Sodium and heart health

This position statement outlines key findings and recommendations from the Heart Foundation on the relationship between sodium intake and heart disease for adults. This position statement was guided by three research questions and replaces the 'Sodium' position statement and evidence paper (2011).

Research questions:

1. What is the relationship between consuming sodium and cardiovascular disease (CVD) risk and mortality in adults?
2. What is the relationship between consuming sodium and blood pressure in healthy adults and those with hypertension or established CVD[1]?
3. What is the relationship between consuming sodium and adverse health outcomes in patients with established heart failure?

EXECUTIVE SUMMARY

Sodium is an essential nutrient involved in maintaining cellular homeostasis and regulating fluid and electrolyte balance in the body. It is well-established that high sodium intake increases blood pressure, which in turn increases risk of CVD. While small amounts of sodium are necessary for good health, New Zealand adults are currently consuming around 3,400mg sodium a day (8.5g of salt) which is more than the recommended maximum intake of 2,000mg (5g of salt).

The Heart Foundation assessed the evidence on the relationship between sodium intake and heart health outcomes up to April 2022 to inform this position statement. There is strong evidence that reducing sodium intake lowers blood pressure in people with both normal and raised blood pressure. There was limited evidence on an appropriate sodium intake for managing heart failure, however it is reasonable to recommend people with heart failure avoid an excessive intake of sodium.

[1] For research question 2) the Heart Foundation is most interested in the following cardiovascular diseases: coronary heart disease, atrial fibrillation and heart failure.

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Although there is limited recent data, the major source of sodium in the diet of most New Zealand adults is processed foods with bread being the largest source. The Heart Foundation recommends adults follow a heart-healthy eating pattern based around whole foods that are naturally low in sodium including vegetables, fruit, legumes, whole grains, nuts, seeds, fish and seafood. Examples of heart-healthy eating patterns include the traditional Mediterranean diet and the Dietary Approaches to Stop Hypertension (DASH) diet.

Health professionals have a role to educate people on the link between sodium and blood pressure and to promote the health benefits of reducing sodium intake at all ages and all levels of heart disease risk. All adults, including people with high blood pressure and living with a heart condition are recommended to eat less than 2,000mg sodium a day (5g salt). With around 75% of the sodium New Zealanders consume coming from processed foods, the food industry has a key role to play in reducing the levels of sodium across the food supply.

KEY OUTCOMES

High blood pressure (hypertension) is a major risk factor for heart disease and the greatest predictor of stroke. High blood pressure is considered to be equal to or higher than 140mmHg systolic or 90mmHg diastolic (1, 2). For most adults, an ideal blood pressure is below 120mmHg systolic and 75mmHg diastolic (3). Eating too much sodium increases the risk of high blood pressure.

There is strong evidence from trials that following a lower sodium diet reduces both average systolic (-3.3mmHg) and diastolic blood pressure (-2.2mmHg), compared with a higher sodium diet. When usual sodium intake falls within the range of 2,300–4,100mg/d, there is strong evidence that reducing sodium intake reduces long term heart disease risk (4). Every 1000mg reduction in sodium is associated with a 2.8mmHg lowering of systolic and 1.7mmHg lowering of diastolic blood pressure (4). The effect of sodium reduction on blood pressure is greater in people with high blood pressure (4).

There is moderate certainty evidence that a sodium-reduced diet had a 26% lower risk of CVD and 21% lower risk of hypertension when compared to participants following their usual diet (4).

A recent trial (SODIUM-HF) demonstrated that reducing sodium intake to 1658mg/day (median) in people with heart failure did not reduce clinical events (5). However, both groups had relatively low intake of sodium when compared with average population intakes and more trials are needed.

BACKGROUND

CVD is the leading cause of death in Aotearoa and includes heart, stroke and blood vessel disease (6). High blood pressure is one of the leading risk factors for the global disease burden and an important risk factor for coronary artery disease (CAD), stroke, heart failure, atrial fibrillation, chronic kidney disease, heart valve disease, aortic syndromes and dementia (7-10).

Sodium is an essential nutrient involved in the maintenance of normal cellular homeostasis and the regulation of fluid and electrolyte balance in the body. Sodium is also associated with blood pressure (11). Sodium balance is influenced by a range of physiological systems and hormones (4). The function of sodium is closely related to potassium as they have opposite roles in the body to maintain physiological homeostasis (4).

Given its relationship with blood pressure, excessive sodium intake is known to be one mechanism that contributes to the development of high blood pressure and, eventually, CVD (4). When blood pressure is high, blood flowing through the arteries exerts more pressure on the artery walls which can cause the artery walls to stiffen and narrow over time, leading to CAD, left ventricular hypertrophy (enlarged left ventricle) and heart failure (4).

Sodium versus salt

Sodium and salt are often used interchangeably. Sodium is a mineral and salt is a combination of two minerals and is known as sodium chloride. Salt accounts for about 90% of the sodium we consume. Sodium occurs naturally in low amounts in some whole foods. Salt is used during food preparation at home, or salt and other sodium-containing compounds can be added to foods commercially during processing to enhance flavour, texture or appearance and to preserve freshness. Around 75% of the sodium we eat comes from salt in processed foods, 10–12% is discretionary salt[2] and 10-12% naturally occurs in foods (12, 13).

