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Letter to the Editor

Levels of dietary sodium intake: diverging associations with arterial stiffness and Atheromatosis. Concerns about the evidence review and methods

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We are concerned about the methodology and some of the evidence reviewed in the publication by Tsirimiagkou et al.[1] Their study estimates sodium intake based on 24-hr dietary recalls – with an addition of 15% to account for discretionary sodium in all participants – and reports a positive association between the estimated sodium intake and arterial stiffness, but an inverse association with atheromatosis. They validate their findings of potential harm caused by dietary sodium reduction using data from animal models that have low sodium intake from their natural diets, and based on "highly biased" epidemiological studies that find harm at sodium intake above 5000 and below 3000 mg/day.[2]

Sodium is an essential nutrient for health. Based on the natural quantities of sodium in diets, human and animal physiological systems have evolved to retain or excrete sodium to maintain homeostasis.[3] Homeostasis is maintained in the Yanomami tribe with dietary sodium levels below 100 mg/day and most natural diets without added salt contain less than 800 mg/day.[3] Tsirimiagkou et al. cite that animal models show increased atherosclerosis caused by the reduction of dietary sodium in their natural diets, and hence, are of little relevance to the present recommended human sodium intake – which is several folds higher than in a diet that has no added sodium.[1]

There is a linear relationship between sodium intake and systolic BP down to 800 mg sodium/day.[4,5] Further, a meta-analysis of randomized controlled trials found that modest reductions in sodium intake (weighted average 3646, reduced to 2690 mg/day) linearly reduced cardiovascular diseases (CVD) by 26% and mortality by 15%.[2] The long-term follow-up of the Trials of Hypertension Prevention (TOHP), assessed as having "low bias", found reductions in CVD under 2,300 mg sodium/day.[6] Finally, high dietary sodium is estimated to cause over 1.8 million deaths, and over 44 million disability-adjusted life years lost in 2019.[7]

An accurate assessment of an individual's usual sodium intake is vital for association studies. Dietary food recall and other dietary surveys are unreliable in assessing an individual's dietary sodium.[8] Adding a fixed proportion of discretionary sodium to diets also does not account for the individual variation in discretionary sodium which is the relevant issue. The lowest quartile of sodium intake (average 1088 mg/day in men and 751 mg/day in women) reported by Tsirimiagkou et al. is also not compatible with the present understanding of sodium intake in the high sodium food environment of high-income countries.

The design, with a population of 'at risk' patients, is also prone to reverse causality. Those at higher risk naturally have more atherosclerosis, but are also more likely to be on dietary interventions to reduce their risk. Hence, lower sodium intake in people with more atherosclerosis may relate to their treatment versus cause and effect. National Academies of Sciences states, "the paradoxical J- and U-shaped relationships of sodium intake and CVD disease and mortality are likely observed because of methodological limitations of the individual observational studies", and call these studies 'highly biased'.[2] Major international health and scientific organizations have expressed concern that apparent controversies about reducing dietary sodium are related to low quality research.[9,10]

Our letter is to ensure that readers are aware that the methodology used in Tsirimiagkou's study is invalid. Furthermore, the present human evidence that suggests harm caused by reduced sodium consumption is highly biased and flawed.

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Conflict of interest

NRCC reports personal fees from Resolve to Save Lives (RTSL), outside the submitted work; and is an unpaid member of World Action on Salt, Sugar and Health, and an unpaid consultant on dietary sodium and hypertension control to numerous governmental and nongovernmental organizations. NRCC chairs the International Consortium for Quality Research on Dietary Sodium/Salt (TRUE) which is an unpaid voluntary position. FJH is an unpaid member of Action on Salt, and World Action on Salt, Sugar and Health (WASSH). FH is partially funded by the National Institute for Health Research (NIHR) and the Medical Research Council (MRC). FPC has the following unpaid activities; immediate-Past President and Trustee of the British and Irish Hypertension Society (2017-19), member of Action on Salt, Sugar and Health, member of the TRUE

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Norm RC. Campbell*
University of Calgary, Calgary, Alberta, Canada

Feng J. He
Wolfson Institute of Preventive Medicine, Barts and The London School of Medicine & Dentistry, Queen Mary University of London, UK

Francesco P. Cappuccio
University of Warwick, WHO Collaborating Centre for Nutrition, Warwick Medical School, Coventry, UK

Graham A. MacGregor
Wolfson Institute of Preventive Medicine, Barts and The London School of Medicine & Dentistry, Queen Mary University of London, UK

Rachael M. McLean
Department of Preventive & Social Medicine, University of Otago, Dunedin, New Zealand

* Correspondence. Norm RC Campbell, MD, Department of Medicine, Physiology and Pharmacology and Community Health Sciences, and Libin Cardiovascular Institute of Alberta, Foothills Medical Centre – North Tower, 9th Floor, 1403 – 29th Street NW, Calgary, AB, Canada, T2N 2T9. Tel: (403) 210-7961, Fax: (403) 210-9837.
E-mail address: ncampbel@ucalgary.ca (N.RC. Campbell).

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