Hypertension

REVIEW

Potassium-Enriched Salt Substitutes: A Review of Recommendations in Clinical Management Guidelines

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ABSTRACT: Excess dietary sodium intake and insufficient dietary potassium intake are both well-established risk factors for hypertension. Despite some successful initiatives, efforts to control hypertension by improving dietary intake have largely failed because the changes required are mostly too hard to implement. Consistent recent data from randomized controlled trials show that potassium-enriched, sodium-reduced salt substitutes are an effective option for improving consumption levels and reducing blood pressure and the rates of cardiovascular events and deaths. Yet, salt substitutes are inconsistently recommended and rarely used. We sought to define the extent to which evidence about the likely benefits and harms of potassium-enriched salt substitutes has been incorporated into clinical management by systematically searching guidelines for the management of hypertension or chronic kidney disease. We found incomplete and inconsistent recommendations about the use of potassium-enriched salt substitutes in the 32 hypertension and 14 kidney guidelines that we reviewed. Discussion among the authors identified the possibility of updating clinical guidelines to provide consistent advice about the use of potassium-enriched salt for hypertension control. Draft wording was chosen to commence debate and progress consensus building: strong recommendation for patients with hypertension—potassium-enriched salt with a composition of 75% sodium chloride and 25% potassium chloride should be recommended to all patients with hypertension, unless they have advanced kidney disease, are using a potassium supplement, are using a potassium-sparing diuretic, or have another contraindication. We strongly encourage clinical guideline bodies to review their recommendations about the use of potassium-enriched salt substitutes at the earliest opportunity. ***(Hypertension.* 2024;81:400–414. DOI: 10.1161/HYPERTENSIONAHA.123.21343.)** • **Supplement Material**.

Key Words: blood pressure ■ cardiovascular diseases ■ guidelines ■ hyperkalemia ■ hypertension ■ salts

Higher levels of dietary sodium intake and lower levels of dietary potassium intake are both associated with raised blood pressure (BP) and increased risks of cardiovascular disease and premature death.[1–5] There is a strong evidence base indicating that both reducing sodium intake and increasing potassium intake will reduce these risks through their BP-lowering effects.[6,7] As a consequence, multiple authoritative bodies acknowledge these risks[8,9] and have made recommendations related to sodium and potassium intake. The World Health Organization (WHO), for example, has guidelines that make strong population-wide recommendations to reduce sodium intake and increase potassium intake.[8,9] For sodium, the WHO has also explicitly proposed that all member states reduce mean population intake by 30% by 2025, with a target maximum intake of 2.0-g/day sodium (5.0-g/day salt),[10] in support of global efforts to reduce the noncommunicable disease burden by one quarter.

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Nonstandard Abbreviations and Acronyms

BP	blood pressure
DECIDE	Diet, Exercise and Cardiovascular Health
WHO	World Health Organization
SSaSS	Salt Substitute and Stroke Study

Mean global sodium intake was recently estimated to be 4.3 g/day,[8] which equates to about 10.8 g/day of table salt. The most recent corresponding estimated value for mean global potassium intake is about 2.3 g/day.[11] These current intake values are substantially different from norms during hominid evolution when the estimated intake of sodium was about 0.5 g/day and the estimated potassium intake was about 10 g/day. Current sodium consumption varies substantially between populations with the estimated intake highest in the WHO Western Pacific region (6.2-g/day sodium and 15.6-g/day salt) driven by high consumption levels in China and lowest in Africa (2.7-g/day sodium and 6.7-g/day salt; Figure).

Sodium reduction has been identified as a potentially highly cost-effective means for preventing hypertension and cardiovascular diseases around the world.[12–14] It is listed as a best-buy intervention by the WHO, which has developed the SHAKE (Surveillance, Harness industry, Adopt standards for labelling and marketing, Knowledge, Environment) package to support national sodium reduction efforts.[15] Multiple countries have commenced implementation of sodium reduction campaigns that include various strategies, for example, consumer education, food voluntary and mandatory reformulation, taxation, and food labeling.[16] Average global sodium consumption has not, however, fallen over the past decade, and the projected decline over coming years is small—global sodium intake is expected to be 4.23 (10.6-g/day salt) g/day in 2025 and 4.16 (10.4-g/day salt) g/day in 2030 (Figure).[8]

On the contrary, average potassium intake falls significantly below the WHO-recommended intake of 3.5 g/day, as indicated by various studies—≈1.0 g/day in India,[17] 1.4 g/day in China,[18] and 1.8 g/day in West Africa.[19] The reasons for low potassium intake vary but are mainly due to limited agricultural capacity for cultivating crops with high potassium content[20] and, in particular, limited consumption of potassium-rich fruits and vegetables.[21] The direct emphasis on increasing dietary potassium intake often lacks guideline recommendations, despite a focus on promoting the consumption of fresh fruits and vegetables (although many are not rich in potassium).[21] These efforts have largely proven to be ineffective, with many people finding difficulty in adhering to recommendations, in both higher and lower resource settings.[22] Due to the importance of both sodium and potassium intake, the WHO recommends an intake of <2000 mg of sodium and >3510 mg of potassium daily, resulting in a sodium-to-potassium ratio of ≤1.[23]

The mechanistic rationale for increasing dietary potassium in BP control is explained in recent pretranslational studies.[24,25] Potassium-rich diets reduce sodium reabsorption along the proximal and distal nephron, analogous to a diuretic, to promote sodium delivery to the collecting duct, which drives potassium secretion and excretion. Reciprocally, low-potassium diets provoke

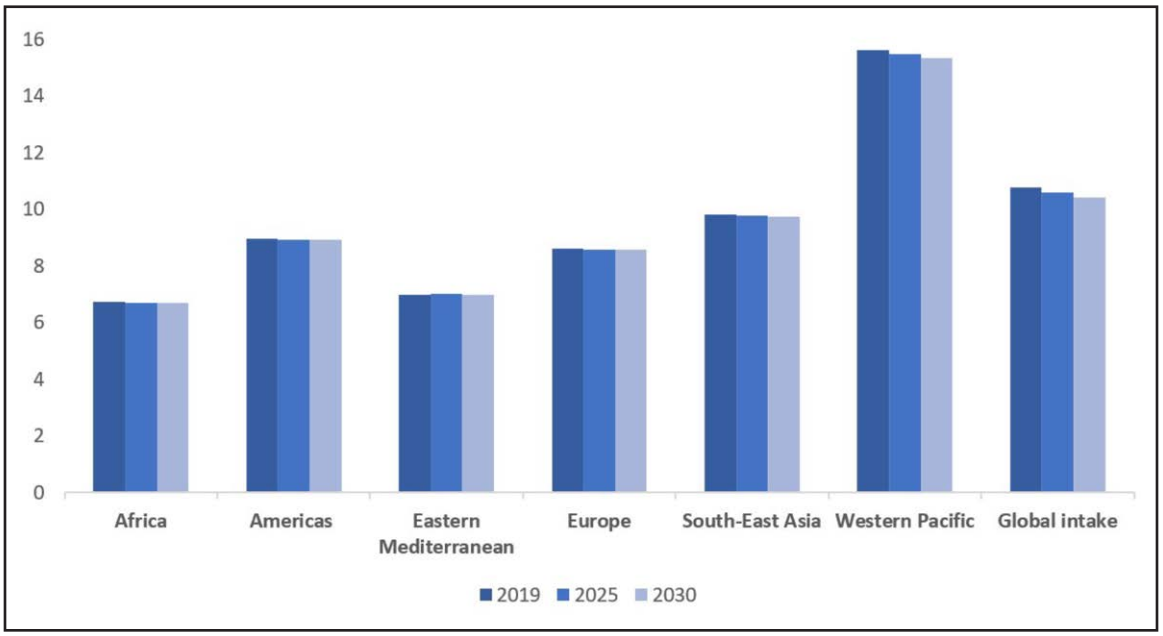

Figure. Estimated mean population dietary salt intake (g/d) by the World Health Organization (WHO) regions in 2019 and projected for 2025 and 2030.
Data from WHO global report on sodium reduction.[8]

sodium reabsorption and retention to minimize delivery to the collecting duct reducing potassium secretion and excretion.

