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PERSPECTIVE – The Growing Global Benefits of Limiting Salt Intake: an urgent call from the World Hypertension League for more effective policy and public health initiatives

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Excess dietary salt adversely impacts blood pressure (BP) and cardiovascular health [1–3]. Reducing salt intake is a well-established intervention for hypertension prevention and management [2–18]. Multiple converging factors magnify the health and economic toll from excess salt consumption and amplify the benefits of limiting intake to healthier levels. The aims of this paper include: (i) highlighting factors underlying the growing time-dependent benefits of limiting salt consumption on BP and cardiovascular disease (CVD) events worldwide and (ii) encouraging policy and public health initiatives to limit sodium consumption to <2000 mg daily (<5000 mg NaCl) in adults, as recommended by the World Health Organization (WHO [16]), within ten years, recognizing more time may be required. Attaining healthier levels of salt intake will be rewarded by growing health and economic dividends throughout the 21st century.

BACKGROUND

BP is a vital sign with powerful prognostic implications for cardiovascular health, healthy aging, and health equity [1–18]. Salt intake is directly related to population BP and the prevalence of hypertension. The INTERSALT Study investigators estimated a 2300 mg increase in daily sodium intake was associated with ~3.5 mmHg higher systolic BP (SBP) [1]. Subsequent reports confirmed that a 2300 mg change in daily sodium intake has a SBP effect ranging from 1–11 mmHg, which is modified by factors including age, race, potassium intake, and hypertension, with an unweighted average of ~4.4 mmHg (Fig. S1) [10, 19–24]). The mean SBP of a population is directly and strongly related to prevalent hypertension [23]. Hypertension is an important risk factor for coronary heart disease, heart failure, stroke, cognitive decline and dementia, chronic kidney disease (CKD), premature disability, and death [2–18].

Limiting salt intake is a cost-effective intervention for lowering BP, limiting age-related increases in BP [1, 25], improving hypertension control, and reducing the health (Table S2, Fig. S1) and economic toll of CVD with a 12-fold or greater return on investment [5, 26]. Effective measures are urgently needed to limit sodium intake of individuals from the current global mean of ~4300 mg to <2000 mg daily [16]. We propose a 10-year investment to achieve and sustain sodium intake at ~2000 mg daily with the promise of enduring health and economic benefits for most people.

THREE KEY POINTS HIGHLIGHT THE CRITICAL AND GROWING IMPORTANCE FOR REDUCING GLOBAL SODIUM INTAKE

Demographic changes

The pressor effects of salt (salt sensitivity) increase with age, and salt contributes to age-related increases of BP [1–7, 24, 27]. The global population is aging rapidly (Fig. 1 [28]). With short- to intermediate term salt reduction, BP falls progressively more with increasing age [10].

Furthermore, salt intake likely explains much of the age-related increase of BP [1, 25]. Estimates from the INTERSALT study suggested that a 2300 mg higher daily sodium intake was associated with ~10 mmHg rise of SBP from 25 to 55 years of age [1]. Clinical studies have indicated that the age-related increase of BP is largely confined to salt-sensitive individuals. Sixteen adults followed for 10 or more years after being defined as salt sensitive had a 1.4 mmHg/year increase in SBP or ~14 mmHg over 10 years, whereas SBP fell slightly over time in 15 salt-resistant individuals [25].

In Europe, the U.S., and most other countries, age-related increases of SBP continue beyond 55 years [29], especially in women [28]. Salt sensitivity increases with aging [10, 26] and is greater in women than men [30]. Given these observations, a 2300 mg higher daily sodium intake from ages 25 to 75 years and beyond may account for a 15 to 20 mmHg increase of SBP over the adult lifespan. Moreover, a