Prevalence of high blood pressure

According to the 2020/21 New Zealand Health Survey, 17% of adults (692,000 people) had a diagnosis of high blood pressure and were currently taking medication. Around 23% of adults had measured blood pressure higher than 140/90mmHg and this was disproportionately higher in underserved communities who are generally living in lower socio-economic areas with less access to fresh food such as Pasifika community (28%) and Māori whānau (24%) (14).

Prevalence of heart disease

According to the 2020/21 New Zealand Health Survey, around 4% of adults (175,000 people) had a diagnosis of CAD and 1.6% of adults (66,000 people) had a diagnosis of heart failure (14). Māori and

[2] Discretionary salt is salt that is added during food preparation at home or at the table while eating

Pasifika people are at risk of developing heart failure at a much younger age compared with other ethnic groups such as Europeans or Asians (15).

Recommended amount of dietary sodium

The suggested dietary target (SDT) is the average daily intake of a nutrient that may help to prevent chronic disease in the general population. The suggested dietary target for sodium for Australian and New Zealand adults is 2,000mg/day (16). This is consistent with World Health Organisation (WHO) recommendations (17). No upper level (UL) of intake was set due to not being able to define the highest average daily sodium intake below which there are no adverse effects on blood pressure (16).

Current New Zealand recommendations

The New Zealand Ministry of Health's Eating and Activity Guidelines for adults recommends 'choosing and preparing foods that are low in salt' while encouraging the consumption of 'whole' and less processed[3] foods (13). The guidelines recommend not adding salt to food, however, if using salt, iodised salt is recommended as most New Zealand soils are low in iodine (13).

The Heart Foundation recommends a plant-rich eating pattern based around whole foods that are naturally low in sodium including vegetables, fruit, whole grains, legumes, nuts, seeds, fish and seafood (18). People with heart failure are recommended to eat low-sodium foods alongside other lifestyle measures to manage their condition (19, 20). Advice around what constitutes a low-sodium diet varies however it is usually <2000mg/day (20, 21).

The CVD Risk Assessment and Management for Primary Care guidelines recommend people with blood pressure ≥130/80mmHg adopt lifestyle measures such as reducing salt and alcohol intake, losing weight and increasing physical activity as a first line treatment over medication management (3). People with persistently raised blood pressure who are at high risk of CVD (>15% cardiovascular risk[4]) are strongly recommended to add medication to existing lifestyle changes (3).

Sodium intakes in New Zealand

The gold standard method for assessing population sodium intake is via 24-hour urinary sodium excretion (22). A sample collected over 24 hours represents approximately 93% of the sodium ingested with the remaining 7% being used by the body or excreted in sweat (22).

There is limited data on sodium intake in New Zealand. The most recent cross-sectional study (2012) collected 24-hour urine samples from a random sample (n=299) of adults aged 18-64 years from Dunedin and Wellington (23). The average 24-hour sodium excretion was 3,386mg/day (3,865mg/day

[3] Less processed foods have had some processing, but kept most of their physical, chemical, sensory and nutritional properties
[4] Five-year CVD risk >15% according to CVD risk assessment and management for primary care guidelines (2018)

for men and 2,934mg/day for women) (23). Sodium intake was higher among younger adults, men and those with a higher body mass index (BMI) (23).

Food sources of sodium

Foods that contribute a large amount of sodium to our overall intake either contain large amounts of salt (e.g. processed meats or sauces/condiments) or moderate amounts of sodium but are consumed frequently in large amounts (e.g. bread) (13).

The most recent national level dietary intake data to assess dietary sources of sodium in New Zealand are from the 2008/09 National Nutrition Survey. A recent study by Eyles and Cleghorn used these data to determine major dietary sources of sodium for the total adult population (16+ years) by gender, ethnicity and age (24). Dietary intake was collected via a single 24-hour recall (n=4,721). Fifteen major food groups contributed 80% of sodium consumed and the top five sources across the total population were 'bread' (18%), 'bread-based dishes' (11%), 'grains/pasta' (includes noodles) (7%), 'pork' (6.5%), 'sausages/processed meats' (5%) (24).

There were, however, some differences in major food sources of sodium between population sub-groups (24). In addition, the top five sources of sodium included the food category 'poultry' for Pacific communities, and the food categories 'vegetables' (includes pickled/preserved) and 'soups and stocks' for Asian people (24). For people aged 61 and older 'soups and stocks' were also among the top six contributors to dietary sodium (24).

It is important to note that given the single dietary recall and age of these data they may not reflect current eating patterns, including potential increases in money spent on food away from home (25).

Sodium in processed foods and fast foods

Packaged food and beverages are readily available and often more affordable compared with whole foods (26). A large proportion of packaged foods in New Zealand supermarkets are classified as ultra-processed[5] (69%) or have an estimated Health Star Rating[6] <3.5 stars (59%) (27).

The 'State of the food supply' report (2019) highlights the extensive number of products with added salt and the wide range of sodium content between categories and across brands (28). Packaged food categories with the highest mean sodium content were fish and fish products 1750mg/100g; sauces, dressings, spreads and dips 1173mg/100g; meat and meat products (including processed meats) 771mg/100g; and snack foods 590mg/100g (28). The mean sodium per 100g in fish and fish products was high in this research due to anchovies which are an outlier. Fish and fish products are

[5] The term 'ultra-processed foods' (UPFs) describes foods that have been through industrial processing. Many of these foods are energy-dense products which are high in sugar, unhealthy fats and salt.