The chief problem with trying to reduce dietary sodium intake or increase dietary potassium intake is that the required changes by individuals, the food industry, and the government are mostly too difficult to achieve. Despite many efforts over many years, it has proved too hard to change consumer behaviors, reset the palates of populations, modify the food system, or persuade governments to implement regulatory instruments in the face of continued resistance from the food industry. Nonetheless, reducing dietary sodium and increasing dietary potassium remain public health priorities with huge potential for disease prevention. Novel approaches are required to address these priorities.[5]

POTASSIUM-ENRICHED, SODIUM-REDUCED SALT SUBSTITUTES

Potassium-enriched, sodium-reduced salt substitutes, or potassium-enriched salts, are products that can be used as a direct switch for regular salt (sodium chloride) for seasoning, preserving, and manufacturing foods. Potassium-enriched salts are made by replacing a proportion of the sodium chloride in regular salt with potassium chloride. Sometimes, other nonpotassium substitutes, such as magnesium sulfate, may also be added.[26] The sodium content of potassium-enriched salts ranges from 0% to 100%.[26] Other terms used to describe the products include low-sodium salt, potassium salt, mineral salt, and sodium-reduced salt.[26] The first formal clinical identification of potassium-enriched salt as an option for BP control was included in the 1995 WHO and International Society of Hypertension guidelines, recommending that substitution of common salt by mineral salt low in sodium and rich in potassium and magnesium has been found to be effective in reducing BP in older hypertensives.[27]

A strong body of evidence supports making a like-for-like switch from regular salt to potassium-enriched salt in patients with hypertension.[28] A key benefit of switching from regular salt to potassium-enriched salt is that it lowers BP through the joint effects of reducing sodium intake and supplementing potassium intake. In addition, potassium-enriched salts seem to be a feasible way of achieving change in sodium and potassium intake in a way that other approaches to reducing sodium and increasing potassium do not. For example, in a recent large-scale and long-term trial that tested the effects of switching to potassium-enriched salt, there was 92% adherence to potassium-enriched salt 5 years after trial commencement with sustained effects objectively demonstrated by 5-year urinary sodium, urinary potassium, and BP levels.[28] The main reasons why adherence was so high in this and other studies of potassium-enriched salt seem to be that the taste is similar to regular salt and the product can be used like regular salt with no requirement for behavior change in cooking or seasoning.[29–31]

Potassium-enriched salt is also of interest because it can be used to replace regular salt in many food-manufacturing processes including in salty sauces and seasoning that are particularly common in Asian countries.[32] Potassium-enriched salt could also be switched to regular salt in restaurants and other settings where food is consumed outside of the home. These options are important in those countries, particularly higher income and middle- and high-income Asian countries, where the majority of dietary sodium and potassium intake derives from packaged and restaurant foods.[33]

The effects of potassium-enriched salts on clinical outcomes have been defined in a series of randomized trials.[34] The most recent systematic review and meta-analyses of 21 trials (31 949 participants) have confirmed the beneficial effects of potassium-enriched salt on a range of clinical outcomes. Across the 19 trials that reported BP outcomes, mean systolic BP was reduced by 4.61 mm Hg and mean diastolic BP was reduced by 1.61 mm Hg. In the 5 trials that reported cardiovascular outcomes, potassium-enriched salt reduced major cardiovascular events by 11%, total mortality by 11%, and cardiovascular mortality by 13%.[34] Importantly, effects were observed across diverse population subgroups and geographies though the majority of the data were accrued in patients under clinical management for hypertension.

We further explored whether any other trials have been performed after this review (search terms in Table S1). Three trials were identified (Table S2), including the DECIDE (Diet, Exercise and Cardiovascular Health) study in China.[35] All trials reached the consensus that potassium-enriched salt led to a notable decrease in BP, with the reduction ranging from 4.6 to 7.1 mm Hg for systolic BP and 1.1 to 2.3 mm Hg for diastolic BP.[35–37] The DECIDE study further reported a 40% reduction in cardiovascular events.[35]

Many of these trials were conducted in regions with notably low dietary potassium consumption, such as rural China[28] and Peru.[38] The average benefit of salt substitutes may be less pronounced in countries with higher baseline potassium intake, such as the United States, though benefits will vary substantially between individuals in every country.[39]

The first ever released 2023 WHO Global Report on Hypertension has proposed that potassium-enriched salt is an affordable strategy to reduce BP and prevent cardiovascular events.[40] Additionally, the recent WHO Global Report on Sodium Intake Reduction suggested that countries explore ways to increase the availability and use of potassium-enriched, sodium-reduced salt substitutes for BP control and other health benefits.[8] At the same time, the US Food and Drug Administration is updating regulations to support the use of salt

Table 1. Sodium and Potassium Recommendations in Global, Regional, and National Hypertension Management Guidelines

Organization	Year	Title	Sodium recommendation	Potassium recommendation
Global				
WHO	2021	Guideline for the pharmacological treatment of hypertension in adults[44]	Reducing salt intake (to <5 g daily)	
International Society of Hypertension	2020	International Society of Hypertension Global Hypertension Practice Guidelines[45]	Reduce salt added when preparing foods and at the table.	Other beneficial foods and nutrients include those high in magnesium, calcium, and potassium, such as avocados, nuts, seeds, legumes, and tofu.
			Avoid or limit consumption of high-salt foods, such as soy sauce, fast foods, and processed foods, including breads and cereals high in salt.	Lifestyle modification should place additional focus on salt restriction and increased intake of vegetables and fruits (potassium intake).
Regional				
ESH	2023	ESH guidelines for the management of arterial hypertension, the task force for the management of arterial hypertension of the ESH endorsed by the European Renal Association, and the International Society of Hypertension[46]	Sodium-restricted diet is recommended for improved BP control.	Increased potassium consumption, preferably via dietary modification, is recommended for adults with elevated BP, except for patients with advanced CKD.
			Dietary salt (NaCl) restriction is recommended for adults with elevated BP to reduce BP. Salt (NaCl) restriction to <5 (≈2-g sodium) g/d is recommended.	
ESC and ESH	2018	2018 ESC/ESH Guidelines for the management of arterial hypertension[47]	Salt restriction to <5 g/d is recommended.	
ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA	2017	2017 ACC/AHA/AAPA/ABC/ACPM/AGS/AphA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high BP in adults[9]	Sodium reduction is recommended for adults with elevated BP or hypertension.	Potassium supplementation, preferably in dietary modification, is recommended for adults with elevated BP or hypertension, unless contraindicated by the presence of CKD or the use of drugs that reduce potassium excretion.
				Good sources of dietary potassium include fruits and vegetables, as well as low-fat dairy products, selected fish and meats, nuts, and soy products. Four to 5 servings of fruits and vegetables will usually provide 1500–>3000 mg of potassium. This can be achieved by a diet such as the DASH diet that is high in potassium content.
Latin American Society of Hypertension	2017	Guidelines on the management of arterial hypertension and related comorbidities in Latin America[48]	Reduction of sodium intake (<6 and >3 g).	Increase in dietary K+ intake
Southern African Hypertension Society	2014	South African hypertension practice guideline 2014[49]	Dietary Na+ <100 mmol or 6 g of NaCl per d	
National/regional				
National Heart Center/Saudi Heart Association, Saudi Arabia	2023	National Heart Center/Saudi Heart Association 2023 guidelines on the management of hypertension[50]	Reducing salt (sodium-containing salts) intake (limit to a maximum of 2–4 g daily)	
VSH, Vietnam	2022	Highlights of the 2022 VSH guidelines for the diagnosis and treatment of arterial hypertension and the collaboration of the VSH task force with the contribution of the Vietnam National Heart Association[51]	Reduce sodium intake.	Increase dietary potassium intake.

(*Continued*)

Table 1. Continued

Organization	Year	Title	Sodium recommendation	Potassium recommendation
Taiwan Society of Cardiology and Taiwan Hypertension Society	2022	2022 guidelines of the Taiwan Society of Cardiology and the Taiwan Hypertension Society for the Management of Hypertension[52]	Sodium intake should be restricted to 2–4 g/d (5–10 g of salt) for better BP control and a lower CV risk.	Apart from sodium intake, a growing body of evidence also shows that potassium supplement is beneficial for better BP control and CV outcomes.
			Salt reduction (<6 g/d) is not recommended as a nondrug therapy for gestational hypertension.	
Hong Kong Health Bureau, Working Group on Primary Care, Task Force on Conceptual Model and Preventive Protocols, Hong Kong	2021	Hong Kong Reference Framework for Hypertension Care for Adults in Primary Care Settings Revised Edition 2021[53]	Encourage all hypertensive patients to reduce salt intake to less than 5 (around 1 teaspoon of table salt) g/d and not to use added salt.	A potassium-rich diet may help to reduce BP.
				Potassium should be from food sources, not from supplements. Many fruits and vegetables, for example, potato, spinach, tomato, lettuce, banana, orange, and apple, some dairy products, for example, yoghurt, and fish are rich sources of potassium.
				However, a potassium-rich diet should be avoided in patients with chronic renal failure or taking potassium-sparing diuretics.
Hypertension Canada, Canada	2020	2020 comprehensive guidelines for the prevention, diagnosis, risk assessment, and treatment of hypertension in adults and children of hypertension Canada[54]	To prevent hypertension and reduce BP in hypertensive adults, consider reducing sodium intake toward 2000 (5 g of salt or 87 mmol of sodium) mg/d.	In patients not at risk of hyperkalemia, increase dietary potassium intake to reduce BP.
Philippine Society of Hypertension, Philippines	2020	Executive summary of the 2020 clinical practice guidelines for the management of hypertension in the Philippines[55]	Sodium restriction to as low as 1500 mg/d. The American Heart Association recommends that sodium intake be limited to 2300 mg/d (roughly half a teaspoon of table salt) in most healthy individuals and 1500 mg/d in people with prehypertension or hypertension.	DASH meal plan that is low in sodium and high in dietary potassium can be recommended for all patients with hypertension without renal insufficiency.
Hypertension Branch of the Chinese Geriatrics Society, National Clinical Research Center for Geriatric Diseases-Chinese Alliance of Geriatric Cardiovascular Disease, China	2019	2019 Chinese guideline for the management of hypertension in the elderly[56]	Sodium-restricted and potassium-rich diet may help the patients control their BP. WHO recommends that daily salt intake should be <6 g, and moderate salt restriction should be applied to elderly patients with hypertension.	Elderly people are encouraged to eat varieties of fresh vegetables, fruits, fish, bean products, coarse grains, skim milk, and other foods rich in potassium, calcium, dietary fiber, and polyunsaturated fatty acids.
Polish Society of Hypertension, Poland	2019	2019 guidelines for the management of hypertension[57]	Reduce salt intake from usual 9–12 to <5 g/d (2-g Na)	Increase the intake of vegetables and other plant products (4–5 servings; 300–400 g/d) rich in potassium, for example, tomatoes (300 g/d, excluding patients with renal failure or an increased risk of hyperkalemia).
Association of Physicians of India), Cardiological Society of India, Indian College of Physicians, and Hypertension Society of India, India	2019	Indian guidelines on hypertension[58]	Salt intake <5 g/d. Patients should be advised to avoid added salt, processed foods, and salt-containing foods, such as pickles, papads, chips, chutneys, and preparations containing baking powder.	Adequate potassium intake from fresh fruits and vegetables may improve BP control in hypertensives.
Japanese Society of Hypertension, Japan	2019	The Japanese Society of Hypertension guidelines for the management of hypertension[59]	The target of salt reduction is <6 g/d.	In view of the target of daily potassium intake (≥3000 mg) proposed in the Dietary Nutrient Intake Standards for Japanese 2015, more active potassium intake is recommended.

