Editorial

Salt Reduction at a Population Level: To do or not to do?

Salt has always managed to take centre stage, be it in history or science. Mahatma Gandhi, who led the 'Dandi march' of 1930 as part of India's freedom struggle, when asked to explain his choice of salt as the focus for the protest, remarked: 'Next to air and water, salt is perhaps the greatest necessity of life.'[1] Salt, infamous for being the cause of wars and disputes between nations, has brought about a similar rift in science. Experts seem to be divided into two factions—one that strongly advocates a population-level reduction in salt intake and the faction that equally vocally refutes the notion—both quoting scientific literature to justify their opinions. The salt controversy, riddled with conspiracy theories and myths, has made it challenging for policy-makers and healthcare providers to pick a side.

Salt: A necessary nutrient or an avoidable toxin?

Scientists have often debated whether to consider salt as an essential nutrient with recommended dietary intake or a toxin with a maximum tolerated dose. The recommended daily intake of a nutrient is calculated using the approximate intake found in the apparently healthy population. However, Graudal[2] observes that salt is the only nutrient for which the recommended adequate intake of 3.3–3.8 g of salt (or 1.3–1.5 g of sodium [2.5 g of salt contains approximately 1 g of sodium]) is drastically below this value (6.6–12.2 g of salt or 2.6–4.9 g of sodium).[3,4] While some would argue that salt is a nutrient and should be no exception to this norm, others hold the opinion that the present average consumption itself is higher than that required by the human body. According to these values only 2.5% of the world's population meets the current recommended salt intake.[2]

A recent meta-analysis done by the Global Burden of Diseases, Nutrition and Chronic Diseases Expert Group (NutriCoDE) has shown that the average global consumption of sodium is 3.95 g/day.[5] They concluded that this was more than twice the current recommended sodium consumption of <2 g/day, and added that almost all countries had values higher than the recommended level.[5] This average consumption, however, varies between populations as well as within a population. A majority of individuals have a moderate sodium intake of 3–6 g/day.[5,6]

Current evidence and controversies

The beneficial effects of sodium reduction in lowering blood pressure and cardiovascular mortality have been shown by numerous studies.[7] Recently, however, the assertion that it is beneficial to reduce sodium intake in all individuals has been challenged.[8,9]

Earlier studies have tried to find the association between sodium and blood pressure, and its ultimate impact on cardiovascular-related morbidity and mortality. Until recently the relationship between sodium reduction, blood pressure, stroke and cardiovascular events was thought to be well understood and linear. However, the PURE study revealed that a moderate intake of sodium (between 3 and 6 g/day) was associated with a lower risk of death and cardiovascular events than was either a higher or lower estimated level of intake resulting in a J-shaped association curve.[8] Further, the recently published study in the *Lancet* (PURE, EPIDREAM and ONTARGET/TRANSCEND Investigators) revealed that while the association of high sodium intake with an increased risk of cardiovascular events and death was only among the hypertensive populations, for low sodium intake it was observed in those with or without hypertension.[9] The PURE investigators also showed a non-linear association between blood pressure and sodium intake, being most pronounced in persons consuming high-sodium diets and non-significant in individuals with low baseline (<3 g/day) sodium intake.[6] These arguments, in addition to the fact that currently <5% of the world's population has a sodium intake of >6 g/day,[5,6] have debated the need for a public health measure aimed at a population level.

Another challenge posed to the advocates of population-level reduction of salt intake is its feasibility.[10] The TOHP-II trial results have shown us that making sustainable changes in sodium consumption among those who already consume moderate levels of sodium is a difficult task even in the setting of a controlled trial.[10,11] The question we need to ask ourselves is whether this should discourage us from trying to reduce the average consumption.

