

2022 WORLD HYPERTENSION LEAGUE AND RESOLVE TO SAVE LIVES DIETARY SODIUM (SALT) FACT SHEET AND GLOBAL CALL TO ACTION

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Introduction.

This fact sheet and global call to action is aimed at hypertension and cardiovascular clinicians and scientists, health advocates, as well as the organizations to which they belong. The 'call' is to align these audiences with the facts on: 1) the burden of disease and key evidence supporting reductions in dietary sodium, 2) the consistent recommendations for reducing dietary sodium from unbiased and comprehensive health and scientific reviews, 3) the current levels of sodium intake, 4) the cost savings from reducing high dietary sodium, 5) the sources of controversial opinions, 6) the current recommended approaches to reduce dietary sodium, and 7) how to stay up to date with evidence on how to reduce dietary sodium and the evolving research on the adverse health effects of a high sodium intake. Hypertension and cardiovascular organizations, and their members, need to become more engaged and advocate for reductions in dietary sodium, and for a greater priority to be given to high quality research on dietary sodium. The World Hypertension League and Resolve to Save Lives are committed to support reductions in dietary sodium as a high priority.

Diets high in sodium (or salt- see table 1) are associated with a high burden of disease from increased blood pressure, cardiovascular disease, premature death and disability.

- Increased blood pressure (BP) is the leading preventable risk factor for heart disease (heart attack and heart failure), stroke, and kidney failure; and a major contributor to premature death, dementia, disability and health care costs (1-4).
- Approximately 30% of hypertension prevalence can be attributed to high dietary sodium, which could result in hypertension in 400 to 500 million people, worldwide (5-7). The evolving definition of hypertension includes all people with a usual systolic blood pressure of ≥ 140 mmHg or diastolic ≥ 90 mmHg and those with or at high risk of cardiovascular disease with a usual systolic blood pressure of ≥ 130 mmHg (8). Reductions in dietary sodium can have a much larger or smaller impact on hypertension prevalence, depending on the population distribution of sodium intake, BP distribution, extent of decrease in dietary sodium and prevalence of other causes of increased BP(7). The INTERSALT study and animal studies indicate high dietary sodium consumption may have a substantively larger life course impact on BP than is identified in the currently available relatively short-term sodium reduction trials and suggest that a component of the increased BP may be irreversible (9, 10). Hence, the adverse blood pressure effects may be greater than currently predicted and greater emphasis may be needed before permanent harm occurs in younger people.
- The Global Burden of Disease Study estimated that in 2019 there were over 1.8 million deaths, and over 44 million disability-adjusted life years lost, as a result of excess dietary sodium (11).
- In populations that consume less than 1000 mg sodium per day, hypertension is rare (12-14).
- A substantial proportion of BP-related disease occurs in people who have an average BP below the levels used to identify hypertension (5, 15). Hence sodium reduction is relevant both for people with hypertension and those with a BP above the optimal level but not yet hypertensive.
- Meta-analyses of randomized controlled trials demonstrate that reducing dietary sodium intake decreases BP in both those with and without hypertension, in children and in adults, and in all ethnic groups (16-20). The association between BP and dietary sodium intake is linear above 800 mg per day, however some individuals are more or less prone to the adverse effects of sodium with a steeper slope in those who have hypertension, are older, or are of black African ancestry (17).

- Meta-analyses of randomized controlled trials show a linear decrease in cardiovascular disease (CVD) with reductions in sodium between 4100 mg and 2300 mg per day (19). Overall, this evidence has been characterized as moderate rather than strong because of an insufficient number of events. However, the one cohort study that the National Academies of Sciences, Engineering, and Medicine viewed as having low bias, found a linear association between sodium intake and mortality with less mortality at sodium intake below 2300 mg/day than above 3600 mg per day (19, 21).
- Other diseases that have been associated with a high sodium intake include gastric cancer (probable procarcinogen) (22, 23), recurrent calcium-oxalate kidney stones (24), osteoporosis (25), obesity (26, 27), Meniere's disease (28, 29), headache (30, 31), and renal and cardiac damage (16). The quality of evidence for many of these disease associations is mixed and they are largely based on observational studies in which it is difficult to confirm causality. A variety of pathophysiologic mechanisms (e.g., increased inflammation and generation of reactive substances (32-35)) support the potential for high sodium intake causing a broad range of disease.