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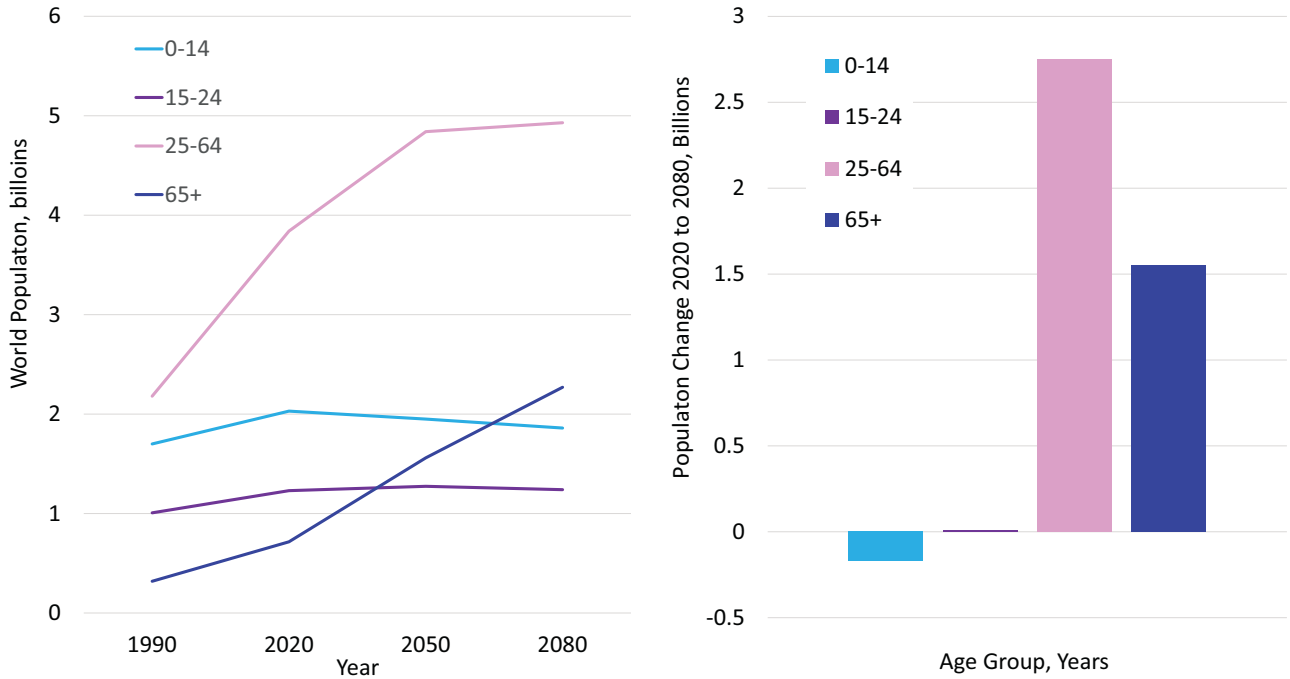

Fig. 1 World population and changes over time in the world population by age group. The world population by age group is shown from 1990 to 2080 (left side). Between 2020 and 2080, the population 25 years of age and older is projected to increase by more than 4 billion. The population <25 years old is projected to decline slightly (right side), which reflects declining birth rates. Data source: UN, World Population Prospects (2024). https://population.un.org/wpp/Graphs/DemographicProfiles/Line/900.

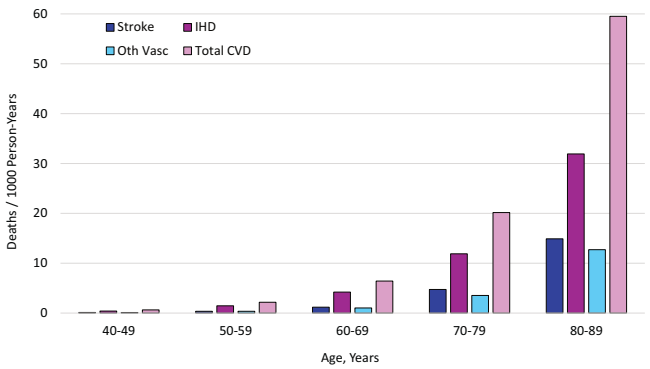

Fig. 2 Death rates from cardiovascular diseases by age group. Death rates from stroke, ischemic heart disease, other vascular diseases, and total cardiovascular disease approximately triple every ten years in adults from the fifth through ninth decades [31].

20 mmHg increase of SBP approximately doubles relative risk for CVD events [31].

Relative risk for cardiovascular events triples every 10 years at any level of SBP (Fig. 2 [31]). From the fifth to ninth decade, relative risk for CVD triples every 10 years with absolute risk increasing ~80 fold at the same SBP. If SBP also increases 20 mmHg from the fourth to ninth decades, absolute risk for CVD events would increase more than 150-fold [31]. Limiting dietary salt intake lowers BP more in older than younger individuals and likely mitigates age-related increases of BP [1–7, 10, 25]. While the relative benefit of lowering SBP on CVD events is similar in younger and older adults, absolute benefits are far greater in older adults.

Other demographic changes, which increase salt sensitivity. Populations in some Asian as well as sub-Saharan African countries and the diaspora are growing more rapidly than Euro-Caucasian populations [32–34]. These populations are generally more sensitive to the hypertensive effects of sodium than Euro-Caucasian populations [10]. Thus, the benefits of limiting dietary salt intake are compounding as aging and other demographic changes augment salt sensitivity of the global population.