[6] Health Star Ratings reflect the overall nutrition content and healthiness of packaged foods. The system uses a rating scale of 0.5 to 5 stars.

generally a heart-healthy source of protein. The sodium levels of canned fish are typically around 300-600mg/100g with fish canned in springwater usually lowest in sodium.

Between 2016-2019 weekly household expenditure on restaurant meals and ready-to-eat food increased by an average of $7 per household (25). In a 2020 study by Mackay et al, 176 meal combos from nine fast-food chains were nutritionally analysed. The median sodium content of meal combos was 1771mg/serving, 90% of the maximum daily salt intake for adults (2,000mg) (29).

EVIDENCE FOR SODIUM AND HEART HEALTH

To inform this updated position, the Heart Foundation's Expert Nutrition Policy (ENP) working group, with co-opted expertise, followed the process outlined below to consider the available scientific evidence on sodium and cardiovascular disease outcomes.

This position statement is largely informed by the evidence synthesis from the 2019 *'Dietary Reference Intakes (DRI's) for Sodium and Potassium'* published by the National Academies Press (NAP) (4). The ENP working group accepted the NAP Committee's rationale for evidence-based revisions to the data that was drawn primarily from a systematic review by Newberry et al (2018) (30). The ENP working group also accepted the NAP Committee's assessment of the evidence using the GRADE[7] system (31, 32). Sections detailing the causal relationship between dietary sodium intake and chronic disease indicators (blood pressure, hypertension incidence and CVD incidence) were most relevant to the research questions and health outcomes of interest. A summary of the GRADE[2] assessments used to inform the position statement can be found in **Appendix 1** (4).

An additional search was conducted to identify systematic reviews and meta-analyses of trials on sodium restriction for people with heart failure for the past five years up to April 2022. Due to the small amount of evidence available, commentary on two recently published international guidelines, one systematic review and one recent randomised controlled trial (RCT) were included (5, 33-35).

Evidence relating to low sodium salt substitutes (LSSS) on CVD outcomes was outside the scope of the review process outlined above, however, commentary on a recent 2022 Cochrane review was included (36).

Blood pressure

High versus low meta-analysis

Thirty parallel and 17 crossover trials investigating the effect of sodium reduction on blood pressure were included in the meta-analysis (4). When a higher sodium diet was compared with a lower sodium diet, the lower sodium diets on average reduced systolic blood pressure by 3.3mmHg and diastolic blood pressure by 2.2mmHg (4). Trials that had larger reductions in sodium intake and trials where participants had higher mean systolic blood pressure at baseline achieved greater reductions in systolic blood pressure (4).

The difference in systolic blood pressure was greater among participants with high blood pressure at the start of the trial (-4.0mmHg) when compared to those without high blood pressure (-1.3mmHg). Similarly, the difference in diastolic blood pressure was greater among participants with high blood pressure (-2.7mmHg) compared to those without high blood pressure (-0.7mmHg). The NAP assessed this evidence as high certainty using the GRADE framework (4).

[7] GRADE (Grading of Recommendations Assessment, Development and Evaluation) is a framework to assess the certainty of the body of evidence for each outcome and uses the following scale: high, moderate, low, or very low to describe confidence in the certainty of the effect related to each outcome

Dose-response meta-analysis

A dose response analysis was also conducted to evaluate the association between sodium and blood pressure across three sodium intake ranges (<2,300mg/day, 2,300-4,100mg/day, >4,100mg/day) (4). In the sodium intake range of 2,300–4,100mg/d (21 RCTs), the NAP determined that there was a high certainty of evidence that reducing sodium intake reduced blood pressure. Every 1000mg reduction in sodium intake was associated with a 2.8mmHg reduction in systolic blood pressure and a 1.2mmHg reduction in diastolic blood pressure (4). In the sodium intake range of 4,100–5,000mg/d (11 RCTs), there was a moderate certainty of evidence that reducing sodium intake reduced blood pressure. Every 1000mg reduction in sodium intake was associated with reduction in systolic (-2.7mmHg) and diastolic (-1.7mmHg) blood pressure (4).

Two recently published systematic reviews and meta-analysis by Huang et al (2020) and Filippini et al (2021) show similar reductions in systolic and diastolic blood pressure and a consistently larger reduction in blood pressure in people with high blood pressure (37, 38).

Cardiovascular disease incidence

Three large studies investigating sodium reduction and CVD incidence were included in the meta-analysis once trials using LSSS were excluded (4). Each of the three studies were long-term follow-ups to trials (>1 year) involving lifestyle interventions to reduce sodium intake. The dietary intervention in each study was highly targeted to encourage a reduction in dietary sodium without changes to other foods or nutrients. Participants following a sodium-reduced diet had a 26% lower risk of CVD at long-term follow-up (15-28 years) when compared to participants following their usual diet (4). The NAP assessed this evidence as moderate certainty using the GRADE framework.

Hypertension incidence

Three large trials investigating the association between sodium reduction and high blood pressure were included in the meta-analysis (4). People following a sodium-reduced diet had a 21% lower risk of high blood pressure (4). The NAP assessed this evidence as moderate certainty using the GRADE framework.

