"Taste modification" strategy for prevention and control of hypertension in India: need for robust clinical trials

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Summary

Hypertension is an important modifiable risk factor for cardiovascular disease (CVD). Among normotensives, excessive dietary salt elevates the blood pressure and thereby increases the risk of CVD events. Despite such solid evidence, there is no effective approach to address excessive salt intake in India. Instead of just encouraging patients to lower their salt intake, we must provide an alternative technique by fostering an environment that facilitates this behaviour change. In this Viewpoint, we propose 'Taste Modification' strategy, i.e., a salt-reduction technique in which individuals are informed that adding spices/herbs to meals will reduce their salt intake. We hypothesise that a gradual reduction in salt intake can aid in the treatment of hypertension over time. The goal is to progressively substitute salt with spices for effective salt reduction. However, the 'Taste Modification' strategy must be first validated using multicentric clinical trials.

Keywords: Hypertension; Non-communicable disease; Health policy

Evidence from multiple studies on salt consumption have demonstrated the negative impact of excessive salt consumption on cardiovascular health, and 17%–30% of hypertension is caused by excessive dietary sodium consumption which is more than the WHO-recommended daily consumption limit of less than 5 g/day, especially additional salt intake during meals.[1]

Despite the overwhelming documentation, Indian health authorities have been unable to design an effective hypertension prevention strategy—specially focussed on the dietary salt reduction—under the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). Previous attempts focused on prices, availability, and nutritional value of packaged and unpackaged foods. A cross-sectional study by Dunford and colleagues from four states in India reported that packaged meals and drinks usually contained high salt and sugar content compared to unpackaged meals and drinks. In most community area types and states, unpackaged goods were more affordable and healthier than packaged goods. Another concept on providing substitutes instead of salt, has also been explored.[2] A recent trial on hypertensive patients in India, demonstrated that the salt substitute intervention significantly decreased the average systolic blood pressure (SBP) by 4.6 mmHg (95% CI 3.0–6.2) and diastolic blood pressure (DBP) by 1.1 mmHg (95% CI 0.2–2.1). There was a significant increase in 24-h urinary potassium excretion in the salt substitute group by 0.24 g/d (95% CI 0.12–0.35) and a decrease in the urinary sodium to potassium ratio by 0.71 (95% CI 0.55–0.87) compared to the control group. The above-mentioned trial demonstrated that the efficacy of salt replacement as a low-cost method of decreasing blood pressure while averting 8%–14% of yearly cardiovascular deaths.[3] Low-sodium salt substitutes (LSSS) as a salt alternative for cardiovascular health has been promising in reducing DBP in adults and probably reduce risk of non-fatal stroke. The effects of LSSS on DBP and SBP in children are currently unclear.[4]

As dietary salt consumption has social, ecological, and cultural attributes (Fig. 1), it would be difficult for individuals to address it alone. Additionally, adapting to the low-salt diet requires behaviour change in

Abbreviations: NPCDCS, National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke; LSSS, Low-sodium salt substitutes; TAS1Rs, Taste receptor type 1 members; TAS2Rs, Taste receptor type 2 members

