Australian Government
National Health and Medical Research Council

NHMRC

Evidence Summary Report

Summary of the evidence used to inform development of Sodium Nutrient Reference Values for Australia and New Zealand

AI statement: Microsoft 365 CoPilot was used to refine language to improve clarity and alignment with the Australian Government Style Manual. All content was reviewed and validated.

Contents

Purpose and scope

The review of sodium Nutrient Reference Values (NRVs) for Australia and New Zealand comprises a comprehensive update of existing recommendations, to ensure they continue to reflect contemporary scientific evidence. The review covers all NRVs for adults, pregnant and lactating populations, and children and adolescents. NRV recommendations for infants are out of scope for this review.

The review is guided by the NHMRC methodological framework (National Health and Medical Research Council, 2026), and draws on multiple evidence sources to examine sodium requirements, the relationship between sodium intake and health outcomes, and contextual factors relevant to the Australian and New Zealand populations.

In line with the methodological framework, NRVs for sodium are being adapted/adopted from contemporary NRVs established by the US National Academies of Sciences, Engineering, and Medicine (NASEM, 2019) and European Food Safety Authority (EFSA, 2019). This report has been prepared to inform the process of adapting these international recommendations to the Australian and New Zealand context. It aims to summarise the evidence underpinning the EFSA and NASEM sodium NRVs alongside supplementary evidence for consideration by the Sodium Expert Working Group and Steering Group Advisory Committee. This includes consideration of:

- Recent evidence reviews commissioned or conducted by comparable international bodies for the purposes of establishing sodium nutrient reference values, including the 2023 Nordic Nutrition Recommendations (Blomhoff et al., 2023; Jula, 2024)
- High quality systematic reviews on the relationship between sodium intake and key health outcomes, published since 1 January 2018, to identify evidence published after the EFSA and NASEM reviews
- Contextual evidence relevant to establishing NRV recommendations for Australia and New Zealand, including systematic reviews on contextual factors (eg. population intakes, dietary sources, at risk populations), primary studies or national population data.

Rationale for prioritising this update

Sodium was identified as a priority nutrient for review due to its significant public health impact in Australia and New Zealand. Excess sodium intake is strongly associated with elevated blood pressure, a major risk factor for cardiovascular and kidney disease – both leading contributors to morbidity and premature mortality. In 2024, cardiovascular disease accounted for 12-14% of the total burden of disease across the two countries, with high blood pressure and dietary risks identified among the leading contributing risk factors (AIHW, 2024, 2025; Institute for Health Metrics and Evaluation, 2024). Hypertension is also highly prevalent; data from 2022 suggests that more than one in ten Australians (11.6%, or 3 million people) had diagnosed hypertension, and almost one in four adults had high measured blood pressure (ABS, 2022).

Population sodium intakes remain well above recommended levels. In Australia, nearly two thirds of adults (65.6%) exceed the current Suggested Dietary Target (SDT) of 2,000 mg /day, and similar patterns are observed in New Zealand (ABS, 2023c; Wang et al., 2023). Persistently high

levels of sodium in the food supply therefore increase population exposure to a dietary factor strongly linked to elevated blood pressure and cardiovascular disease.

Since the NRVs for Australia and New Zealand were partially updated in 2017 (adult SDT recommendations only), several major international reviews of sodium NRVs have been completed (Blomhoff et al., 2023; EFSA, 2019; NASEM, 2019). These warrant consideration, in particular noting differences in values between jurisdictions.

Current recommendations for adequacy have not been revised since 2006, nor have NRVs for children and adolescents. In addition, internal inconsistencies have arisen following the 2017 partial update, which focused solely on the SDT and Upper Levels (UL) for adults. During this review, the SDT was increased from 1,600 mg/day to 2,000 mg/day and the previous UL values for adults were replaced with a statement that the UL could not be determined. However, as ULs for children and adolescents were not reviewed at that time, the current SDT only applies to adults and the UL for older children is higher than the adult SDT, creating potential inconsistencies in messaging across age groups.

Review of child and adolescent recommendations is therefore needed to ensure consistency with the current evidence base and the chronic disease risk–reduction framework adopted for adults. Aligning recommendations across life stages will support clearer public health guidance and strengthen the application of sodium targets in policy and practice. In addition, the adequacy recommendations warrant reassessment to reflect contemporary evidence.

Methods summary

The NHMRC Methodological Framework establishes administrative and technical criteria for assessing the suitability of existing NRVs from comparable international jurisdictions for adaptation or adoption (NHMRC, 2026). These criteria were used to assess the suitability of the US NASEM (2019) and EFSA (2019) guidelines, with both guidelines identified as suitable (see **Appendix A – Assessment of guideline suitability**).

However, neither set of recommendations were wholly suited to adoption or adaptation; although EFSA's methods for developing its NRVs – and country-specific contextual factors - aligned more directly with NHMRC criteria, the 2019 EFSA recommendations do not specify distinct recommendations for nutritional adequacy and risk-reduction, instead presenting a single 'safe and adequate' value. This approach does not align with the required approach for NRVs for Australia and New Zealand. Although the US NASEM provides recommendations for both adequacy and risk reduction, the public health nutrition context in the United States differs to that of Australia and New Zealand. Consequently, it was determined that both the EFSA and US NASEM recommendations – and their underpinning evidence – would be considered collectively to derive recommendations that best suit the Australian and New Zealand context.

Given the time elapsed since these guidelines were issued, an additional search for systematic reviews published since 1 January 2018 was undertaken, to consider any recently published evidence during the Evidence-to-Decision process. Systematic reviews were identified based on a priori inclusion criteria specified by the Sodium Expert Working Group (see **Appendix B – Methods for supplementary evidence searches**). Evidence relevant to the Australian or New Zealand context was also sought to support adaptation of these international

recommendations to the local nutrition context. This included systematic reviews on relevant contextual factors along with primary studies, national data or statistics. This Evidence Summary Report presents the evidence underpinning current international recommendations, along with supplementary evidence sources, to inform the process of deriving NRVs for sodium for the Australian and New Zealand context.

Further information about the methods utilised in developing this Evidence Summary Report are presented in **Appendix B – Methods for supplementary evidence searches**.

Governance

Governance processes for the sodium NRV reviews comprised:

- NHMRC CEO: responsible for issuing NRVs under the National Health and Medical Research Council Act 1992
- NHMRC Council: advises the CEO
- Office of NHMRC: responsible for the ongoing project management of NRVs reviews and supports the CEO, Council and Committees
- Steering Group: comprising NHMRC, the Department and New Zealand Ministry of Health, with responsibility for strategic leadership, funding and resourcing elements of NRV updates
- Steering Group Advisory Committee (Advisory Committee): advising the Steering Group on methods and prioritisation
- Sodium Expert Working Group: sodium experts to provide nutrient-specific advice and guide the development of revised NRVs.

The Steering Group prioritised updating the sodium as part of the 2018 schedule to the Memorandum of Understanding when NHMRC agreed to take on the priority rolling review of NRVs. Throughout the review, the Advisory Committee provided advice on the application of the methodological framework and methods for deriving NRVs, whilst the Sodium Expert Working Group provided technical advice on considerations specific to sodium nutrition. Members' interests were declared and managed in line with NHMRC's Policy on the Disclosure of Interests Requirements for Prospective and Appointed NHMRC Committee Members (NHMRC, 2019).

Sodium background

Function, physiology and metabolism

Sodium is an essential mineral that plays a central role in maintaining the body's fluid balance and supporting normal cellular function. It is the main extracellular cation, working closely with chloride to regulate extracellular volume and osmotic pressure. By controlling the movement of water between body compartments, sodium helps stabilise blood volume and supports adequate circulation to tissues. These functions are tightly co-ordinated with intracellular potassium, allowing the body to maintain distinct internal and external fluid environments.

At the cellular level, sodium plays a critical role in nutrient transport and enabling electrical activity. Specialised transport systems use sodium gradients to move substances such as glucose and amino acids into cells, particularly in the bowel and kidneys. Maintaining these gradients requires active energy use, reflecting sodium's fundamental role in metabolism. Differences in sodium and potassium concentrations across cell membranes also generate electrical signals that underpin nerve transmission, muscle contraction, and heart rhythm, making sodium indispensable for neuromuscular and cardiovascular function.

Sodium balance is maintained through closely integrated hormonal and neural control systems, with the kidneys playing a central role in homeostasis, adjusting sodium excretion to maintain stable plasma sodium concentration despite large day-to-day variation in intake. Hormones such as aldosterone and angiotensin regulate how much sodium is conserved or lost in urine, while thirst and water retention respond to changes in blood concentration and volume. In healthy individuals, these systems are highly effective, with hyponatraemia (low sodium concentration in blood) typically occurring in the context of disorders of water or electrolyte balance rather than due to inadequate dietary sodium intake (EFSA,2019). Similarly, these homeostatic mechanisms mean that acute effects of sodium excess from dietary intake are uncommon, typically arising from high sodium chloride ingestion (e.g. self-poisoning) or from clinical parenteral nutrition. Indeed, hypernatremia (high serum sodium concentration) typically results from dehydration rather than high sodium intake. In contrast, long-term high sodium intake is strongly linked to increased systolic blood pressure, which is an independent risk factor for cardiovascular disease morbidity and mortality, highlighting the importance of maintaining sodium intake within a range that supports physiological needs without promoting chronic disease.

These paragraphs provide a summary of the function, physiology and metabolism of sodium in humans, based on the information provided in EFSA's Dietary Reference Values for sodium (EFSA,2019). Refer to Section 2 of EFSA's report for more comprehensive information.

Dietary sources of sodium

Sodium is present in small amounts in all unprocessed foods, including meat and fish (between 30 and 150mg per 100g) and fruits and vegetables (less than 50mg per 100g) (EFSA,2019). However, the predominant source of dietary sodium is through the addition of sodium chloride or 'salt' to foods during manufacturing or processing, cooking or at the table. Specific data on

the sodium content of diet or the food supply in Australia and New Zealand is presented under 'Australian and New Zealand nutrition context' on page 26.

Bioavailability and other factors

Most dietary sodium is efficiently absorbed from the gastrointestinal tract, regardless of intake level, and is rapidly distributed throughout the extracellular fluid. While most sodium remains outside cells, substantial amounts are also stored in bone, muscle, and skin (Wang et al., 2017). These tissue stores appear to act as flexible reservoirs, allowing the body to buffer changes in intake without large shifts in blood sodium levels or body weight. Emerging evidence suggests that sodium content in these tissues can vary over time and may influence long-term blood pressure regulation.

Measurement of sodium intake

Biomarkers of sodium intake

In healthy people most dietary sodium is excreted via urine (around 90%), with some sodium lost in sweat and faeces (He & MacGregor, 2010). Estimating sodium intake from 24-hour urine samples is generally considered to be the best available method (McLean, Farmer, et al., 2018).

Twenty-four hour urine samples can be affected by day-to-day variations. Indeed, evidence suggests that salt intake may increase by up to 14% over weekends compared with week-day intakes (Nowson et al., 2018). Consequently, whilst a single collection is sufficient for estimating population mean intake, repeat 24-hour collections provide better estimates of individual usual (habitual) intake. However, this significantly increases the burden on respondents and the risk of incomplete collection. Several quality control measures can reduce the risk of bias from incomplete collection, including self-report of missed voids, total urine volume, 24-hr urinary creatinine excretion, urinary recovery of ingested para-aminobenzoic acid (PABA) and a longer duration of collection time(EFSA, 2019).

Methods such as spot collection or timed collection (for example, overnight) are subject to greater intra-person variability than 24-hr collections and are not considered to be reliable biomarkers of individual sodium intake (Campbell et al., 2019).

Dietary assessment methods

Sodium poses specific challenges for dietary assessment of sodium, in addition to the known limitations, such as accuracy of reporting (Shim et al., 2014; Subar et al., 2015). Dietary surveys often fail to include or accurately quantify sodium chloride added to foods during cooking and at the table. In addition, food composition tables aligned with dietary surveys may not reflect the sodium content of all foods available in the food supply, including new products and product reformulation.

Health effects of insufficiency or excess

Insufficiency

Hyponatraemia –a serum sodium concentration below the normal range of 135 mmol/L – is indicative of systemic sodium imbalance, but does not necessarily reflect systemic sodium deficiency. Overall, the symptoms of hyponatraemia progress from malaise, nausea, vomiting

and headache to lethargy, impaired consciousness, seizures and coma. Severe neurological symptoms are generally associated with serum sodium concentrations < 120 mmol/L, at which level cerebral oedema develops.

However, dietary sodium deficiency is uncommon in healthy populations in Australia and New Zealand. Sodium is widely present in the food supply, and physiological adaptation mechanisms help to conserve sodium by reducing losses in urine, faeces and sweat when intake is low.

Excess

Acute sodium toxicity is rare but may occur in situations of very high sodium exposure, most often involving ingestion (such as deliberate self-poisoning) or parenteral administration in clinical settings. Hypernatraemia - a high serum sodium concentration above 145 mmol/L - is generally associated with inadequate fluid balance (e.g. dehydration) rather than excessive sodium intake. Clinical features are broadly similar to those observed in hyponatraemia (EFSA, 2019; Sterns, 2015).

Sodium plays a critical role in fluid balance and maintaining normal physiological function, and homeostatic mechanisms allow the body to tolerate a wide range of sodium intakes in the short term. Consequently, transient changes in intake may elicit short-term physiological responses, including alterations in hormonal systems involved in fluid and electrolyte regulation. Evidence from short-duration studies suggests that such responses may reflect acute adaptation rather than sustained effects (EFSA, 2019; Huang et al., 2019; NASEM, 2019).