Heart failure and sodium restriction

A 2021 systematic review by Zhu et al of 10 RCTs (n=1011) evaluated the effect of dietary sodium restriction on quality of life in people with heart failure (33). Hospital readmission rate (6 RCTs) and all-cause mortality (5 RCTs) were reported as secondary outcomes in a sub-group meta-analysis. However, most of the data in the meta-analysis comes from a single study where the intervention group received a hypertonic saline solution (HSS), high dose furosemide and moderate dietary sodium restriction which makes it difficult to make any clear conclusions (39).

A recent international RCT ('SODIUM-HF') including sites in New Zealand was published in 2022 by Ezekowitz et al (5). People (n=806) with chronic heart failure (functional class 2-3) were randomly assigned to usual care or a low sodium diet of less than <1,500mg/day. The median sodium intake

decreased from 2286 to 1658mg/day in the low sodium group and from 2119 to 2073mg/day in the usual care group at 12 months. There was no difference in events (cardiovascular-related hospitalisation, cardiovascular-related emergency department visit or all-cause mortality) between the low sodium and usual care group at 12 months. These results demonstrate that reducing sodium intake to 1658mg/day (median) in people with heart failure did not reduce clinical events (5). However, both groups had relatively low intake of sodium at the start of the trial when compared with average population intakes.

The 2022 AHA/ACC/HFSA[8] Guideline for the Management of Heart Failure recommends for people with stage C[9] heart failure, to avoid excessive sodium intake to reduce congestive symptoms (34). The DASH diet is recommended for achieving sodium restriction without compromising nutritional adequacy (34). The strength of this recommendation is moderate due to RCTs in this area being low-quality because of small numbers, lack of ethnic diversity and concerns around the validity of several RCTs (34). The 2021 European Society of Cardiology Guidelines for diagnosing and treating acute and chronic heart failure recommend avoiding excessive salt intakes (>2000mg sodium/day or >5g salt/day) and maintaining a healthy body weight (35). The guidelines state that there is little evidence for specific lifestyle advice, however, people who reported more effective self-management[10] have a better quality of life, lower readmission rates and reduced mortality (35).

Low sodium salt substitutes

Low sodium salt substitutes (LSSS) which are often referred to as 'salt substitutes' are lower in sodium than ordinary salt. Some of the sodium is replaced with other mineral salts, most commonly potassium chloride. Salt substitutes are intended for use in food processing and discretionary salt use (at home or in cooking) and are seen as an alternative approach to reducing sodium and increasing potassium intake (40).

A 2022 Cochrane review assessed the effects of replacing salt with LSSS on blood pressure and cardiovascular outcomes (36). Safety was also considered. A total of 26 RCTs (34,961 adults) were included with 16 RCTs randomising individual participants and 10 RCTs randomising clusters (families, households or villages). Studies included participants with high blood pressure and normal blood pressure. All trials excluded participants for whom higher intakes of potassium would be harmful. The length of trials ranged from two months to five years and the proportion of sodium chloride replacement in the LSSS interventions varied from 3% to 77% (36).

LSSS compared to regular salt reduced systolic blood pressure by an average of -4.76 mmHg and diastolic blood pressure by an average of -2.43 mmHg (36). On average, for every 100,000 person years of follow up the use of a LSSS was associated with 20 fewer non-fatal strokes, 150 fewer non-

[8] American Heart Association (AHA)/ American College of Cardiology (ACC) / Heart Failure Society of America (HFSA)

[9] Stage C as defined by the New York Heart Association (NYHA) Classification as symptomatic heart failure: structural heart disease with current or previous symptoms of heart failure.

[10] Self-management was defined by a range of characteristics which differed between interventions and included (but was not limited to) monitoring/recording symptoms, contact with peer patients, being taught goal setting and problem-solving skills.

fatal cases of acute coronary syndrome and 180 fewer deaths from CVD (36). On average, LSSS increased blood potassium slightly (+0.12 mmol/L) compared to regular salt (36). The safety of LSSS may need to be considered for groups in the population who have a higher risk of high blood potassium (hyperkalaemia) i.e. people with chronic kidney disease (36).

Certainty of evidence

The data from the NAP report used to inform this position statement (CVD incidence, hypertension incidence and blood pressure) is from randomised trials and the certainty of evidence is moderate to high for these outcomes (**Appendix 1**).

The strength of evidence for CVD incidence was assessed as moderate owing to imprecision related to the relatively low total number of events observed across studies (<300) when excluding LSSS studies (4). The strength of evidence for hypertension incidence was assessed as moderate due to the relatively small size of effect (<25% risk reduction) and the upper confidence interval being close to 1.0 (4).

There are limitations with the available evidence on sodium restriction in people with heart failure due to lack of systematic reviews and meta-analyses in secondary prevention. Recent international guidelines recommend avoiding excessive intake instead of recommending a level of sodium restriction due to the low quality of evidence available from existing RCTs (34, 35). The recent SODIUM-HF trial may influence future heart failure guidelines, however, more trials are needed to understand the appropriate level of sodium while maintaining quality of life and nutritional adequacy of diet (5).

DISCUSSION

This position statement provides clear evidence for the benefit of reducing population intakes of sodium to lower blood pressure, risk of hypertension and the burden of CVD. Diets moving from high to low in sodium are associated with clinically meaningful reductions in systolic and diastolic blood pressure with a greater effect seen in people with high blood pressure (4). Given around 20% of adults in Aotearoa are living with high blood pressure there is potential for significant public health gain with sodium reduction strategies (14).

