to the diets consumed by populations with low rates of cardiovascular risk and disease, thus minimizing the concerns resulting from focus on sodium as an isolated variable. Although the DASH low-sodium diet is high in carbohydrates, the foods are primarily those with a low glycemic index, which should be favorable in terms of risk for obesity and insulin resistance.

The recommendation for universal Na\(^+\) restriction is dependent in part on the anticipated blood pressure benefit in the normotensive population. In this regard, comprehensive meta-analyses have reached discordant conclusions on the magnitude of blood pressure changes for the same level of sodium restriction in normotensives. The disparities in these and other meta-analysis of sodium restriction and blood pressure appear to reflect, to a greater extent, different statistical assumptions and regression techniques rather than variations in studies included in the meta-analysis. Given the limitations of this original paper by Obarzanek and colleagues for the purposes of assessing the intra-individual reproducibility of salt sensitivity, the results do not appear to provide further compelling evidence in favor of universal salt restriction beyond that generated by previous publications. The DASH-Sodium trial remains a landmark study with important public health implications for the prevention of hypertension and its complications.

**References**


Reproducibility of BP Responses to Changes in Dietary Salt: Compelling Evidence for Universal Sodium Restriction?

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