However, sustained sodium intakes above requirements increase the risk of chronic disease, with high intake associated with elevated blood pressure - a major risk factor for cardiovascular and kidney disease - along with other outcomes including gastric cancer, obesity, osteoporosis and Meniere's disease (EFSA, 2019; NASEM, 2019; Newberry et al., 2018; WHO, 2026).

End points

The key end point related to excess sodium consumption is blood pressure, with strong evidence of a relationship between increasing sodium intake and elevated blood pressure which is in turn a key risk factor for a range of cardiovascular disease outcomes. Other relevant end points include other cardiovascular outcomes including arterial stiffness, blood lipids and cardiovascular disease, as well as kidney function or kidney disease.

To capture stable effects on blood pressure, a minimum intervention duration of four weeks was adopted in this evidence evaluation. This distinction is important when interpreting findings from shorter-term studies, which may reflect adaptive changes or be more relevant to acute clinical responses than to long-term population health outcomes.

Sensitive or at-risk groups

Sensitivity of blood pressure to sodium varies considerably between individuals and has been identified as a potential cardiovascular disease risk factor (National Academies of Sciences, 2019). However, salt sensitivity is not well characterised, and is likely multifactorial, influenced by age, environmental, dietary and lifestyle factors along with individual physiology and genetics (EFSA, Elijovich et al., 2016; 2019; Luzardo et al., 2015) These findings highlight that salt

sensitivity is not uniform across populations and is influenced by both physiological and contextual factors.

At a population level, higher sodium intake is strongly influenced by the sodium content of the food supply (including staple foods), dietary patterns, food environments, and cultural practices. In many high-income countries, a substantial proportion of sodium intake comes from discretionary foods - including processed and packaged foods - and meals eaten outside the home(WHO, 2026) . Cultural and culinary practices, including the use of salt in cooking or reliance on high-sodium condiments and traditional dishes, also contribute to variation in intake between population groups (Bennett et al., 2022; Bhat et al., 2020; Cheng et al., 2025). Socioeconomic factors play an additional role, with social disadvantage, including lower socioeconomic status, lower income or food insecurity associated with diets higher in sodium (Bennett et al., 2022; de Mestral et al., 2017), in part due to the affordability and accessibility of processed foods. Together, these factors contribute to persistent disparities in sodium intake and related health outcomes, including hypertension and cardiovascular disease risk.

Consequently, for the purposes of establishing NRVs, the sodium intakes and associated health outcomes among at-risk groups - including culturally and linguistically diverse populations, and those from low socioeconomic status backgrounds - must be explicitly considered. Evidence regarding at-risk populations specific to the Australian and New Zealand context is discussed on page 21.

Interactions with other nutrients

Sodium interacts closely with potassium, chloride and calcium in ways that are relevant to both physiological function and the health effects associated with sodium intake. Sodium and potassium are functionally linked through cellular transport mechanisms and have complementary effects on blood pressure regulation. Higher potassium intakes may attenuate the blood pressure–raising effects of sodium, and some evidence suggests that the sodium-to-potassium ratio may be a stronger predictor of blood pressure than either nutrient alone (Ndanuko et al., 2021; Perez & Chang, 2014). However, both EFSA (2019) and NASEM (2019) noted uncertainties regarding optimal sodium to potassium ratios, heterogeneity across studies, and the absence of well-defined intake–response relationships suitable for deriving quantitative estimates.

Sodium and chloride are closely associated in the diet and in extracellular fluid, where they work together to maintain fluid balance, osmotic pressure and acid–base homeostasis. Evidence indicates that the blood pressure effects of sodium are most apparent when consumed as sodium chloride than when sodium is combined with other anions (EFSA, 2019; McCallum et al., 2015). Sodium also interacts with calcium through shared renal transport pathways, with higher sodium intakes consistently increasing urinary calcium excretion and potentially affecting calcium balance and bone health (US IoM, 2005).

Both EFSA (2019) and NASEM (2019) concluded that although nutrient interactions present an important contextual consideration, the relationships are insufficiently characterised to inform sodium NRV establishment.

Current recommendations and international comparisons

The Australian and New Zealand Nutrient Reference Values (2006 NRVs) for sodium were partially revised in September 2017, including the Suggested Dietary Target (SDT) and Upper Level (UL) for adults (NHMRC, 2006b; updated 2017). Sodium NRVs for other populations (pregnancy, lactation, children and adolescents) were developed in 2006 and adapted from values published by the US Institute of Medicine (IOM) (US IOM, 2005).

Since this time, several international jurisdictions have published updated NRVs for sodium, based on contemporary evidence review methods and recently published research (Blomhoff et al., 2023; EFSA, 2019; NASEM, 2019; Strohm et al., 2018).

Nutritional requirements – Adequate Intake

Australian and New Zealand NRVs

Adequate Intake (AI) recommendations for each population are shown at Table 1, along with recommendations from comparable international jurisdictions.

At the time of last review (2006) it was determined that there was insufficient evidence to establish an EAR and RDI. Although the 2006 NHMRC NRVs were developed from US IoM Dietary Reference Values, for the sodium AI a different value was set, because the reviewers considered that evidence pointed to lower requirements than the recommendations set by the US IoM (NHMRC, 2006a). The AI for adults was set at 460-920 mg/day (20-40 mmol/day) on the basis that:

- the 'Hobart salt study' in a systematically recruited sample of 94 Hobart residents included three participants (2 females, 1 male) who excreted between 20 and 40 mmol/day of sodium in otherwise normal urine samples (Beard et al., 1997)
- a restricted diet limited to low salt foods (per the definition of the Australian New Zealand Food Code) achieved sodium excretion rates below 50 mm/day in males and 40 mmol / day in females
- most foods in their natural state have a sodium content of well under 100mg/100 g.

It was noted that this recommendation may not apply to highly active adults – such as endurance athletes, or those undertaking physical work in hot conditions – who lose larger amounts of salt through sweat.

Requirements during pregnancy and lactation were set at the same level as adult requirements, as the expected increase in maternal requirements was expected to be small and fall within the existing margins of the adult AI. Values for children and adolescents were extrapolated from adult AIs based on relative energy intake. This was on the assumption that sodium requirements in children aged 1 to 18 years does not fundamentally differ from that of adults, with kidney function maturing in children by 12 months of age.

International Comparisons

The US NASEM established its 2019 AI value at 1,500 mg/day for adults (National Academies of Sciences, 2019). In deriving the AI, it noted the difficulties in estimating the AI from median population intakes, as this would result in the AI exceeding the Chronic Disease Risk Reduction recommendation of 2,300 mg/day. Consequently, the AI was based on trials with low sodium dose (less than 2,300 mg/day) that did not report deficiency. The most robust balance study was used as supportive evidence against which the derived AI could be compared. The adult AI value of 1,500 mg/day for healthy adults not engaged in high-intensity physical activity was set based on:

- the Dietary Approaches to Stop Hypertension (DASH) sodium-reduction trial in 412 participants, which reported no symptoms of deficiency among participants with a mean intake of 1,449 mg/day (Sacks et al., 2001)
- a balance study reporting that intakes of 1,525 mg/day resulted in either neutral or positive balance depending on environmental conditions (temperature) (Allsopp et al., 1998).

The AI during pregnancy or lactation was established at the same level as for adults, with no evidence to suggest that requirements differ to those of non-pregnant, non-lactating females. Requirements for children and adolescents were extrapolated from adult AI values, based on energy requirements for sedentary children.

The Nordic Nutrition Recommendations 2023 also adopted NASEM's AI of 1.5g/day in adults (Blomhoff et al., 2023).

When establishing NRVs for sodium, EFSA concluded that there was insufficient evidence to establish an EAR and associated RDI (EFSA, 2019). Instead of establishing an AI, EFSA established a 'safe and adequate' intake; a hybrid NRV reflecting a level of intake that is sufficient for maintaining sodium balance, and associated with a reduced risk of adverse health effects. The value of 2,000 mg/day was selected for all adults including pregnant and lactating females. Safe and adequate intake values for children and adolescents were extrapolated from the adult value based on energy requirements, adjusted to account for growth.

Table 1 – Comparison of Adequate Intake (AI) recommendations for Australia and New Zealand with values set by comparable international jurisdictions

	Australia & New Zealand (NHMRC, 2006b)		United States (NASEM, 2019)	European Union (EFSA, 2019)	Nordic and Baltic Populations (Blomhoff et al., 2023)	Germany, Austria & Switzerland (Strohm et al., 2018)
	AI		AI	'Safe and Adequate'#	AI	AI
Age group	mg/day	mmol/day	mg/day	mg/day	mg/day	mg/day
Adults	460-920	20-40	1,500	2,000	1,500	1,500*
Pregnancy						
Lactation						
Children & adolescents						
1 yr	200-400	9-17	800	1,100	NS	400
2 yr						
3 yr						
4 yr	300-600	13-26	1,000	1,300		500
5 yr						
6 yr						
7 yr				1,700		750
8 yr						
9 yr	400-800	17-34	1,200			1,100
10 yr						
11 yr				2,000		
12 yr						1,400
13 yr						
14 yr	460-920	20-40	1,500			1,500^
15 yr						
16 yr						
17 yr						
18 yr		Included in adult age grouping	Included in adult age grouping	Included in adult age grouping	Included in adult age grouping	Included in adult age grouping

NS = Not specified

* D-A-CH age grouping for adults is 19 years and older

^ up to 19 years

EFSA elected not to establish an AI, instead establishing a 'safe and adequate' intake; a level of intake that is both sufficient for requirements, and reduces health risk.

Chronic disease prevention

Australian and New Zealand NRVs

The NHMRC Methodological Framework has recently been updated, including revisions to the terminology for NRV recommendations to reduce chronic disease risk. In line with these changes, the term 'Suggested Dietary Target' or 'SDT' will be replaced with 'Chronic Disease Risk Reduction' or 'CDRR'. This aligns with the terminology used by international counterparts. Throughout this report the term SDT is used to describe the current recommendations, with proposed recommendations presented as a CDRR value going forwards.

Using the 2015 Methodological Framework for the Review of NRVs, the value of the SDT for sodium was increased from 1,600 mg/day to 2000mg/day in 2017. The revised SDT was based on a meta-analysis showing a reduction of 2 mm Hg in systolic blood pressure when mean sodium excretion was lowered from about 3,500 mg/day to 2,100 mg/day (when corrected to the Australia and New Zealand population) (Department of Health, 2017). The value was rounded to 2,000 mg/day to align with the current WHO recommendations and in line with dietary modelling underpinning the Australian Dietary Guidelines, to support nutritional adequacy of the whole diet. The revised target of 2000mg/day was expected to be more realistic, as it represented a total diet that meets all nutritional requirements, given the current food supply.

Suggested Dietary Target (SDT) or equivalent Chronic Disease Risk Reduction (CDRR) recommendations for each population are shown at Table 2, along with recommendations from comparable international jurisdictions.

International Comparisons

In 2019, the US NASEM established its CDRR for sodium at 2,300 mg/day (NASEM, 2019). This recommendation was based on evidence from sodium reduction trials and cardiovascular outcomes including incident cardiovascular disease, hypertension, and blood pressure (systolic blood pressure - SBP and diastolic blood pressure - DBP). It noted that while sodium intakes below the CDRR of 2,300 mg/day are expected to demonstrate a further lowering effect on blood pressure, the relationship between further reductions in blood pressure and chronic disease risk could not be characterised (NASEM, 2019).

The NASEM CDRR of 2,300 mg/day was also adopted by the 2023 Nordic Nutrition Recommendations (Blomhoff et al., 2023).

EFSA established a 'safe and adequate' intake; a hybrid NRV reflecting a level of intake that is sufficient for maintaining sodium balance, and associated with a reduced risk of adverse health effects. The value of 2,000 mg/day was selected for all adults, using an Expert Knowledge Elicitation approach that considered evidence for the relationship between sodium reduction and blood pressure levels or CVD risk, and levels required to maintain null sodium balance. Collectively, this evidence was then integrated to arrive at a final recommendation (EFSA, 2019). Although this value is broadly comparable to a CDRR, it does not fully align with the NHMRC's approach for NRV derivation which will involve establishment of both an AI and CDRR value.

The World Health Organisation issued sodium intake recommendations for adults and children in 2012 (WHO, 2012). Recommendations were based on a systematic review of the evidence for the relationship between sodium intake and blood pressure or cardiovascular disease risk in

adults, or blood pressure in children. It was recommended that adults (including during pregnancy or lactation) and children aged 16 years and over reduce their sodium intake to 2,000 mg/day (strong recommendation). For children aged 2 to 15 years, it recommended that intakes should be extrapolated from the 2,000 mg/day threshold in adults on the basis of relative energy requirements (strong recommendation).