Table 1: Sodium is largely ingested as sodium chloride (salt). The table provides approximate equivalent amounts of sodium and salt.

Equivalent amounts of salt and sodium in differing units (g, mg and mmol)		
Salt (sodium chloride)	Sodium	
	mg	mmol
grams		
1	400	17.4
5	2000	87
5.75	2300	100
teaspoon	~2300	~100

Scientific reviews of the evidence by governmental and nongovernmental health organizations.

- Several independent, comprehensive, and unbiased scientific reviews of the evidence conducted by governmental organizations provide recommendations for reduction in dietary sodium (Table 2) (19, 36-39).
- Similar recommendations for reducing dietary sodium come from most non governmental health and scientific organizations (e.g. Chinese Hypertension League (40), British and Irish Hypertension Society (41), Turkish Hypertension Consensus Report (42), European Societies of Hypertension and of Cardiology (43), American College of Cardiology and American Heart Association (44), Japanese Society of Hypertension (45), Brazilian Hypertension Guideline (46) and a broad range of Canadian Health and Scientific organizations (<https://hypertension.ca/wp-content/uploads/2019/01/Sodium-Fact-Sheet-FINAL-Jan-23-2019.pdf>). The American Heart Association and the American College of Cardiology - American Heart Association Hypertension Recommendations advise that adults should consume less than 1500 mg sodium per day (44).

Table 2: Selected population recommendations for dietary sodium in adults*

Government / governmental organization recommendations	Dietary sodium recommendations for adults, mg per day (salt g per day)
World Health Organization (38)	< 2000 (< 5)
United States and Canada (National Academies of Sciences, Engineering, and Medicine)(19)	< 2300 (<5.75); adequate intake 1500 (3.75)
China (Healthy China Action Plan http://www.nhc.gov.cn/quihuaxxs/s3585u/201907/e9275fb95d5b4295be8308415d4cd1b2.shtml , accessed July 23, 2021)	2000 (5)
European Union (37)	~ 2000 (5)
Australia and New Zealand (39)	< 2000 (< 5); adequate intake 460-920 (1.15-2.3)
Russia (47)	< 2400 (< 6)
United Kingdom (https://pathways.nice.org.uk/pathways/diet/national-policy-on-diet#content=view-node:nodes-reducing-salt-saturated-and-trans-fats , accessed June 18 2021; https://www.nhs.uk/conditions/vitamins-and-minerals/others/ , accessed June 18 2021)	< 2400 (< 6) with the National Institute for Health and Care Excellence indicating an ultimate goal of 1200 (3)
Brazil (48)	< 2000 (< 5)
South Africa (49)	< 2000 (< 5)
Nigeria (50)	< 2000 (< 5)

* several guidelines recommend lower limits for children based on their lower caloric intake.

Globally, people consume too much sodium.

- The average intake of sodium in adults, globally, is estimated to be about 4000 mg per day (salt 10 g per day), with higher intakes in Asia than other regions (51-53). However, there is uncertainty regarding the exact levels of population sodium intake in many countries because few representative population studies have been based on 24 hr. urine collections, the best way of estimating sodium intake (52, 53).
- Only a small portion of dietary sodium intake results from consumption of unprocessed natural foods: < 700 mg per day (salt < 1.75 g per day) in a typical mixed paleolithic non-vegetarian diet and < 200 mg per day (salt < 0.5 g per day) in a paleolithic vegetarian diet (54).
- In many high-income countries, most of the sodium consumed (70-80%) results from addition of sodium during food manufacturing and during food preparation in fast-food and sit-down restaurants. In many middle- and low-income countries, excessive sodium intake results from 'discretionary' addition of sodium, high-sodium sauces and condiments during home cooking and use of saltshakers at the table. However, globalization of the food industry (nutrition transition) is increasing the exposure of populations in middle- and low-income countries to sodium in processed foods (16, 55-58).

