The Salt Debate – Far More Salacious Than Salubrious

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Abstract

The scientific evidence supporting dietary sodium reduction as a means of improving overall health outcomes is not yet confirmed and continues to generate considerable controversy. As previously with fat reduction, sodium reduction has become the dominant research subject in the global food industry. To comply with perceived public opinion, the largest multinational food companies have made public commitments to major reductions in sodium to meet current recommendations. This is the precise approach taken when fat came under criticism by public health agencies in the past and many believe that this precipitated our current obesity epidemic. The contradiction between the published scientific evidence on overall health outcomes and the aggressive promotion of sodium reduction policies by health authorities has inspired the characterization of this strategy as, '... the largest delusion in the history of preventative medicine' and others have concluded '... the concealment of scientific uncertainty in this case has been a mistake that has served neither the ends of science nor good policy'. While policy makers may occasionally be forced to act in the face of limited evidence to attempt to limit risks at the population level, this exception cannot be taken as a broad license to deny all new evidence that contradicts a planned agenda, if policies are to be the product of evidence rather than dogma. As

was the case with fat, the strategy of sodium reduction may well qualify as a 'Trojan Horse' of preventative medicine – a policy with an outward façade of great value but simultaneously concealing a significant risk to the population.

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The scientific evidence supporting dietary salt reduction as a means of improving the overall health outcomes is anything but settled and continues to generate controversy in the medical world. As with lipid reduction in the past, salt reduction now dominates the research budget of the multinational food industry, where many companies have made public commitments to major reductions in sodium in order to meet the current recommendations [1, 2]. Sodium reduction is actively promoted by national and international public health agencies and a 30% reduction in intake was endorsed by the 66th World Health Assembly, as a follow-up to the 2011 United Nations High-Level Summit on the Prevention and Control of Non-Communicable Diseases [3].

However, after years of silence on the issue, it is now recognized that the original Dietary Reference Intake for Sodium – the benchmark upon which the current sodium intake recommendations are based – did not conform to the protocols established to set all other Dietary Reference Intakes [4].

Page 270 of the Dietary Reference Intakes [5] for sodium states, 'Because of insufficient data from dose-re-

sponse trials, an Estimated Average Requirement (EAR) could not be established, and thus the recommended dietary allowance could not be derived. Hence, an Adequate Intake (AI) is provided'. Further on page 270, 'The AI for sodium is set for young adults at 1.5 g (65 mmol)/day (3.8 g of sodium chloride) to ensure that the overall diet provides an adequate intake of other important nutrients ...' 'The AI for sodium for older adults and the elderly is somewhat less based on lower energy intakes, and is set at 1.3 g (55 mmol)/day for men and women 50 through 70 years of age, and at 1.2 g (50 mmol)/day for those 71 years of age and older'. On page 271 of the same document it states, 'For adults, a UL (Upper Level) of 2.3 g (100 mmol)/day is set'.

However, no convincing evidence for the AI to be set at 1.5 g/day '... to ensure that the overall diet provides an adequate intake of other important nutrients ...' was provided. Indeed, the latest evidence contradicts this position [6].

More critically, page 3 of the 'Dietary Reference Intakes: Guiding Principles for Nutrition Labeling and Fortification' [7] clearly sets out the formal procedure for establishing values as follows:

Adequate Intake (AI): The recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate; used when an RDA cannot be determined.

All the available data from the well-known Intersalt [8] and later studies [9] reveals there is not a single healthy population in the world that consumes as low as 1.5 g (65 mmol) sodium/day. Thus, the foundation figure used to establish the sodium figure completely disregarded the directive set out for the establishment of all DRIs.

With reference to the UL or upper level, on page 3 of the same 'Dietary Reference Intakes: Guiding Principles for Nutrition Labeling and Fortification' it states:

Tolerable Upper Intake Level (UL): the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population.

Again, all the available data establishes that there is not a single population in the world that demonstrates a risk of adverse health effects to almost all individuals in the general population resulting from consuming more than the UL figure of 2,300 mg sodium per day, because virtually every healthy population in the world consumes levels significantly above that figure. The continued dramatic improvements in health status and life expectancy over

the past 50 years demonstrate the compatibility with the present existing levels of sodium consumption.