Obesity and related conditions increase salt sensitivity

The global population is becoming progressively more obese [35], a major risk factor for developing hypertension and cardiometabolic disorders including diabetes mellitus and CKD [36]. Obesity, diabetes mellitus, and CKD all amplify BP responses to salt [37]. Thus, limiting dietary salt intake to healthier levels is especially important in populations with a high and growing prevalence of obesity and cardiometabolic disorders, which combine to heighten salt sensitivity.

Low diet quality

When diet quality is low, the effect of salt on BP is magnified. For example, in the DASH-Sodium trial, the reduction of BP when limiting daily sodium consumption by 2300 mg from 3450 to 1150 mg daily was roughly twice as large on the lower quality usual diet, typical of intake in the United States, than the higher quality DASH diet [19]. Thus, limiting salt intake reduces BP more when diet quality is low, which characterizes much of the global population [38].

DESIGNING AND IMPLEMENTING NATIONAL PLANS FOR GLOBAL ACTION TO REDUCE SALT INTAKE AND IMPROVE CARDIOVASCULAR HEALTH

Given the three previously mentioned factors, the health and economic benefits of reducing global sodium consumption [5, 26] and the costs of inaction are both substantial and progressively growing. Two broad strategies to reduce sodium intake, including public policy and public health mass media campaigns, separately and combined are supported by current evidence, previous recommendations, and experience [2, 3, 11, 14, 39, 40]. Non-

discretionary intake predominates as the source of excessive sodium consumption in many high-income countries. Conversely, discretionary salt intake is a greater challenge in many low- and middle-countries (LMIC), especially in rural areas [41].

While this Perspective aims at reinvigorating national efforts to reduce sodium consumption from ~4300 mg to <2000 mg daily within ten years, it seems prudent to dedicate the first two years to building consensus and laying the foundation for sustainable action. Following a focused two-year coalition building and planning period, the next 8 years would focus on implementation, ongoing data monitoring, and periodic plan refinement as required to remain on target. In fact, reducing sodium intake could take longer given historical challenges and recognizing that sources of excessive sodium intake can change with time.

Reducing non-discretionary salt consumption

For nations where the predominant source of sodium is non-discretionary, policies to reduce sodium added during food processing and in meals prepared outside the home by 10% can be implemented and repeated at yearly intervals without detection by most consumers [5, 16, 20]. Assuming the global average of 4300 mg daily sodium intake, when non-discretionary intake is high, approximately 3100 of daily sodium intake is added in processing and meals prepared outside the home. These foods naturally contain approximately 400 mg of sodium.

A 10% annual reduction of non-discretionary sodium intake for eight years would reduce non-discretionary intake from 3100 to 1334 mg, lowering total sodium intake from 4300 to 2534 mg daily. If discretionary intake of ~800 mg daily also fell 7% annually for 8 years, then sodium consumption would fall to ~2180 mg daily, approaching the WHO target of <2000 mg (Fig. 3).

Reducing discretionary salt consumption

When discretionary intake is high, as it is in many low- and middle-income countries [41, 42], substituting a salt that contains 75% NaCl and 25% KCl instead of the usual 100% NaCl combination has been acceptable and effective in reducing BP, major CVD events, and death [42, 43]. Where discretionary intake is high, one can generally assume that approximately 400 mg of salt is naturally present in foods, 800 mg is added during food processing, and 3100 mg is added by the consumer. If consumers replace 20% of their usual NaCl intake with a 75% NaCl: 25% KCl, then sodium consumption would decline 5% annually from 3100 mg at baseline to 2057 mg after 8 years (Fig. 4). Phasing in KCl containing salt substitutes over time provides an opportunity for consumer marketing to increase the use of salt substitutes as well as for monitoring of safety concerns due to hyperkalemia. The ~1040 mg reduction (45 mmol) in daily sodium consumption over eight years would parallel a rise of 1800 mg (45 mmol) in daily potassium intake. If non-discretionary sodium intake could also be reduced 10% annually, then daily sodium consumption would fall to ~2800 mg/d. While sodium intake remains above the <2000 mg/d target, potassium intake rises. The combined benefits of reducing sodium and increasing potassium intake include lowering SBP ~4–6 mmHg and CVD mortality approximately 10% [41, 42].

Safety of potassium-enriched salt. The 75% NaCl: 25% KCl approach to reducing sodium intake is especially relevant to LMIC where daily potassium intake is 1000–1800 mg below the WHO recommended level of 3500 mg [42]. In the example above, daily potassium intake would increase by ~1800 mg. In the Salt Substitution and Stroke Study (SSaSS), 24-urine potassium increased 800 mg daily to ~2200 mg/ daily, which remained below the WHO recommended level of 3500 mg, recalling that ~90% of potassium ingested is excreted in the urine [43]. Hyperkalemia and sudden death did not increase in SSaSS [42], and fewer arrhythmias were observed in participants assigned to potassium-substituted salt [44]. Individuals with known CKD and those taking potassium supplements and potassium-sparing diuretics were excluded, although patients with diabetes mellitus and those taking renin-angiotensin system blockers were included. Evidence suggests that potassium-enriched salt is safe for most adults in LMIC, where baseline potassium intake is low.