- Table 3 provides standardized nomenclature for describing levels of sodium intake recommended by the World Hypertension League, and partner organizations, based on the level of sodium intake recommended by the World Health Organization (12).

Table 3: Standardized nomenclature of levels of sodium intake.

Terminology	Dietary Intake, per day		
	Salt (g)	Sodium (mg)	Sodium (mmol)
Recommended	< 5	< 2000	< 87
High	≥ 5-10	≥ 2000-4000	≥ 87-174
Very high	> 10-15	> 4000-6000	> 176-264
Extremely high	> 15	> 6000	> 264

Reduction in dietary sodium saves lives, health care resources and costs.

- Noncommunicable diseases threaten the global economy and economic development. In response, the World Health Assembly supports nine targets for prevention and control of noncommunicable diseases, including a key recommendation to reduce dietary sodium by 30% by 2025 (59).
- Reducing dietary sodium is one of the most impactful and cost-effective mechanisms to improve population health and is one of the World Health Organization's 'best buys' for prevention of chronic disease (60, 61) (<https://resolvetosavelives.org/cardiovascular-health/lives-saved-calculator>, accessed July 25, 2021).
- A modest 15% reduction in dietary sodium is estimated to prevent 8.5 million deaths over 10 years in 23 developing countries where 80% of chronic disease deaths in developing nations occur (62). An analysis published in 2019 showed that a 30% reduction of sodium, could save 40 million lives globally within 25 years (63).
- In low- and -middle income countries, programs to reduce dietary sodium were estimated to provide a return on investment of 13-18:1 (64, 65).

Controversies related to dietary sodium reduction are based largely on low quality research.

- There are no definitive randomized controlled trials to define the optimum level of sodium intake to reduce mortality and morbidity . Very large, expensive trials of long duration would be required, and it is difficult for individuals, even in a clinical trial setting, to maintain a substantially reduced sodium diet in the current high sodium food environments (66). Extensive funding and innovative research designs have been lacking. Nevertheless, sodium reduction has been associated with prevention of CVD events in randomized comparisons of those assigned to a dietary sodium reduction behavioral intervention compared with usual care during long-term follow up (trial and post-trial experience) even though optimal levels of sodium intake remain undefined (19, 21, 67).
- Several prospective cohort studies in high profile journals have identified paradoxical J- and U-shaped relationships between sodium intake and CVD events, leading to a controversial conclusion that dietary sodium intake should only be reduced in adults with a daily sodium intake > 5000 mg/day (68-70). These studies have been criticized as having significant methodological limitations that could alter sodium intake disease associations (e.g., inaccurate measurement of baseline sodium intake, residual confounding, reverse causality, inadequate adjustment of confounding factors, inadequate sample sizes, and follow-up duration) (71). Many of the controversial studies

that have identified a paradoxical relationship between sodium intake and CVD have employed spot (single untimed spontaneously voided) urine samples to estimate usual sodium intake. The Kawasaki, and other formulae, used to estimate 24 hr. sodium intake based on spot urine measurements have been shown to result in biased estimates of sodium intake compared with estimates based on 24 hr. urinary collections (53, 72, 73), to result in a spurious J-shaped association between sodium intake and mortality, and to provide an inaccurate representation of the association between dietary sodium and BP (74-76).

