CHAPTER

5 Salt Intake and Cardiovascular Disease Protection: Role of Professional Organizations for Successful Strategies

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ABSTRACT

Excess dietary salt consumption has been implicated to have adverse impact on blood pressure (BP) and increased risk of cardiovascular diseases (CVDs). Since hunter-gathering period, consumption of dietary salt has increased from less than 1 gram/day to about 7.5–12.5 g/day globally and about 11 g/day in India. Salt is an essential electrolyte for human metabolism used universally in cooking, seasoning, and preserving foods stuffs. Over the past century, intense scientific research has been carried out on the subject of salt and current evidence has consistently shown that dietary salt reduction lowers BP and provides CVD risk protection. The United Nations (UN) and the World Health Organization (WHO) has launched a global initiative aimed to reduce 30% salt intake at the population level by 2025 recommending <5 g/day dietary salt intake. India is the first country to adopt the noncommunicable diseases (NCDs) global monitoring framework and committed to the WHO's global action plan for dietary salt reduction and has developed the National Multi-Sectoral Action Plan to reduce premature NCDs in India. The role of professional organizations under present circumstances should be in the leadership role for effective implementation of global and national NCDs control program including dietary salt reduction strategies.

Keywords: salt intake, CVD risk, CVD protection, India, professional organisations.

Introduction

Increased sodium consumption has been implicated to have adverse impact on blood pressure (BP) and increased risk of cardiovascular diseases (CVDs).[1,2] Non-communicable diseases (NCDs) are now considered major health problem of grave economic concern causing chronic disability resulting in two-thirds of deaths worldwide.[3] In India, among NCDs mortality about two-thirds of its burden is contributed by CVD,[4] and CVDs are currently responsible for about 28% of all deaths in India.[5] Amongst CVDs, hypertension (HTN) is one of the most important reasons for total disease burden and premature death worldwide. So, the concept of reduction of dietary salt intake for CVD protection gains immense importance, especially from primary prevention point of view. In this chapter, we are going to review the literature exploring the evidence for dietary salt intake and CVD protection; and more importantly, the role of professional organizations for successful CVD protection strategies in context of dietary salt intake.

History of Dietary Salt Consumption

During the hunter-gathering period, meat was the main food of humans consuming less than 1 gram (g) of salt per day which continued even during the agricultural period with declining meat consumption and increasing vegetables/grain consumption.[6] The oldest verifiable salt-works dated back to about 6,000 years when processing of salt started with Romanian people extracting salt by boiling the salt-laden spring water and Chinese harvesting salt from the surface of Xiechi Lake. About 5,000 years ago, salt gained great economic importance with discovery of

its food preservative qualities by the Chinese which lead to increased salt intake to about 5 g/day approximately 1000 years ago particularly in the Western world.[7] Gradually, salt became the world's one of the important trading commodities, with increasing consumption leading to the imposition of oppressive salt tax in France, an important cause of the French Revolution as well as Mahatma Gandhi's civil disobedience campaign against salt tax imposed by the British leading to the famous 'Dandi March.'[8]

Salt is an essential electrolyte for human metabolism used universally in cooking, seasoning, and preserving food stuffs; and, now, with increased consumption of highly salted processed food, salt intake has reached to about 7.5–12.5 g /day in about 95% of the global population and most of the people in India consume about 11 g/day of salt.[9]

Cardiovascular Disease Risk Factors

Worldwide, CVDs are the leading cause of morbidity and mortality responsible for about 17.5 million deaths per year and >75% of deaths occur in the lower middle-income countries (LMIC). Important cardiovascular (CV) risk factors include hypertension (HTN), diabetes mellitus (DM), dyslipidemia, obesity, hyperuricemia, metabolic syndrome, smoking, high alcohol intake, and sedentary lifestyle. In the presence of HTN, additional CV risk factors proportionally increase the CVD risk.[10] Uncontrolled HTN is mainly responsible for an increase in CVDs in India, a country of 1.32 billion people.[11] A meta-analysis documented more than trebled prevalence rates of coronary artery disease (CAD) and stroke in the Indian population. The INTERHEART and INTERSTROKE studies showed that HTN was responsible for 17.9% of population attributable risk for CAD and 34.6% for stroke. Currently, the overall prevalence of HTN in India is 29.8% including 33.8% in urban and 27.6% in rural areas, which has increased significantly in the last two decades. HTN presently is considered to be a major contributor to CVD burden as well as CV morbidity and mortality.[12]

