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CARDIOVASCULAR RISK HEALTH POLICY (W ROSAMOND, SECTION EDITOR)

Reducing Sodium in the Global Food Supply to Reduce Population Burden of Cardiovascular Disease

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Abstract Populations around the world are consuming salt in quantities that far exceed physiological requirements. In view of the association of a high salt intake with hypertension, cardiovascular and kidney disease, many countries have introduced population-based recommendations and initiatives to reduce salt intake. Salt reduction is recognised as one of the most cost-effective public health strategies that a country can make in reducing the growing burden of non-communicable diseases. As such, the World Health Organisation has recommended salt reduction as one of the top three priority actions to tackle the non-communicable disease crisis. At the recent World Health Assembly, it was unanimously agreed that all countries should reduce their salt intake by 30 % towards a target of 5 g/day, by 2025. Many countries are now looking to follow in the footsteps of the UK, who are considered world leaders in this area.

Keywords Sodium · Salt · Cardiovascular disease · Heart disease · Strokes · Heart attacks · Blood pressure · Hypertension · Food industry · Government · Salt reduction · Targets · Voluntary · Legislation · Regulation

Introduction

The importance of salt (sodium) for the human body is well recognised. Sodium is required for every cell in our body. Without it, our muscles would cease to function, including our hearts. However, the amount required for optimal health is minimal in comparison to what we eat [1••]. Humans require less than 1 g of salt for peak health; however, people in most countries around the world are eating between 9 and 12 g per day [1••].

Salt in the diet was minimal millions of years ago, with the only sources of sodium found naturally occurring in foods. Indeed, in some tribes in South America, where their diet is still somewhat similar to that of our ancestors, small levels of sodium in the diet, obtained primarily from natural organic materials, e.g. fruit and vegetables, have been shown to be sufficient for health [2].

The rise in use and consumption of salt came around 5000 years ago after its preservative qualities were realised. Thus, in time, people learned how to find salt and extract it from the ocean and earth. With the use of salt, people were able to preserve food to make it last longer. However, salt was scarce, so it became a valuable commodity that was used, amongst other things, for currency. In fact, this is where the word salary has been derived, 'sal' meaning salt in Latin.

After the Industrial Revolution, salt became inexpensive and plentiful. As more became available, so more was used, until we became accustomed to the taste. Since then, salt has been added to processed foods, which now equates to over 75 % of salt intake in high-income countries [3]. As time has evolved, we find ourselves now living in a world that is fast paced and demanding, with increased reliance on cheap and convenient processed foods. This comes with a guaranteed high salt (>5 g) intake [4].

Salt has long since outlived its use as a preservative, primarily due to the invention of refrigerators as well as better and easier access to food. However, we remain accustomed to the taste, and addition to food became habitual. In high-income countries, where most of our salt intake comes predominantly from processed foods, the addition of salt also

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allows the food industry to substitute good quality fresh produce for cheaper less flavoursome ingredients.

Aside from its historical value and physiological significance, high salt consumption has been recognised as detrimental to health, particularly to blood pressure. Evidence for salt and elevated blood pressure throughout life is well established. Many studies show that increased salt intake is directly associated with raised blood pressure, thereby increasing the risk of cardiovascular disease, the biggest killer worldwide [5] and kidney disease.

The totality of evidence, including animal studies, epidemiological studies, randomised trials and outcome studies, all show a reduction in blood pressure from reducing salt intake [6]. Also, several meta-analyses of randomised clinical trials have consistently shown that people with hypertension have a greater response to a reduced salt intake than do persons with normal blood pressure [7–10]. In a meta-analysis of ten controlled trials involving a total of 966 children, a 42 % reduction in salt intake was associated with small but significant reductions of both systolic pressure (−1.17 mmHg; 95 % confidence interval [CI], −1.78 to −0.56) and diastolic pressure (−1.29 mmHg; 95 % CI, −1.94 to −0.65) [11]. However, recent analyses have questioned this outcome, suggesting there to be a U-shaped association between salt intake and all-cause mortality with higher rates of mortality shown in intakes lower than 6 g/day and greater than 12 g/day [12]. However, these analyses have since been criticised and many retracted due to severe methodological flaws in the studies analysed (e.g., errors in salt assessment, residual confounding and reverse causality) [13].