- A 2019 Consensus Study Report from the National Academies of Sciences, Engineering, and Medicine confirmed an Agency for Healthcare Research and Quality report that many of the controversial studies had a high risk of bias and stated “the paradoxical J- and U-shaped relationships of sodium intake and CVD and mortality are likely observed because of methodological limitations of the individual observational studies” (19).
- Similarly, international scientific organizations and scientific reviews also concluded that low quality research methods and designs were a source of controversy regarding the benefits of reducing the intake of dietary sodium (41, 77-80).
- A major issue is that estimation of dietary sodium intake is challenging because intake varies substantially from day to day, depending on food choice and portion size, as well as random variation (81, 82). The best feasible estimate of dietary sodium intake for individuals in clinical research is based on multiple carefully collected 24 hr. urines on nonsequential days but few studies have used this methodology (79, 83). However, most studies use methods that are very inaccurate with both systematic and random error in assessing usual sodium intake (19, 71, 79, 83-86).
- Other studies with controversial findings have used dietary recall or food frequency questionnaire methods for estimation of 24 hr. dietary sodium intake that are not recommended for this purpose because they are known to underestimate dietary sodium intake and to be unreliable for assessing an individual’s sodium intake (85, 86).
- One study found that a single 24 hr. estimate of usual sodium intake had a spurious J curve association with cardiorenal outcomes that became linear when multiple 24 hr. urine assessments defined usual sodium intake (87).

Resources for keeping up to date on the evolving evidence on dietary sodium and how to reduce dietary sodium.

- The World Hypertension League, with other national and international partners and the Journal of Human Hypertension, have developed multiple mechanisms to ensure that the evidence on dietary sodium intake is maintained up to date.
- The ‘science of salt’, a regularly updated critical appraisal of research evidence related to dietary sodium measurement and consumption, clinical consequences, and effectiveness of programs to reduce dietary sodium intake has been published in the Journal of Clinical Hypertension from 2013 until 2020 and more recently in the Journal of Human Hypertension (52, 88-94) (<https://www.georgeinstitute.org/projects/science-of-salt-weekly>, accessed June 19, 2021).
- Resolve To Save Lives maintains a website that includes best practices in dietary sodium reduction and an updated annotated bibliography which summarizes important evidence on sodium intake, reduction strategies, and measurement (<https://resolvetosavelives.org/cardiovascular-health/sodium>, and <https://linkscommunity.org/toolkit/salt-reduction>; accessed July 18, 2021).

- The Nourishing Framework provides regular updates to governmental policies to promote healthier nutrition including reducing dietary sodium (https://www.iccp-portal.org/system/files/resources/PPA_Nourishing_A5%2520leaflet_web%2520FINAL.pdf, accessed June 18, 2021)
- The Centre for Disease Control and Prevention (USA) has a CDC salt bites newsletter that provides updates on sodium reduction research and activities (<https://www.cdc.gov/salt/index.htm>)
- The WHO Collaborating Centre on Population Salt Reduction at the George Institute for Global Health also regularly reviews national salt reduction activities around the world (95) and features a regular newsletter updating sodium reduction activities and science (<https://whoccsaltreduction.us19.list-manage.com/subscribe?u=6060e9c708cfe0eb3b2814c7b&id=3816288fb8>)
- The Centre for Science in the Public Interest hosts a listserv communications group (subscribe by contacting tschwab@cspinet.org).
- World Action on Salt, Sugar and Health (WASSH) provides regular updates on publications and worldwide salt reduction activities (<http://www.worldactiononsalt.com/news/salt-in-the-news/2021/>; accessed August 7, 2021)
- The World Health Organization and the Pan American Health Organization provide updated national policy actions on dietary sodium reduction (<https://extranet.who.int/nutrition/gina/es/scorecard/sodium> and <https://www.paho.org/en/noncommunicable-diseases-and-mental-health/noncommunicable-diseases-and-mental-health-data-29>, respectively, accessed August 16, 2021)

Multicomponent comprehensive policies can be effective in reducing dietary sodium intake and have been associated with reductions in BP and CVD (96, 97).