Reducing sodium intakes has been identified by the WHO as one of the most cost-effective measures to improve population health outcomes (41). A 30% relative reduction in mean population intake of sodium by 2025 is one of nine voluntary targets in the '*Global Action Plan for the Prevention and control of Noncommunicable Diseases 2013-2020'* (42).

Reducing sodium in the food supply

Most dietary sodium we consume in Aotearoa is 'hidden' in processed and packaged foods and meals eaten outside of the home. Therefore, reducing sodium content across the food supply is a key action needed to reduce population intakes of sodium and highlighted in the WHO's '*SHAKE technical package for salt reduction'* (2016) (41). Major food companies should be encouraged to prioritise sodium reduction across all processed foods. Reformulating high volume and low-cost foods is an equitable approach to reducing population intake of sodium and will have the most significant impact on health outcomes.

Sodium (in the form of salt) is a widely used additive due to its low cost, ability to enhance flavour, extend shelf life and for other functions such as dough development in bread (41, 43). However, the sodium content of many food products exceeds the functional requirements and primarily acts to enhance palatability (43). When high-sodium foods are consistently consumed, the salt taste receptors are suppressed, creating the habit of eating highly salted foods and leading to greater consumer demand (41)

Since 2007, the Heart Foundation has been working with food companies to support a reduction in the sodium levels of supermarket foods. Voluntary sodium targets have been set for key food categories that are sources of sodium in the New Zealand diet. The targets are set in partnership with food companies and the aim is to have 80% market share meet the targets within a set timeframe. The goal of 80% market share encourages food companies to reformulate main brands and leading selling products (44). Although success has been achieved in key food categories such as bread, breakfast cereals and processed meats, further reductions are needed to address the New Zealand population's current intake of sodium from processed foods and to achieve greater health gains across the population (44-46).

Government and policy makers should implement a range of initiatives to reduce the availability and consumption of processed and convenience foods. This could include strengthening labelling

requirements (food products, takeaway foods and imported foods), establishing limits around advertising and marketing of highly processed and/or unhealthy foods and improving food environments within schools, hospitals, workplaces and other community settings. Early intervention is particularly important in schools and early learning services given the positive association between elevated childhood blood pressure and high blood pressure in adulthood (41, 47).

Changing taste preferences

When reducing sodium intake, taste preferences can take up to 8-12 weeks to adjust (48, 49). If a low-sodium diet can be maintained for this time, the formerly preferred concentrations of sodium chloride (salt) are found to be unpleasantly strong (48). A small pilot study in people with high blood pressure (n=29) saw people significantly reduce sodium intake by 30% (-1158mg/day) and increase enjoyment of a sodium-reduced diet at a 4-month follow-up. The intervention group received 16 weeks of education with individualised advice and an electronic device to detect the sodium content of food. This study suggests that with the right support, taste buds can be retrained to enjoy low sodium food leading to sodium reduction. However, a larger trial with longer follow-up is needed (50).

Applicability of low sodium salt substitutes to New Zealand

Currently, salt substitute products are not widely available in New Zealand supermarkets and the one brand that is most commonly available is around 15 times more expensive than regular table salt (per 100g) (40). Given discretionary salt use is around 10-15% of total sodium intake, the relevance and applicability of salt substitute products to the New Zealand population are unknown. At present, the additional cost is inequitable at an individual level and makes feasibility of using salt substitutes within food processing less likely. There is also lack of data on the safety of LSSS for people where higher potassium intakes may be harmful which means the safety of LSSS in the broader population is not known. Most research on salt substitutes has been conducted in low-and-middle income countries where discretionary salt intakes are much higher than Aotearoa (>50%) (36, 51). Discretionary salt use is, on average, a small contributor to sodium intakes of New Zealanders and use of salt substitutes doesn't reduce practises around using less salt or contribute to altering taste preferences (51).

Gourmet and rock salts

The extent to which gourmet and rock salts are used in Aotearoa is unknown, however, these products are often perceived as nutritionally better choices than traditional table salt. Some products claim to be a natural/unrefined source of minerals and trace elements; however, they contain the same amount of sodium as regular salt and the quantity of trace elements are unlikely to provide any additional benefit. In 2017, Consumer NZ compared sixteen types of salt found on supermarket shelves and found gourmet salts were more expensive than table salt and often not iodised (52).

Eating patterns

The evidence informing this position statement needs to be interpreted within the context of overall diet as adherence to a heart-healthy eating pattern is associated with positive cardiovascular health outcomes (18, 53). One example is the Dietary Approaches to Stop Hypertension (DASH) diet which is associated with a decreased incidence of CVD in prospective cohort studies and improved blood pressure in trials and may be associated with improved outcomes for heart failure patients (54-56). The DASH diet emphasises fruit, vegetables, whole grains, nuts and legumes, low-fat dairy products and limits saturated fat, added sugars and sodium. It is also high in potassium, which supports the heart to function and helps to lower blood pressure (57).

The cost of food is a major determinant of food choice. It is difficult to compare the cost of individual foods and eating patterns due to fluctuating prices, however, some diets containing highly processed foods may be cheaper than those based around whole foods (58-60). The Heart Foundation currently recommends a heart-healthy eating pattern based around vegetables, fruit, whole grains, legumes, nuts and seeds, fish and seafood (18). Although this way of eating is naturally low in sodium, the practical application of this dietary approach must include food examples and recipes which are low-cost, seasonal and culturally relevant to diverse population groups in Aotearoa.