Salt Reduction Commitment Worldwide

Populations around the world are consuming salt in quantities that far exceed physiological requirements [14]. In view of the association of a high (>5 g) salt intake with hypertension, cardiovascular and kidney disease, many countries have introduced population-based recommendations and initiatives to reduce salt intake [15]. Salt reduction is recognised as one of the most cost-effective public health strategies that a country can make in reducing the growing burden of non-communicable diseases [16–20].

As such, the WHO has recommended salt reduction as one of the top three priority actions to tackle the non-communicable disease crisis [21]. At the recent World Health Assembly, it was unanimously agreed that all countries should reduce their salt intake by 30 % towards a target of 5 g/day, by 2025 [22]. The main sources of salt in the diet differ from country to country, so it is important that this is recognised before implementing any national strategies to reduce salt. In high-income countries where most products contributing to salt are processed, the most effective strategy would be to target the manufacturers and caterers to reduce the salt content of their food through 'reformulation'. In other countries, where most of the salt is added during cooking, e.g. Southern China, approaches looking to change consumer behaviour are more appropriate. In most countries, where salt intake falls predominantly within processed foods, programmes have been developed to engage the food industry in salt reductions, with a reported 38 countries now setting targets for salt in certain food categories, nine of which have introduced legislation [23].

High-Income Countries

UK

One of the main population-based initiatives to reduce salt in the food supply was pioneered in the UK. The UK has successfully developed a semi-voluntary salt reduction programme strongly supported by government ministers which is considered one of 'the most successful nutrition policies in the UK since the second world war' [24]. First developed by Consensus Action on Salt and Health (CASH), the strategy involves lowering salt intakes by:

1. Reducing the amount of salt added to processed foods by 40 %
2. Reducing salt in cooking or at the table by 40 % [25]

In order to reduce average salt intake from 9.5 g/day to the projected target of 6 g/day in adults, the Food Standards Agency (FSA) then set a series of progressively lower salt targets for over 80 categories of food [26, 27]. This was subsequently incorporated as part of the government's Public Health Responsibility Deal Salt Reduction Pledge, known as the '2012 targets' [28].

To date, significant progress has been made by many food manufacturers and retailers in the UK, with salt content being reduced across the board, including by up to 50 % in breakfast cereals, 45 % in biscuits, 40 % in pastry products, 25 % in cakes and pasta sauces and 20 % in bread [25, 29].

The reduction in salt content of bread is highly significant in the UK and indeed in many other countries around the world, as bread is the highest contributor of salt to the diet. Recently published survey-based data collected between 2001 and 2011 show the progressive and unobtrusive reductions that have been made over this time—equating to a 20 % reduction [29]. A wide variation in the salt content of UK breads surveyed was found, with many products already meeting the 2012 targets, indicating that further reductions can be made. Additional pressure on producers and retailers has come from front of

pack labelling, which has thus far been successful in the UK.

Furthermore, it has been reported that less salt is being added at the table by consumers [30]. The average salt intake in the UK population is steadily decreasing in parallel, with the latest reported intakes at 8.1 g/day [31], the lowest known accurate figure for any high-income country (measured by 24-h urinary sodium excretion) [14]. However, this continues to exceed the maximum recommended limit of 6 g/day.

Nevertheless, this represents a 15 % reduction from 2001 (9.5 g) [32]. This reduction in salt intake has been accompanied by a fall in the average population blood pressure and a reduction in mortality rates from stroke and ischaemic heart disease [33•]. This is estimated to be saving approximately 9000 lives every year and resulting in annual health care savings of ≈£1.5 bn [34].

Whilst the salt reduction programme is proven to be successful in the UK, much more needs to be done. Recent research has shown the salt content of cheese in the UK is still high, with a wide variation of salt content, both within different types of cheeses (e.g. Roquefort and cheddar) as well as within the same type of cheese [35]. Despite this, 84.5 % of cheeses have already met their respective 2012 targets. These findings demonstrate that much larger reductions in the amount of salt added to cheese specifically and food in general could be made and more challenging targets need to be set.