(*Continued*)

Table 1. Continued

Organization	Year	Title	Sodium recommendation	Potassium recommendation
				For patients with CKD, potassium intake needs to be restricted (≤2000 mg/d at stage 3b and ≤1500 mg/d at stage 4 or higher), and appropriate guidance about vegetable/fruit intake is needed.
				In Japan where salt intake is high but potassium intake is low, we may consider it important to provide guidance on salt reduction plus active intake of potassium. For hypertension in older people, generally, a potassium-rich diet is recommended, but hyperkalemia must be considered in patients with renal dysfunction.
National Institution for Health and Care Excellence, United Kingdom	2019	Hypertension in adults: diagnosis and management[60]	Encourage people to keep their dietary sodium intake low, either by reducing or substituting sodium salt, as this can reduce BP.	Do not offer calcium, magnesium, or potassium supplements as a method for reducing BP.
Thai Hypertension Society, Thailand	2019	2019 Thai guidelines on the treatment of hypertension: executive summary[61]	Limiting the amount of salt and sodium in food	
Brunei Cardiac Society, Brunei	2019	Brunei Darussalam national hypertension guideline 2019[62]	Limit sodium intake to <2 (5 g of salt) g/d.	An increase in dietary potassium by increasing the amount of fruit and vegetables consumed every day has been shown to lower BP.
Chinese Hypertension League and the Chinese Society of Cardiology, China	2018	2018 Chinese guidelines for prevention and treatment of hypertension[63]	To reduce sodium intake, gradually reduce the daily salt intake to <6 g.	Increasing potassium intake. The main measures are (1) increasing the intake of potassium-rich foods (fresh vegetables, fruits, and beans) and (2) individuals with good kidney function can choose low-sodium potassium-rich alternative salts. It is not recommended to take potassium supplements (including drugs) to reduce BP. Patients with renal insufficiency should consult a doctor before potassium supplementation.
Malaysian Society of Hypertension, Malaysia	2018	Clinical practice guidelines management of hypertension 5th edition (2018)[64]	Reduce salt intake to <2 g of sodium or <5 g of salt per d (about 1 teaspoonful of salt).	Increase dietary potassium; this can be achieved by eating fruits, vegetables, nuts, and legumes.
Korean Society of Hypertension, Korea	2018	2018 Korean Society of Hypertension guidelines for the management of hypertension[65]	Restriction of salt intake <6 g of salt per d	Eating potassium-rich foods can help prevent hypertension and can lower BP in hypertensive patients. However, attention should be paid to potassium intake in patients with impaired renal function.
Pakistan Hypertension League, Pakistan	2018	3rd national hypertension guideline for the prevention, detection, evaluation & management of hypertension[66]	Salt intake: ≤100 mmol/d, 2.4-g Na, and 6-gm NaCl	Potassium intake: 120 mmol/d
Saudi Hypertension Management Society, Saudi Arabia	2018	Saudi hypertension guidelines 2018[67]	Reduction of daily salt intake to <5 g/d (about 1teaspoon; 2 g of sodium)	Foods rich in potassium are vegetables, fruit, dairy products, nuts, and so forth. A natural source of potassium is preferable.
				Pharmacological potassium supplementation is not recommended.
Brazilian Society of Cardiology, Brazil	2017	2017 guidelines for arterial hypertension management in primary health care in Portuguese language countries[68]	Salt restriction (portion per d): ≈6 g (3000 mg of sodium)	
Singapore Hypertension Society, Singapore	2017	Ministry of Health clinical practice guidelines on hypertension[69]	Advise patient to restrict salt intake to 5–6 g/d.	
National Heart Foundation of Australia, Australia	2016	Guideline for the diagnosis and management of hypertension in adults-2016[70]	Reduce salt intake to <6 g/d for primary prevention and <4 g/d for secondary prevention.	For patients with normal renal function, increasing dietary potassium can reduce systolic BP by 4–8 mm Hg in patients with hypertension. This can be achieved by eating a wide variety of fruits and vegetables, plain unsalted nuts, and legumes. Patients taking potassium-sparing diuretics must limit potassium intake to avoid severe hyperkalemia.

(*Continued*)

Table 1. Continued

Organization	Year	Title	Sodium recommendation	Potassium recommendation
Oman Heart Association, Oman	2015	2015 Oman Heart Association guidelines for the management of hypertension[71]	Moderate sodium reduction to a level of 2.4 (6 g of salt per d) g/d is recommended for both prevention and treatment of hypertension.	
Egyptian Hypertension Society, Egypt	2014	Egyptian hypertension guidelines[72]	Reduce salt intake to <5 g of NaCl per d. Salt restriction is essential, particularly in the elderly, diabetics, and CKD.	
French Society of Hypertension, France	2013	Management of hypertension in adults: the 2013 French Society of Hypertension Guidelines[73]	Reduce excessive consumption of salt.	
Directorate General of Health Services Ministry of Health and Family Affairs, Bangladesh	2013	National guidelines for the management of hypertension in Bangladesh[74]	Limiting total salt intake to <5 g/d	

AAPA indicates American Academy of Physician Assistants; ABC, Association of Black Cardiologists; ACC, American College of Cardiology; ACPM, American College of Preventive Medicine; AGS, American Geriatrics Society; AHA, American Heart Association; APhA, American Pharmacists Association; ASH, American Society of Hypertension; ASPC, American Society for Preventive Cardiology; BP, blood pressure; CKD, chronic kidney disease; CV, cardiovascular; DASH, dietary approaches to stop hypertension; ESC, European Society of Cardiology; ESH, European Society of Hypertension; NMA, National Medical Association; PCNA, Preventive Cardiovascular Nurses Association; VSH, Vietnamese Society of Hypertension; and WHO, World Health Organization.

substitutes as a mechanism to reduce sodium content in processed foods.[41] As for sodium reduction, several studies project that salt substitutes have the potential to be a cost-effective approach to lowering BP at a population level.[42,43]

HYPERTENSION MANAGEMENT GUIDELINE RECOMMENDATIONS ON POTASSIUM-ENRICHED SALT SUBSTITUTES

There has been long-standing recognition of the importance of sodium in the causation of high BP, and therefore, hypertension management guidelines have for many iterations included recommendations for dietary sodium reduction. Some, though many fewer, have also made recommendations related to enhancing dietary potassium consumption. Less clear is the extent to which recommendations relating to the use of potassium-enriched salt have been included. Accordingly, we performed a review of global, regional, and national hypertension guidelines by searching the databases of Medline and Web of Science for guidelines published between January 1, 2013, and June 21, 2023 (Table S3). We also screened the reference lists of relevant publications and retrieved a total of 32 hypertension management guidelines from the initial 847 hits returned by the searches. The search process is documented in a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart (Figure S1).

The 32 guidelines identified included those from 2 global organizations, 5 regional organizations, and 25 country organizations (Table 1). All were searched for recommendations related to dietary sodium reduction, dietary potassium supplementation, and the use of potassium-enriched salts. All included specific reference to sodium reduction, with most recommending to reduce salt intake to a level between 4 and 6 g/day for the primary or secondary prevention of cardiovascular disease (Table 1).[44,46–50,52–55,57–59,62,63,65,66,68–72,74,75] Many made specific recommendations on dietary potassium intake,[9,45,46,48,51–60,62–67,70] and 4—the Chinese, European, Taiwanese, and British—made specific mention of potassium-enriched salt (Table 2).[46,52,60,63] Of those, 2 made a specific recommendation for the use thereof,[46,63] one simply mentioned the recently completed SSaSS trial (Salt Substitute and Stroke Study),[52] and one included only a warning that potassium-enriched salt should not be used in those in whom it may be contraindicated.[60]

POTASSIUM-ENRICHED SALTS AND THE RISK OF HYPERKALEMIA

A frequently raised concern about the use of potassium-enriched salts is the risk of hyperkalemia. This is raised particularly in the context of patients with chronic kidney disease, where there is a longstanding advice to avoid dietary potassium, but, sometimes, more broadly to other population subgroups. The National Institution for Health and Care Excellence in the United Kingdom,[60] for example, advises that salt substitutes containing potassium chloride should not be used by older people, people with diabetes, pregnant women, people with kidney disease, and people taking some antihypertensive drugs, such as ACE inhibitors and angiotensin II receptor blockers.