- The World Health Organization technical package for dietary sodium reduction 'SHAKE' is based on
 - Surveillance: to measure and monitor the amount of sodium consumed, the main dietary sources of sodium and the amount of sodium in specific foods.
 - Harnessing (through policies that include regulations) the food industry to reduce the amount of sodium added in food processing including the setting of targets and timelines for sodium content of foods (98, 99).
 - Adopting front of package food labels and implementing strategies to reduce misleading marketing of high sodium foods.
 - Knowledge enhancement to empower individuals to eat less sodium.
 - Environmental changes through healthy food procurement policies.
- The World Health Organization has developed global benchmarks for the sodium content of packaged foods (<https://www.who.int/publications/i/item/9789240025097>, accessed Aug 16, 2021) and the Pan American Health Organization updates its regional benchmarks for sodium content of packaged foods (100).
- The Pan American Health Organization (101) and the World Health Organization Regional Office for Europe (https://www.euro.who.int/_data/assets/pdf_file/0006/457611/Accelerating-salt-reduction-in-Europe.pdf accessed August 24, 2021) also have useful technical resources for reducing dietary sodium (102).
- As of 2020, 96 countries have national strategies to reduce dietary sodium intake (95). A recent systematic review of sodium reduction found 4 population-based interventions had

Comment [NRC1]: Change this to reference the new targets when available

reduced average intake levels by 2 or more g/day (Argentina, China, South Korea, Turkey) (95).

- Population-based sodium reduction interventions in Japan, Finland and the United Kingdom have also been associated with reduction in BP and CVD (103-107).
- Governments in more countries should take action to develop and implement multi-sectoral national strategies based on the WHO SHAKE technical package to reduce sodium consumption using implementation research methodology (97, 108, 109).
- Broad policies to reduce dietary sodium and consumption of ultra processed foods to improve nutrition (e.g., mandatory sodium targets, front of pack warning labels, marketing restrictions especially to children, healthy public food procurement, and fiscal measures (i.e. taxes)) are believed to be important to reduce population sodium intake (97, 108).
- Industry-based voluntary approaches to reduce the addition of sodium during food processing have a long history of being ineffective unless they are coupled with strong government oversight and close monitoring (110). Government-led regulated approaches may be more effective (111).
- Public education (particularly through mass media campaigns) and behavior change interventions (e.g., using a COMBI framework) are likely important as part of a broader strategy, especially where discretionary sodium is the major dietary source (112-115). The use of social marketing strategies and 'whole of society' approaches may be beneficial to change social norms and behaviours related to the use of discretionary sodium (112, 116).
- Replacing salt with the use of reduced-sodium salts (where some of the sodium is replaced with potassium) as part of population sodium reduction strategies is also increasingly advocated and likely to be effective in many countries (annotated bibliography https://linkscommunity.org/toolkit/sodium-reduction-an-annotated-bibliography#_Toc14352403, accessed July 25, 2021) (117-123). Reduced sodium salts and condiments may also help to reduce sodium intake from packaged foods, restaurant foods and discretionary use (124). In China, reduced sodium salt decreased stroke, major cardiovascular events and death rates in people who have had a prior stroke or were aged 60 or over (122).
- Integrating efforts to reduce dietary sodium with those to optimize dietary potassium and iodine through salt fortification are important to enhance health (117, 118, 125, 126).
- Close monitoring of sodium intake, sources of sodium in the diet, sodium levels in foods, as well as knowledge, attitudes and behaviours of the public are essential components of sodium reduction programs (101, 108).

National hypertension and cardiovascular organizations.

Hypertension and cardiovascular organizations have important roles in research, interpretation of research, education, and advocacy. We call on these organizations to:

- Promote research, presentations and publications on high quality research related to dietary sodium emphasizing the importance of high-quality research methodology, data that is in the public domain and where interpretation is free of commercial bias.
- Educate members on the health risks of high dietary sodium and how to reduce sodium intake.
- Broadly disseminate relevant information on dietary sodium integrated with other healthy nutrition and physical activity advice to the public and patients.