Dietary Salt Intake and Cardiovascular Disease Protection

Over the past century, intense scientific research has been carried out on the subject of salt, elevated BPand CV morbidity and mortality. The earliest evidence of salt, BP relationship was mentioned in 2698–2598 BC by a Chinese medical doctor that "if large amounts of salt are taken, the pulse will stiffen or harden" in 'The Yellow Emperor's Classic of Internal Medicine'; and, then, in 1904, Ambard and Beaujard suggested that dietary salt primarily affected BP. Walter Kempner in 1948 introduced rice diets containing mainly rice, fruits, little fat, 20 g of protein, and <0.5 g salt for treatment of HTN, and was the first scientist to show effect of a dietary manipulation to improvement in BP.[13] In 1969, Louis Dahl transformed HTN research from historical to modern era drawing a famous linear graph expressing positive relationship between dietary salt intake and HTN suggesting physiological need of about 1 g of salt/day and recommended 24 hours urine excretion as the best method available to measure salt intake.[14]

Since then, several evolutionary, epidemiological and human clinical studies have documented important relationship of salt intake and elevation of BP. MacGregor et al. in 1982 published a double-blind controlled trial of moderate salt restriction in patients of mild to moderate essential HTN suggesting moderate sodium restriction as management strategy for essential HTN.[15] Since then, scientific research has established relationship between high salt intake and HTN.[13] The 2005 dietary guide for Americans suggests 2,300 mg of sodium a day for the general population and about 1,500 mg of sodium for hypertensive patients.[14] Effect of salt intake on CV events and mortality benefits has been still debated. Studies on influence of salt intake on overall CVDs suggested prevention of onset of CVDs with salt reduction and concluded that high sodium intake predicted high risk and mortality from CAD independent of other CV risk factors, including BP. Another study and a meta-analysis of prospective cohort studies observed tendency of increase in CVDs with excessive salt intake and recommended salt reduction strategy as a useful method for preventing CVDs.[13]

A meta-analysis including the Trials of Hypertension Prevention (TOHP) I, TOHP II, and Trial of Non-pharmacologic Interventions in the Elderly (TONE) studies showed significant reduction of CV events with reduction in sodium intake.[16] Another study[17] documented an inverse relationship between 24-hour urine sodium and risk of CVD mortality in hypertensive patients without CVD and in general population. Several cohort studies have documented different relationships between CV

outcomes and sodium intake. A review evaluating the association between CV outcomes and sodium intake among studies in PubMed from 2009 to 2019 documented five studies showing U-shaped associations or inverse J, a positive association, or no association with CV outcomes, but another 5 studies using different methods of urine sodium measurement were associated with a higher risk of CV outcomes with linear association. The review noted several large-scale studies consistently found paradoxical J- or U-shaped associations between CV outcomes and sodium intake. The review concluded the existence of convincingly significant relationship between CV outcomes and high sodium intake and not ruling out the reverse causality, generally recommending reduction of sodium intake not only limited to patients with HTN or CVDs.[18] A review in 2016 found five studies supporting the evidence of reduction of CVD incidence and mortality with reduction in salt intake. This evidence was contradicted by three studies and two studies found evidence to be insufficient.[19] Similarly, an analysis of 27 studies and 106 letters published in journals supported the evidence of reduction of CVD with reduction in salt intake, contradicted this salt evidence by 34 studies and 51 letters, and found inconclusive salt evidence by 7 studies and 19 letters. But, several long-term studies documented sodium-restricted diets lower incidences of CVD in all groups.[20]