The case for avoiding potassium-enriched salt in the presence of advanced kidney disease is widely accepted, but the rationale for broad contraindications

Table 2. Potassium-Enriched Salt Recommendations in Hypertension Management Guidelines

Organization	Year	Potassium-enriched salt substitute recommendation
European Society of Hypertension[46]	2023	In adults with hypertension consuming a high-sodium diet (most Europeans), salt substitutes replacing part of the NaCl with KCl are recommended to reduce BP and the risk for CVD.
Taiwan Society of Cardiology and Taiwan Hypertension Society[52]	2022	The recently published SSaSS (Salt Substitute and Stroke Study) examined whether salt substitutes (75% NaCl and 25% KCl by mass), compared with regular salt (100% NaCl), could provide beneficial effects on CV and safety outcomes in an open-label, cluster-randomized trial involving people from 600 villages in rural China.
National Institution for Health and Care Excellence, United Kingdom[60]	2019	Salt substitutes containing KCl should not be used by older people, people with diabetes, pregnant women, people with kidney disease, and people taking some antihypertensive drugs, such as ACE inhibitors and angiotensin II receptor blockers.
Chinese Hypertension League and Chinese Society of Cardiology, China[63]	2018	Individuals with good kidney function can choose low-sodium potassium-rich alternative salts. It is not recommended to take potassium supplements (including drugs) to reduce BP.

BP indicates blood pressure; CKD, chronic kidney disease; and CV, cardiovascular.

like those applied in the United Kingdom is unclear. The most recent review of trials of potassium-enriched salt[34] identified no effect on hyperkalemia risk. Salt substitute–induced hyperkalemia has been identified in the recently reported DECIDE salt study though sustained elevations were uncommon and there were no adverse effects associated with the observed elevations.[35] Of note, the DECIDE salt design included people regardless of potential hyperkalemia risk, whereas all other studies have used some form of screening to avoid use in those potentially contraindicated. In SSaSS, the largest trial to collect safety data related to potassium-enriched salts, the highly pragmatic design meant that there was no information about the occurrence of biochemical hyperkalemia, but the rate of serious adverse events attributed to hyperkalemia was not higher with potassium-enriched salt compared with regular salt. Neither was there any increased risk of sudden cardiac death that might be attributed to hyperkalemia-induced arrhythmia.[28] Because most trials took steps to exclude participants at elevated risk of hyperkalemia, primarily those with advanced kidney disease or using medications that elevate serum potassium, good data about the effects of potassium-enriched salt in these groups are not available.[34,76] In some, including SSaSS, exclusion was, however, based only on patient reports with no direct measurement of kidney function suggesting that population-wide use may be safe and effective.

MANAGEMENT GUIDELINES FOR CHRONIC KIDNEY DISEASE AND RECOMMENDATIONS ON POTASSIUM-ENRICHED SALT SUBSTITUTES

Given long-standing clinical advice to restrict dietary potassium consumption among patients with chronic kidney disease, we also investigated chronic kidney disease management guidelines for recommendations related to potassium-enriched salt. In parallel, we also extracted data referencing dietary sodium and dietary potassium. Once again, we searched the databases of Medline and Web of Science for relevant guidelines published between January 1, 2013, and June 21, 2023 (Table S4), and, as before, screened the reference lists of relevant publications for additional data sources. We identified a total of 14 chronic kidney disease management guidelines (Table 3) and documented the search process in a PRISMA flowchart (Figure S2).

Of the 14 guidelines, there was 1 from a global organization, 2 from regional organizations, and 11 from national organizations. All the guidelines stressed sodium restriction[76–89] (Table 3) though some, such as the Japanese Society of Nephrology, set a lower limit below which sodium intake should not be further reduced because of perceived risks of harm.[84] However, a recent meta-analysis of studies classifying sodium intake with 24-hour urine collections found a direct linear association between sodium intake and cardiovascular events, demonstrating that sodium restriction is safe.[90] Seven guidelines provided advice about the value of a potassium-restricted diet to avoid hyperkalemia (Table 3).[76,78–81,88,89] Only 4 of these management guidelines specifically mentioned potassium-enriched salt (Table 4). Three guidelines[76,78,80] warned that salt substitutes rich in potassium are not recommended for patients with CKD, while the fourth, the Chinese Clinical Practice Guideline,[79] advised of potential benefit from careful use of salt substitutes during the predialysis phase. The Kidney Disease Improving Global Outcomes guideline advises exercising caution when using salt substitutes in individuals with advanced CKD of stage 4 and stage 5 but not for individuals at early stages[76] (Table 4).

ALIGNING THE EVIDENCE WITH GUIDELINE RECOMMENDATIONS FOR USE OF POTASSIUM-ENRICHED SALT

The evidence base leaves little doubt that switching from regular salt to potassium-enriched salt will lower BP in patients with hypertension by jointly reducing sodium intake and increasing potassium intake.[91] It is also clear

Table 3. Sodium and Potassium Recommendations in Global, Regional, and National CKD Management Guidelines

Organization	Year	Title	Sodium recommendation	Potassium recommendation
Global				
KDIGO	2021	KDIGO 2021 clinical practice guideline for the management of blood pressure in CKD[64]	Targeting a sodium intake of <2 g of sodium per d (or <90 mmol of sodium per d or <5 g of NaCl per d) in patients with high BP and CKD	The dietary approaches to stop hypertension-type diet or use of salt substitutes that are rich in potassium may not be appropriate for patients with advanced CKD or those with hyporeninemic hypoaldosteronism or other causes of impaired potassium excretion because of the potential for hyperkalemia.
Region				
Europe Renal Association	2014	A European renal best practice position statement on the KDIGO clinical practice guideline for the management of blood pressure in nondialysis-dependent CKD: an endorsement with some caveats for real-life application[77]	Lowering salt intake to <90 mmol/d deserves particular attention, as hypertension in CKD should be considered predominantly secondary to a reduced capability of the kidney to handle salt loading.	
Caring for Australian & New Zealanders with Kidney Impairment, Australia and New Zealand	2013	KHA-CARI Guideline: Early CKD: Detection, prevention and management[78]	Early CKD patients restrict their dietary sodium intake to 100 mmol/d (or 2.3 g sodium or 6 g salt per d) or less.	Patients with CKD should not use salt substitutes that contain high amounts of potassium salts. Early CKD patients with persistent hyperkalemia restrict their dietary potassium intake with the assistance of an appropriately qualified dietitian.
National				
Chinese Experts Group of the Guideline for the Management of "CKD-PeriDialysis"	2022	Chinese Clinical Practice Guideline for the Management of "CKD-PeriDialysis"-the Periods before and in the Early Stage of Initial Dialysis[79]	No >100 mmol/d (2.3 g sodium or 6-g salt per d)	In populations with high sodium intake as in China, replacing some of the sodium with potassium reduces systolic and diastolic BP in the adult population.
				In the predialysis phase, depending on the potassium level of the patient, substituting 25% of the daily dietary sodium with potassium may also reduce BP but must be done carefully.
Kidney Health, Australia	2020	CKD management in primary care[80]	No >100 mmol/d (2.3 g sodium or 6-g salt per d)	In people with CKD and eGFR ≥30 mL/min per 1.73 m^2, avoid salt substitutes that contain high amounts of potassium salts. If persistent hyperkalemia is present, refer to an accredited dietitian for nutrition assessment and advice about dietary potassium restriction.
National Kidney Foundation	2020	KDOQI clinical practice guideline for nutrition in CKD: 2020 update[81]	In adults with CKD 3–5, CKD 5D, or post-transplantation, sodium intake should be limited to <100 mmol/d (or <2.3 g/d) to reduce BP and improve volume control.	In adults with CKD 3–5D or post-transplantation, it is reasonable to adjust dietary potassium intake to maintain serum potassium within the normal range.
				In adults with CKD 3–5D or post-transplantation with either hyperkalemia or hypokalemia, we suggest that dietary or supplemental potassium intake should be based on the individual needs of a patient and clinician judgment.
				Potassium is widely distributed in foods, ranging from fruits, vegetables, legumes, and nuts, as well as dairy and meat products. Notably, potassium content is available on food labels in many countries, and consumers and practitioners could have a better idea of its content, especially foods that are processed.
Department of Veterans Affairs Department of Defense, Australia	2019	VA/DoD clinical practice guideline for the management of CKD[82]	A sodium intake of 90–100 mmol (2070–2300 mg/d) is generally accepted and consistent with the KDOQI guidelines of NKF.	