A proposed flaw to the UK salt reduction programme is the speed at which it has taken for many members of the food industry to reduce the levels of salt in their food. This is most likely due to the semi-voluntary nature of sign up by food companies and its progress being stalled by political change. Similar patterns are undoubtedly seen in other countries, where voluntary targets are being set, as they lack enforcement or strict monitoring by government. A recent modelling study has shown that voluntary reformulation potentially resulted in a life-year gain over baseline of 14,560 life years, whilst mandatory reformulation might result in 19,320 life-years [36]. Therefore, mandatory reformulation, particularly for foods that contribute the most salt intake, is clearly preferable.

Nevertheless, the current UK government continues to take the voluntary approach to salt reduction, with some success. In 2013, the Department of Health (DH) renewed its commitment to improving public health, by agreeing to review the 2012 targets for further reductions in these 80 categories of food. In March 2014, new targets were published as a new pledge within the Responsibility Deal (RD), with a deadline of 2017 in which to achieve them [37].

However, a recent paper has raised some concerns about whether such a salt reduction programme is reducing health inequality in the UK population. The analysis found that whilst overall population wide salt intakes have decreased since the national salt reduction programme began in 2001, intakes have varied across socioeconomic groups, with those in lower levels of education still consuming greater levels of salt than the more educated [38]. Efforts are therefore needed to minimise the gap between socioeconomic groups for an equitable delivery of cardiovascular prevention.

Furthermore, for years, the out-of-home sector was wrongly left out of the RD. This has led to the sector lagging behind the rest of the food industry. The out-of-home sector struggled to apply the 2012 salt pledges to their own place of work, as they do not operate on per 100 g basis, but rather per serving. With this in mind and in an attempt to bring them up to speed with the rest of the food industry, the DH created a separate pledge for the out -of -home sector. This new pledge provides part of a solution due to its simplicity and outlines maximum values of salt for ten of the UK's most popular food groups purchased in the out -of -home sector on a per serving basis, as well as one for children's meals. Thus far, interest in the out of home pledge has been disappointing with very little take-up up since its launch in March 2014. Nevertheless, it is a potentially important step in the salt reduction programme. Furthermore, with increased pressure from government, non-government organisations such as CASH and other supporters, it is likely that the sector will follow in the footsteps of the rest of the food industry.

Reformulation is important as it will reduce salt content of foods that are consumed by children and adults alike, such as cereal and cereal-based products (which included bread), meat products, and milk and milk- based products, which studies have shown are major contributors of salt intake in children's diet in the UK [39]. However, there needs to be a greater focus on foods that are liked and generally marketed to children. The reformulation process needs to be fast-tracked for foods that are marketed towards children too. A recent policy review by the Labour party in the UK suggested legal maximum limits for sugar, fat and salt in children's food [40].

Other High-Income Countries

Other countries around the world, including Australia, the US and Canada, are adopting a similar target-based approach to salt reduction, be it voluntary or mandatory [23]. This has also been shown to contribute to major savings. For instance, a recent study in the US showed that even a very modest reduction in salt intake of only 10 % would prevent hundreds of thousands of strokes and heart attacks over the lifetimes of

adults aged 40–85 years who are alive today, and could save more than $32 billion in medical expenses in the USA alone [41]. Indeed, New York City, for example, has set targets for over 60 categories of food, whilst others have settled on a broader range of products [42]. However, many of these are not implemented in a structured and forceful manner, and as a result, there is little evidence of a corresponding salt reduction trend, as is the case in New York. Indeed, a recent study has shown no meaningful reduction in the salt content of lunch/dinner menu offerings at the leading fast-food restaurants examined in the last 14 years [43]. Furthermore, almost the entire population is failing to meet dietary salt guideline recommendations [44].