Limitations

A limitation of this position statement is the lack of up-to-date data on the sodium consumption patterns of key population groups in Aotearoa. Regular measuring and monitoring of population sodium intake and major food sources is desperately needed to inform targeted consumer messages and campaigns for sodium reduction (41). Food sources of sodium and discretionary salt use are likely to vary widely between population groups (61). Some research has suggested that certain traditional diets such as Chinese and South Asian diets may have a higher proportion of discretionary salt use (61, 62). However, there is lack of data to understand whether this applies to the New Zealand context.

KEY MESSAGES

- Reducing sodium intake reduces blood pressure and risk of CVD including heart, stroke and blood vessel disease in the general population.
- New Zealand adults eat around 8.5g of salt a day (3,400mg sodium) which is more than the recommended daily amount of 5g of salt or 1 teaspoon (2,000mg sodium).
- To reduce the risk of high blood pressure, heart disease and stroke it is recommended that adults eat less than 5g of salt or 1 teaspoon (2,000mg sodium) each day (16).

Messages for all New Zealand adults

Including home cooks, chefs and food preparers working in hospitality.

- ✓ The sodium in salt raises blood pressure and increases your chance of having heart disease or a stroke.
- ✓ The foods you eat can make a big difference to your blood pressure.
- ✓ High blood pressure often has no symptoms and many people who have high blood pressure do not know it.
- ✓ Most of the salt (sodium) we eat is hidden in processed and packaged foods.
- ✓ Many people add salt to food out of habit.
- ✓ It can take several weeks or even a few months for our taste buds to adapt to tasting less salty foods.

THREE WAYS TO EAT LESS SALT

A heart-healthy way of eating isn't about single foods or nutrients. It's about your whole diet and how it fits together. If you base your meals around as many heart-healthy foods as possible, the nutrients will look after themselves.

1. **Eat more heart-healthy foods**

These foods are close to how they are found in nature and naturally low in salt:

- vegetables and fruit including frozen
- whole grains like oats and brown rice
- legumes like chickpeas, lentils and kidney beans
- unsalted nuts and seeds
- fish like tuna, salmon, mackerel and sardines.

2. **Small swaps can make a big difference**

- Choose eggs, fish or lean meat instead of processed meats like sausages, ham, luncheon, bacon, canned corned beef and salted beef.
- Choose fruit and vegetables instead of biscuits, chips, crackers, instant noodles, bhuja mix or salted nuts.
- Make your favourite takeaway foods at home like pizza, burgers, Chinese, Indian, fried chicken, fish and chips – so you have control over the amount of salt.
- Choose lower-salt versions or use less of your favourite sauces and condiments like tomato sauce, sweet chilli sauce, mustard, barbeque sauce, chutney or Indian pickles.
- Use lemon, herbs and spices to add flavour to food instead of salt, marinades, dressings and cooking sauces like soy sauce, Worcestershire sauce, tamari, miso or teriyaki.

3. **Shop for lower salt foods**

Reading food labels can help you and your whānau to choose healthier foods and eat less salt, especially for foods you eat often (e.g. bread, breakfast cereals, cheese).

a. Check and compare one new food product each time you shop.
b. Look for ‘sodium’ on the food label of packaged food products.
c. Look at the amount of sodium in the ‘per 100g’ column.
d. Compare the labels on similar foods and choose the product that has the lowest sodium.
e. Look for foods labelled as ‘low salt’, ‘salt-reduced’, ‘unsalted’ or ‘no added salt’.

Messages for health professionals

Reducing daily salt intake benefits people of all ages and at all levels of heart disease risk.

People with high blood pressure (>140/90mmHg) or living with a heart condition

- Promote the heart health benefits of reducing daily salt intake.
- When diets move from high to low in salt there are clinically meaningful reductions in blood pressure with a greater effect seen in people with high blood pressure.
- Follow the general adult recommendation of less than 5g of salt (2,000mg sodium).
- Recommend lifestyle interventions such as reducing salt and alcohol intake, managing weight and increasing physical activity for people with blood pressure ≥130/80mmHg (as per '*CVD risk assessment and management for primary care' 2018 guidelines*).
- Recommend 'Three ways to eat less salt' (as above).

People with heart failure

- Avoid excessive intakes of sodium to reduce congestive symptoms.
- Follow the general adult recommendation of less than 5g of salt (2,000mg sodium).
- Recommend 'Three ways to eat less salt' (as above).
- Consider referral to a dietitian for individualised support.

Support people and whānau to eat more heart-healthy foods and less salt

When discussing food, include the whole whānau and use clear, simple language and visual prompts. Regularly check understanding of key messages.

Provide practical tips and ideas	• Give affordable examples of 'whole' and 'less processed' foods, e.g. frozen peas, bananas, oats, chickpeas, unsalted peanuts, chicken drumsticks. • Encourage plenty of colourful vegetables and fruit because they are naturally low in salt and high in potassium. Aim for half a plate of colourful vegetables. • Recommend frozen vegetables and shopping at local markets, supermarkets or fruit and vegetable stores for produce in season. • Give quick and easy snack ideas that are naturally low in salt like fruit, veggie sticks, unsalted nuts, plain popcorn, boiled eggs, plain yoghurt. • Encourage dried herbs as a cheap way to add flavour to food. Fresh herbs and chilli plants may be options for people who want to and can grow their own.