(*Continued*)

Table 3. Continued

Organization	Year	Title	Sodium recommendation	Potassium recommendation
Malaysian Society of Nephrology, Malaysia	2018	Clinical practice guidelines 2018: management of CKD (second edition)[83]	Restrict sodium intake to <2400 mg/d (1 teaspoon of table salt).	
Japanese Society of Nephrology, Japan	2018	Essential points from evidence-based clinical practice guidelines for CKD 2018[84]	Restricting salt intake to <6 g/d to prevent hypertension, proteinuria, and CVD in patients with CKD. Set a lower limit for each patient with 3 g/d as a guide because extreme salt restriction could be harmful.	
An Expert Pane of Indian Nephrologists, India	2017	Management of hypertension in CKD: consensus statement by an expert panel of Indian nephrologists[85]	In nondialysis-dependent CKD patients: lower salt intake to <90 (<2 g) mmol/d of sodium, which corresponds to 5 g of NaCl, unless contraindicated.	
GAIN and the Northern Ireland Nephrology Forum, Northern Ireland	2015	Northern Ireland guidelines for the management of CKD, updated[86]	Reduce dietary salt intake to <6 g/d.	
New Zealand Ministry of Health, New Zealand	2015	Managing CKD in primary care: national consensus statement[87]	Many patients require 2 or 3 antihypertensive agents, and advice on sodium restriction to <100 mmol/d is essential for most.	
National Institute for Health and Care Excellence, United Kingdom	2014	CKD: early identification and management of CKD in adults in primary and secondary care (partial update)[88]	Offer dietary advice about potassium, phosphate, calorie, and salt intake appropriate to the severity of CKD.	Dietary potassium should not be restricted routinely, only in those with raised serum levels, as potassium-containing foods are required for a healthy balanced diet and restrictions need to be carefully monitored.
India Society of Nephrology, India	2013	Indian CKD guideline[89]	Lowering salt intake to <2 g/d of sodium (5 g of NaCl), unless contraindicated. For patients on maintenance hemodialysis, fluid, and salt intake should be such that interdialytic weight gain does not exceed 1–1.5 kg.	Potassium intake has to be advised according to serum potassium levels.

BP indicates blood pressure; CKD, chronic kidney disease; DoD, Department of Defense; eGFR, estimated glomerular filtration rate; GAIN, Guidelines and Audit Implementation Network; KDIGO, Kidney Disease: Improving Global Outcomes; KDOQI, Kidney Disease Outcomes Quality Initiative; and VA, Department of Veterans Affairs.

that the BP reduction achieved with potassium-enriched salt will protect against serious complications of hypertension, such as stroke and premature death. Furthermore, the overviews of the trials suggest that a BP-lowering effect will be achieved across diverse subsets of people with hypertension though the magnitude of the fall will vary according to factors such as the starting BP, the baseline levels of sodium and potassium consumption, and how much dietary salt consumption can be switched. Given that potassium-enriched salt is one of the few dietary interventions that patients are likely to be able to adhere to long term, it is logical for all patients with hypertension to be considered for the use of potassium-enriched salt.

At the same time, it is important that patients with hypertension are not harmed by a potassium-enriched salt, so contraindications to use must be part of any recommendation on their use. These should include the presence of advanced kidney disease and the concomitant use of potassium-sparing diuretics or potassium supplements. However, it is almost certainly not appropriate to exclude all older people, all people with diabetes, and all people taking antihypertensive drugs, such as ACE inhibitors and angiotensin II receptor blockers. Unless there is an undiagnosed intercurrent advanced kidney disease that results in misuse of potassium-enriched salt, most will have a low risk of hyperkalemia, which will be outweighed by a high likelihood of benefiting from additional BP reduction. Many older people, people with diabetes, and people taking antihypertensive drugs, such as ACE inhibitors and angiotensin II receptor blockers, have difficulty in controlling hypertension and were observed to achieve benefits, without any evidence of harm, in the SSaSS trial.[28]

Data to directly support the use of potassium-enriched salt outside the clinical hypertension setting are more limited though the totality of the available evidence suggests that the use of potassium-enriched salt would also reduce BP among the general population.

Table 4. Potassium-Enriched Salt Recommendations in CKD Management Guidelines

Organization	Year	Potassium-enriched salt substitute recommendation
Global		
Kidney Disease: Improving Global Outcomes[76]	2021	Use of salt substitutes that are rich in potassium may not be appropriate for patients with advanced CKD or those with hyporeninemic hypoaldosteronism or other causes of impaired potassium excretion because of the potential for hyperkalemia.
Region		
Caring for Australian and New Zealanders With Kidney Impairment, Australia and New Zealand[78]	2013	Patients with CKD should not use salt substitutes that contain high amounts of potassium salts.
National		
Chinese Experts Group of the Guideline for the Management of CKD-PeriDialysis[79]	2022	In the predialysis phase, depending on the potassium level of the patient, substituting 25% of the daily dietary sodium with potassium may also reduce BP but must be done carefully.
Kidney Health, Australia[80]	2020	Avoid salt substitutes that contain high amounts of potassium salts in people with CKD and eGFR 30 mL/min per 1.73 m.

BP indicates blood pressure; CKD, chronic kidney disease; and eGFR, estimated glomerular filtration rate.

The chief concern about the population-wide use of potassium-enriched salt relates to the possibility that individuals with undiagnosed advanced kidney disease might use potassium-enriched salt and develop hyperkalemia as a consequence. While trials that test this question directly have not been done, high-quality modeling studies suggest a large net benefit from population-wide use of potassium-enriched salt, even under worst-case assumptions about harm from hyperkalemia.[43,92] The benefit-risk balance is defined primarily by the high global prevalence of hypertension (about 32% of adults),[93] the low prevalence of chronic kidney disease (about 10%[94] with only 2% at late-stage end-stage kidney disease),[95] and the potential for patients with chronic kidney disease to benefit from BP lowering, not just be harmed by hyperkalemia. Other data also suggest that concerns about hyperkalemia from dietary potassium consumption may be overestimated.[96,97] A 2023 study of 367 patients with stage 1 to 4 chronic kidney disease reported no association between dietary potassium consumption and blood potassium levels.[97] This is a finding directly comparable to that observed in 212 patients with dialysis- and nondialysis-dependent chronic kidney disease reported a few years earlier.[98]

RECOMMENDED TEXT FOR INCLUSION IN CLINICAL MANAGEMENT GUIDELINES

The adoption of agreed standardized wording to describe recommendations for the use of potassium-enriched salt would provide consumers, clinicians, and governments worldwide reassurance about the best practices. To this end, we have drafted boilerplate text that can form the basis for discussion about updates to clinical management guidelines worldwide. This text will be shared with guideline groups to seek input and achieve widespread clinical use.

RECOMMENDED STANDARD WORDING FOR GUIDANCE ABOUT THE USE OF POTASSIUM-ENRICHED SALT IN CLINICAL MANAGEMENT GUIDELINES

Strong Recommendation for Patients With Hypertension

Potassium-enriched salt with a composition of ≈75% sodium chloride and 25% potassium chloride should be recommended to all patients with hypertension, unless they have advanced kidney disease, are using a potassium supplement, are using a potassium-sparing diuretic, or have another contraindication.

Conditional Recommendation for the General Population

If you have to add salt to foods, potassium-enriched salt with a composition of ≈75% sodium chloride and 25% potassium chloride can be recommended for use by the general population in settings where there is a low likelihood that people with advanced kidney disease (stages 4 and 5) will be undiagnosed by the health system and contraindications to use can be printed on product packaging.

The strong recommendation for use in patients with hypertension is underpinned by the premise that the clinical contact inherent in the management of hypertension will make it possible to control the risk of hyperkalemia.[34,35] The conditional recommendation for use in the general population depends on there being clear enunciation of the contraindications to use on the package labeling.[99]

It is important to increase the production capacity and align with the growing market demand for salt substitutes. Key stakeholders, such as the American Heart Association and the American Society of Nephrology,

and also global organizations are strongly encouraged to engage with manufacturers and provide heart-healthy recommendations for using potassium-enriched salt substitutes as alternatives to traditional salt (including in processed, packaged, and prepared foods). By replacing traditional salt with potassium-enriched salt substitutes in the household, the cumulative protective effects are likely applicable across the entire life course and may lead to enhanced BP control from childhood and the prevention of cardiovascular disease into adulthood.

CONCLUSIONS

A strong body of evidence supports the replacement of regular salt with potassium-enriched salt in patients with hypertension. There is also a case for the general population making the switch to potassium-enriched salt where risks of misuse can be managed. Current clinical guidelines offer incomplete and inconsistent recommendations about the use of potassium-enriched salt substitutes, as well as reducing dietary sodium intake and increasing dietary potassium intake. We urge all relevant clinical guideline bodies to debate the value of potassium-enriched salt as a routine adjunct to drug therapy and update their recommendations accordingly. Evidence suggests that there are likely to be substantial benefits from the much wider use of potassium-enriched salt with a composition of 75% sodium chloride and 25% potassium chloride, by patients with hypertension. As part of their updates, clinical guideline bodies should provide consistent recommendations about the use of potassium-enriched salt substitutes and actively promote these recommendations to their constituents.

