

## Reduction in Dietary Sodium is Associated With a Reduction in Cardiovascular Events and Mortality

Editorial

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Most studies have reported a dose-dependent reduction in blood pressure after decreasing sodium intake with the greatest reduction in blood pressure occurring in patients with the highest blood pressures and the most successful interventions [1-3]. A meta-analysis of 56 randomized controlled trials showed a mean blood pressure reduction of 3.7/0.9 mm Hg for a 100 mmol/day reduction in sodium excretion [4]. Most US adults consume a diet of 5 grams of sodium daily [2]. Guidelines recommend no more than 2,300 mg of sodium (6 grams of sodium chloride daily) [5] to no more than 1500 mg of sodium daily, especially in black persons, elderly persons, and those with hypertension, diabetes mellitus, and chronic kidney disease [6]. The vast majority of excess dietary sodium is added during processing of foods [7]. In a randomized control trial, 412 persons ate foods with high, intermediate, and low levels of sodium for 30 consecutive days each, in a randomized order [8]. Decreasing the sodium intake from the high to the intermediate level during a control diet lowered the systolic blood pressure by 2.1 mm Hg ( $p < 0.001$ ). Decreasing the sodium intake from the intermediate to the low level during a control diet lowered the systolic blood pressure by an additional 4.6 mm Hg [8]. Compared to a control diet with high sodium intake, a DASH diet with low sodium intake reduced the systolic blood pressure by 7.1 mm Hg in persons without hypertension and by 11.5 mm Hg in persons with hypertension [8].

Excess salt causes severe structural and functional cardiovascular and renal changes experimentally and clinically in patients with hypertension [9]. Dietary sodium restriction reverses vascular endothelial dysfunction in middle aged/older persons with moderately increased systolic blood pressure [10,11].

Numerous clinical studies have demonstrated that reduction of dietary sodium intake is associated with a reduction in cardiovascular events and mortality [12-16]. A one-third reduction in dietary sodium intake in Finland was associated with a reduction in blood pressure and a 75% to 80% reduction in both stroke and coronary heart disease mortality [12]. In a veterans retirement home, 1981 men, mean age 74.8 years, were randomized to either a potassium-enriched salt diet or a regular salt diet [13]. At 31-month follow-up, the patients randomized to the potassium-enriched salt diet had a 41% reduction (5% to 63%) in cardiovascular disease mortality [13]. Men in the potassium-enriched salt group lived 0.3 to 0.90 years longer and spent 426 US dollars per year less on inpatient care for cardiovascular disease than did men on a regular salt diet [13].

In the Trial of Hypertension Prevention (TOHP), 744 adults aged 30 to 54 years with prehypertension during 1987 to 1990 (TOHP I) and 2382 adults aged 30 to 54 years with prehypertension during 1990 to 1995 (TOHP II) were randomized to dietary sodium reduction or a usual sodium diet (25% to 35% greater sodium intake) [14]. An observational follow-up for cardiovascular events (myocardial infarction, stroke, coronary revascularization, or cardiovascular death) was performed 10 to 15 years after the original trial. This study demonstrated that dietary sodium reduction reduced cardiovascular events by 25% ( $p = 0.04$ ) [14].

The Third National Health and Nutrition Examination Survey included 12,267 US adults [15]. At 14.8-year mean follow-up, higher sodium intake was associated with a 20% (3% to 41%) increase in all-cause mortality per 1000 mg/day of increased sodium intake [15]. For sodium-potassium ratio, the adjusted hazard ratios comparing the highest quartile with the lowest quartile were 46% (27% to 67%) for all-cause mortality, 46% (11% to 92%) for cardiovascular disease mortality, and 215% (148% to 312%) for ischemic heart disease mortality [15].

Data from the Health Survey for England included 9183 adults in 2003, 8762 adults in 2006, 8974 adults in 2008, and 4753 adults in 2011 [16]. These data showed that from 2003 to 2011, salt intake measured by 24 hour urinary sodium decreased by 1.9 grams per day ( $p < 0.01$ ), blood pressure in persons not on antihypertensive medication was lowered by 2.7/1.1 mm Hg ( $p < 0.001$ ), mortality from stroke was decreased by 42% ( $p < 0.001$ ), and mortality from ischemic heart disease was decreased by 40% ( $p < 0.001$ ) [16].

On the basis of the available data, reduction of dietary sodium intake by reducing sodium content in processed food and by not adding salt to food would lead to a reduction in blood pressure and to a reduction in cardiovascular events and mortality. A na-

tional salt reduction program is one of the simplest and most cost-effective ways of improving public health [17].

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