This contradiction between the published evidence on overall health outcomes and the aggressive promotion of sodium reduction policies by public health authorities has inspired the characterization of this approach as, '... the largest delusion in the history of preventative medicine' [10] and others have concluded '... the concealment of scientific uncertainty in this case has been a mistake that has served neither the ends of science nor good policy' [11]. While it is understood that policy makers may on occasion be compelled to act in the face of scientific disputes and reservations in order to attempt to limit risks at the population level, this concession cannot be construed as a broad license to deny all new evidence that contradicts a planned agenda if policies are to be the product of evidence rather than dogma.

During the McGovern Nutrition Committee hearings in 1977, when Senator McGovern was cautioned to await stronger scientific evidence before proceeding with severe cautions on fat consumption to the public, he replied, '... I would only argue that Senators don't have the luxury that a research scientist does, of waiting until every last shred of evidence is in'. Thus began, from the very first set of Dietary Guidelines for Americans, a 35-year long odyssey of incredible cost, misinformation, misdirection, increased risk to health outcomes and an epidemic of obesity for American consumers [12]. It is a testament to the power of bureaucratic machinery to manipulate the behavior of a society based upon a modicum of scientific evidence combined with an abundance of opinion – an ability to achieve harm in the pursuit of good. In the case of sodium, this approach has not changed.

Our understanding of salt/sodium consumption has been influenced by a great deal of myth-information. Most people believe that we now consume more salt than ever before, because of processed foods. This is not the case. The only published evidence we have regarding historical salt consumption comes from military archives going as far back as the War of 1812. The available data suggests that Western societies consumed between 16 and 20 g of salt per day from the early 1800s until the end of World War II, based on military archives for prisoner-of-war and soldier rations around the world. During the Anglo-American War of 1812, despite its high cost, salt rations amounted to 18 g per day [13]. American prisoners of war, incarcerated in Britain's Dartmoor prison, bitterly complained that the 9 g of salt per day they received was part of '... scanty and meager diet for men brought up in the land of liberty, and ever used to feast on the lus-

cious fruits of plenty ...' [14]. Declassified World War II documents regarding rations fed to American prisoners of war show a ration of 140 g per week [15].

After World War II, refrigeration displaced salt as the main means of food preservation and salt consumption in the United States (and somewhat later in other countries) dropped dramatically to about half or 9 g (1½ teaspoons) per day and, based on 24-h urinary sodium data, has remained flat for the last 50 years [16]. (It should be noted that the average hospital saline drip of 3 l/day (0.9% NaCl) amounts to 27 g salt).

It is of interest that this sudden drop in salt consumption took place without public pressure, changes to policy or influence from any public health institutions or government Dietary Guidelines. The massive reduction in sodium intake was simply the result of an effortless shift to a fresher, more desirable, cold-chain-based food supply. It is further interesting that this major drop ceased (during the mid-1950s) at one level of consumption and descended no further.

For more than a century, the salt/hypertension hypothesis has remained a highly controversial subject, influenced as much by personal opinions and individual convictions as by scientific evidence. At the start of the 20th century, the chloride portion of sodium chloride was thought to be responsible for increased blood pressure in hypertensives, but subsequent research shifted this relationship to sodium. Even at that time, however, there was opposition to this idea [17]. What was clear was that the entire controversy hinged on a mere handful of patient case studies rather than a solid base of scientific evidence. Furthermore, because one physician's work could seldom be reproduced by another, the salt/hypertension debate was characterized by compelling advocacy rather than reproducible evidence. One of the earliest proponents for salt reduction was Allen [18], who vowed that if anyone with hypertension was not found experimentally to have elevated chloride levels, they had surely been incorrectly analyzed. In 1922, together with Sherril, Allan placed patients with essential hypertension on low salt diets and apparently achieved success [19], but their results could not be verified by other physicians and the practice was eventually abandoned.

During the 1940s, the austere rice diet advocated by Kempner for treating malignant hypertension severely curtailed salt intake and the very high consumption of fruit and fruit juices served to reverse the customary sodium/potassium ratio, providing almost 20 times as much potassium as sodium. Kempner did not take the sodium/potassium ratio reversal into account or the impact of weight loss and claimed salt reduction to be solely respon-

sible for the observed drop in blood pressure. His celebrity, along with the fame of his diet, led to a major shift in support for the sodium/hypertension hypothesis.