PROJECTED IMPACT OF ATTAINING WHO TARGETS FOR SALT INTAKE ON BP, CVD EVENTS, AND MORTALITY

Preventing 1.89 million premature deaths annually is a compelling reason for more effective policy initiatives and public health programs to limit salt consumption [16], yet even more non-fatal events are averted. Data from Norfolk, United Kingdom, documented that the ratio of total to fatal CVD was 4.6 in men and 6.8 in women and was greater in adults <60 years (≥10:1) than ≥60 years (≥4:1) [45]. Thus, limiting sodium intake to <2000 mg daily may prevent ~1.9 million fatal CVD and at least 7.5 million non-fatal CVD events annually. CVD prevention with salt reduction may be underestimated as benefits have been attributed to BP reduction, although BP-independent effects may contribute, especially for stroke [46].

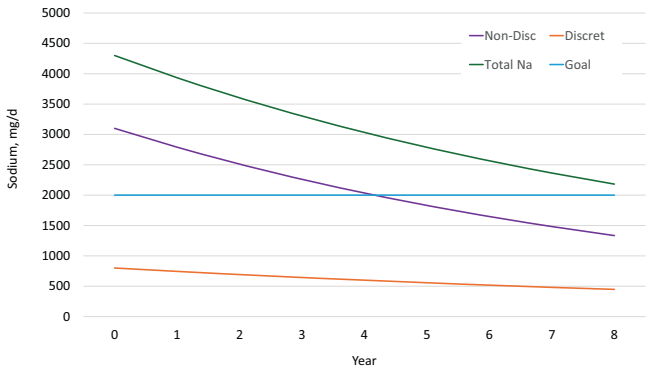

Fig. 3 Projections for reducing sodium consumption when non-discretionary intake is high. Assuming roughly 3100 mg salt is added to food processed and prepared outside the home each day, a 10% annual reduction for 8 years would lower non-discretionary intake from 3100 to ~1334 mg and total sodium intake from 4300 to 2534 mg daily. If discretionary sodium intake were also reduced 7% per year (orange line), then total sodium intake would decline to ~2180 mg daily.

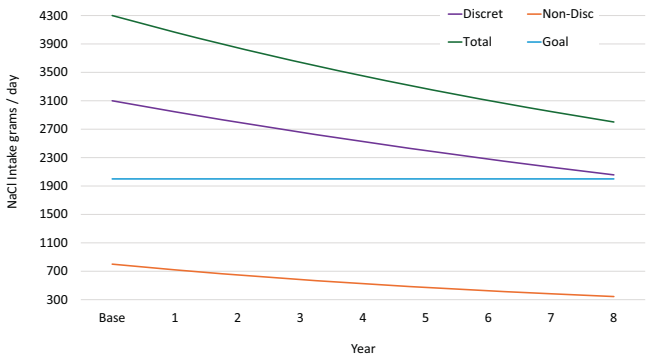

Fig. 4 Projections for reducing sodium consumption when discretionary intake is high. The estimate assumes 3100 mg sodium/d is added in food preparation and seasoning at home. Discretionary would fall 5% annually by replacing 20% of added salt with 75% NaCl: 25% KCl each year for 8 years. If non-discretionary sodium also declines 10% annually, then total sodium intake would fall from 4300 to 2800 mg daily. Potassium intake would rise ~1800 mg/d.

OVERCOMING THE BARRIERS AND CHALLENGES TO ATTAINING GLOBAL SODIUM INTAKE OF <2000 MG DAILY

This Perspective concurs with several prior reports cited above that document the adverse effects of sodium consumption on population health. Our Perspective highlights the impact of increasing age, diabetes, obesity, CKD, and greater numerical growth of non-Caucasian than Caucasian populations. These factors converge to increase salt sensitivity and magnify the benefits of lowering population sodium intake. These initiatives must align with the sources of dietary sodium. While most estimates on the benefits of healthier levels of sodium intake have focused on CVD mortality, non-fatal events occur more often and contribute to a large and costly burden of disability adjusted life years. The time for effective and sustained multilateral action is now as time lost is costly and lives are being lost [47]. The adverse effects of limiting sodium consumption to <2000 mg daily [5, 6] are minimal relative to the documented health and economic benefits. The time has come for a rationale balance of benefits, risks, and competing interests to coalesce around a multi-national initiative to attain and sustain sodium consumption at the WHO recommended target of <2000 mg daily.

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ADDITIONAL INFORMATION

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