	• Encourage and support behaviour change around salt use including tasting food before adding salt and keeping the saltshaker off the table. • Teach people what to look for on a food label and how to compare levels of sodium in similar products to choose lower salt foods. • Provide links to heart-healthy recipes to show meals lower in salt don't need to taste bland and can suit the whole whānau. • Encourage to start with one new healthier meal each week. • Refer to healthy cooking courses in your community, e.g. Pacific Heartbeat community nutrition courses.

Common food sources of salt	• Food preferences and sources of salt will vary between individuals.
	• Get people to think about the foods they eat often that may be contributing salt such as bread, meals containing bread (pizza/burgers/wraps), breakfast cereals, ham, sausages, noodles, sauces, condiments, takeaways/fast-food.
	• Examples of common food sources of salt for different ethnic groups:
	  ○ **Pasifika foods:** Noodles, corned beef, povi masima, snack foods like chips, takeaways, lunch bars/bakery food, soy sauce.
	  ○ **Māori foods:** Pork, sausages and processed meats.
	  ○ **Asian foods:** Chinese sausage, noodles, soups, salt-preserved foods (meat/fish/egg/veg), kimchi/pickled vegetables, teriyaki sauce, hoisin sauce, oyster sauce, miso, shrimp paste, soybean paste, curry paste.
	  ○ **South Asian foods:** Samosas, noodles, sausages, snack foods like bhujas, churas, spiced peas, peanuts, packaged curry pastes/mixes, soy sauce, chutney, pickles (achars).

Discuss the different types of salt	• Rock salt, Himalayan salt and sea salt contain the same amount of sodium as table salt, and often do not contain iodine. • Some products contain less sodium and more potassium than table salt ('salt substitutes' or LSSS). They are not widely available and are generally more expensive than table salt. They may be best suited to people who use large amounts of salt during cooking and are unable to use less salt. • Salt substitutes may not be suitable for people at risk of high blood potassium/ hyperkalaemia (such as people with kidney problems or on certain medications).

Messages for food industry

- More than 75% of the sodium (salt) people eat comes from processed and packaged foods.
- Food manufacturers have a key role to reduce sodium in the food supply through reformulation approaches.
- All sectors of the food industry are encouraged to be engaged in a salt reduction programme to gradually decrease the sodium content of foods within their product range.

RECOMMENDATIONS

The recommendations around sodium are to be included within the context of an overall heart-healthy dietary pattern.

The Heart Foundation's eating pattern for heart health includes (18):

1. eating more vegetables and fruit
2. swapping from refined cereals and grains to whole grains
3. choosing reduced-fat varieties of dairy products
4. eating healthy fats sourced from nuts, seeds, plant oils (other than coconut and palm), avocado, and oily fish in place of animal fats
5. reducing unprocessed red meat to <350g/week (cooked) spread across 3 meals per week (with an individual portion size of 100g cooked red meat)
6. swapping other red meat meals with plant proteins such as soy, legumes and nuts
7. limiting or avoiding processed red meat
8. reducing highly processed and refined foods such as junk food, takeaways, deep-fried foods, pastries, pies, sweet bakery items, lollies, processed snack foods and sugary drinks.

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APPENDIX 1

Question 1: What is the relationship between consuming sodium and CVD risk and mortality in adults?

Bibliography: Dietary Reference Intakes (DRI's) for Sodium and Potassium, National Academies Press (2019)(4)

Certainty assessment							№ of people	Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		Relative (95% CI)	Absolute (95% CI)		
Sodium Reduction and Cardiovascular Disease Incidence (excluding trials on salt substitutes)											
3	Randomised trials	Not serious[a]	Not serious[b]	Not serious[c]	Serious[d]		N/A	RR: 0.74 (0.58, 0.93)	N/A	⊕⊕⊕ MODERATE	CRITICAL
Sodium Reduction and Incidence of Hypertension											
3	Randomised trials	Not serious[a]	Not serious[b]	Not serious[e]	Serious[f]		N/A	RR: 0.79 (0.67, 0.94)	N/A	⊕⊕⊕ MODERATE	CRITICAL

a. All studies have low or moderate risk of bias
b. No statistical heterogeneity was detected. All study point estimates were in the same direction.
c. Evidence directly answers the question of interest in terms of relevant populations, interventions, comparators, and outcomes. No change in overall results with inclusion of salt-substitution studies, which are more indirect because they also involve increases in other nutrients, usually potassium. Although interventions were not continued during long-term follow-up, postintervention changes to sodium intake would tend to bias toward the null. Moreover, adherence and loss to follow-up were nondifferential and unlikely to introduce bias.
d. Statistically significant summary effect, with meaningful size of effect (26–28% change in hazard ratio). However, when salt-substitution studies are excluded, upper confidence bound of 0.93 would imply a substantially smaller size of effect (7% change) and total cardiovascular disease events number <300 across studies.
e. Evidence directly answers the question of interest in terms of relevant populations, interventions, comparators, and outcomes.
f. Statistically significant summary effect, with total events numbering >1,000 across studies. However, the 20% change in hazard ratio is less than the 25% considered "appreciable" under GRADE (Guyatt et al., 2011c), with an upper confidence limit of 0.94 that is close to 1.00.