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REFERENCES

1. GBD 2017 Diet Collaborators. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2019;393:1958–1972. doi: 10.1016/S0140-6736(19)30041-8
2. Mente A, O'Donnell M, Rangarajan S, McQueen M, Dagenais G, Wielgosz A, Lear S, Ah STL, Wei L, Diaz R, et al. Urinary sodium excretion, blood pressure, cardiovascular disease, and mortality: a community-level prospective epidemiological cohort study. *Lancet*. 2018;392:496–506. doi: 10.1016/S0140-6736(18)31376-X
3. Zhou B, Stamler J, Dennis B, Moag-Stahlberg A, Okuda N, Robertson C, Zhao L, Chan Q, Elliott P. Nutrient intakes of middle-aged men and women in China, Japan, United Kingdom, and United States in the late 1990s: the INTERMAP study. *J Hum Hypertens*. 2003;17:623–630. doi: 10.1038/sj.jhh.1001605
4. He FJ, Tan M, Ma Y, MacGregor GA. Salt reduction to prevent hypertension and cardiovascular disease: JACC state-of-the-art review. *J Am Coll Cardiol*. 2020;75:632–647. doi: 10.1016/j.jacc.2019.11.055
5. Greer RC, Marklund M, Anderson CA, Cobb LK, Dalcin AT, Henry M, Appel LJ. Potassium-enriched salt substitutes as a means to lower blood pressure: benefits and risks. *Hypertension*. 2020;75:266–274. doi: 10.1161/hypertensionaha.119.13241
6. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, Obarzanek E, Conlin PR, Miller ER, Simons-Morton DG, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. *N Engl J Med*. 2001;344:3–10. doi: 10.1056/nejm200101043440101
7. Cook NR, Appel LJ, Whelton PK. Lower levels of sodium intake and reduced cardiovascular risk. *Circulation*. 2014;129:981–989. doi: 10.1161/CIRCULATIONAHA.113.006032
8. World Health Organization. *WHO Global Report on Sodium Intake Reduction*. World Health Organization; 2023.
9. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Dennison Himmelfarb C, DePalma SM, Gidding S, Jamerson KA, Jones DW, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2018;71:e127–e248. doi: 10.1016/j.jacc.2017.11.006
10. World Health Organization. *Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020*. World Health Organization; 2013.
11. Reddin C, Ferguson J, Murphy R, Clarke A, Judge C, Griffith V, Alvarez A, Smyth A, Mente A, Yusuf S, et al. Global mean potassium intake: a systematic review and Bayesian meta-analysis. *Eur J Nutr*. 2023;62:2027–2037. doi: 10.1007/s00394-023-03128-6
12. He FJ, MacGregor GA. A comprehensive review on salt and health and current experience of worldwide salt reduction programmes. *J Hum Hypertens*. 2009;23:363–384. doi: 10.1038/jhh.2008.144
13. Murray CJ, Lauer JA, Hutubessy RC, Niessen L, Tomijima N, Rodgers A, Lawes CMM, Evans DB. Effectiveness and costs of interventions to lower systolic blood pressure and cholesterol: a global and regional analysis on reduction of cardiovascular-disease risk. *Lancet*. 2003;361:717–725. doi: 10.1016/s0140-6736(03)12655-4
14. Bibbins-Domingo K, Chertow GM, Coxson PG, Moran A, Lightwood JM, Pletcher MJ, Goldman L. Projected effect of dietary salt reductions on future cardiovascular disease. *N Engl J Med*. 2010;362:590–599. doi: 10.1056/nejmoa0907355
15. World Health Organization. The SHAKE technical package for salt reduction. WHO. 2016. Accessed July 6, 2023. https://iris.who.int/bitstream/handle/10665/250134/WHO-NMH-PND-16.4-eng.pdf?sequence=1
16. Santos JA, Tekle D, Rosewarne E, Flexner N, Cobb L, Al-Jawaldeh A, Kim WJ, Breda J, Whiting S, Campbell N, et al. A systematic review of salt reduction initiatives around the world: a midterm evaluation of progress towards the 2025 global non-communicable diseases salt reduction target. *Adv Nutr*. 2021;12:1768–1780. doi: 10.1093/advances/nmab008

17. Anand S, Shivashankar R, Kondal D, Garg V, Khandelwal S, Gupta R, Krishnan A, Amarchand R, Poulter N, Reddy KS, et al. Potassium Intake in India: opportunity for mitigating risks of high-sodium diets. *Am J Prev Med*. 2020;58:302–312. doi: 10.1016/j.amepre.2019.09.017
18. Tan M, He FJ, Wang C, MacGregor GA. Twenty-four-hour urinary sodium and potassium excretion in China: a systematic review and meta-analysis. *J Am Heart Assoc*. 2019;8:e012923. doi: 10.1161/JAHA.119.012923
19. Mizéhoun-Adissoda C, Houinato D, Houehanou C, Chianea T, Dalmay F, Bigot A, Aboyans V, Preux PM, Bovet P, Desport JC. Dietary sodium and potassium intakes: data from urban and rural areas. *Nutrition*. 2017;33:35–41. doi: 10.1016/j.nut.2016.08.007
20. Sardans J, Peñuelas J. Potassium control of plant functions: ecological and agricultural implications. *Plants (Basel)*. 2021;10:419. doi: 10.3390/plants10020419
21. World Health Organization. *Guideline: Potassium Intake for Adults and Children*. World Health Organization; 2012.
22. Swanepoel B, Schutte AE, Cockeran M, Steyn K, Wentzel-Viljoen E. Sodium and potassium intake in South Africa: an evaluation of 24-hour urine collections in a white, black, and Indian population. *J Am Soc Hyperten*. 2016;10:829–837. doi: 10.1016/j.jash.2016.08.007
23. World Health Organization. *WHO Guideline: Sodium Intake for Adults and Children*. World Health Organization; 2012.
24. Ellison DH, Welling P. Insights into salt handling and blood pressure. *N Engl J Med*. 2021;385:1981–1993. doi: 10.1056/NEJMra2030212
25. McDonough AA, Fenton RA. Potassium homeostasis: sensors, mediators, and targets. *Pflugers Archiv*. 2022;474:853–867. doi: 10.1007/s00424-022-02718-3
26. Yin X, Liu H, Webster J, Trieu K, Huffman MD, Miranda JJ, Marklund M, Wu JHY, Cobb LK, Li KC, et al. Availability, formulation, labeling, and price of low-sodium salt worldwide: environmental scan. *JMIR Public Health Surveill*. 2021;7:e27423. doi: 10.2196/27423
27. Zanchetti A, Chalmers JP, Gyarfas I, Arakawa K, Cohn JN, Hamet P, Hansson L, Mancia G. Prevention of hypertension and associated cardiovascular disease a 1995 statement: conclusions from a joint WHO/ISH meeting. *Clin Exp Hypertens*. 1996;18:581–593. doi: 10.3109/10641969609088987
28. Neal B, Wu Y, Feng X, Zhang R, Zhang Y, Shi J, Zhang J, Tian M, Huang L, Li Z, et al. Effect of salt substitution on cardiovascular events and death. *N Engl J Med*. 2021;385:1067–1077. doi: 10.1056/NEJMoa2105675
29. Li N, Prescott J, Wu Y, Barzi F, Yu X, Zhao L, Neal B; China Salt Substitute Study Collaborative Group. The effects of a reduced-sodium, high-potassium salt substitute on food taste and acceptability in rural northern China. *Br J Nutr*. 2008;101:1088–1093. doi: 10.1017/S0007114508042360
30. Saavedra-Garcia L, Bernabe-Ortiz A, Gilman RH, Diez-Canseco F, Cárdenas MK, Sacksteder KA, Miranda JJ. Applying the triangle taste test to assess differences between low sodium salts and common salt: evidence from Peru. *PLoS One*. 2015;10:e0134700. doi: 10.1371/journal.pone.0134700
31. Maleki A, Soltanian AR, Zeraati F, Sheikh V, Poorolajal J. The flavor and acceptability of six different potassium-enriched (sodium reduced) iodized salts: a single-blind, randomized, crossover design. *Clini Hypertens*. 2016;22:1–5. doi: 10.1186/s40885-016-0054-9
32. Ajenikoko A, Ide N, Shivashankar R, Ge Z, Marklund M, Anderson C, Atun A, Thomson A, Henry ME, Cobb LK. Core strategies to increase the uptake and use of potassium-enriched low-sodium salt. *Nutrients*. 2021;13:3203. doi: 10.3390/nu13093203
33. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Böhm M, Christiaens T, Cifkova R, De Backer G, Dominiczak A, et al. 2013 ESH/ESC guidelines for the management of arterial hypertension. *Eur Heart J*. 2013;34:2159–2219. doi: 10.1093/eurheartj/eht151
34. Yin X, Rodgers A, Perkovic A, Huang L, Li KC, Yu J, Wu Y, Wu JHY, Marklund M, Huffman MD, et al. Effects of salt substitutes on clinical outcomes: a systematic review and meta-analysis. *Heart*. 2022;108:1608–1615. doi: 10.1136/heartjnl-2022-321332
35. Yuan Y, Jin A, Neal B, Feng X, Qiao Q, Wang H, Zhang R, Li J, Duan P, Cao L, et al. Salt substitution and salt-supply restriction for lowering blood pressure in elderly care facilities: a cluster-randomized trial. *Nat Med*. 2023;29:973–981. doi: 10.1038/s41591-023-02286-8
36. Yu J, Thout SR, Li Q, Tian M, Marklund M, Arnott C, Huffman MD, Praveen D, Johnson C, Huang L, 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;114:185–193. doi: 10.1093/ajcn/nqab054
37. Che L, Song W, Zhang Y, Lu Y, Cheng Y, Jiang Y. A randomized, double-blind clinical trial to evaluate the blood pressure lowing effect of low-sodium salt substitution on middle-aged and elderly hypertensive patients with different plasma renin concentrations. *J Clin Hypertens (Greenwich)*. 2022;24:140–147. doi: 10.1111/jch.14396
38. Bernabe-Ortiz A, Saly Rosas VG, Ponce-Lucero V, Cárdenas MK, Carrillo-Larco RM, Diez-Canseco F, Pesantes MA, Sacksteder KA, Gilman RH, Miranda JJ. Effect of salt substitution on community-wide blood pressure and hypertension incidence. *Nat Med*. 2020;26:374–378. doi: 10.1038/s41591-020-0754-2
39. Whelton PK. Sodium and potassium intake in US adults. *Circulation*. 2018;137:247–249. doi: 10.1161/CIRCULATIONAHA.117.031371
40. World Health Organization. *Global Report on Hypertension: The Race Against a Silent Kille*. World Health Organization; 2023.
41. Food and Drug Administrations. Use of Salt Substitutes to Reduce the Sodium Content in Standardized Foods. Accessed September 4, 2023. https://www.federalregister.gov/documents/2023/04/10/2023-06456/use-of-salt-substitutes-to-reduce-the-sodium-content-in-standardized-foods
42. Taylor C, Hoek AC, Deltetto I, Peacock A, Ha DTP, Sieburg M, Hoang D, Trieu K, Cobb LK, Jan S, et al. The cost-effectiveness of government actions to reduce sodium intake through salt substitutes in Vietnam. *Arch Public Health*. 2021;79:1–13. doi: 10.1186/s13690-021-00540-4
43. Marklund M, Singh G, Greer R, Cudhea F, Matsushita K, Micha R, Brady T, Zhao D, Huang L, Tian M, et al. Estimated population wide benefits and risks in China of lowering sodium through potassium enriched salt substitution: modelling study. *BMJ*. 2020;369:m824. doi: 10.1136/bmj.m824
44. World Health Organization. *Guideline for the Pharmacological Treatment of Hypertension in Adults*. World Health Organization; 2021.
45. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, Ramirez A, Schlaich M, Stergiou GS, Tomaszewski M, et al. 2020 International Society of Hypertension global hypertension practice guidelines. *Hypertension*. 2020;75:1334–1357. doi: 10.1161/HYPERTENSIONAHA.120.15026
46. Mancia G, Kreutz R, Brunström M, Burnier M, Grassi G, Januszewicz A, Muiesan ML, Tsioufis K, Agabiti-Rosei E, Algharably EAE, et al. 2023 ESH guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the European Society of Hypertension Endorsed by the European Renal Association (ERA) and the International Society of Hypertension (ISH). *Hypertension*. 2023;41:1874–2071. doi: 10.1097/HJH.0000000000003480
47. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, Clement DL, Coca A, de Simone G, Dominiczak A, et al; ESC Scientific Document Group. 2018 ESC/ESH guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). *Eur Heart J*. 2018;39:3021–3104. doi: 10.1093/eurheartj/ehy339
48. Task Force of the Latin American Society of Hypertension. Guidelines on the management of arterial hypertension and related comorbidities in Latin America. *J Hypertens*. 2017;35:1529–1545. doi: 10.1097/HJH.0000000000001418
49. Seedat YK, Rayner BL, Veriava Y. Hypertension guideline working group. South African hypertension practice guideline 2014. *Cardiovasc J Afr*. 2014;25:288–294. doi: 10.5830/CVJA-2014-062
50. Alhabeeb W, Tash AA, Alshamiri M, Arafa M, Balghith MA, ALmasood A, Eltayeb A, Elghetany H, Hassan T, Alshemmari O. National Heart Center/Saudi Heart Association 2023 guidelines on the management of hypertension. *J Saudi Heart Assoc*. 2023;35:16–39. doi: 10.37616/2212-5043.1328
51. Van Minh H, Van Huy T, Long DPP, Tien HA. Highlights of the 2022 Vietnamese Society of Hypertension guidelines for the diagnosis and treatment of arterial hypertension: the collaboration of the Vietnamese Society of Hypertension (VSH) task force with the contribution of the Vietnam National Heart Association (VNHA). *J Clin Hypertens (Greenwich)*. 2022;24:1121–1138. doi: 10.1111/jch.14580
52. Wang TD, Chiang CE, Chao TH, Cheng HM, Wu YW, Wu YJ, Lin YH, Chen MY, Ueng KC, Chang WT, et al. 2022 guidelines of the Taiwan Society of Cardiology and the Taiwan Hypertension Society for the management of hypertension. *Acta Cardiol Sin*. 2022;38:225–325. doi: 10.6515/ACS.202205_38(3).20220321A
53. Food and Health Bureau Hong Kong. Hong Kong reference framework for hypertension care for adults in primary care settings. 2021. Accessed May 8, 2023. https://www.healthbureau.gov.hk/pho/rfs/src/pdfviewer/web/pdf/hypertensioncareforadults/en/13_en_RF_HT_full.pdf
54. Rabi DM, McBrien KA, Sapir-Pichhadze R, Nakhla M, Ahmed SB, Dumanski SM, Butalia S, Leung AA, Harris KC, Cloutier L, et al. Hypertension Canada's 2020 comprehensive guidelines for the prevention, diagnosis, risk assessment, and treatment of hypertension in adults and children. *Can J Cardiol*. 2020;36:596–624. doi: 10.1016/j.cjca.2020.02.086