Over the last three decades, more than 30 cohort studies have documented direct association between salt intake and CV outcomes. A meta-analysis in 2009 also documented a direct relationship between salt intake and CVD risk and findings were supported in 2013 by 2 meta-analyses, but several cohort studies have documented a J-shaped relationship including a pooled data of four cohort studies documenting association of lower as well as higher intake of salt with an increased CVD risk and all-cause mortality. The reports of a J-shaped relationship between CVD risk and salt intake had created a controversy initiating debate on public health policy of decreasing salt consumption in a population. But experts, on the other hand, pointed out several gross methodological, reverse causality, random and systematic errors in assessment of salt intake thus negating the conclusions by these studies.[21] A number of large-scale intervention studies, Cochrane review, and meta-analysis of clinical trials documented significant antihypertensive effects of dietary salt reduction in hypertensive and normotensive people. Since HTN control is documented to reduce CVD risk, it is plausible to infer salt consumption as a risk factor for CVDs.[22]

Among the population-based studies, estimation of average population salt intake was subjected to less errors as compared to estimation of salt intake in individuals, and data suggests reduction in CVD mortality with reduction of salt intake across the population; whereas significant relationship between salt intake and CVD mortality was not shown by the cohort studies using inaccurate individual estimation methods.[21] But, the problem with the population-based studies was that only Japan, Finland, Portugal, and the UK have successfully reduced the salt intake in population and evaluated the effect on CVD. With the population-based salt reduction initiative, data from Japan showed BP reduction and about 80% reduction in stroke mortality. Data from Finland documented a reduction of >10 mmHg in systolic and diastolic BP with reduction of 75–80% of CVD mortality. The UK data after successful implementation of voluntary salt reduction program documented mean systolic BP reduction of 2.7 mmHg and about 36% mortality reduction due to both stroke and ischemic heart disease (IHD) which were consistent with the National Institute for Health and Care Excellence (NICE) predictions of prevention of 9,000 deaths from stroke and IHD per year because of reduction of salt intake and had proved to be a cost-effective measure. Data from Portugal salt reduction program lead to an average BP decrease of 7.3/5.8 mmHg along with significant decrease in stroke and IHD mortality.[21]

The WHO reported about 17 million per year deaths globally because of CVDs and high BP. About 45% of deaths were because of CVDs and 51% because of fatal strokes; but more importantly, the WHO stated that with the implementation of effective and inexpensive interventions, about 80% of NCDs and 40% of cancers can be prevented.[23] Currently, the association between dietary salt intake and BP is very well documented and established on the basis of a diverse evidence including animal experiments, physiological studies, human genetics, migration, epidemiology, population-based intervention studies, and large clinical trials. Studies of various types have consistently shown that high dietary salt intake is established cause of increased BP and that dietary salt reduction lowers BP and provides CVD risk protection.[21 22]

The Dietary Approaches to Stop Hypertension (DASH) study designed to explore the effects of varying nutrients on BP and the DASH-Sodium study was to test the effect of only in salt content in the diet on BP were conducted by the National Heart, Lung, and Blood Institute of USA observed substantial BP lowering effect of reduced dietary sodium intake alone with maximum BP lowering effect with the lowest sodium intake of 1,500 mg/day.[13]

Several studies, international, national, and regional guidelines and initiatives including the *Lancet* Series in NCDs, the *Lancet* Commission on HTN, the Disease Control Priorities study, the WHO Action Plan for the Prevention and Control of NCDs, 2018 guidelines by the European Society of Cardiology and the European Society of Hypertension, 2020 guidelines by the International Society of Hypertension, national guidelines from Canada, China, India, Kenya, the UK, and the USA, have evaluated and a clear consensus exists for nonpharmacological interventions including salt restriction for prevention and management of HTN and to provide CVD protection. The WHO has also initiated formulation of its first hypertension clinical guideline expected to be released in 2021.[24]