Question 2: What is relationship between consuming sodium and blood pressure in healthy adults, and those with hypertension or established CVD?

Bibliography: Dietary Reference Intakes (DRI's) for Sodium and Potassium, National Academies Press (2019)(4)

Certainty assessment							№ of people	Effect	Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations		Mean difference (95% CI)		
Sodium Reduction and Systolic Blood Pressure										
47	Randomised trials	Not serious[a]	Not serious[b]	Not serious[c]	Not serious[d]	Intake-response[e]	N/A	-3.34mmHg (-4.17, -2.52)	⊕⊕⊕⊕ HIGH	CRITICAL
Sodium Reduction and Systolic Blood Pressure in people with hypertension										
36	Randomised trials	Not serious[a]	Not serious[b]	Not serious[c]	Not serious[d]	Intake-response[e]	N/A	-4.08mmHg (-5.03, -3.13)	⊕⊕⊕⊕ HIGH	CRITICAL
Sodium Reduction and Diastolic Blood Pressure										
47	Randomised trials	Not serious[a]	Not serious[f]	Not serious[c]	Not serious[d]	Intake-response[e]	N/A	-2.16mmHg (-2.84, -1.48)	⊕⊕⊕⊕ HIGH	CRITICAL
Sodium Reduction and Diastolic Blood Pressure in people with hypertension										
34	Randomised trials	Not serious[a]	Not serious[f]	Not serious[c]	Not serious[d]	Intake-response[e]	N/A	-2.68mmHg (-3.50, -1.86)	⊕⊕⊕⊕ HIGH	CRITICAL

a. Results similar if high risk of bias studies are excluded
b. Although the overall summary estimate had substantial heterogeneity, with *I*2 = 76 percent, meta-regression and subgroup analyses showed that most of the heterogeneity is explained by the difference in sodium intake between control and intervention groups and hypertension status and/or baseline systolic blood pressure. The residual *I*2 = 36 percent is considered "low" to "moderate".
c. Evidence directly answers the question of interest in terms of relevant populations, interventions, comparators, and outcomes.
d. Statistically significant and biologically meaningful summary effect size across all studies and within subgroups, including those with and without individuals with hypertension.
e. Meta-regression showed that larger contrast in sodium intake between control and intervention groups were associated with larger effect sizes. Additionally, the intercept term was not statistically significant, consistent with a linear intake–response relationship down to zero contrast in sodium intake.
f. Meta-regression showed that the substantial heterogeneity of the overall summary estimate (*I*2 = 73%) is partially explained by baseline diastolic blood pressure and to a small extent by the difference in sodium intake between control and intervention groups. The residual *I*2 = 64 percent is considered substantial. However, excluding the studies with the largest effect sizes further reduced heterogeneity to "moderate", with *I*2 = 37 percent. Thus, the observed heterogeneity involves differences between small and large beneficial effects, not whether an effect exists or whether an effect is beneficial or harmful. Thus, this heterogeneity is not considered serious for the strength of evidence grading for a causal relationship, and no downgrade for inconsistency was applied.

Certainty assessment							№ of people	Effect	Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations				
Reduced chronic disease risk per 1,000 mg/d sodium intake reduction, as indicated by cardiovascular disease, hypertension, systolic blood pressure, and diastolic blood pressure, in the intake range 2,300–4,100 mg/d										
-	Randomised trials	Not serious[a]	Not serious[b]	Not serious[c]	Not serious[d]	Dose-response	N/A	CVD risk -0.32[e] (-0.56, -0.08) Hypertension risk -0.22[f] (-0.39, -0.05) Systolic blood pressure -2.8mmHg (-1.6, -4.0) Diastolic blood pressure -1.2mmHg (-0.5, -1.9)	⨁⨁⨁⨁ HIGH	CRITICAL

a. a No CVD or hypertension studies had high risk of bias. For systolic blood pressure and diastolic blood pressure, summary slope remains statistically significant, with lower heterogeneity when removing the one study with high risk of bias.
b. b Little or no heterogeneity for cardiovascular disease or hypertension. For systolic blood pressure, moderate heterogeneity overall ($I2$ = 47 percent), which was largely explained by hypertension or blood pressure medication status. Effects were greater in populations that included individuals with hypertension or that included those taking blood pressure medication, but
c. effects remained statistically significant for populations without these characteristics.
d. c All studies used control and intervention intake levels within the specified intake range. Cardiovascular disease and hypertension are direct measures of chronic disease risk; systolic blood pressure and diastolic blood pressure are indirect but serve as qualified surrogate markers.
e. d Statistically significant and biologically meaningful summary effect sizes for all indictors, across all studies and within subgroups, including those with and without individuals with hypertension
f. e to calculate the percent reduction from the size effect ln (RR) = -0.32 in cardiovascular disease incidence the following conversion was made: RR=exp(-0.32) = 0.726 which corresponds to a 27% reduction in cardiovascular disease (1.0 - 0.27 = 0.73).
g. f To calculate the percent reduction from the size effect ln(RR) =-0.22 in hypertension incidence the following conversion was made: RR = exp(-0.22) = 0.803 which corresponds to a 20% risk reduction in hypertension incidence (1.0 – 0.20 = 0.80).

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