55. Ona DID, Jimeno CA, Jasul GV Jr, Bunyi MLE, Oliva R, Gonzalez-Santos LE, Mercado-Asis LB, Luz VA, Leus AG, Diaz ABF, et al. Executive summary of the 2020 clinical practice guidelines for the management of hypertension in the Philippines. *J Clin Hypertens (Greenwich)*. 2021;23:1637–1650. doi: 10.1111/jch.14335
56. Hua Q, Fan L, Li J; Joint Committee for Guideline Revision. 2019 Chinese guideline for the management of hypertension in the elderly. *J Geriatr Cardiol*. 2019;16:67–99. doi: 10.11909/j.issn.1671-5411.2019.02.001
57. Tykarski A, Filipiak KJ, Januszewicz A, Litwin M, Narkiewicz K, Prejbisz A, Ostalska-Nowicka D, Widecka K, Kostka-Jeziorny K. 2019 guidelines for the management of hypertension—part 1–7. *Arterial Hypertens*. 2019;23:41–87. doi: 10.5603/ah.a2019.0008
58. Shah SN, Munjal Y, Kamath SA, Wander GS, Mehta N, Mukherjee S, Kirpalani A, Gupta P, Shah H, Rohatgi R, et al. Indian guidelines on hypertension-IV (2019). *J Hum Hypertens*. 2020;34:745–758. doi: 10.1038/s41371-020-0349-x
59. Umemura S, Arima H, Arima S, Asayama K, Dohi Y, Hirooka Y, Horio T, Hoshide S, Ikeda S, Ishimitsu T, et al. The Japanese Society of Hypertension guidelines for the management of hypertension (JSH 2019). *Hypertens Res*. 2019;42:1235–1481. doi: 10.1038/s41440-019-0284-9
60. NICE Guidance. Diagnosis and management of hypertension in adults. 2019. Accessed May 30, 2023. https://www.nice.org.uk/guidance/ng136/resources/hypertension-in-adults-diagnosis-and-management-pdf-66141722710213
61. Kunanon S, Chattranukulchai P, Chotruangnapa C, Kositanurit W, Methavigul K, Boonyasirinant T, Rawdaree P, Tejavanija S, Wataganara T, Satirapoj B, et al. 2019 Thai guidelines on the treatment of hypertension: executive summary. *J Med Assoc Thai*. 2021;104:1729–1738.
62. Cardiac Society Brunei Darussalam. Brunei Darussalam National Hypertension Guideline 2019. Accessed June 12, 2023. https://cardiacsociety.org.bn/wp-content/uploads/2019/10/National-Hypertension-Guidelines.pdf
63. Joint Committee for Guideline Revision. 2018 Chinese guidelines for prevention and treatment of hypertension-a report of the revision committee of Chinese guidelines for prevention and treatment of hypertension. *J Geriatr Cardiol*. 2019;16:182–245. doi: 10.11909/j.issn.1671-5411.2019.03.014
64. Malaysian Society of Hypertension MoHM, Academy of Medicine of Malaysia. Clinical practice guidelines on the management of hypertension 2018. 5th ed. 2018. Accessed May 5, 2023. https://www.moh.gov.my/moh/resources/penerbitan/CPG/MSH%20Hypertension%20CPG%202018%20V3.8%20FA.pdf.
65. Kim HC, Ihm SH, Kim GH, Kim JH, Kim KI, Lee HY, Lee JH, Park JM, Park S, Pyun WB, et al. 2018 Korean Society of Hypertension guidelines for the management of hypertension: part I-epidemiology of hypertension. *Clin Hypertens*. 2019;25:1–6. doi: 10.1186/s40885-019-0121-0
66. Pakistan Hypertension League. 3rd National Guideline for the Prevention, Detection, Evaluation and Management of Hypertension. 2020. Accessed May 5, 2023. https://phlpk.org/wp-content/uploads/2022/09/3rd-Hypertension-Guideline-2018-PHL.pdf
67. Saudi Hypertension Management Society. Saudi Hypertension Guidelines 2018. Accessed June 8, 2023. https://shms.wildapricot.org/resources/Guidelines/Saudi%20Hypertension%20Guideline%202018.pdf
68. Oliveira GMM, Mendes M, Malachias MVB, Morais J, Moreira O, Coelho AS, Capingana DP, Azevedo V, Soares I, Menete A, et al. 2017 guidelines for arterial hypertension management in primary health care in Portuguese language countries. *Arq Bras Cardiol*. 2017;109:389–396. doi: 10.5935/abc.20170165
69. Tay JC, Sule AA, Chew E, Tey JS, Lau T, Lee S, Lee SH, Leong CK, Lim ST, Low LP, et al. Ministry of health clinical practice guidelines: hypertension. *Singapore Med J*. 2018;59:17–27. doi: 10.11622/smedj.2018007
70. Gabb GM, Mangoni AA, Anderson CS, Cowley D, Dowden JS, Golledge J, Hankey GJ, Howes FS, Leckie L, Perkovic V, et al. Guideline for the diagnosis and management of hypertension in adults—2016. *Med J Aust*. 2016;205:85–89. doi: 10.5694/mja16.00526
71. El-Deeb MH, Sulaiman KJ, Al-Riyami AA, Mohsin N, Al-Mukhaini M, Al-Lamki M, Al-Busaidi N, Al-Salmi I, Al-Lawati J, Al-Rawahi N, et al; Oman Heart Association. 2015 Oman Heart Association guidelines for the management of hypertension: practical recommendations from the Oman Heart Association (OHA). *High Blood Press Cardiovas Prev*. 2015;22:83–97. doi: 10.1007/s40292-014-0074-z
72. Ibrahim MM. Egyptian hypertension guidelines. *Egypt Heart J*. 2014;66:79–132. doi: 10.1016/j.ehj.2014.03.001
73. Blacher J, Halimi JM, Hanon O, Mourad JJ, Pathak A, Schnebert B, Girerd X; French Society of Hypertension. Management of hypertension in adults: the 2013 French Society of Hypertension guidelines. *Fundam Clin Pharmacol*. 2014;28:1–9. doi: 10.1111/fcp.12044
74. World Health Organization. National guidelines for management of hypertension in Bangladesh. 2013. Accessed May 22, 2023. https://cdn.who.int/media/docs/default-source/searo/bangladesh/pdf-reports/year-2013/national-guidelines-for-management-of-hypertension-in-bangladesh.pdf?sfvrsn=2244c473_2
75. Campbell NR, Lackland DT, Niebylski ML, Orias M, Redburn KA, Nilsson PM, Zhang XH, Burrell L, Horiuchi M, Poulter NR, et al; International Council of Cardiovascular Prevention and Rehabilitation. 2016 dietary salt fact sheet and call to action: the World Hypertension League, International Society of Hypertension, and the International Council of Cardiovascular Prevention and Rehabilitation. *J Clin Hypertens (Greenwich)*. 2016;18:1082–1085. doi: 10.1111/jch.12894
76. Cheung AK, Chang TI, Cushman WC, Furth SL, Hou FF, Ix JH, Knoll GA, Muntner P, Pecoits-Filho R, Sarnak MJ, et al. KDIGO 2021 clinical practice guideline for the management of blood pressure in chronic kidney disease. *Kidney Int*. 2021;99:S1–S87. doi: 10.1016/j.kint.2020.11.003
77. Verbeke F, Lindley E, Van Bortel L, Vanholder R, London G, Cochat P, Wiecek A, Fouque D, Van Biesen W. A European Renal Best Practice (ERBP) position statement on the Kidney Disease: Improving Global Outcomes (KDIGO) clinical practice guideline for the management of blood pressure in non-dialysis-dependent chronic kidney disease: an endorsement with some caveats for real-life application. *Nephrol Dial Transplant*. 2014;29:490–496. doi: 10.1093/ndt/gft321
78. Johnson DW, Atai E, Chan M, Phoon RKS, Scott C, Toussaint ND, Turner GL, Usherwood T, Wiggins KJ. KHA-CARI Guideline: early chronic kidney disease: detection, prevention and management. *Nephrology (Carlton)*. 2013;18:340–350. doi: 10.1111/nep.12052
79. Chinese Experts Group of the Guideline for the Management of 'CKD-PeriDialysis'. Chinese Non-Government Medical Institutions Association. Chinese clinical practice guideline for the management of "CKD-PeriDialysis"-the periods prior to and in the early-stage of initial dialysis. *Kidney Int Rep*. 2022;7:S531–S558. doi: 10.1016/j.ekir.2022.10.001
80. Kidney Health Australia. *Chronic Kidney Disease (CKD) Management in Primary Care*. 4th ed. Kidney Health Australia; 2020.
81. Ikizler TA, Burrowes JD, Byham-Gray LD, Campbell KL, Carrero JJ, Chan W, Fouque D, Friedman AN, Ghaddar S, Goldstein-Fuchs DJ, et al. KDOQI clinical practice guideline for nutrition in CKD: 2020 update. *Am J Kidney Dis*. 2020;76:S1–S107. doi: 10.1053/j.ajkd.2020.05.006
82. Department of Veterans Affairs and Department of Defense. VA/DoD Clinical Practice Guideline for the Management of Chronic Kidney Disease. 2019. Accessed May 5, 2023. https://www.healthquality.va.gov/guidelines/CD/ckd/VADoDCKDCPGFinal5082142020.pdf
83. Ministry of Health Malaysia MSoN, Academy of Medicine Malaysia. Management of Chronic Kidney Disease (Second Edition). 2018. Accessed May 6, 2023. https://www.moh.gov.my/moh/resources/penerbitan/CPG/CPG%20Management%20of%20Chronic%20Kidney%20%20Disease%20(Second%20Edition).pdf
84. Japanese Society of Nephrology. Essential points from evidence-based clinical practice guidelines for chronic kidney disease 2018. *Clin Exp Nephrol*. 2019;23:1–15. doi: 10.1007/s10157-018-1648-1
85. Abraham G, Arun K, Gopalakrishnan N, Renuka S, Pahari DK, Deshpande P, Isaacs R, Chafekar DS, Kher V, Almeida AF, et al. Management of hypertension in chronic kidney disease: consensus statement by an expert panel of Indian nephrologists. *J Assoc Physicians India*. 2017;65(2 Suppl):6–22.
86. GAIN and the Northern Ireland Nephrology Forum. Northern Ireland Guidelines for the Management of Chronic Kidney Disease (CKD). Accessed May 26, 2023. https://www.rqia.org.uk/RQIA/files/07/071a66f7-e6f4-4b97-abba-10ace68dc0a4.pdf
87. Ministry of Health. *Managing Chronic Kidney Disease in Primary Care: National Consensus Statement*. Wellington: Ministry of Health; 2015.
88. National Clinical Guideline Centre (UK). *Chronic Kidney Disease (Partial Update): Early Identification and Management of Chronic Kidney Disease in Adults in Primary and Secondary Care*. London: National Institute for Health and Care Excellence; 2014.
89. Indian Society of Nephrology. Indian Chronic Kidney Disease Guidelines. Accessed June 8, 2023. https://isn-india.org/images/CKD_1.pdf
90. Ma Y, He FJ, Sun Q, Yuan C, Kieneker LM, Curhan GC, MacGregor GA, Bakker SJL, Campbell NRC, Wang M, et al. 24-hour urinary sodium and potassium excretion and cardiovascular risk. *N Engl J Med*. 2022;386:252–263. doi: 10.1056/NEJMoa2109794
91. Huang L, Tian M, Yu J, Li Q, Liu Y, Yin X, Wu JH, Marklund M, Wu Y, Li N, et al. Interim effects of salt substitution on urinary electrolytes and blood