- Educate policy and decision makers on the health benefits of lowering BP among normotensive and hypertensive people, regardless of age.
- Advocate for policies and regulations that will contribute to population-wide reductions in dietary sodium, possibly in collaboration with other health advocacy groups. The World Health Organization has released a Sodium Country Score Card to track governmental progress to reduce dietary sodium that can be used by cardiovascular organizations and experts in advocacy. (<https://extranet.who.int/nutrition/gina/es/scorecard/sodium> accessed July 18, 2021).
- Provide opportunities for members to be involved in advocacy. Reach the public and policy makers by promoting and advocating through media releases on dietary sodium.
- Promote coalition building, increase organizational capacity for advocacy, and develop advocacy tools to promote civil society actions.
- Be cautious about the role of low-quality research, research from domains that are not publicly accessible to be independently validated, and of investigators with commercial conflicts of interest in generating controversy related to dietary sodium reduction.
- Global networks of concerned health care professionals and scientists have formed to help support reductions in dietary sodium. World Action on Salt, Sugar and Health (WASSH) sponsors World Salt Awareness Week annually during the second week of March (www.worldactiononsalt.com/, accessed June 12, 2021). Other organizations with a similar goal include the European Salt Action Network (euro.who.int/en/health-topics/disease-prevention/nutrition/policy/member-states-action-networks/reducing-salt-intake-in-the-population), WHO Collaborating Centre on Population Salt Reduction at the George Institute for Global Health (<https://www.georgeinstitute.org/projects/world-health-organization-collaborating-centre-for-population-salt-reduction-who-cc-salt>, accessed July 18, 2021), and Action on Salt (<http://www.actiononsalt.org.uk/>, accessed June 12, 2021).
- Resolve to Save Lives, a global initiative to save 100 million lives in 30 years, has reducing dietary sodium as one of its four pillars (63).

Public health dietary sodium research priorities.

Research is urgently required to accelerate the reduction of dietary sodium in populations.

Priorities include research to:

- Better define optimal policies and interventions for reducing dietary sodium in populations including discretionary sodium, sodium from street foods, sodium from packaged foods, and sodium from restaurants. This research is needed in a wide variety of settings and cultures to better understand the obstacles and facilitators to dietary sodium reduction programs.
- Better define optimal interventions for reducing dietary sodium in individuals including discretionary sodium, sodium from street foods, sodium from packaged foods, and sodium from restaurants.
- Accelerate the uptake of best practices in sodium reduction particularly for low- and middle-income countries (127, 128).
- Develop more rapid, feasible and accurate methods to assess individual and population average sodium intake, sources of dietary sodium and levels of sodium in specific foods.
- Better define potential interactions between dietary sodium and potassium in causing disease.

- Implement large scale randomized controlled trials to define optimal levels of sodium and potassium intake in the general population to prevent disease, if feasible designs can be developed.
- Implement large scale randomized controlled trials to assess long term health and common non cardiovascular diseases reported to be associated with high sodium intake if feasible designs can be developed.
- Define the role of salt (consumed in excess) as a vehicle for providing nutrients that are deficient in the diet (e.g., iodine, fluoride, folate).
- Better identify individuals more or less prone to adverse health consequences from dietary sodium ('salt sensitivity').
- Explore the intake of sodium and vulnerability to and complications from COVID -19 infection.
- Uncover the causes and solutions for misinformation on dietary sodium, the role of low-quality research and the role of commercial conflicts of interest in hindering dietary sodium reduction programs.

World Hypertension League Actions.

- The World Hypertension League and Resolve to Save Lives have led the development of this fact sheet and call to action targeted at hypertension and cardiovascular experts and scientists and their organizations to support achievement of the WHO recommended sodium intake levels.
- The World Hypertension League has developed the Graham MacGregor Award and Excellence Awards to recognize organizations and individuals who have contributed to efforts to reduce dietary sodium at the population level.
(<http://www.whleague.org/index.php/news-awards-recognition>, accessed June 1, 2021).
- Assisting the global and national efforts to reduce dietary sodium is a top priority of the World Hypertension League.

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