The limitations of current studies

Though these results have been used for and against the motion in the debate on population-level salt reduction, it is important to keep in mind the limitations of all these studies. Prospective observational studies of salt consumption and cardiovascular outcomes suffer from numerous methodological issues.[12] These include selection bias, short durations of follow-up, reverse causality and so on. Of these, reverse causality is a confounder that most studies have struggled to rule out in the past. Reverse causality occurs when the outcome is a determinant of the predictor, and not vice versa.[13] This bias could result from a behavioural change as a consequence of illness or medical recommendations, such as a reduction in sodium intake in persons with prior cardiovascular disease or increased cardiovascular risk.[8] The PURE investigators attempt to rule out the role of reverse causation in their results by conducting various subgroup analyses and also by showing comparability of mean INTERHEART modifiable risk scores between the low and moderate sodium excretion groups.[8] Nonetheless, they eventually accept that reverse causality cannot be completely ruled out and that it may in part account for the increased risk observed in the group of participants with a low estimated sodium excretion.[8]

The validity of conclusions from previous studies hinges on the accuracy with which sodium intake was estimated. The results reported and the conclusions drawn from large studies have been questioned because of the flaws in the estimation of sodium. The two main methods used are measuring urinary sodium excretion and estimating sodium intake from dietary questionnaires.[10] Though the repeated 24-hour urinary estimation of sodium is the gold standard, most large studies have been incapable of adhering to the demands of this method. Difficulty in collecting repeated samples, high frequency of incomplete sample collections and the cost of repeated measurements have posed barriers to investigators. Several formula-based estimates including the Kawasaki formula,[14] Tanaka formula,[15] the INTERSALT formula[16] and the Mage[17,18] formula have been used to overcome these problems. The accuracy of these formulae to estimate sodium excretion depends on the type of sample collected (time and fasting status) and the population covered;[10] however, the appropriateness and relevance of these formulae have been questioned.

Current gaps in evidence

A major limitation has been the absence of large and long-term randomized controlled trials to determine the effects of reducing sodium intake on cardiovascular disease. As stated by O'Donnell *et al*., the evidence so far is based on observational studies with wide heterogeneity between them particularly with regard to differences in mean sodium intake of the populations studied and the range of sodium intake.[10] No trial has determined whether low sodium intake compared to moderate sodium intake reduces the incidence of cardiovascular events or mortality and none seems to be in the offing.[10,19]

In India, a major gap is the paucity of data on salt intake.[20] The last large-scale study was conducted in 1988 by the Indian Council of Medical Research, which found that the average sodium consumption ranged from 2.8 to 10.4 g/day/person.[21] In 1988, the INTERSALT cooperative group estimated sodium intake in Ladakh and Delhi to be 4.8 g/day and 3.6 g/day, respectively.[22] Subsequent studies from various regions of India showed sodium intake in the range of 3.4 to 16.9 g/day,[23,24] but no nationwide effort has been made to document sodium intake in a standardized and comprehensive manner. Moreover, with the exception of studies such as the INTERSALT,[22] a smaller study conducted in Kashmir in 2006,[25] and a more recent study conducted in urban Delhi and rural Haryana,[26] all estimates of sodium intake in the Indian population have been made using dietary questionnaires rather than using the more reliable and accurate measurement of urinary sodium excretion. An accurate measurement of sodium intake levels in India would be critical if we are to embark on a population-level intervention to reduce salt intake.

Do we wait or do we act?

Various authors have cited these and other limitations to contest the need of a salt intake reduction strategy at the population level, while others have asked to refrain from letting poor science create uncertainty and thereby snare us into inaction.

Zoccali and Mallamaci have suggested that an ideal solution would be a trial that provides actual data rather than relying on data from observational studies or modelled data.[27] But do we wait for such a trial or do we act on the basis of best available evidence? The pros of our action will have to be carefully weighed against inaction. The precedent of smoking and lung cancer, as pointed out by Cappuccio,[28] has shown that in the past the scientific community has not necessarily waited for concrete evidence to advocate public health action. At the same time, public health policy made hastily on the basis of inconclusive data may have devastating repercussions.

Besides uncertainties, the task of the policy-makers is made difficult by the rift in opinions between the leading scientists working in this field. An open dialogue is needed between the warring groups to help bring clarity to the present situation and evolve a consensus for the most appropriate public health measure.

While stressing the need for further research and more robust evidence to recommend a population-level policy, we agree on the current WHO monitoring framework target of a 30% reduction in sodium intake[29] for Indian settings that are presently presumed to have high salt consumption. Considering the recently published evidence,[9] there is an urgent need to develop strategies for the reduction in salt consumption among individuals who suffer from hypertension. We also strongly recommend against a drastic reduction in sodium intake to <3 g/day until evidence is available from large clinical trials that show clear benefits. The foremost priority in India at present should be to set up a strong surveillance system to provide the basis for policy formulation and implementation, and to adhere to the WHO 2025 target of 30% reduction in salt intake.

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