Table 2 - Comparison of Chronic Disease Risk Reduction (CDRR) recommendations for Australia and New Zealand with values set by comparable international jurisdictions

Age group	Australia & New Zealand (NHMRC, 2006b)^ SDT mg/day	United States (NASEM, 2019) CDRR mg/day	European Union (EFSA, 2019) 'Safe and Adequate'# mg/day	Nordic and Baltic Populations (Blomhoff et al., 2023) CDRRI mg/day	Germany, Austria & Switzerland (Strohm et al., 2018) CDRR mg/day	World Health Organisation (WHO, 2012) CDRR mg/day
Adults	2,000	2,300	2,000	2,300	2,400*	2,000
Pregnancy	NS				NS	2,000
Lactation						2,000
Children & adolescents						
1 yr	NS	1,200	1,100	1,100	NS	NS
2 yr						*No specific value provided - Recommended maximum level extrapolated from an adult value of 2,000 mg/day based on energy requirements of children relative to those of adults.*
3 yr						
4 yr		1,500	1,300	1,400		
5 yr						
6 yr						
7 yr			1,700	1,700		
8 yr						
9 yr		1,800				
10 yr						
11 yr			2,000	2,300		
12 yr						
13 yr						
14 yr		2,300				
15 yr				2,300		
16 yr						2,000
17 yr						

NS = Not specified

^ SDT values for Australia and New Zealand were revised in September 2017

* D-A-CH age grouping for adults is 19 years and older

EFSA did not establish a 'CDRR', instead establishing a 'safe and adequate' intake, which constitutes a level of intake that is both sufficient for requirements, and reduces health risk

Upper Levels

Australian and New Zealand NRVs

During the 2017 review of the adult SDT, the adult UL was changed from 2,300 mg/day to 'not determined' reflecting the inability to identify a single point of sodium exposure below which there is low risk. This was based on an analysis of intakes between 1200 and 3300mg which suggested that increased sodium intake was associated with increased blood pressure at all measured levels of intake. This approach aligns with recommendations of comparable international jurisdictions (EFSA, 2019; NASEM, 2019).

The ULs for infants and children were not reviewed at this time, and remain as per the 2006 NRVs (shown at Table 3)(NHMRC, 2006b). These values were extrapolated from the adult UL on an energy intake basis. The adult UL was based on evidence for the adverse effects of higher sodium intake on blood pressure, with a NOAEL of 2,300 mg/day selected on the basis of evidence of low levels of hypertension with intakes below this threshold (NHMRC, 2006b). However, the recommendations also noted the difficulty in precisely estimating a UL, given then progressive and continuous relationship between sodium intake and blood pressure.

International Comparisons

Currently, no other comparable jurisdictions include UL recommendations for sodium intake, with most incorporating SDT/CDRR recommendations for children and adolescents instead. This was considered to better reflect the nature of risk posed by high sodium intake, with insufficient evidence of a toxicological risk from high sodium intakes beyond the association with increased chronic disease risk (NASEM, 2019).

Table 3 - Comparison of Upper Level recommendations for Australia and New Zealand with values set by comparable international jurisdictions

Age group	Australia & New Zealand (NHMRC, 2006b)^ UL mg/day	United States (NASEM, 2019) UL mg/day	European Union (EFSA, 2019) UL mg/day	Nordic and Baltic Populations (Blomhoff et al., 2023) UL mg/day	Germany, Austria & Switzerland (Strohm et al., 2018) UL mg/day
Adults 18 + y	ND	ND	ND	NS	NS
Pregnancy 18+ y					
Lactation 18+ y					
Pregnancy 14-18 y*	2,300	ND	ND	NS	NS
Lactation 14-18 y*	2,300	ND	ND	NS	NS
Children and adolescents					
1 -3 yr	1,100	ND	ND	NS	NS
4 -8 yr	1,400				
9 -13 yr	2,000				
14 -18yr*	2,300				

ND = Not determined; NS = Not specified

* Due to the review of adult UL values in 2017 - and revision of age groupings for adults from 19+ years to 18+ years - there are overlapping UL recommendations for 18 year olds. The recommendations state: *The 2006 UL for 14 - 18 years, including for pregnancy and lactation, remains until the UL for infants, children and adolescents are reviewed. The 2017 UL for adults of 'not determined' is for adults 18+ years. It is recognised that currently there is overlap in the UL recommendations for 18 year olds. The UL for 18 year olds should be taken as the 2017 UL for adults as this is more up-to-date.*

^ In 2017 the UL values for adults were reviewed. Values for children and adolescents have not been reviewed since 2006.

Australian and New Zealand nutrition context

Population intakes

Australia

The 2023 National Nutrition and Physical Activity Survey (NNPAS) and 2023 National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey (NATSINPAS) both estimated nutrient intake from 24-hour dietary recall, with the sodium content of food estimated using Food Standards Australia New Zealand's AUSNUT 2023 data (ABS, 2023a; ABS, 2023b; ABS, 2023c). These data represent sodium from food sources only and do not account for additional sodium added during food preparation in the home, or at the table (i.e. discretionary salt). Although participants could list 'salt' as a food consumed within their dietary recall, they were not specifically prompted by the data collection software to do so. Participants also reported on the frequency of discretionary salt use, however intake estimates from food were not adjusted to account for discretionary salt use. Both NNPAS and NATSINPAS data suggest that discretionary salt use is prevalent in Australia (see '**Sodium content of diets and food supply**'). A 2018 systematic review of Australian studies also found that estimated intakes based on dietary recall methods were substantially lower than estimates using urinary sodium excretion measures (Land et al., 2018). Consequently, the available population data may significantly underestimate population sodium intakes and should be interpreted with caution. Where available, data from Australian studies reporting 24 hour urinary sodium excretion are presented to supplement national data.

Comparisons are presented for previous and current national surveys, where these data are reported by the Australian Bureau of Statistics (ABS). However, the ABS advises that temporal comparisons should be made with caution owing to methodological differences between surveys.

Adults

NNPAS data on adult intakes and the proportion exceeding the SDT are presented in Table 4. Adults aged 18 years and over had an average sodium intake of 2,384mg per day, with higher intakes reported for males (2,711 mg/day vs 2,070 mg/day for females), and those aged 18-29 years (2,645 mg/day) (ABS, 2023b). Average daily intakes have remained similar over time (2,404 mg/day in 2011-12 vs 2,375 mg/day in 2023), although a small decrease over time was noted for people aged 30-49 years (from 2,551 mg/day in 2011-12 to 2,464 mg/day in 2023). Energy-adjusted sodium intakes increased slightly between 2011-12 and 2023 (from 289.4 mg/1,000 kJ in 2011–12 to 295.3 mg/1,000 kJ in 2023). This suggests increased sodium concentration in diets despite overall reductions in food consumption (ABS, 2023b).

Almost two thirds of adults (65.6% or 12.9 million) had daily sodium intakes exceeding the current SDT of 2,000mg/day, with more males than females exceeding the SDT across all age groups (ABS,2023c). Males aged 18-29 years had the greatest proportion of individuals exceeding the SDT (88.2%), followed by males aged 30-49 years (81.5%). Females in these age groups were also more likely to exceed the SDT (59.6% and 56.8% respectively) compared to older females. The proportion of adults with usual intakes exceeding 2,000mg/day has

decreased since 2011-12 (down from 84.8% to 79.9% in males, and from 54.2% to 51.2% in females).

Table 4 –Population intake of sodium from food and beverages among Australian adults and proportion of adults exceeding SDT, by age group and sex. Source: 2023 NNPAS (ABS, 2023b; ABS, 2023c)

Age group	All persons	Males		Females	
	Intake *(mg/day)*	Intake *(mg/day)*	% exceeding SDT	Intake *(mg/day)*	% exceeding SDT
18 – 29 years	2,645	3,106	88.2%	2,157	59.6%
30 – 49 years	2,464	2,765	81.5%	2,176	56.8%
50 – 64 years	2,309	2,603	78.5%	2,030	47.4%
65 – 74 years	2,140	2,372	71.2%	1,925	44.2%
75+ years	2005	2,266	68.1%	1,780	35.4%

Intake data from the 2023 NNPAS are substantially lower than estimates from Australian studies which have utilised 24-hour urinary sodium excretion, although the data are not contemporaneous. A 2018 systematic review meta-analysed data from studies measuring 24-hour urine collection from 3,896 adults in Australia with a mean age ranging from 31 to 69 years. Daily salt intake was estimated at 9.6 grams per day, equating to 3,800 mg/day of sodium (Land et al., 2018). Intakes were higher among males compared with females (4,040 mg/day vs 2,936 mg/day).

Pregnancy and lactation

No data were identified in pregnant or lactating Australian populations.

Children and adolescents

NNPAS data from Australian children and adolescents are presented in Table 5. Average intakes are similar to the previous (2011-12) NNPAS survey, except for a small increase among people aged 12 -17 years (2,635 mg/day in 2011-12 vs 2,903 mg/day in 2023). No data is available on the proportion of children and adolescents exceeding the UL. However, when the UL is weighted to align with the ABS age-groupings, average intakes for all age groups and sexes exceed the relevant UL recommendations.

Table 5 - Population intake of sodium from food and beverages among Australian children and adolescents, by age group and sex. UL data from the 2006 NRVs are also presented for comparison purposes. Sources: 2023 NNPAS (ABS, 2023b), NRVs 2006 (NHMRC, 2006b)

Age group	All persons Intake *(mg/day)*	Males Intake *(mg/day)*	Females Intake *(mg/day)*	UL (weighted average)* *(mg/day)*
2 – 4 years	1,521	1,605	1,431	1,200
5 – 11 years	2,188	2,312	2,055	1,657
12 – 17 years	2,903	3,365	2,419	2,200

*Data on the proportion of children exceeding the UL was not reported in the NNPAS. The current (2006) UL is presented here for comparison purposes; values have been derived for the age groups specified by applying a weighted average. Source: (NHMRC, 2006b)

Among the studies that report 24-hour urinary sodium measures, one cross-sectional study in 666 Victorian children aged 4 to 12 years sampled in 2010-2013 reported a mean (SD) urinary sodium excretion of 2,369 mg/day (Grimes, Riddell, et al., 2017). Statistically significantly higher urinary sodium values were reported for boys (2,507 mg/day) compared with girls (2,231 mg/day) and for older (9-12 years) compared with younger (4-8 years) children (2,599

mg/day vs 2,070 mg/day). A follow-up cross-sectional study conducted by the same research group in 2018-19 among 161 children aged 4 to 12 years reported similar results (Grimes et al., 2023). Mean sodium intake was 2,440 mg/day of sodium, with higher intakes recorded for boys (2,719 mg/day) compared with girls (2,200 mg/day). For children aged 4-8 years mean intake was 2,040 mg/day compared with 2,639 mg/day for 9 – 12 year olds. Across both time points, around 70% of children exceeded the UL recommendation.

These intakes are higher than those reported by the NNPAS for comparable aged children, although they were not contemporaneously sampled. Nevertheless, the ABS reports that intakes for 5 to 11 year olds in 2023 were similar to 2011-12 values (ABS, 2023b). Assuming comparability on this basis, data from studies reporting 24-hour urinary sodium measures suggest that intakes among Australian children may exceed the levels reported in the NNPAS.

Aboriginal and Torres Strait Islander populations

Data from the NATSINPAS are presented in Table 6. Average intakes for people aged 2 years and over have remained similar over time (2,382 mg in 2012–13 and 2,486 mg in 2023)(Australian Bureau of Statistics, 2023a).

Among Aboriginal and Torres Strait Islanders, higher mean daily sodium intakes were recorded for:

- males (2,764 mg/day) compared with females (2,213 mg/day)
- those aged 18-29 years (2,752 mg/day) and 30-49 years (2,578 mg/day) than for older adult age groups
- those residing in non-remote areas (2,538 mg/day) compared with remote areas (2,190 mg/day).

Mean intakes exceeded the SDT for all adults aged under 65 years, with females aged 50 years and older the only group with mean intakes lower than the SDT. Intakes among Aboriginal and Torres Strait Islander people were greater than those of the general Australian population for all age groups, except 12 to 17 year olds and those aged over 50 years (ABS, 2023a, 2023b).

Table 6 – Aboriginal and Torres Strait Islander population intakes of sodium from food and beverages Australia. Source: 2023 NATSINPAS (ABS, 2023a)

Age group	All persons Intake *(mg/day)*	Males Intake *(mg/day)*	Females Intake *(mg/day)*
2 – 4 years	1,988	1,767	2,197
5 – 11 years	2,416	2,586	2,191
12 – 17 years	2,801	3,212	2,459
18 – 29 years	2,752	3,264	2,292
30 – 49 years	2,578	2,833	2,316
50 – 64 years	2,197	2,528	1,908
65 + years	1,873	2,109	1,749

These data may under-estimate intake, with a study estimating average sodium intake across 20 remote Indigenous communities at 2,770 mg/day (McMahon et al., 2015). The study used apparent consumption data based on store-sales data from 2012-14 and factored in discretionary salt use. There was significant variability in estimated mean intakes across communities, ranging from 2,410 mg/day to 3,450 mg/day. These estimates are higher than the

NATSINPAS estimated intake of 2,190 mg/day among remote populations (which did not include discretionary salt use).

Other sensitive or at-risk groups

A 2017 systematic review evaluating social patterns in sodium intake among high-income countries found that adults of lower socioeconomic status (SES) had greater sodium intakes than high socioeconomic status adults (de Mestral et al., 2017). Pooled relative differences were estimated for various countries, with intake in Australian adults of low SES estimated to be 423 mg/day (352 – 493 mg/day) greater than their high SES counterparts.

Evidence from studies in Australian children also suggests that those from a low SES background have higher sodium intakes compared with high SES children. Analysis of nationally representative data from the 2007 National Children's Nutrition and Physical Activity Survey found that sodium intake in low SES children was 195 mg/day higher than high SES children; an average of 9% greater (Grimes et al., 2013). More recently, a study in 666 children aged 4 to 12 years in Victoria also found greater 24-hour sodium excretion among children from low SES compared with high SES backgrounds (equivalent to 230mg/day (95% CI 48 to 409), p=0.04)(Grimes, Riddell, et al., 2017).