Hypertension as an important risk factor for CVD has become a huge public health concern and affects a large population across the world including India. Prevention and management of HTN through nonpharmacological interventions has traditionally been practised, especially for CVD protection. Among nonpharmacological interventions, dietary salt restriction is recognized as an important factor, so excessive salt intake has become a global issue.[25]

Hypertension is highly prevalent in India and is the cause for at least 10% HTN-related mortality, expected to rapidly increase in the future. Evidence suggests that because of dietary risk factors, such as high salt intake, 8.9% disability-adjusted life years (DALYs) were lost; and, in the last decade, 30% increase in DALYs lose was observed.[26] To reduce the preventable and avoidable burden of morbidity, mortality, and disability due to NCDs by means of multisectoral collaboration and cooperation at national, regional, and global levels, to enable people reach the highest attainable standards of health, quality of life and productivity so that NCDs are no longer a barrier to well-being or socioeconomic development, global as well as national initiatives were launched focusing on reduction of dietary salt intake at individual and population level.

Role of Professional Organizations for Successful Dietary Salt Reduction Strategies

A global initiative backed by the United Nations and the WHO aimed to reduce 30% salt intake at the population level by 2025, recommending <5 g/day dietary salt intake for adults and 75 countries have already adopted national sodium reduction program to help meet this goal because evidence suggests that even a small decrease in BP at the population level would lead to significant decrease in BP-related CVDs.[26] India is the first country to adopt the NCDs global monitoring framework and committed to the WHO's global action plan for dietary salt reduction and has developed the National Multi-Sectoral Action Plan, which provides a platform for implementation and monitoring the dietary salt reduction measures to reduce premature NCDs in India.[27]

Besides the government's and policy-related stakeholders efforts for implementation of action plan, consensus among all stakeholders including the Food Safety and Standards Authority of India (FSSAI), Indian Council of Medical Research (ICMR), National Institute of Nutrition, and the medical professional organizations was for creating awareness among population, the health care professionals, and the food industry about the adverse effects of excessive dietary salt intake; and more importantly, salt reduction strategies should be very well suited to the Indian settings. Most of the stakeholders in India agreed on the need for a salt reduction program to control and prevent HTN and related CVDs. Strategies to reduce dietary salt intake at the population level have taken different approaches and data analysis of qualitative research on stakeholders' perspectives and health policy issues determined three major themes for salt reduction strategy for India.[28]

- Barriers for salt reduction.
- Facilitators for salt reduction.
- Strategies for salt reduction.

Major Themes for Salt Reduction Strategy for India

Barriers for Salt Reduction

- *Barriers related to cultural and social beliefs:* There is a widespread belief that since India is a tropical country, population needs extra salt intake because of excessive sweating as compared to other countries, which is not

agreed by most of the experts; but this belief can only be contradicted with evidence, increasing awareness and, a complex time-consuming process of behavioral change. Illiteracy, cultural diversity, types of foods, and preparation methods vary widely across India making the task difficult.

- *Barriers of the unorganized food retail sector:* Huge unorganized food retail sector is not under any food regulations law, which is a cause of major concern for implementation of salt reduction strategies.
- *Lack of effective implementation of existing dietary and food policies:* It is the general view that existing food and dietary policies are not being properly implemented and so implementation of any new policy will be a time-consuming, difficult, and less effective process *because of constrains of human resources and enforcement issues.*
- *Decrease in sales:* It is a general feeling of most of the food retail sector stakeholders that reduced salt content will affect the taste of the food and impact the sales leading to financial implications and implementation problems.

Facilitators for Salt Reduction in India

- *Salt reduction as global and national multisectoral action program: Since reduction of dietary salt intake is part of* global as well as national multisectoral action, the government is duty bound for its effective implementation because progress reports will have to be submitted to the WHO Regional Committee sessions.
- *Salt reduction being implemented by some food industries:* Feedback from organized food industry suggests already existing awareness of the health impact of excess dietary salt intake among food industry, so some multinational companies have started process for salt reduction and reformulation of foods especially packed.
- *Increased level of awareness regarding salt reduction among HTN patients:* Data suggests that hypertensive patients and families are more aware of adverse effects of excess dietary salt intake than nonhypertensive population and so they can help improving salt-related education and act as potential facilitator.

