

ORIGINAL RESEARCH

Sodium Intake, Blood Pressure, and Dietary Sources of Sodium in an Adult South Indian Population



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Abstract

BACKGROUND The association between prevalence of hypertension and its relationship with dietary sodium intake has never been published from large epidemiological studies in the South Indian population before.

OBJECTIVES To assess sodium intake and its association with blood pressure, and major dietary sources of sodium in an adult population in southeastern India.

METHODS This study included a representative population-based sample of 8080 individuals (57% women) >20 years of age. Individuals with previous history of hypertension and outliers for sodium intake were excluded, resulting in a sample size of 6876, with 4269 from semi-urban/urban and 2607 from rural areas. Baseline measurements included evaluation of systolic (SBP) and diastolic (DBP) blood pressures, anthropometric, sociodemographic, and psychosocial parameters. Based on 24-hour recall, we calculated total daily sodium intake and the percentage contributed by each food group to the total sodium intake. Participants were assigned based on quintiles of dietary sodium intake. Mixed-effects multivariable linear regression models assessed the association of SBP and DBP with sodium intake.

FINDINGS Men had higher mean sodium intake (4.1 ± 2 versus 3.2 ± 1.7 g/day; $P < 0.01$) with higher mean SBP and DBP (123/77 versus 117/74 mm Hg; $P < 0.01$), and higher prevalence of hypertension (22.2% versus 12.9%; $P < 0.01$) compared with women. Mean dietary sodium intake was significantly higher in the hypertensive men (4.2 ± 2 g/day) and women (3.2 ± 1.7 g/day) compared with normotensive men (4 ± 2 g/day), and women (3.2 ± 1.7 g/day; $P < 0.05$). Significant ($P < 0.01$) increases in SBP and DBP were evident in men, but not women with increasing quintile of sodium intake. After multivariable adjustments, sodium intake was independently associated with SBP, but not DBP, in both sexes. The predominant source of dietary sodium in both semi-urban/urban and rural populations was from homemade foods where salt is part of the traditional recipe.

CONCLUSION In a South Indian population, the dietary intake of sodium was higher than recommendations by major dietary guidelines and was an independent predictor of SBP.

KEY WORDS blood pressure, hypertension, Indian, sodium, south

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INTRODUCTION

Excess dietary sodium intake is associated with risk factors for cardiovascular disease (CVD), most prominently with elevated blood pressure (BP).^{1–3} High BP or hypertension (HTN) is a major risk factor for CVD and accounts for about 7.6 million, or 13.5% of deaths annually worldwide.⁴ Current estimates indicate that HTN is responsible for 54% of all strokes and 47% of all coronary artery disease (CAD) worldwide.⁴ Most people with HTN currently live in low- and middle-income countries.^{4,5}

Epidemiologic studies reveal a growing prevalence of HTN in both rural and urban India. The prevalence of HTN in India has been estimated at 33% in urban areas and 25% in rural areas.⁶ In India, HTN is estimated to be directly responsible for 57% of all deaths from stroke and 24% from CAD.⁷ In 2010, 1.65 million deaths from cardiovascular causes worldwide were attributed to sodium consumption of >2 g per day. Notably, 4 of 5 of these deaths occurred in low- and middle-income countries, and 2 of 5 occurred prematurely (before the age of 70 years).⁸

It has been projected that a population-wide decrease of 2 mm Hg in BP can prevent 151,000 stroke-related and 153,000 CAD-related deaths in India.⁷ There is clear evidence that reducing the amount of dietary salt consumption reduces mean population BP and associated risk for cardiovascular events in both hypertensive and normotensive individuals.^{9,10} Based on these findings, the World Health Organization (WHO) and other organizations have established dietary salt reduction as an important strategy to prevent CVD.^{11–13}

The global effects of sodium consumption and how they vary with age, sex, and ethnicity are poorly understood. Moreover, given the global variation in foods and methods of preparation and addition of salt to indigenous recipes, estimating the dietary intake presents enormous challenges. Nevertheless, to develop public health strategies, particularly in an ethnically diverse country like India, better understanding of dietary patterns, actual sodium intake, and their relation to BP among the regional populations is crucial to patient counseling, public health interventions, and program planning.

Apart from the common table and rock salt (sodium chloride) used generally, sodium can be found in other food items as well, and the primary contributors to dietary sodium depend on the cultural context and dietary habits of a population.¹⁴ Sodium is found naturally in a variety of foods, such as milk,

meat, and shellfish. It often is found in large amounts in processed foods such as breads, crackers, meats, and snack foods.^{15–18} Large amounts of sodium are found in many condiments (eg, soy and fish sauces).¹⁵ Information on the sodium content of Indian foods is sparse. There are very limited data on the association between dietary sodium intake and BP in the Indian population.

In the present study, we assessed intake of sodium, its association with BP, and the major sources of dietary sodium among adults living in south-eastern India who are enrolled in PURSE-HIS (Population Study of Urban, Rural and Semi-urban Regions for the Detection of Endovascular Disease and Prevalence of Risk Factors and Holistic Intervention Study).

METHODS

Chennai, the fourth largest metropolitan city in India, served as the primary urban location from which the study population was recruited. The adjacent semi-urban and rural areas were in Thiruvallur and Kanchipuram districts, respectively, in the state of Tamil Nadu, India.

The detailed methodology of PURSE-HIS is published elsewhere.¹⁹ As of June 2012, 8080 (urban: 2221; semi-urban: 2821; rural: 3038) participants >20 years of age were recruited by 2-stage cluster sampling using the 2001 India census database. In this current analysis, because both semi-urban and urban populations were very similar in their risk profile, they were combined and identified as semi-urban/urban population. After excluding individuals with previous history of hypertension ($n = 961$) and the outliers for sodium intake (sodium intake $\geq 10,000$ mg/day; $n = 260$), the sample size was 6876, with 4269 from semi-urban/urban and 2607 from rural areas.

An interviewer-administered questionnaire was used to collect data on history of CVD and its risk factors. Physical activity was measured by a physiotherapist, using the Global Physical Activity Questionnaire,²⁰ and the sedentary score (SDS) was calculated. A clinical psychologist assessed the level of stress using the Presumptive Stressful Life Event Scale,²¹ and lifetime stress score (LTSS) was computed. The Kuppussamy classification²² was used to assess socioeconomic status and is reflected as socioeconomic score (SES); which was computed from information on education, occupation, and income status. After a general clinical examination, seated BP of participants was

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