New Zealand

The most recent New Zealand Adult Nutrition Survey (NZ ANS) was conducted in 2008/09. Data on sodium intake was collected using 24-hour dietary recall and the New Zealand Food Composition Database. However, food composition data were deemed insufficiently reliable for estimating sodium intake and corresponding data were not presented (University of Otago & NZ MoH, 2011). Subsequently, these data were published in an analysis comparing estimated intakes from spot urine and 24-hour dietary recall among a subsample of participants in the 2009/09 NZ ANS (McLean, Williams, et al., 2018). However, as both these data collection methods have limitations and owing to the significant time elapsed since data collection, these data were not extracted.

More recently, the 2016 New Zealand Total Diet Study estimated a lower, mid and upper bound of intake based on simulated diets and food sampling data. Estimated intakes were presented for several population groups aged from 1 years and over. However, the model did not account for discretionary salt use. The modelled data are imprecise and may underestimate intakes or the proportion of individuals with intakes exceeding recommendations, due to exclusion of discretionary salt and reliance on modelled average diets.

Adults

Data from the 2016 NZTDS are shown at Table 7. Younger males 19 to 24 years had the highest mean daily intakes, and females aged 25 years the lowest.

Table 7 - Modelled sodium intake in adults based on New Zealand food sampling and simulated diets. Source: 2016 NZTDS (New Zealand Food Safety, 2018)

Measure	Adult females 25 yr +	Adult females of Pacific Island ethnicity 25 yr +	Adult males 25 yr +	Adult males of Pacific Island ethnicity 25 yr +	Young adult males 19-24 yr

Daily intake - mid bound (mg/day)	2,068	2,385	2,899	3,039	3,470
% of AI consumed daily	225-450%	259-518%	315-630%	330-661%	377-754%
% of SDT (2017) consumed	103%	119%	145%	152%	174%
% of UL (pre-2017) consumed	90%	104%	126%	132%	151%

In the absence of national data, studies reporting 24-hour urinary sodium measures among a convenience sample of New Zealand adults may be informative. One 2011 study in 98 New Zealand adults reported mean urinary sodium of 3,459 mg/day (McLean et al., 2014). Similarly, in 2012 a study in a sample of 299 adults aged 18 to 64 years reported mean urinary sodium of 3,386 mg/day (N=299), with 77% of participant with intakes above 2,300 mg/day (McLean et al., 2015). More recently, a study conducted in 109 adults aged 18 to 40 years from Dunedin in 2020-21 measured median urinary sodium at 3,222 mg/day (Wang et al., 2023). Although not from a nationally representative sample, these findings suggest that the 2016 NZTDS data may under-estimate intake.

Pregnancy and lactation

No data were identified in pregnant or lactating New Zealand populations.

Children and adolescents

The 2016 NZ TDS modelled intakes for children aged 1 to 3 years, 5 to 6 years, and 11 to 14 years, as shown in Table 8. Although these estimates are based on simulated diets and food composition sampling, they align well with the limited available data from 24-hour urine sampling. A 2022 study in school children aged 8 to 13 years reported that mean (SD) 24-hour sodium excretion was 2,420 (1,025) (Eyles et al., 2025). Approximately one third of children (N=19; 32%) had intakes which met the WHO recommendation of less than 2000 mg/day, although the true number who met the recommendation may be higher given the potential for underestimation in this study.

Table 8 - Modelled sodium intake in children and adolescents based on New Zealand food sampling and simulated diets. Source: 2016 NZTDS (New Zealand Food Safety, 2018)

Measure	Boys 11-14 yr	Girls 11-14 yr	5-6 yr olds	1-3 yr olds
Daily intake - mid bound (mg/day)	2,877	2,419	1,920	1,361
% of AI consumed daily	360-719%	302-603%	320-640%	340-681%
% of UL consumed	144%	121%	137%	136%

Māori or Pasifika populations

No studies or national data were identified that reported on sodium intakes from dietary assessment or urinary sodium among Māori populations. Although several studies were identified that reported on sodium intake and included Māori participants, samples included insufficient participant numbers to report data by ethnicity (Eyles et al., 2023; Eyles et al., 2025; McLean et al., 2015). Studies examining sources of dietary sodium across different New Zealand populations suggest that Māori groups may consume greater amounts of bread compared with other groups and consequently intakes among Māori may be higher than those of the general New Zealand population (H. C. Eyles & C. L. Cleghorn, 2022; Metcalf et al., 2008).

The 2016 NZTDS modelled intake data for Pacific people residing in New Zealand, with results shown in Table 7. Intakes for adults of Pacific Island ethnicity were higher than intakes for comparable aged adults among the general New Zealand population.

Sodium content of diets and food supply

Diets

It has previously been estimated that 80% of Australians' dietary sodium comes from processed foods[1], with up to 20% coming from salt used in cooking or added at the table (Boorman, 2008; FSANZ, 2015).

Data from the 2023-24 NNPAS suggests that the main dietary contributors of sodium are cereal-based mixed dishes (25%), bread and bread rolls (7%), processed meat (5%), poultry-based mixed dishes (5%) and pastries (4%). These findings are consistent with other studies among Australian adults (Bolton et al., 2020; Nowson et al., 2018), children (Grimes, Riddell, et al., 2017; O'Halloran et al., 2016), and from remote Indigenous communities (McMahon et al., 2015).

Both NNPAS and NATSINPAS data suggest that discretionary salt use is prevalent in Australia, with around three quarters of those aged 2 years and over (78% of Australians; 73% of Indigenous population) adding salt during cooking or food preparation, and around half adding salt at the table (45% of Australians; 60% of Indigenous population) (ABS, 2023a; ABS, 2023b).

Discretionary foods[2] present significant sources of dietary sodium. Among a 2016-17 sample of 142 Victorian adults, discretionary foods accounted for 38% of dietary sodium (Bolton et al., 2020). Similarly, a study in 666 Australian children aged 4-12years found that 45% of dietary sodium came from discretionary foods, and 55% from core foods (Grimes, Riddell, et al., 2017). Finally, among a sample of 251 Victorian children aged around 3.5 years, discretionary foods contributed 35% of daily sodium intake, compared with 65% from core foods(O'Halloran et al., 2016).

Recent evidence from New Zealand is sparse, although data from the 2008/09 NZ Adult Nutrition Survey suggests dietary sodium sources mirror those of Australia, with bread (18.2%), bread-based dishes (10.9%), grains and pasta (6.6%), pork (6.5%) and processed meats (5.2%) identified as the predominant contributors (Helen C. Eyles & Christine L. Cleghorn, 2022). Similar to Australia, data suggests that discretionary salt – added during food preparation or at the table – accounts for 10-20% of total dietary sodium (Wang et al., 2023).

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[1] In this context, the term 'processed' refers to any foods that have been modified from their raw state, including foods processed for safety (eg. pasteurisation of milk) or to extend shelf life (canned goods), as well as processing to enhance flavour, texture or appearance (e.g. ultra-processed foods)

See: Food Standards Australia and New Zealand. (2023). *Processed foods*. FSANZ Retrieved from https://www.foodstandards.gov.au/consumer/our-safe-food-supply/processed-foods.

[2] Discretionary foods are defined as "foods and drinks not necessary to provide the nutrients the body needs, but that may add variety." National Health and Medical Research Council, N. (2013). *Australian Dietary Guidelines - Educator Guide*. Canberra Retrieved from https://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/n55b_eat_for_health_educators_guide.pdf

Food supply

A 2019 analysis of sodium in the Australian food supply by Food Standards Australia New Zealand (FSANZ) found that potato crisps, processed meat and meat products, cheese and pizza were highest in sodium, along with sauces, spreads and condiments (FSANZ, 2019). Similarly, the New Zealand Total Diet Study (2016) evaluated the sodium content of foods, with highest concentrations found in bacon, ham, and processed foods including sausages, bread, condiments, breakfast cereals, takeaway and snack foods (New Zealand Food Safety, 2018). This represents food composition data and should be interpreted in the context of relative consumption data presented above.

Modelling undertaken to inform the *Queensland Health Nutrition Standards for Meals and Menus* suggests that high sodium in the food supply presents a challenge to developing nutritionally balanced meal plans that fall within the recommended levels of intake for sodium. Although the bread used in modelling had a sodium level less than 400mg/100g and no discretionary salt was added, sodium intakes from the modelled, nutritionally balanced diets consistently exceeded the current SDT of 2,000 mg/day (127% to 137%). Similarly, the New South Wales Government *Nutrient Goal Standard for adult patients* requires institutional menus to provide no more than 2,300 mg/day of sodium; a value that exceeds the current SDT. This likely represents a pragmatic decision taken to ensure that requirements for protein, energy and other micronutrients can also be met. These circumstances highlight structural barriers to achieving intakes aligned with NRV recommendations in the context of ongoing high sodium content of foods in the Australian and New Zealand food supply.

Interventions to reduce population sodium intakes

Food reformulation

In 2013, Australia and New Zealand joined all WHO Member States in committing to a 30% reduction in population salt intake by 2025 (WHO, 2013) In 2015, following on from the former Food and Health Dialogue (2009-2015) the Australian Government launched the Healthy Food Partnership (HFP); a voluntary program involving collaboration between food industry, the public health sector and government to lower the amount of sodium, as well as saturated fat and sugar, in processed foods.

Evaluation of the HFP indicates modest progress. The average sodium content across all participating products decreased by 4.3% between June 2020 and June 2024 (ABS, 2025). However, modelling suggests that this translated to only a small reduction in dietary intake of 14.8 mg per person per day, representing approximately 0.5% of estimated average daily consumption (ABS, 2025). Furthermore, Australians' energy-adjusted sodium intakes increased slightly between 2011-12 and 2023 (from 289.4 mg/1,000 kJ in 2011–12 to 295.3 mg/1,000 kJ in 2023), suggesting increased sodium concentration in diets despite overall reductions in food consumption (ABS, 2023b). While national intake data suggests a slight decline in average sodium intakes between 2011-12 and 2023, trends are not consistent across population groups; notably, intake increased among adolescents aged 12 – 17 years (ABS, 2023b). Analysis of the HFP's impact on sodium purchasing estimated that the program resulted in very small reductions in sodium purchases of around 50mg/day per capita, suggesting that more stringent targets incorporating a broader range of foods are required to achieve meaningful population

health outcomes (Coyle et al., 2021). These findings were echoed by a mid-term evaluation of the HFP using food composition data, which revealed minimal progress. Although there was a small increase in the proportion of products meeting HFP targets between 2019 and 2022, 42% of products assessed did not meet the targets (Coyle et al., 2025).

In New Zealand, a similar voluntary food reformulation initiative – the Heart Foundation Food Reformulation Programme - has been progressively implemented by the Heart Foundation since 2007. Earlier evidence from the 2016 New Zealand Total Diet Study (NZTDS) suggested little overall change in sodium levels in processed foods as of 2016, with reductions observed only in select categories such as pizza and flavoured snacks (New Zealand Food Safety, 2018). More recent estimates indicate larger reductions, with an approximate 20% decrease in sodium content across in scope foods, corresponding to an estimated intake reduction of 260 mg/day (Wang et al., 2022). However, this level of reduction remains insufficient to meet WHO targets. Product-level analyses also show mixed progress, with decreases observed in foods such as bread and processed meats, but increases in other groups including noodles (Fuavao et al., 2023). Overall, while New Zealand food reformulation initiatives have achieved measurable reductions in the sodium content of some products, such as bread (Monro et al., 2025), progress has been modest and uneven. There remains significant potential for further reduction across the food supply, particularly in some sectors such as fast foods (Gomes et al., 2024).

Health Stars Rating system

The Health Star Rating (HSR) system is a voluntary nutrition labelling scheme jointly implemented in Australia and New Zealand in June 2014 to provide consumers with a quick, simple and consistent method for comparing the nutritional profile of similar packaged foods (FSANZ, 2026). Products are assigned a rating from ½ to 5 stars based on an algorithm that considers both nutrients and food components that decrease health risk (e.g. fruit, vegetables, nuts, legumes, protein and fibre) and those associated with increased risk, including sodium, saturated fat and total sugars. Higher-rated products are intended to represent healthier choices within a food category. The HSR system was also designed to incentivise product reformulation by providing an incentive for manufacturers to improve the nutritional composition of foods and beverages to achieve higher star ratings.

Sodium content is one component of the HSR algorithm, and reductions in sodium can contribute to improved ratings for many products. As such, the HSR system forms one part of the broader public health strategies in Australia and New Zealand aimed at reducing population sodium intakes and supporting progress towards the WHO 30% reduction target (WHO, 2012). At the time of writing (July 2026), FSANZ was developing a proposal to mandate the HSR system in Australia and New Zealand, in response to low voluntary uptake relative to 2020 targets (Australian Government, 2026).

A 2020 analysis of the impact of the HSR on food reformulation in both Australia and New Zealand found that products displaying the HSR were more likely to increase their rating by half a star or more, compared with unlabelled foods (Bablani et al., 2020). A relative decrease in sodium content of 4% (95% CI -6.4% to -1.7%, p=0.001) was observed for labelled products in New Zealand and a more modest relative decrease of 1.4% (95% CI -2.7% to 0.0%, p=0.045) in Australia. Although greater reformulation changes were observed among initially unhealthy products, these products were also less likely to adopt the HSR.

These findings were echoed in a smaller study examining the effects of the HSR on food reformulation in New Zealand, based on annual food and beverage packaging surveys from prior to (2014) and 2 years after (2016) adoption of the HSR system. Mean sodium content of products displaying HSR labelling were reduced by 4.6% over the period, compared with a 3.1% increase in mean sodium content of unlabelled products (Mhurchu et al., 2017).

