

Dietary sodium and potassium consumption and cardiovascular health

Diets with high amounts of potassium and low amounts of sodium are associated with the best cardiovascular outcomes



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Hypertension is a prevalent medical problem among US women, with a higher prevalence among Black women, than among White, Hispanic, or Asian women (TABLE 1).¹ Among US women aged 55 to 64 years, approximately 50% have hypertension or are taking a hypertension medicine.¹ Hypertension is an important risk factor for cardiovascular disease, including stroke, coronary heart disease, heart failure, atrial fibrillation, and peripheral vascular disease.^{1,2} In a study of 1.3 million people, blood pressure (BP) \geq 130/80 mm Hg was associated with an increased risk of a cardiovascular event, including myocardial infarction and stroke.² Excessive sodium intake is an important risk factor for developing hypertension.³ In 2015–2016, 87% of US adults consumed $>2,300$ mg/d of sodium,⁴ an amount that is considered excessive.¹ Less well known is the

TABLE 1 Prevalence of Stage 2 hypertension or self-reported use of antihypertensive medication among US women by age and race-ethnicity^{1,8,a}

Age group, years	BP \geq 140/90 or self-reported use of antihypertension medication
20-44	10%
45-54	27%
55-64	52%
65-74	63%
\geq 75	78%
Race-Ethnicity	
Non-Hispanic Black	46%
Hispanic	32%
Non-Hispanic White	30%
Non-Hispanic Asian	27%
^a Sample size = 4,906	

association between low potassium intake and hypertension. This editorial reviews the evidence that diets high in sodium and low in potassium contribute to the development of hypertension and cardiovascular disease.

Sodium and potassium dueling cations

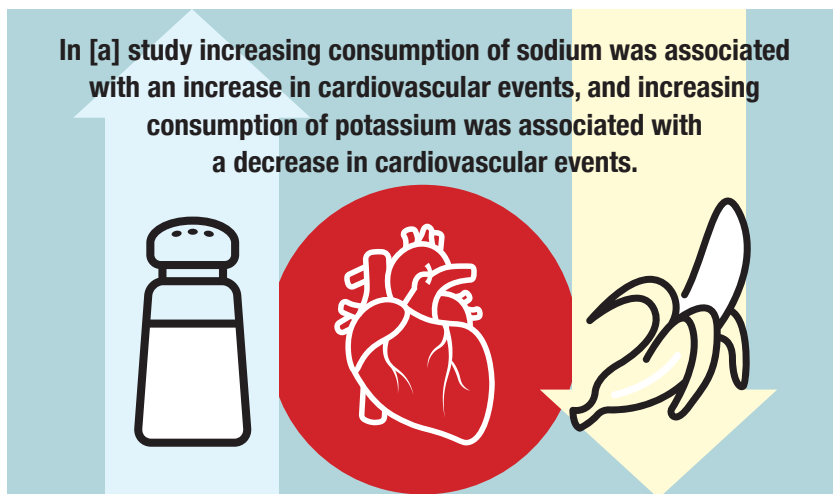
Many cohort studies report that diets high in sodium and low in potassium are associated with hypertension and an increased risk of cardiovascular disease. For example, in a

doi: 10.12788/obgm.0231

cohort of 146,000 Chinese people, high sodium and low potassium intake was positively correlated with higher BP.⁵ In addition, the impact of increasing sodium intake or decreasing potassium intake was greater for people with a BMI ≥ 24 kg/m², than people with a BMI < 24 kg/m². In a cohort of 11,095 US adults, high sodium and low potassium intake was associated with an increased risk of hypertension.⁶

In a study of 13,696 women, high potassium intake was associated with lower BP in participants with either a low or high sodium intake.⁷ In addition, over a 19-year follow up, higher potassium intake was associated with a lower risk of cardiovascular events.⁷ Comparing the highest (5,773 mg/d) vs lowest (2,783 mg/d) tertile of potassium intake, the decreased risk of a cardiovascular event was 0.89 (95% confidence interval [CI], 0.83–0.95).⁷