Brookhaven's Lewis Dahl began studying the Kempner diet in 1950 [20] and by 1962 became the principal advocate of salt reduction in the United States. Dahl held a number of opinions on salt that were not fully supported by evidence. As an example, the introduction to his paper, 'Possible role of salt intake in the development of essential hypertension' [21], he stated that the widespread use of salt as a condiment to food was uncommon until modern times. However, salt had functioned both as a preservative and a condiment (by itself and in sauces) for more than two millennia in Europe and Asia.

Dahl's principal research was carried out on rats, under experimental conditions that could only be qualified as extreme. He continually fed his rats levels of salt bordering on the LD₅₀ for sodium chloride – the human equivalent of 1¼ lbs. of salt per day! Under these conditions, some of the rats did eventually develop increased blood pressure and Dahl maintained this was evidence of the relationship of salt to hypertension.

The renewed interest in linking sodium consumption to hypertension prompted the famed Intersalt Study [8] – an observational study based on a sample of more than 10,000 men and women between the ages of 20 and 59, from 52 population centers in 38 countries spread across the world. The purpose of Intersalt was to investigate in a systematic and standardized way the relationship between electrolyte excretion and blood pressure based on samples from many countries. The report analyzed sodium excretion, potassium excretion, and the sodium/potassium ratio from 24 h urine samples in relation to blood pressure among over 10,000 men and women aged 20–59, taking body mass index and alcohol intake into consideration as confounding variables.

Although most populations around the world had sodium consumption levels in a narrow region from 100–200 mmol (2,300–4,600 mg Na/day), there was an outlier group of primitive tribes that consumed 50 mmol or less per day. A critical conclusion of the study was that those Intersalt populations with very low-sodium intakes appeared to have had low median blood pressures, a low prevalence of hypertension and no increase in blood pressure with age, leading to the conclusion that the low levels of hypertension among these tribes was the exclusive result of low-salt consumption. When the four low sodium outlier populations were included in the analysis, a direct relationship between sodium intake and blood pressure was established (fig. 1). However, when this same outlier group was not

Fig. 1. Taken from Intersalt [8].

included, there was an inverse relationship noted between sodium and blood pressure for all other populations.

Unfortunately, this conclusion was made without the benefit of any genetic information. Two out of the four low-sodium populations in the Intersalt study – the Yanomamo and Xingu Indians are of Amerindian origin – rainforest populations that have a near absence or a very low frequency of the D/D genotype – a genotype associated with cardiovascular diseases and hypertension. These individuals present a low risk for developing cardiovascular disease, in spite of data that show serum triglyceride concentrations to be slightly higher in this population than in Caucasians at any age [22, 23]. Another one of the outlier groups (from Papua New Guinea) is also from a region where a low incidence of D/D genotype is prevalent. The genotype of the fourth outlier (from Kenya) has not been published.

Thus, the most influential sodium/hypertension study could be interpreted in any number of ways, and it was. Nevertheless, Intersalt set the stage for the Dietary Refer-

ence Intakes that we now use internationally and, without the benefit of genetic information, the primitive Yanomami rainforest dwellers (the lowest outlier), who have a life expectancy of 47 years, were held up as the example of how low sodium intakes minimize age-related increases in blood pressures.

The most recent IOM report on sodium reduction [2013] recognized the limitations of the available evidence, and indicated that there was no consistent support for an association between sodium intake and either beneficial or adverse effects on most direct health outcomes [24]. Several new studies have questioned the concept of population-wide sodium reduction on the basis of limited benefit [25–28], while others have highlighted the possible risks associated with the current recommended levels, which serve as the core of all ongoing salt reduction initiatives [29–38]. In almost all instances, these risks are related to the rapid rise of renin-angiotensin-aldosterone (RAS) activity once sodium intakes fall below 2.8 g/day [39].

Despite the unresolved controversies in evidence and the unacceptable manner in which they were derived, there continues to be overwhelming support for the current sodium recommendations by all public health agencies. Much like the storm originally surrounding the consumption of fat, the strategy of salt reduction may well qualify as a ‘Trojan Horse’ of preventative medicine – a policy with an outward façade of great value but, at the same time, concealing a significant risk to the population. The question is whether we will have the discipline to heed the preponderance of scientific evidence or the desires of the establishment, as did the Trojans.

Disclosure Statement

M. Satin is an employee of the Salt Institute.

The views expressed in this paper are the author’s and do not necessarily reflect those of the Salt Institute or its members.

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