Prevalence of associated disease burden

Cardiovascular disease is the leading cause of death worldwide and is a significant contributor to the burden of disease in Australia and New Zealand (World Health Organization, 2026). In 2024, CVD accounted for almost 12% of the total burden of disease in Australia; the leading single cause of burden among males and sixth highest among females (fourth overall)(AIHW, 2024).

Among First Nations Australians, CVD accounted for 10% of disease burden in 2018, ranking as the third greatest contributor(AIHW, 2022). The burden from CVD accounted for 14% of the gap in disease burden between Indigenous and non-Indigenous Australians, with the rate of Disability Adjusted Life Years (DALY) attributed to CVD among First Nations Australians nearly double that of non-Indigenous people (2.2 times higher for Indigenous males, 2.7 times higher for Indigenous females).

Disparities in morbidity and mortality are also noted for people from socially disadvantaged groups, with national data from 2023-24 reporting that cardiovascular disease prevalence is 1.9 times as high for adults residing in areas of greatest socioeconomic disadvantage compared with the least disadvantaged, whilst the CVD death rate was 1.6 times as high (AIHW, 2026a). Similarly, the proportion of adults with hypertension was 1.2 times higher among those residing in the lowest socioeconomic areas compared with the highest (Australian Institute of Health and Welfare, 2026b).

The 2024 estimated burden of disease from CVD in New Zealand is similar to that of Australia, representing 14% of the total disease burden and accounting for over 210,000 DALYs and nearly 12,000 deaths per year (Institute for Health Metrics and Evaluation, 2024). There is also significant disparity in the CVD burden across New Zealand, with the burden among Māori and Pacific peoples more than 1.5 times that of other New Zealand groups (Earle et al., 2018; Mason et al., 2019; Wheeler et al., 2025).

National data in children are sparse. However, analysis of two cohorts (2010-13; 2018-19) of Australian schoolchildren aged 4 to 12 years found that almost one in five had elevated blood pressure, with 74% of children exceeding the UL for sodium intake (Grimes et al., 2026). It is well established that blood pressure tracks across the lifespan, with higher levels during childhood associated with an increased future risk of hypertension and subclinical cardiovascular outcomes (Chen & Wang, 2008; Meng et al., 2024).

In both Australia and New Zealand, high blood pressure and dietary risks are leading risk factors for total CVD burden (AIHW, 2025; Institute for Health Metrics and Evaluation, 2024), although the CVD burden attributable to high dietary sodium intake has decreased over the past 30 years (Moreno et al., 2024). A paper exploring risk factors associated with total CVD mortality and morbidity in 2019 estimated that diets high in sodium accounted for 377 deaths and 6,920 DALYs (Wilson et al., 2023).

Knowledge, attitudes, and behaviours

A 2018 systematic review examined the knowledge, attitudes and behaviours towards dietary salt intake among people living in high income countries(Bhana et al., 2018). Three-quarters of the twelve included studies were from Australia (8 of 12 studies) or New Zealand (1 of 12 studies). Although participants were mostly aware of the cardiovascular disease risks associated with high salt intake, many were unaware of current recommended intake levels, or of how their own salt intake compared with recommendations. Across studies, there appears to be broad support for – and understanding of - the need for individual dietary changes to address the health risks associated with excessive salt consumption.

A recent nationally representative survey among 1,271Australian adults supports these findings, with most participants (85%) identifying processed foods as a main contributor to salt in Australian diets (Rosewarne et al., 2021). However, only one in three participants believed their salt intakes were above recommendations. Although other studies have reported higher overall sodium intakes among people from low socioeconomic backgrounds (de Mestral et al., 2017), the authors found no consistent pattern between sociodemographic factors and discretionary salt behaviours.

One study examined parental knowledge, attitudes and behaviours, recruiting 837 Australian parents from shopping centres in Victoria (Khokhar et al., 2018). Most parents surveyed were aware of the relationship between high dietary salt and adverse health outcomes (91%) although fewer understood that this relationship was also a concern for child health (77%). Those who reported knowledge about this relationship in children were less likely to report adding salt to child meals at the table (OR = 0.51, $p < 0.001$) or during food preparation (OR = 0.46, $p < 0.001$). Although 70% agreed that it was important to reduce salt in their child's diet, almost 1 in 2 still added salt to food prepared for their children (Khokhar et al., 2018). Two-thirds of parents believed that their intakes were equal to - or below - the recommended daily limits.

Collectively, these studies indicate broad public recognition of the health risks associated with high sodium intake and support for reducing consumption. However, gaps in consumers' knowledge about recommendations and personal sodium intakes persist. These findings underscore the importance of establishing evidence-based sodium NRVs that inform and support clear, actionable public health messages for the Australian and New Zealand populations.

Summary of Evidence

This section summarises the evidence underpinning the EFSA (2019) and US NASEM (2019) recommendations that are being adapted to the Australian and New Zealand context, and presents additional evidence published since these reviews that may influence the estimated effects or the overall body of evidence used to derive reference values.

It begins with a brief overview of the scope and methods of the EFSA and NASEM reviews. The evidence identified in these reviews is then considered alongside findings from supplementary systematic reviews addressing key research questions relating to sodium intake and health outcomes. These reviews were selected on the basis of a priori inclusion criteria specified by

the Sodium Expert Working Group (see **Appendix B – Methods for supplementary evidence searches**). Results are presented by population group (adults, children and adolescents, pregnancy and lactation).

Scope of reviews underpinning international recommendations

EFSA (2019)

EFSA (2019) reviewed evidence for the relationship between sodium intake and blood pressure (SBP and DBP), hypertension, cardiovascular disease (any, stroke, coronary heart disease) and bone health among the general adult (≥18 years) and child (6 months to <18 years) population. Eligible studies included randomised controlled trials (RCTs) including parallel or crossover trials (wash-out period of any duration) and prospective cohort, nested case-control or case-cohort studies with a minimum duration of 4 weeks (blood pressure), 6 months (CVD outcomes) or 1 year (bone health). Sodium intake was assessed based on urinary sodium excretion from 24-hour single or multiple 24-urine measures; other measures of sodium intake were not eligible. For blood pressure and other CVD outcomes, studies with concomitant interventions with the potential to affect the outcome of interest were excluded.

NASEM (2019)

NASEM commissioned the Agency for Healthcare Research and Quality (AHRQ) to review the evidence on the effect of sodium reduction (randomised controlled trials) on blood pressure, or the association between sodium intake and health outcomes (non-randomised or observational studies) among adults and children within the general population (ie. not sampled on the basis of pre-existing disease)(Newberry et al., 2018). A broad range of health outcomes were considered including mortality (all-cause, CVD related and CKD related), various cardiovascular outcomes (blood pressure, hypertension, cardiovascular disease risk) and chronic kidney disease measures. For RCTs, both parallel and cross-over trials were included; crossover trials with a washout phase less than 2 weeks, or those that did not specify a washout period or assess carryover effects were excluded. A minimum study duration of 4 weeks was specified, with increased duration required for select study designs and outcomes, including: 3 months for RCTs measuring CVD outcomes and 12 months for observational studies on CVD; and 2 years for studies measuring kidney disease outcomes. Accepted sodium intake measures included validated dietary assessment measures or biomarkers including at least one 24-hour urinary analysis.

Summary of Findings

The AHRQ systematic review (Newberry et al., 2018) conducted to inform the 2019 NASEM dietary reference values for sodium evaluated the strength of evidence for key outcomes and comparisons. AHRQ Summary of Findings tables for key outcomes have been extracted from Newberry et al (2018) and presented in the relevant section, where suitable.

AHRQ Strength of evidence assessment

The AHRQ's strength of evidence assessment evaluates the body of evidence for each outcome against 5 criteria: study limitations (risk of bias of included studies); directness; consistency; precision; and reporting bias. Evidence from RCTs starts at an assumed 'high' strength of evidence, with the strength of evidence downgraded by 1- or 2- levels depending on concerns

identified across the evaluated domains. The various strengths of evidence are defined as follows:

- **High:** We are very confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions
- **Moderate:** We are moderately confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains
- **Low:** We have limited confidence that the estimate of effect lies close to the true effect for this outcome. The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect
- **Insufficient:** We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome. No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion.

This approach aligns broadly with the GRADE Working Group approach to assessing the level of certainty of evidence outlined in the NHMRC Methodological Framework (National Health and Medical Research Council, 2026).

Physiological requirements for adequacy

Balance studies

Evidence underpinning international recommendations

Both NASEM and EFSA have noted the limitations of balance studies for reliably estimating sodium requirements, although both considered evidence from balance studies when deriving NRVs (EFSA, 2019; NASEM, 2019). The NASEM Committee identified a subset of 'better designed' balance studies that – whilst insufficient for characterising sodium requirements on their own – may provide supportive evidence for the level of sodium intake required to support adequacy. These studies are summarised in Table 2 (adapted from NASEM 2019). Only two studies were identified that comprehensively measured total sodium losses from urine faeces and sweat (Allsopp et al., 1998; Palacios et al., 2004), only one of which had robust intake measurement (Palacios et al., 2004). Included balance studies typically ranged from 3 to 8 days duration, except for one study of 4-weeks duration (Kirkendall et al., 1976). The short duration of most balance studies was noted as a limitation, as it may be insufficient to account for individual variability and the infradian rhythm of total-body sodium with sufficient accuracy (Lerchl et al., 2015; National Academies of Sciences, 2019). Concerns about the potential for unmeasured sequestration to confound estimates from balance studies were also raised, citing emerging evidence on sodium sequestration in skin and muscle (Wang et al., 2017).

Overall, the reports noted significant variability across studies, with negative balance reported with intakes from 230 to 2,210 mg/day (3 studies), and positive balance reported with intakes ranging from 1,525 to 15,180 mg/day in adults (8 studies). One study reported neutral balance with intakes of 1,525 mg/day under heat stress conditions (40ºC for 10hrs/day for 5 days) whereas strong positive balance was observed under more typical environmental conditions (25ºC for 3 days)(Allsopp et al., 1998). The only study to rigorously measure intake and losses

was conducted in girls aged 11 to 15 years, reporting positive balance with intakes between 1,300 and 4,000 mg/day (Palacios et al., 2004).

EFSA examined balance studies comparing sodium intake and excretion if the study allowed for an adaptation period, although criteria for determining this were not explicitly specified (EFSA, 2019). It summarised the evidence from Holbrook et al (1984), Allsopp et al (1998), Kodama et al (2005), and Palacios et al (2004). Similar to NASEM, the EFSA Panel also raised concerns about the validity of balance studies for determining sodium requirements, concluding that they could not be used to derive sodium requirements, although they provide supportive evidence about the intake level that is adequate for null sodium balance.

Supplementary evidence

No supplementary systematic reviews were identified that included balance studies published since 2018.

Requirements during pregnancy or lactation

Evidence underpinning international recommendations

Both EFSA and NASEM estimated total body sodium requirements throughout pregnancy at around 23g, with requirements unevenly distributed throughout pregnancy (EFSA, 2019; NASEM, 2019; Pitkin et al., 1972). The EFSA Panel reported a study in two groups of pregnant adults living in a salt-poor environment, with sodium requirements met via homeostatic mechanisms to increase sodium retention (Oliver et al., 1981). Overall, both EFSA and NASEM concluded that sodium requirements during pregnancy could be met by adaptive changes during pregnancy.

Regarding lactation, both guideline groups noted evidence suggesting that sodium losses through human milk are small, estimated at a few mmol/day (Allen et al., 1991; Bauer & Gerss, 2011; Butte et al., 1984; Dewey et al., 1984; Dewey & Lönnerdal, 1983; Garza et al., 1983; Gross et al., 1980; Holt, 1993; Lemons et al., 1982; Morriss et al., 1986; Motil et al., 1997; Perrin et al., 2017; Picciano et al., 1981; Wack et al., 1997) Furthermore, it was noted that the sodium content in human milk is regulated via membrane transport pathways(Truchet & Honvo-Houéto, 2017; Wack et al., 1997) and is not influenced by maternal intake (Ereman et al., 1987; Filippi et al., 1981; Keenan et al., 1982). On this basis, both EFSA and NASEM concluded that the sodium requirement of lactating females was unlikely to differ to that of non-lactating females.

Supplementary evidence

No supplementary systematic reviews were identified that examined physiological requirements for sodium during pregnancy or lactation published since 2018.