Potential Strategies for Salt Reduction in India

- *Generate awareness among population:* Most important strategy for reduction of dietary salt intake is educating and generating awareness among population, all age groups, doctors, organized or unorganized food industry, small or large food vendors including all stakeholders about every aspect of dietary salt intake incorporated into overall general healthy dietary guidelines rather than only on salt communicated through every type of mass media methods such as print, digital, electronic, or social media.
- *Gradual and voluntary salt reduction by the industry:* General opinion support gradual and voluntary reduction of salt content in foods in collaboration with food industry which will not affect the taste, cost, sale, and may prove to be the most feasible way forward.
- *Improving product reformulation and nutrition labeling:* Since the nutrition labeling in India is not comprehensive, general consensus among the stakeholders was to make product reformulation and nutrition labeling mandatory for all nutritional components to enable healthier food choices and concerned authorities should enforce and monitor it periodically.
- *Incentives for food industry:* The best was to motivate food industry to produce low salt products is to give incentives, such as tax exemptions, interest free loans, subsidised modern technology, logos of healthy food, and providing assured markets, such as government institutions, hospitals, offices, and *defence forces canteens,* to sustain sales and profits till the population becomes aware and the demand for low salt products increases.
- *Strengthen salt-related scientific research in Indian context:* Since there is paucity of data on various aspects of dietary salt and stakeholders expressed need to strengthen salt-related scientific research in Indian context that will help in monitoring and effective implementation salt reduction strategy.

The role of professional organizations, such as the Cardiological Society of India (CSI), Association of Physicians of India (API), and others, is generally educational and informational, but under present circumstances, professional organizations should be in leadership role for effective implementation of global and

national NCDs control program including dietary salt reduction strategies with multistakeholder engagement and coordination for multisectoral and multifactorial dietary salt reduction health action plan at the government and nongovernment levels in partnership with civil society empowering the people and communities. Professional organizations can play an important role in policy making, advocacy, planning, service provision, strengthen institutional capacity, training and education, monitoring, evaluation and research formulating evidence-based strategies and guidelines, generating scientific evidence for best practice, and cost-effective affordable dietary salt reduction public health strategies not ignoring the social, religious, and cultural considerations.[28]

COVID-19 Pandemic and Hypertension

During COVID-19 pandemic, routine patient care including HTN care has been adversely affected, especially during prolonged lockdowns leading to suspension of non-COVID medical services, decreased social interactions, physical inactivity, increased smoking, mental stress or alcohol use, and neglected diet influencing HTN care directly or indirectly; and a WHO survey reported disruptions of HTN management in 53% of countries. During the distressing times of COVID-19 pandemic, the government health care institutions and professional organizations offering teleconsultation or remote consultation to ensure all social groups, especially deprived, poor, and vulnerable population have opportunities and support to access HTN preventive and treatment services. Long-term effect of COVID-19 pandemic on HTN cares both prevention and management remains uncertain.[24]

CONCLUSION

Scientific evidence convincingly shows association of dietary salt intake and BP, CVD risk mortality, invalidating the argument of insufficient evidence for BP and CVD risk reduction, so the WHO strongly recommended reduction of dietary salt intake among population initiating global action plan as top priority public health actions to reduce global burden of NCDs and provide CVD protection. Qualitative research on stakeholders' perspectives and health policy issues has identified three major themes for salt reduction strategy for India namely barriers for salt reduction, facilitators for salt reduction, and strategies for salt reduction. The National Multi-Sectoral Action Plan, provides a platform for the government, all policy-related stakeholders, and professional organizations to initiate multistakeholder engagement and coordination for multisectoral and multifactorial dietary salt reduction health action plan in partnership with civil society empowering the people and communities for best practice and cost-effective affordable dietary salt reduction public health strategies not ignoring the social, religious, and cultural considerations.

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