In a meta-analysis of data culled from 6 cohort studies, 10,709 adults with a mean age of 52 years, 54% of whom identified as women, were followed for a median of 8.8 years.⁸ Each adult contributed at least two 24-hour urine samples for measurement of sodium and potassium content. (Measurement of sodium and potassium in multiple 24-hour urine specimens from the same participant is thought to be the best way to assess sodium and potassium consumption.) The primary outcome was a cardiovascular event, including heart attack, stroke, or undergoing coronary revascularization procedures. In this study increasing consumption of sodium was associated with an increase in cardiovascular events, and increasing consumption of potassium was associated with a decrease in cardiovascular events. The hazard ratio for a cardiovascular



event comparing high versus low consumption of sodium was 1.60 (95% CI, 1.19–2.14), and comparing high versus low consumption of potassium was 0.69 (95% CI, 0.51–0.91) (TABLE 2).⁸

Clinical trial data on decreasing Na and/or increasing K consumption on CV outcomes

Building on the cohort studies reporting that diets high in sodium

TABLE 2 Daily sodium and potassium intake and risk of a cardiovascular event (heart attack, stroke, or undergoing a cardiovascular revascularization procedure)^{8,a}

24-hour sodium excretion				
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Median sodium excretion (mg)	2,212	2,942	3,588	4,692
Percent of participants with a cardiovascular event	4.1%	5.2%	5.4%	6.6%
24-hour potassium excretion				
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Median potassium excretion (mg)	1,755	2,336	2,784	3,501
Percent of participants with a cardiovascular event	5.5%	5.8%	5.2%	4.7%
Sodium to potassium ratio				
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Median ratio	1.5	2.0	2.4	3.4
Percent of participants with a cardiovascular event	4.2%	4.3%	5.7%	7.1%

^aParticipants were followed for a median of 8.8 years. Daily sodium and potassium intake was determined by multiple 24-hour urine measurements.

and low in potassium are associated with hypertension and cardiovascular disease, clinical trials report that decreasing dietary sodium intake reduces BP and the risk of a cardiovascular event. For example, in a meta-analysis of 85 clinical trials studying the link between sodium and BP, the investigators concluded that there was a linear relationship between sodium intake and BP, with larger reductions in sodium intake associated with greater reductions in BP, down to a daily sodium intake of 1,000 to 1,500 mg.⁹ The effect of sodium reduction on BP was greatest in study participants with higher BP at baseline.

In a cluster-randomized clinical trial in China, people living in 600 villages were assigned to a control group, continuing to use sodium chloride in their food preparation or an experimental intervention, replacing sodium chloride with a substitute product containing 75% sodium chloride and 25% potassium chloride by weight.¹⁰ The inclusion criteria included people ≥ 60 years of age with high BP or a history of stroke. The mean duration of follow-up was 4.7 years. Half of the participants were female. A total of 73% of the participants had a history of stroke and 88% had hypertension. In this study, the rate of death was lower in the group that used the salt substitute than in the group using sodium chloride (39 vs 45 deaths per 1,000 person-years; rate ratio (RR) 0.88; 95% CI, 0.82–0.95, $P < .001$). The rate of major cardiovascular events (nonfatal stroke, nonfatal acute coronary syndrome or death from vascular causes) was decreased in the group that used salt substitute compared with the group using sodium chloride (49 vs 56 events per 1,000 person-years, rate ratio (RR), 0.87; 95% CI, 0.80–0.94; $P < .001$). Similarly,

Sodium intake and pregnancy-associated hypertension: Is there a link?

Two randomized clinical trials completed in the 1990s, comparing a low-sodium and a standard diet, showed no effect of reducing sodium intake by 32% and 57% on the risk of developing preeclampsia.^{1,2} Based on these 2 studies, a Cochrane review concluded that during pregnancy salt consumption should remain a matter of personal preference.³ Three recent observational studies report a relationship between sodium intake and the risk of developing pregnancy-associated hypertension.

In a study of 66,651 singleton pregnancies in the Danish Birth Cohort, participants with the greatest daily sodium intake, ranging from 3,520 to 7,520 mg/d had a 54% increased risk of developing gestational hypertension (95% confidence interval [CI], 16%–104%) and a 20% increased risk of developing preeclampsia (95% CI, 1%–42%).⁴ Another cohort study also reported that elevated sodium chloride intake was associated with an increased risk of developing preeclampsia.⁵ In one study, among patients with preeclampsia, those with lower urinary sodium to potassium ratio were less likely to develop severe preeclampsia.⁶ In a pregnant rat model, high salt intake is associated with a severe increase in blood pressure, the development of proteinuria, and an increase in circulating plasma soluble fms-like tyrosine-kinase 1 (sFlt-1)—changes also seen in preeclampsia.⁷ Pregnancy associated hypertension may not be as “salt sensitive” as chronic hypertension.