Table 9 – Summary of balance studies included in NASEM (2019)

Reference	Population	Sodium intake (mg/day)			Comment
		Negative balance	Neutral balance	Positive balance	
Rigorous and complete balance studies [a]					
Palacios et al. (2004)	36 white and black American adolescent females, 11-15 years of age			1,300 4,000	
Incomplete balance—Limitation on intake assessment [b]					
Allsopp et al. (1998)	25 British males,18-40 years of age		1,525	1,525 4,004 8,013	Intake of 1,525 mg/day associated with both near neutral balance under heat stress conditions (40ºC for 10hrs/day for 5 days) or strong positive balance under normal conditions (25ºC for 3 days)
Incomplete balance—Limitation on loss assessment [c]					
Kodama et al. (2005)	109 Japanese males and females, 18-28 years of age	2,210 [lowest intake]		6,870 [highest intake]	Sample size represents all participants across a series of 11 balance studies conducted over a 14 year period. Across the 11 balance studies, participants consumed different levels of sodium; the sample size in any given balance study is limited.
Consolazio et al. (1963)	3 healthy, young American adult males, ages not reported			8,729 10,229	
(Holbrook et al., 1984)	12 healthy American adult males (M) and 16 healthy American females (F), 20-53 years of age			4,200 (M) 2,700 (F)	Average sodium intake based on analysis of 1 weeks' worth of food and beverage samples collected four times over the course of 1 year.
Incomplete balance—Limitation on both intake assessment and loss assessment [d]					
Heer et al. (2000)	6 German nonsmoker, nonathlete males, mean 24 years of age			5,060 10,120 15,180	
Heer et al. (2009)	9 German males, mean 25.7 years of age	1,151			
Lerchl et al. (2015)	10 Russian males in simulated Mars environment			2,453 3,662 4,782-4,835	
Kirkendall et al. (1976)	7 American males, 24-47 years of age	230		4,828 9,426	

[a] Rigorous complete balance studies were those that measured directly sodium content of foods consumed and all losses (urinary, fecal using appropriate fecal markers, and whole body sweat)

[b] Balance studies limited by the lack of direct measurement of sodium content in foods consumed and relied on nutrient composition data from various sources.

[c] Balance studies limited by lack of direct assessment of one or more sources of sodium loss, typically either faecal or whole body sweat or both.

[d] Balance studies limited by lack of direct measurement of sodium content in foods consumed and by lack of assessment of one or more sources of sodium losses

Low sodium intake and adverse health outcomes

Morbidity and mortality

Evidence underpinning international recommendations

The 2018 AHRQ systematic review noted that some meta-analyses of cohort studies have suggested a curvilinear relationship between sodium intake and mortality, with greater mortality associated with both low and high sodium intakes (Newberry et al., 2018). However, this relationship is not supported by the limited evidence from RCTs, which found a non-statistically significant decrease in the risk of all-cause mortality with lower sodium intakes (certainty rating: insufficient). The authors suggest that findings from observational studies may be explained by reverse causality (whereby participants with medical conditions may lower their intake of sodium owing to their pre-existing health status) or errors in estimation of intake. This finding has also been supported in a Policy Statement from the World Hypertension League, which noted that inclusion of studies using estimation of 24-hour excretion via the Kawasaki equation changed the mortality association from a linear relationship (observed when based on 24-hour urine collections) to a J-shaped curve (Petersen et al., 2020).

To inform establishment of an 'Adequate Intake' recommendation, the AHRQ (2018) sought to identify RCTs that examined sodium reduction trials in which:

- one or more arms had low sodium intake (below 1,800 mg/day) and
- no deficiency symptoms or adverse health outcomes were recorded.

Eight RCTs were identified with mean sodium intakes in the low sodium arm ranging from 851 to 1,794 mg/day; the majority among hypertensive or pre-hypertensive groups. Data on these studies are extracted (as presented in Newberry et al, 2018) and shown in Table 10 below.

Supplementary evidence

No supplementary systematic reviews were identified published since 2018 that examined the relationship between low sodium intake and adverse health outcomes among the general population.

Table 10 - RCTs with low sodium dose reporting no adverse health outcomes, adapted from:(Newberry et al., 2018)

Study ID	Setting / Design	Participants	Interventions	Comparison	Sodium measurement
Beard et al (1982) Australia High risk of bias	Multi-site, parallel RCT in a community setting (years NR)	113 hypertensive 'white' adults taking antihypertensive medication for 3 months or longer	Diet / lifestyle counselling to reduce sodium intake (no-added-sodium diet) for 3 months	Usual sodium diet for 3 months	24-hour urinary sodium excretion (without quality control measure) Int: 37 mmol/day (851 mg/day) Com: NR by AHRQ (2018)
Sciarrone et al (1992) Australia Low risk of bias	Multi-site, factorial RCT in a community setting (1987-1988)	81 hypertensive adults (treated or untreated) without cardiovascular disease, diabetes or renal disease	Int 1: Normal sodium, normal fat, normal fibre diet plus sodium supplement 100 mmol/day Int 2: Low sodium, normal fat, normal fibre diet plus placebo pill Int 3: Low sodium, low fat, high fibre diet plus placebo Duration: 2 months	Com: normal sodium, low fat, high fibre plus sodium supplement 100mmol/day for 2 months	Single 24-hour urine analysis with validation (NR) Int 1:NR by AHRQ (2018) Int 2: 58.1 mmol/day (1,336.3 mg/day) Int 3: 53.1 mmol/day (1,221.3 mg/day) Com: 136.2 mmol/day (3,132.6 mg/day)
Todd (2012) New Zealand Moderate risk of bias	Multi-centre crossover RCT in a community setting (14 day washout) (years NR)	23 adults without pre-hypertension or hypertension aged 20-65 years; non-smokers; BMI <30 (kg/m2); no history of cardiovascular disease, diabetes or renal disease.	Int 1: Low dietary sodium of 60 mmol/day, duration NR Int 2: Intermediate dietary sodium of 150 mmol/day, duration NR	Dietary sodium of 200-250 mmol/day, duration NR	Partial urine (8h urine) with no mention of equation Sodium:creatinine ratio Int 1: 10.2 or 1,233 mg/day Int 2: 18.4 Com: NR by AHRQ (2018)

Study ID	Setting / Design	Participants	Interventions	Comparison	Sodium measurement
Sacks et al (2001) US Low risk of bias	Multi-site crossover RCT in a community setting (washout period <5 days) (1997-1999)	412* adults with blood pressure exceeding 120/80. Excluded were individuals with: cardiovascular disease; renal insufficiency; poorly controlled hyperlipidemia or T2DM; insulin-dependent diabetes; special dietary requirements; high alcohol intake; use of anti-hypertensive or other medication affecting BP or nutrient metabolism	Crossover group 1: Int 1: Prescribed or synthetic diet (high sodium) aiming for 150 mmol/day sodium Int A2: Prescribed or synthetic diet (intermediate sodium) aiming for 100 mmol/day sodium Crossover group 2: Int B1: DASH high sodium diet (150 mmol/day) Int B2: DASH intermediate sodium diet (100 mmol/day) Duration: 30 days per arm (2 weeks run in at high sodium dose initially; no wash out between periods)	Com crossover 1: Prescribed or synthetic diet (low sodium) aiming for 50 mmol/day. Com crossover 2: DASH low sodium diet (50 mmol/day) Duration: 30 days per arm (2 weeks run in at high sodium dose initially; no wash out between periods)	Sodium measured using chemical analysis of diet with intervention/exposure adherence measure, and 24-hour urinary excretion (without quality control measure) Int 1: 141 +/- 55 mmol/day (mean: 3,243 mg/day) Int 2: 106 +/- 44 mmol/day (2,438 mg/day) Int 3: 144 +/- 58 mmol/day (3,312 mg/day) Int 4: 107 +/- 52 mmol/day (2,461 mg/day) Com: 64 +/- 37 mmol/day (1,472 mg/day)
Parker et al (1990) Australia Low risk of bias	Multi-site, factorial RCT in a community setting (years NR)	28 males taking regular antihypertensive medication for at least 6 months without renal disease, T2DM.	Int 1: Low alcohol, low salt Int 2: Normal alcohol, low salt Duration: 1 month	Com 1: Low alcohol, normal salt Com 2: Normal alcohol, normal salt Duration: 1 month	24-hour urine analysis with validation using food records and tablet counts Int 1&2: 68.6 mmol/day (1,577.8 mg/day; average of 2 low sodium groups reported together) Com 1&2: 141.7 mmol/day (3,259.1 mg/day; average of 2 normal sodium groups reported together)
Morgan and Anderson (1987) USA Moderate risk of bias	Multi-site, factorial RCT in a community setting (years NR)	20 hypertensive adults without CVD	Reduced sodium diet between 50 and 75 mmol/day for 6 months	Usual sodium diet for 6 months	24-hour urinary sodium excretion (without quality control measure) Int: 75 mmol/day (1,725 mg/day) Com: NR by AHRQ (2018)

Study ID	Setting / Design	Participants	Interventions	Comparison	Sodium measurement
Puska et al (1983) Finland Low risk of bias	Multi-site parallel RCT in a community setting (1981)	114 adults without 'major health problems' and not treated with antihypertensive medication	Diet / lifestyle counselling to reduce sodium intake (aim to reduce salt intake to less than half the baseline level) for 1.5 months	Usual diet for 1.5 months	24-hour urinary sodium excretion with validation using food records. Int: 77 mmol/day (1,771 mg/day) Com: NR by AHRQ (2018)
Nestel et al (1993) Location NR Low risk of bias	Multi-site parallel RCT in a community setting (years NR)	66 normotensive adults without anti-hypertensive use and without cardiovascular, renal or endocrine disorders	No added salt diet (low salt) for 2.5 months	Added salt diet for 2.5 months	24-hour urine analysis with validation using 24-h creatinine excretion Int: 77 mmol/day (F); 106 mmol/day (M) equating to 1,771 mg/day (F) and 2,438 mg/day (M). Com: NR by AHRQ (2018)
Todd et al (2010) Location NR Moderate risk of bias	Multi-site crossover RCT in a community setting (years NR)	35 adults with hypertension or pre-hypertension; Nonsmokers with BMI<30, no history of cardiovascular disease, diabetes, or renal disease.	Int: No sodium tomato juice daily for 1 month	Com 1: 90mmol sodium tomato juice daily for 1 month Com 2: 140 mmol sodium tomato juice daily for 1 month	Partial or spot urine without validated prediction equation Sodium:creatinine ratio Int: 7.6 or 1,794 mg/day Com (unclear 1 or 2): 11.8

* AHRQ (2018) reports Sacks et al (2001) as having a total N of 79 participants, however the NASEM (2019) report and in-text references describe this trial as having 412 participants. This detail was verified by reference to the primary study. It is presumed that the N=79 documented by AHRQ (2018) is a transposition error.

Int = intervention Com = comparison

Summary of findings

Summary of Findings: Adverse effects of sodium reduction (Newberry et al., 2018)
Population: Free-living adults (including hypertensive and normotensive populations). Studies in outpatient settings were eligible; samples exclusively comprised of participants with select clinical conditions were excluded.
Study designs: Randomised controlled trials evaluating reduced sodium intake (via oral consumption of food or supplements of quantified amounts of sodium). The minimum intervention duration was 4 weeks. For cross-over RCTs, a minimum washout period of 2 weeks was applied.
Intervention: Lower sodium diet
Comparison: Higher sodium diet

Outcomes	Effect description	Number of studies (No. participants)	Strength of evidence (AHRQ approach)	Evidence statement
Blood lipid levels	*"Sodium reduction does not affect blood lipid levels 3 RCTs"*	3 RCTs (N= NR)	Low[a]	Low strength of evidence for no effect of sodium reduction on blood lipids
'Dizziness, headache, insulin sensitivity, muscle cramping'	MD -4.4, 95% CI -5.6, -3.3	5 RCTs *("1-2 RCTs per type of adverse event")* (N=NR)	Insufficient[b]	Evidence is insufficient, based on one to two studies per type of adverse event, to assess the effects of sodium reduction

* **Strength of evidence levels (AHRQ)**

High strength of evidence: We are very confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions.

Moderate strength of evidence: We are moderately confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains

Low certainty: We have limited confidence that the estimate of effect lies close to the true effect for this outcome. The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect

Insufficient: We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome. No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion

[a] -2 for imprecision

[b] Reasons for downgrading NR.

High sodium intake and health outcomes

Blood pressure

Adults

Evidence underpinning international recommendations

EFSA (2019) identified thirty-two RCTS (7 parallel, 1 cluster-randomised and 25 crossover) including 11 to 1,159 participants with intervention durations from 4 weeks to 36 months. Sodium differences between-groups ranged from 13.3 to 285 mmol/day. Random-effects meta-analysis found that sodium reduction had a significant effect on SBP (3.9 mm Hg, 95% CI 5.1 to 2.8; I^2=61.9%, p < 0.001) and DBP (2.0 mm Hg, 95% CI 2.8 to 1.2; I^2=60.6%, p < 0.001). Subgroup analyses revealed greater effects in adults aged 50 years or older, hypertensive individuals and in predominantly male samples. Examination of methodological sources of heterogeneity identified that effect size varied by trial design (greater effects with crossover trials vs parallel), blood pressure measurement position (greater with supine vs seated) and study duration (smaller effects with longer duration).

Meta-regression modelling revealed increases in SBP (5.3 mm Hg, 95% CI 3.6 to 6.9) and DBP (2.6 mm Hg, 95% CI 1.6 to 3.7) for each 100mmol (2.3 g) increase in mean 24 hour urinary sodium. Stratified analyses explored the moderating effects of age and hypertensive status, with greater reductions in adults aged 50 years or older (SBP 7.1 mm Hg, 95% CI 5.0 to 9.2) and hypertensive individuals (SBP 6.4 mm Hg, 95% CI 4.3 to 8.6) for both SBP and DBP.

Findings from RCTs were supported by one prospective cohort study that followed 1,499 adults for over 6 years, which found an increase of 1.71 mm Hg, 95% CI 0.79 to 2.64) increase in SBP for every 100mmol increase in sodium excretion (Stolarz-Skrzypek et al., 2011). The association with DBP was not significant (0.38 mm Hg, 95% CI 0.31 to 1.07). However, the study was at moderate risk of bias with concerns including the failure to adjust for significant confounders, potential for misclassification within the low sodium group, and missing data due to loss to follow up.

Based on these studies, the EFSA Panel concluded that there is strong evidence for increasing SBP with increased urinary sodium over the range of mean urinary sodium measures across studies (49 to 209 mmol per 24 hours, corresponding to 1.3 to 4.8 grams per day).