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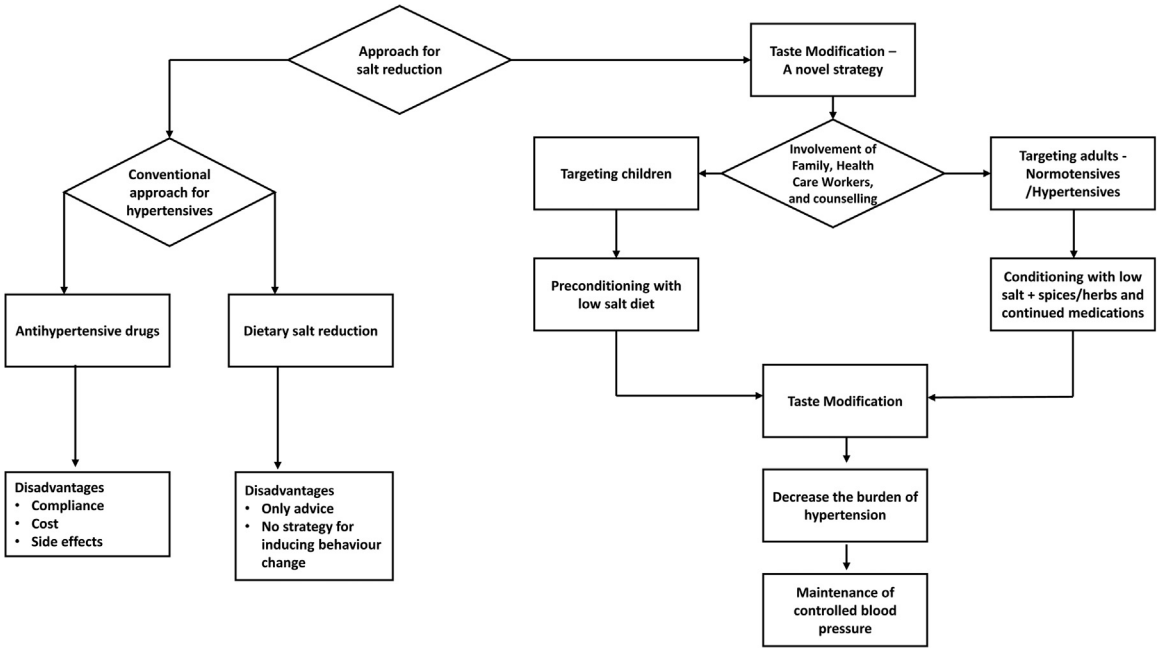

Fig. 1: **Taste modification strategy**.

consumers, which is a complex process, and this component is completely left out from existing hypertension prevention guidelines under NPCDCS. Incorporating salt substitutes in diet results in significant reduction in blood pressure. However, side effects of salt substitutes include hyperkalaemia, arrythmias, and sudden cardiac failure in people with chronic kidney disease in addition to negative impact on the saltiness, flavour, or general acceptability of food.[4] Moreover, previous studies on salt substitutes have been conducted on individuals with hypertension or at risk of cardiovascular disease events narrowing the gap for effective behaviour change. Many components of WHO's "SHAKE technical package for salt reduction"[5] is yet to be implemented in south-east Asian countries like India.

Humans perceive salt more as a taste than a micronutrient. A sensitivity to and desire for salty taste things appears to be inherent and begins in infants by age of 4 months. By the age of two years, children's preferences for salty foods outnumber those of adults. Birth weight is adversely associated to various behavioural variables related to salty taste preference across the first four years of life and that early experiences may substantially influence children's preference for salt.[6] In accordance with the SHAKE package,[5] which imagines a society in which the daily average salt intake of adults and children would be less than 5 g. If such reduction in salt consumption is accomplished, it will positively impact the sustainability of health systems and public health, by reducing the burden of non-communicable diseases.

We propose preconditioning the child during this period, using a method called "Taste Modification," which involves exposing the child to low-salt diet at an early age. Several trials found that after a specific length of salt depletion from the diet, foods previously regarded as usual were deemed salty. For instance, if individuals consume salads with less salt and more citric juice, their taste buds may change with time. Such individuals may no longer consume a salad with a high salt content. The discovery of receptors, namely taste receptor type 1 members (TAS1Rs) and taste receptor type 2 members (TAS2Rs) in cardiac myocytes, is critical in this context. As TAS2Rs are upregulated following starvation, there is a potential research avenue that may explore the relationships between taste modification and cardiovascular health.[7] This observation has important implications for salt restriction in the diet. Rather than being established by genetics, the taste is primarily acquired via experience, which makes it highly manipulable. According to a study conducted in China, adding herbs and spices can increase the acceptability of low-salt tomato soup among the populace.[8] Reducing the salt content and adding herbs and spices to a basic tomato soup resulted in initial client rejection. However, after continuous exposure, it was eventually embraced by the same clients. Simple repetition of an action in a consistent environment leads, via associative learning, to the behaviour being triggered upon habitual exposure

to those contextual signals. Once action initiation is "transferred" to external stimuli, cognitive attention and motivational processes become less critical.[9]