Also, encouraging behavioural changes and improving health education, whilst useful, will not have a big enough impact on public health, as in many instances, people do not realise the amount of salt they are eating. The importance of salt reduction through reformulation for consumers was recently emphasised by research, which showed that consumers were less likely to be engaged in dietary advice such as to avoiding foods higher in salt, processed foods and implementing salt reduction strategies whilst eating in restaurants [22]. The best plan of action for these countries would therefore be progressive and unobtrusive reductions in the salt content of processed foods.

Middle-Income Countries

South Africa

In 2013, South Africa chose to set mandatory targets for food [45]. It is estimated that by decreasing daily salt intake by 0.85 g per person, mostly through reformulations in bread, approximately 7400 cardiovascular deaths (2900 from stroke) and some 4300 lives from non-fatal stroke could be averted. The savings from reduced numbers of hospital admissions of patients with non-fatal strokes alone could save around ZAR300 million, or $28 million a year [46].

The world will be looking to South Africa to see how effective their mandatory targets are, and whether they will be adequately monitored. The regulations could potentially benefit the health of population's within the region, as relaxation of tariff agreements enables South African retail chains to sell processed foods across the continent [45].

Other Middle-Income Countries

There is limited analysis on the effect of salt reduction on middle-income countries. However, a recent analysis reviewed the effect of three policies to reduce dietary salt intake: a health promotion campaign, labelling of food packaging and mandatory reformulation of salt content in processed food in Tunisia, Syria, Palestine and Turkey. In all four countries, most policies were cost saving compared with the baseline. The combination of all three policies (reducing salt consumption by 30 %) resulted in estimated cost savings of $235 million in Tunisia, $39 million in Syria, $6 million in Palestine and $13 billion in Turkey [47].

The Pan American Health Organisation (PAHO) Technical Advisory Group (TAG) on Cardiovascular Disease Prevention through Dietary Salt Reduction led a Technical Meeting on 'Setting Targets and Timelines for Dietary Salt Reduction' in Mexico, December 2013. Thirteen countries discussed steps towards setting progressive targets for food groups [48].

Discussion

The evidence suggesting population salt reduction is beneficial to health is extremely strong. With the support of the WHO, many countries are now recognising the need for action, and engaging with industry and consumers. The question now is how we can do it most effectively so as to meet the WHO's worldwide targets.

Supply side polices such as reformulation are far more effective than health education and counselling methods in primary care, particularly in high-income and increasingly middle-income countries, where salt is consumed predominantly from processed foods [49]. However, the proportion of salt intake from processed foods varies greatly from nation to nation. Any country looking to carry out a salt reduction programme must first determine the main sources of salt in their countries' diet.

Many experts around the world favour the legislative approach as it is undoubtedly a much stronger driver for reformulation, ensuring all companies comply and create a level playing field that many supporters strive for and demand [50, 51]. However, laws can take a considerable amount of time to be realised, as there is a lot of political red tape to cut through. Thus, many countries prefer to initially implement a more voluntary approach.

Nearly 40 countries have now applied voluntary salt targets in foods, with nine introducing some form of legislation for a number of products. This demonstrates considerable progress. However, many countries have yet to make salt reduction a priority in their public health agenda. If they are to achieve the WHO target of 30 % reduction in salt consumption worldwide, then they will need to act now. Based on the success of the comprehensive UK salt reduction programme [29], the following could perhaps be applied to other countries, with appropriate local modifications, in order to reduce salt in the food supply:

- Set up an action group similar to Consensus Action on Salt and Health (CASH)

- Determine population salt consumption (via 24-h urinary analysis) and identify major sources of salt in the diet
- Elicit government support
- Set targets for different categories of food
- Engage with the food industry
- Enforce clear labelling of salt content in food
- Set up consumer awareness campaigns

Conclusion

This review summarises the most recent evidence on reducing salt in the food supply to reduce population burden of hypertension and hence cardiovascular disease. For most countries, implementing a salt reduction programme is likely to be one of the most effective and cost-saving ways of improving public health. It will undoubtedly prevent millions of deaths worldwide.

Compliance with Ethics Guidelines

Conflict of Interest Kawther Hashem and Sonia Pombo-Rodrigues are employed by Consensus Action on Salt and Health. Simon Capewell is a member of Consensus Action on Salt and Health.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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