Similar to EFSA's findings, the AHRQ (2018) evidence evaluation identified moderate certainty evidence that reducing sodium intake significantly decreased SBP (–3.23 mm Hg, 95% CI –4.07 to –2.38; I^2=77%; 47 RCTs) and DBP (–2.26, 95% CI -2.91 to –1.60; I^2=72%; 48 RCTs). Greater reductions were reported for hypertensive individuals (moderate certainty evidence for SBP, low certainty for DBP), although significant reductions were reported for both hypertensive and non-hypertensive individuals for SBP. However, there was low certainty evidence that reduced sodium may not decrease DBP in people with normal blood pressure. Reduction in SBP was not moderated by sex (low certainty evidence) and there was insufficient evidence for the potential moderating effects of race or ethnicity, health status (diabetes, renal disease, obesity). Prospective observational studies provided low certainty evidence of an association between reduced sodium and reductions in SBP, but not DBP (5 studies at moderate or high risk of bias).

Supplementary evidence

Three supplementary systematic reviews were identified that explored the relationship between sodium intake and blood pressure in adults (Filippini et al., 2021b; Graudal et al., 2020; Huang et al., 2020).

Huang et al. (2020) was the most recent review at low risk of bias and most closely aligned with the review inclusion criteria. The authors examined the effect of sodium dose and intervention duration on blood pressure in adults. Eligible studies were RCTs comparing reduced dietary sodium intake with usual/higher intake (estimated by 24 hour urine collection) reporting data on SBP or DBP. The dose-response relationship between sodium and changes in SBP and DBP were explored by grouping RCTs into quintiles based on change in 24-hour urinary sodium excretion. Analysis was stratified by intervention duration (>14 days duration vs ≤14 days), with additional analysis restricted to trials >14 days duration and with >100 mmol reduction in 24-hour urinary sodium. The review included 133 studies across 12,197 participants, comprising 58 studies (9,196 participants) >14 days duration, and 77 studies (2,977 participants) ≤14 days or less. Of those studies exceeding 14 days duration, most (48/58; 7,410 participants) had urinary sodium reductions of ≤ 100 mmol.

Fully adjusted regression modelling found that a 50 mmol reduction in 24 hour urinary sodium was associated with statistically significant decreases in SBP (1.10 mm Hg, 95% CI 0.66 to 1.54) and DBP (0.33 mm Hg, 95% CI 0.04 to 0.63). Reductions in blood pressure were reported across both hypertensive and non-hypertensive individuals. Effects of sodium reduction on SBP were modified by age, ethnicity and blood pressure level, with greater effects observed in older people, non-white populations and those with higher SBP at baseline. Shorter trials (<15 days duration) showed smaller reductions in SBP for each 50mmol reduction in 24-hour urinary sodium (1.05 mm Hg, 95% CI 0.40 to 1.70; p=0.002) compared with longer trials of 15 days duration or more (2.13 mm Hg; 95% CI 0.85 to 3.40; p=0.002), although confidence intervals for the latter were also wider.

A dose response relationship was observed, with a greater magnitude of sodium reduction associated with greater reductions in SBP. This finding was also supported by a plot of studies with more than two levels of sodium intake which also showed a dose-response relationship for SBP across 7 studies.

Huang et al (2020) included literature published up to 21 January 2019 and is therefore not substantially more current than the reviews undertaken by EFSA (current to October 2018) and AHRQ (current to December 2017). Furthermore, as the dose-response analysis was performed as quintiles of sodium reduction from baseline, rather than comparing sodium intake to SBP, it does not facilitate selection of a reference value for the purposes of establishing a SDT/CDRR for sodium. Nevertheless, it provides further supportive evidence of a consistent linear relationship between blood pressure and urinary sodium reduction. It also helps to explain divergent findings between various systematic reviews regarding the effect on SBP in non-hypertensive populations, by highlighting the sensitivity of analyses to both study duration and the level of sodium reduction of included studies.

Graudal et al 2020 also conducted a Cochrane systematic review on the effects of low vs high sodium on blood pressure (low risk of bias), searching for studies up to 11 April 2018. The review adopted inclusive criteria, with studies that estimated sodium intake based on fractional urine samples (minimum 8 hour samples) and studies with any duration of intervention eligible for

inclusion. These decisions are a significant departure from the preferred inclusion criteria nominated by the Sodium Expert Working Committee - and those adopted by EFSA (2019) and AHRQ (2018) - which required a minimum intervention duration of 4 weeks, and 24 hour sampling for urinary measures. Analyses for the effect of sodium intake on blood pressure were stratified by 'race' (grouped as 'white', 'black' or Asian populations) or hypertensive status (non-hypertensive vs hypertensive). Overall meta-analyses across all populations were not presented. Although mean sodium in the high and low intake groups was reported for each population, the magnitude of sodium reduction across different studies was not factored into analysis.

Sodium intakes – and the magnitude of sodium reduction between groups - varied substantially across studies, with a mean (SD) intake of 203 (66) mmol/day in the high sodium group and 65 (40) mmol/day in the low sodium group, equating to a mean sodium reduction of 138 mmol/day. Significant statistical heterogeneity was noted across all analyses except among normotensive Asian participants, with unexplained heterogeneity remaining after subgroup analysis to exclude trials of less than 7 days duration or with intakes above 250mmol/day. Significant clinical heterogeneity across studies was noted, including disparities in the duration of intervention (range 3 to 1,100 days) and the mean sodium reduction of included studies (range 23 mmol/day to 341 mmol/day) across studies.

Meta-analyses found statistically significant reductions in SBP with lower sodium intake across both "white" and "black" populations, with greater reductions observed in hypertensive populations. In Asian populations, a statistically significant reduction in SBP was reported with lower sodium intakes in hypertensive populations (MD -7.75 mm Hg, 95% CI -11.44 to -4.07), although the effect was non-significant in normotensive Asian participants (MD -1.50 mm Hg, 95% CI -3.09 to 0.10).

Results for DBP varied depending on hypertensive status, with sodium reduction having no effect on DBP among normotensive "white" participants (MD +0.01 mm Hg, 95% CI -0.37 to 0.39) and significantly reducing DBP among hypertensive "white" participants (MD -2.87 mm Hg, 95% CI -3.41 to -2.32). Similar patterns were observed among "black" and Asian populations.

Based on these analyses – coupled with findings examining the concomitant effects of short-term sodium reductions on hormones and lipids - the authors questioned the benefit of sodium reduction in normotensive white populations. However, this conclusion should be interpreted with caution, as the review had several limitations. Firstly, the authors' conclusions about the relative benefits and harms of sodium reduction may have been unduly influenced by the inclusion of studies with of short duration which may not accurately reflect long-term effects. Despite undertaking sensitivity analyses to explore the effect of intervention duration, the threshold selected by Graudal et al (2020) of 7 days duration or longer remained significantly shorter than the 4 week period adopted by other reviews. Huang et al (2020) reported an approximate doubling of effect size when studies longer than 2 weeks were compared with shorter studies, suggesting some latency in the effects of sodium reduction, which may not be captured in studies of shorter duration. Similarly, Huang et al (2020) noted that concerns about potential effects on hormones and lipids raised by Graudal et al (2020) are not found in studies with longer term interventions, and may represent short-term metabolic effects rather than adverse long-term outcomes.

Another limitation of the review was the failure to account for the magnitude of sodium reduction (and level of sodium intake) in analysis. In some cases, the level of intake – and associated sodium reductions – was not reflective of usual dietary intakes or the types of sodium reduction seen in response to public health interventions. Furthermore, no criteria were set for what constituted a 'low' vs 'high' sodium intake, instead relying on comparisons of lower vs higher intakes. Consequently, it is possible that there was overlap between classifications across studies (ie. a 'low' intake for one study may correspond to a 'high' intake for another study). Insufficient data were presented in characteristics of included studies (which only reported sodium reduction, not intake levels for each group) limiting the ability to assess the extent to which this impacted on analysis.

The review's approach to analysing blood pressure relative to race and hypertensive status also had limitations. Studies in mixed race groups were classified according to the predominant group within the study, and where the race of participants was not reported, the study race was inferred based on the predominant race in the study country. In endeavouring to assign all studies to a single 'race' or hypertensive status grouping, the review may have introduced classification error in studies among mixed populations. Furthermore, analysis based on hypertensive status is challenging, with some populations including a mix of hypertensive and non-hypertensive participants, and the definition of 'hypertension' varying across studies and over time. Finally, conceptualising populations as hypertensive or not arbitrarily reduces baseline blood pressure to a binary measure, overlooking the graded relationship between reduced sodium intake, blood pressure reduction, and starting blood pressure consistently observed in the literature (Huang et al 2020).

Finally, a systematic review by Filippini et al. (2021b) searched for RCTs on the effect of dietary sodium reduction on blood pressure published up to 12 October 2020 (high risk of bias). Eligibility criteria included participants with or without hypertension (excluding secondary hypertension) undergoing experimental dietary intervention aimed at reducing sodium or sodium supplementation (vs. placebo) for a minimum of 4 weeks trial duration. Sodium was measured using 24-hour urinary sodium excretion. The review was judged to be at high risk of bias because of concerns about the comprehensiveness of its search strategy and unclear information about duplicate data extraction and risk of bias assessment. Eighty-five RCTs were identified for inclusion in the review, predominantly in hypertensive populations (65 RCTs). There was significant clinical heterogeneity across trials, with dietary sodium intakes ranging from 0.4 to 7.6 grams / day, and study duration from 4 weeks to 36 months. Dose–response meta-analysis was undertaken using a 1-stage cubic spline mixed-effects model to explore the effect of dietary changes in sodium intake on blood pressure, using a reference value of 2,000mg/day of sodium (see Figure 1). A linear relationship between sodium intake and SBP was observed across the range of included dietary sodium intakes, with greater effects noted in participants with higher blood pressure at baseline. Regression analysis reported that for every 10 mmol/day reduction in urinary sodum excretion, SBP reduced by 5.56mmHg (95% CI -4.52 to -6.59) and DBP by 2.33 mmHg (95% CI, −1.66 to −3.00) (Filippini et al., 2021b).

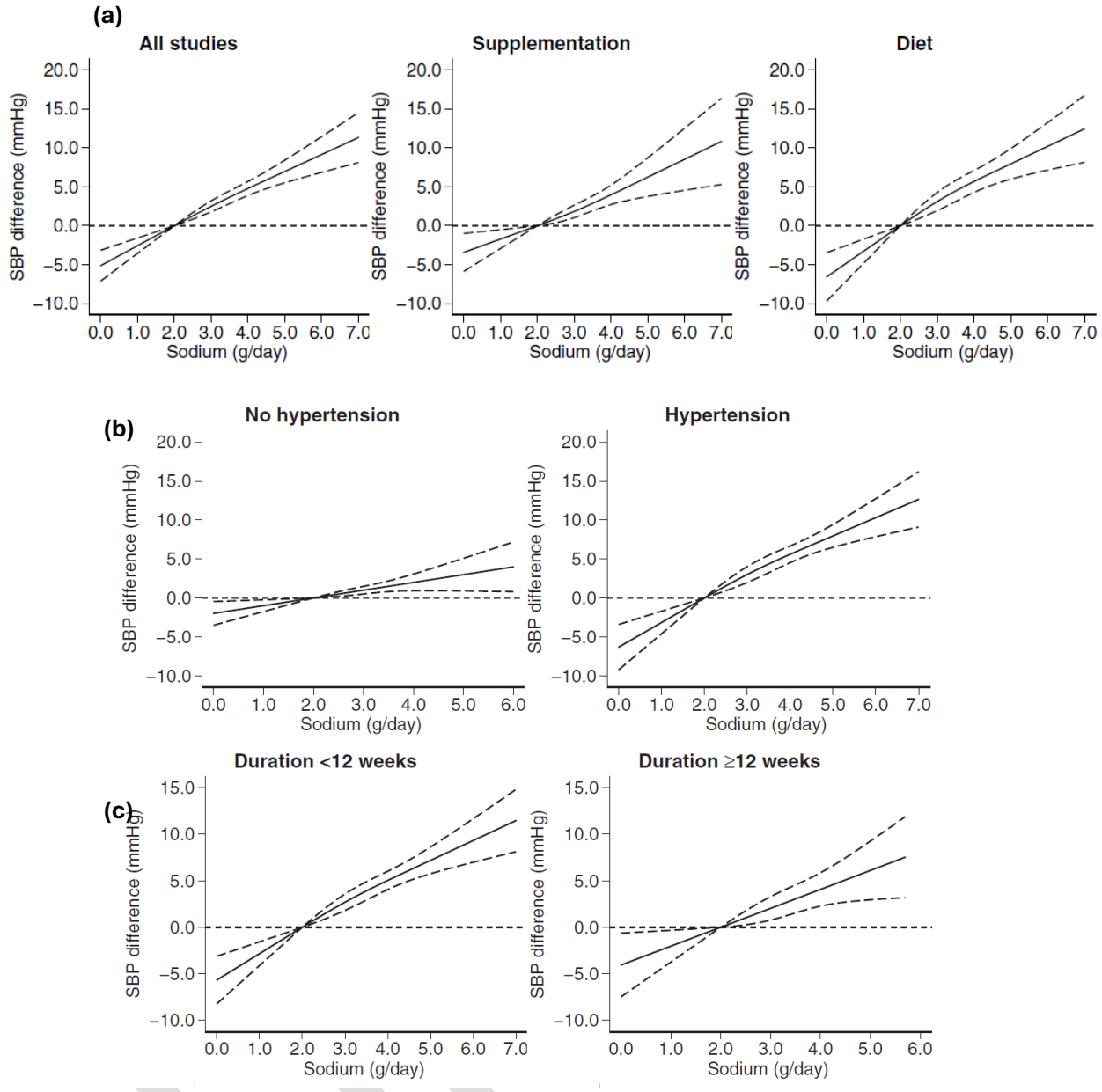

Figure 1 - Dose-response meta-analysis showing changes in systolic blood pressure (SBP) according to achieved sodium excretion. Results shown are for: (a) all studies and by type of intervention (supplementation or diet); (b) studies by baseline hypertension status of included participants (no hypertension vs hypertension); (c) studies by trial duration (4 to <12 weeks vs ≥12 weeks). The average curve (solid line) with 95% confidence limits (dashed lines) was estimated with a 1-stage random-effects restricted cubic spline model, using 2 g/d as referent. Source: Fillippini et al (2021), Figures 2 – 4.