pressure in the China Salt Substitute and Stroke Study (SSaSS). *Am Heart J.* 2020;221:136–145. doi: 10.1016/j.ahj.2019.12.020
92. Marklund M, Tullu F, Raj Thout S, Yu J, Brady TM, Appel LJ, Neal B, Wu JHY, Gupta R. Estimated benefits and risks of using a reduced-sodium, potassium-enriched salt substitute in India: a modeling study. *Hypertension.* 2022;79:2188–2198. doi: 10.1161/HYPERTENSIONAHA.122.19072
93. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet.* 2021;398:957–980. doi: 10.1016/S0140-6736(21)01330-1
94. Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. *Kidney Int Suppl.* 2022;12:7–11. doi: 10.1016/j.kisu.2021.11.003
95. Gupta R, Woo K, Jeniann AY. Epidemiology of end-stage kidney disease. *Semin Vasc Surg.* 2021;34:71–78. doi: 10.1053/j.semvascsurg.2021.02.010
96. Einhorn LM, Zhan M, Hsu VD, Walker LD, Moen MF, Seliger SL, Weir MR, Fink JC. The frequency of hyperkalemia and its significance in chronic kidney disease. *Arch Intern Med.* 2009;169:1156–1162. doi: 10.1001/archinternmed.2009.132
97. Granal M, Fouque D, Ducher M, Fauvel JP. Factors associated with kalemia in renal disease. *Nephrol Dial Transplant.* 2023;38:2067–2076. doi: 10.1093/ndt/gfad015
98. Ramos CI, González-Ortiz A, Espinosa-Cuevas A, Avesani CM, Carrero JJ, Cuppari L. Does dietary potassium intake associate with hyperkalemia in patients with chronic kidney disease? *Nephrol Dial Transplant.* 2021;36:2049–2057. doi: 10.1093/ndt/gfaa232
99. World Health Organization. Online Public Consultation: Draft Guideline on Use of Low-Sodium Salt Substitutes. Accessed September 24, 2023. https://www.who.int/news-room/articles-detail/online-public-consultation-draft-guideline-on-use-of-low-sodium-salt-substitutes