Indian cuisine includes a range of regional and traditional Indian dishes. Modifying the flavour of food with low to no salt-containing "*masala*" (commonly used spices like turmeric, pepper, and ginger) can be a potential strategy for hypertension prevention. Similarly, after initial evaluation of the adult population who are hypertensive or have associated risk factors, they could be referred to a counselling room by the hypertension clinic. It may be suggested that adding spices/herbs, such as ginger, black pepper, etc., to their food can assist in altering their eating habits. A modest reduction in salt intake can help regulate hypertension over time. The goal is to substitute these spices for salt progressively.

We call for multicentric trials emphasising "taste modification" strategies and "social and cultural appropriateness" in different age groups. Also, pharmacological approaches to mitigate CVD by targeting taste receptors TAS1R and TAS2R may complement non-pharmacological measures under NPCDCS.[7] Furthermore, we strongly recommend strategies like (a) monitoring and measuring salt consumption, (b) front-of-pack nutrition labelling and marketing of foods, (c) promoting the reformulation of foods and meals to contain less salt, and (d) encouraging people to eat less salt via awareness programmes. Given the high potential of these non-pharmacological measures, we need to emphasise these health promotion strategies within the hypertension prevention guidelines in India under the NPCDCS after conducting comprehensive trials. Integrating preventive behavioural interventions within NPCDCS and facilitating evidence-based practices may help reduce the high burden of hypertension in South-east Asian countries like India.

Contributors

Conceptualisation – SB and AS. Writing – original draft: SB, AS and MMH. Writing – review and editing: SMS, SV, PG, MMH, and SB. All authors read and approved the final version of the manuscript.

Declaration of interests

None.

References

1 Stamler J. The INTERSALT Study: background, methods, findings, and implications [published correction appears in *Am J Clin Nutr* 1997 Nov;66(5):1297] *Am J Clin Nutr*. 1997;65(2 Suppl):626S–642S. https://doi.org/10.1093/ajcn/65.2.626S.

2 Dunford EK, Farrand C, Huffman MD, et al. Availability, healthiness, and price of packaged and unpackaged foods in India: a cross-sectional study. *Nutr Health*. 2022;28(4):571–579. https://doi.org/10.1177/02601060211039124.

3 Yu J, Thout SR, Li Q, et al. Effects of a reduced-sodium added-potassium salt substitute on blood pressure in rural Indian hypertensive patients: a randomized, double-blind, controlled trial. *Am J Clin Nutr*. 2021;114(1):185–193. https://doi.org/10.1093/ajcn/nqab054.

4 Marklund M, Tullu F, Raj Thout S, et al. Estimated benefits and risks of using a reduced-sodium, potassium-enriched salt substitute in India: a modeling study. *Hypertension*. 2022;79(10):2188–2198. https://doi.org/10.1161/HYPERTENSIONAHA.122.19072.

5 The SHAKE technical package for salt reduction [Internet] [cited 2022 Dec 11]. Available from: https://apps.who.int/iris/handle/10665/250135.

6 Beauchamp GK, Mennella JA. Flavor perception in human infants: development and functional significance. *Digestion*. 2011;83(Suppl 1):1–6. https://doi.org/10.1159/000323397.

7 ZhuGe R, Roura E, Behrens M. Editorial: extra-oral taste receptors: function, disease and evolution. *Front Physiol*. 2020;11:607134. https://doi.org/10.3389/fphys.2020.607134.

8 Ghawi SK, Rowland I, Methven L. Enhancing consumer liking of low salt tomato soup over repeated exposure by herb and spice seasonings. *Appetite*. 2014;81:20–29. https://doi.org/10.1016/j.appet.2014.05.029.

9 Bhattacharya S, Singh A. "Taste modification" - a new strategy for reduction of salt intake among Indian population. *Epidem Int*. 2016;1(2):44–50.