Future research could explore the effect of dietary sodium and potassium intake on the risk of developing severe hypertension during pregnancy in patients with chronic hypertension.

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the rate of stroke was decreased in the group that used salt substitute compared with the group using sodium chloride (29 vs 34 events per 1,000 person-years; rate ratio (RR), 0.86; 95% CI, 0.77–0.96; $P = .006$). This study shows that by decreasing sodium intake and increasing potassium, cardiovascular outcomes are improved in people at high risk for a cardiovascular event.¹⁰ People with kidney disease or taking

medications that decrease renal excretion of potassium should consult with their health care provider before using potassium chloride containing salt substitutes.

What is your daily intake of sodium and potassium?

Almost all packaged prepared foods have labels indicating the amount of

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sodium in one serving. Many packaged foods also report the amount of potassium in one serving. Many processed foods contain high amounts of sodium and low amounts of potassium. Processed and ultra-processed foods are a major dietary source of sodium.¹¹ In contrast to processed foods, fresh fruits, vegetables, and milk have high quantities of potassium and low amounts of sodium. As an example, a major brand of canned chicken broth has 750 mg of sodium and 40 mg of potassium per one-half cup, a ratio of sodium to potassium of 19:1. By contrast, canned red kidney beans have 135 mg of sodium and 425 mg of potassium in one-half cup, a ratio of sodium to potassium of 1:3. Patients can better understand their

daily sodium and potassium intake by reading the food labels. Calculating a sodium to potassium ratio for a food may help people better understand their salt intake and identify foods associated with positive health outcomes.

The optimal target for daily consumption of sodium and potassium is controversial (**TABLE 2**). The mean daily intakes of sodium and potassium in the United States are approximately 3,380 mg and 2,499 mg, respectively.¹² **The American College of Cardiology (ACC) recommends that an optimal diet contains <1,500 mg/d of sodium, a stringent target.**¹ If that target is unattainable, people should at least aim for a 1,000 mg/d-reduction in

their current sodium intake.¹ The World Health Organization strongly recommends that adults consume <2,000 mg/d of sodium.¹³ The National Academy of Science recommends adults seeking to reduce the risk of cardiovascular disease consume <2,300 mg/d of sodium.¹⁴ The top dietary sources of sodium include deli meat, pizza, burritos and tacos, soups, savory snacks (chips, crackers, popcorn), fried poultry, burgers, and eggs.¹⁵

The optimal target for daily consumption of potassium is controversial. **The ACC recommends that an optimal diet contains 3,500–5,000 mg/d of potassium.**¹ The World Health Organization recommends that adults consume >3,510 mg/d of

potassium.¹⁶ The top dietary sources of potassium include milk, fruit, vegetables, coffee, savory snacks (chips, crackers, popcorn), fruit juice, white potatoes, deli meats, burritos, and tacos.¹⁵ The foods with the greatest amount of potassium include banana, avocado, acorn squash, spinach, sweet potatoes, salmon, apricots, grapefruit, broccoli, and white beans. People with kidney disease or those who are taking medications that interfere with renal excretion of potassium should consult with their health care provider before adding more potassium to their diet.

The ACC also recommends¹:

- Maintaining an optimal weight (a 1-kg reduction in weight is

associated with a 1-mm Hg reduction in BP).

- Eating a healthy diet rich in fruits, vegetables, whole grains, and low-fat dairy products with reduced saturated and total fat.
- Regular aerobic physical activity 90 to 150 min/wk.
- Moderation in alcohol consumption, with men limiting consumption ≤ 2 drinks/d and women limiting consumption to ≤ 1 drink/d.
- Smoking cessation.

Most adults in the US have too much sodium and too little potassium in their daily diet. Diets high in sodium and low in potassium increase the risk of hypertension. In turn, this increases the risk of

cardiovascular disease, including myocardial infarction and stroke. Many personal choices and societal factors contribute to our current imbalanced and unhealthy diet, rich in sodium and deficient in potassium. Our best approach to improve health and reduce cardiovascular disease is to guide people to modify unhealthy lifestyle behaviors.¹⁷ For patients who are ready to change, a counseling intervention using the 5 A's (including **assess** risk behaviors, **advise** change, **agree** on goals/action plan, **assist** with treatment, and **arrange** follow-up) has been shown to result in improved dietary choices, increased physical activity, and reduced use of tobacco products.¹⁸ ●

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