Summary of evidence

Overall, systematic reviews published since the EFSA (2019) and AHRQ (2018) reviews suggest that the findings of these reviews remain a current reflection of the evidence base. There is a consistent relationship between modest reductions in dietary sodium and reduced blood pressure over the long-term. There remains insufficient evidence to characterise a level of sodium intake at which there is not a corresponding increase in blood pressure. Consequently, the sodium NRV for chronic disease risk reduction should be established based on pragmatic factors, including consideration of the evidence for the relative benefits and harms, alongside factors relevant to the Australian and New Zealand context.

The AHRQ (2018) review presented Summary of Findings tables for SBP in adults. Although several more recent systematic reviews were identified in supplementary searches, none of

those reviews comprehensively evaluated the strength of evidence. Findings across systematic reviews are largely consistent, with variable findings explained by differing review criteria; notably, the inclusion of studies with short duration or with varying methods for measuring sodium intake. The AHRQ review applied a minimum 4 week intervention period for studies evaluating the effect of sodium on blood pressure, consistent with the Sodium Expert Working Group a priori criteria. Consequently, the AHRQ Summary of Findings table was considered to remain an accurate summary of the current body of evidence.

Summary of Findings: Effect of sodium reduction on systolic blood pressure in adults (Newberry et al., 2018)
Population: Free-living adults (including hypertensive and normotensive populations). Studies in outpatient settings were eligible; samples exclusively comprised of participants with select clinical conditions were excluded.
Study designs: Randomised controlled trials evaluating reduced sodium intake (via oral consumption of food or supplements of quantified amounts of sodium). The minimum intervention duration was 4 weeks. For cross-over RCTs, a minimum washout period of 2 weeks was applied.
Intervention: Lower sodium diet
Comparison: Higher sodium diet

Outcomes	SBP (mm Hg)	Number of studies (No. participants)	Strength of evidence (AHRQ approach)	Evidence statement
SBP (all adults)	MD -3.2, 95% CI -4.1 -2.4	47 RCTs; 54 comparisons (N= NR)	Moderate[a]	Moderate strength of evidence for a beneficial effect of sodium reduction on systolic BP in adults
SBP (hypertensive adults)	MD -4.4, 95% CI -5.6, -3.3	36 RCTs; 38 comparisons (N= NR)	Moderate[b]	Moderate strength of evidence that sodium reduction decreases systolic BP in populations with HTN
SBP (normotensive adults)	MD -1.5, 95% CI -2.8, -0.3	9 RCTs; 14 comparisons (N= NR)	Moderate[c]	Moderate SoE that sodium reduction decreases systolic BP in adults with normal BP

* **Strength of evidence levels (AHRQ)**
High strength of evidence: We are very confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions.
Moderate strength of evidence: We are moderately confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains
Low certainty: We have limited confidence that the estimate of effect lies close to the true effect for this outcome. The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect
Insufficient: We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome. No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion

[a] -1 for inconsistency
[b] -1 for inconsistency and some indirectness
[c] -1 for inconsistency

Children and adolescents

Evidence underpinning international recommendations

Two RCTs were identified for inclusion in EFSA's review; one 12-week trial in school-age identical twin pairs in the United Kingdom at low risk of bias, and a cluster randomised study across 28 primary schools in China at moderate risk of bias (EFSA 2019). No significant association between urinary sodium and blood pressure was observed in either study.

Two publications from the DONALD prospective cohort study, an open cohort study ongoing in Germany since 1985 examining children throughout early childhood (3, 6, 9, 12, 18 and 24-months) and then annually into young adulthood were identified. One analysis in 435 children stratified by age group found no significant association between urinary sodium and SBP or DBP in pre-pubertal and pubertal children (Shi et al 2014). A second publication used multivariable linear regression to examine the association between urinary sodium (per 1 mmol/day increase) in adolescence (11 to 16 years) and SBP in young adulthood (18 to 25 years). A positive association was observed for SBP in boys (β (95% CI) = 0.10 (0.03, 0.18), p = 0.01) but not for SBP in girls (0.05 (0.11, 0.02), p = 0.1), nor for DBP for either sex (boys: 0.02 (0.08, 0.04), p = 0.6; girls: 0.02 (_0.03, 0.08), p = 0.4).

The EFSA Panel concluded that overall the available evidence does not support an effect of sodium reduction on blood pressure in school-age children.

These findings were echoed in the AHRQ (2018) review, which reported "low strength of evidence for a lack of beneficial effect of sodium reduction on systolic BP in children" (Newberry et al., 2018). Pooled estimates found reduced sodium intake resulted in a non-significant reduction in SBP (–0.73 mm Hg, 95% CI –1.83 to 0.36; I^2 =48%, 8 RCTs;) or DBP (–2.10 mm Hg, 95% CI –4.75 to 0.55; I^2 =79%, 7 RCTs). Sensitivity analyses omitting studies at high or unclear risk of bias found that blood pressure reductions with low sodium reached statistical significance for DBP but not for SBP. The review identified three prospective cohort studies at high risk of bias that examined the association between sodium intake and blood pressure, finding insufficient evidence to draw conclusions.

Supplementary evidence

One supplementary systematic review was identified that examined the association between sodium intake and blood pressure in children and adolescents. The review was assessed at high risk of bias; there was insufficient detail in the a priori data analysis plan to confirm adherence, and the exclusion of conference abstracts, and studies in languages other than English, French, German or Spanish (Leyvraz et al., 2018). Both experimental and observational studies were included, with a minimum duration of 8 days for experimental designs. A broad range of sodium measurement methods were eligible for inclusion including dietary methods (24-hour recall, semi-quantitative food frequency questionnaire) or urinary sodium (including spot or 24-hour samples).

Eighty-five studies conducted in 58,531 participants were included, comprising:

- 14 experimental studies in 3,094 participants (7 parallel RCTs, 3 cross-over RCTs, 2 non-randomised controlled trials and 2 non-controlled trials)
- 71 observational studies in 55,437 participants (60 cross-sectional, 6 cohort and 5 case-control).

Included studies were quality assessed across four criteria: sodium measurement, blood pressure measurement, external validity and reporting, and risk of bias assessment was also undertaken. Only five of the included studies met the quality criteria across all four measures (comprising 1 RCT, 1 prospective cohort study, 3 cross-sectional studies).

The review reported multiple pooled and subgroup analyses of experimental and observational studies. However, most analyses were not eligible for data extraction because they included study designs or measurement methods that did not meet the pre-specified inclusion criteria for this evidence evaluation (see **Appendix B – Methods for supplementary evidence searches**); most pooled analyses and the dose response modelling included studies with ineligible sodium intake measurement methods, and/or uncontrolled experimental studies.

Although a separate meta-analysis of observational studies with high-quality sodium intake and blood pressure measurement met the review's inclusion criteria, the findings were not extracted owing to significant concerns about risk of bias. The analysis combined evidence from cohort, cross-sectional and case-control studies despite the differing methodological strengths and limitations of these designs, resulting in substantial heterogeneity (I^2 = 99%). In addition, the authors departed from their pre-specified analytical approach by applying post hoc study selection criteria and implementing modelling decisions that were not described in the protocol. These deviations were not acknowledged or justified and may have materially influenced the results. Given these concerns regarding methodological rigour and potential bias, no data were extracted from this review.

Summary of findings

Systematic reviews on the relationship between sodium and blood pressure in children and adolescents report inconsistent findings depending on the review inclusion criteria and analytical approach adopted. Both the Leyvraz (2018) and AHRQ (2018) reviews included RCTs and controlled observational studies; however the Leyvraz review included a broader range of study designs including cross-sectional studies and single-arm or shorter duration experimental studies. The Leyvraz (2018) review's inclusion of studies that did not meet our a priori review criteria – and concerns about methodological rigour and risk of bias – limited the utility of this review for informing our evidence evaluation. In contrast, the AHRQ review restricted inclusion to interventions of at least 4 weeks duration, in line with the a priori criteria for this evidence evaluation (see **Appendix B – Methods for supplementary evidence searches**).

Overall, there is no consistent evidence that lower sodium intake reduces blood pressure in children; further high-quality, controlled studies are required to clarify this relationship.

Summary of Findings: Effect of sodium reduction on systolic blood pressure in children (Newberry et al., 2018)				
Population: Free-living children, including studies in outpatient settings; samples exclusively comprised of participants with select clinical conditions were excluded.				
Study designs: Randomised controlled trials evaluating reduced sodium intake (via oral consumption of food or supplements of quantified amounts of sodium). The minimum intervention duration was 4 weeks. For cross-over RCTs, a minimum washout period of 2 weeks was applied.				
Intervention: Lower sodium diet				
Comparison: Higher sodium diet				
Outcomes	**SBP (mm Hg)**	**Number of studies (No. participants)**	**Strength of evidence (AHRQ approach)**	**Evidence statement**
SBP (all children and adolescents)	MD -0.7, 95% CI -1.8, 0.4	8 RCTs; 11 comparisons (N= NR)	Low[a]	Low strength of evidence for a lack of beneficial effect of sodium reduction on systolic BP in children[3]

* **Strength of evidence levels (AHRQ)**
High strength of evidence: We are very confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions.
Moderate strength of evidence: We are moderately confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains
Low certainty: We have limited confidence that the estimate of effect lies close to the true effect for this outcome. The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect
Insufficient: We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome. No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion

[a] -2 for inconsistency

Other cardiovascular outcomes

Adults

Evidence underpinning international recommendations

The EFSA (2019) review examined other cardiovascular outcomes including hypertension and cardiovascular disease (all, stroke, or coronary heart disease). Four studies (2 RCTs at low risk of bias and 2 prospective observational studies at low and moderate risk of bias) were identified that examined the relationship between urinary sodium and hypertension risk. EFSA (2019) concluded that these studies provided supportive evidence for the positive relationship between urinary sodium and blood pressure.

Overall, EFSA (2019) identified three cohorts respectively that examined the relationship between urinary sodium and risk of cardiovascular disease (EPOGH/FELEMENGHO, InCHIANTI and TOPHI/II cohorts) and risk of stroke or coronary heart disease (PREVEND, EPOGH/FLEMENGHO and Finnish cohorts). The Panel considered that limited conclusions

[3] Summary of Findings tables are presented as per the AHRQ (2018) review. However, consistent with GRADE recommended wording, the evidence may be more accurately summarised as "low certainty evidence that lower sodium intake may have little to no effect on systolic blood pressure in children."

could be drawn from the available evidence, with interpretation constrained by the small number of studies and mechanistic uncertainties about the relationship between sodium intake and cardiovascular disease risk. However, the Panel considered the studies provide some evidence for:

- a positive association between urinary sodium and coronary heart disease risk, supported by the positive relationship between urinary sodium and elevated blood pressure; an independent risk factor for coronary heart disease
- an inverse association between urinary sodium and stroke risk (although the mechanism of effect is unclear particularly in the context of the relationship between urinary sodium and elevated blood pressure, an established risk factor for stroke)
- a positive association between urinary sodium and cardiovascular disease risk, noting that compositive CVD outcomes include a range of conditions that may not be consistently affected by sodium intake.

The AHRQ (2018) evidence evaluation considered a broad range of cardiovascular outcomes. Overall, the review found low certainty evidence from RCTs that reductions in sodium may decrease combined CVD morbidity and mortality risk (RR 0.81, 95% CI 0.67 to 0.98; 8 RCTs) and risk of any CVD outcome based on author-defined composite measures (RR 0.80, 95% CI 0.67 to 0.96, I^2=0%; 7 RCTs in 4,328 participants) but may not affect blood lipids (3 RCTs) or stroke risk (3 RCTs). There was insufficient evidence from RCTs about the effect of sodium reduction on all-cause mortality (7 RCTs) or CVD mortality (2 RCTs), or risk of hypertension (3 RCTs) or myocardial infarction (1 RCT).

Prospective studies provided low certainty evidence of an association between increasing sodium intake and hypertension risk (5 studies). Low certainty evidence for a relationship between sodium exposure and all-cause mortality was also identified, although there was insufficient evidence to characterise the shape of the relationship. There was insufficient evidence from observational studies to support conclusions about the relationship between sodium exposure and other cardiovascular disease outcomes including CVD or CHD risk, and stroke morbidity or mortality.

Supplementary evidence

Four supplementary systematic reviews were identified that examined the relationship between sodium intake and other cardiovascular outcomes including hypertension (Filippini et al., 2022), cardiovascular disease risk (Zhao et al., 2022), cardiovascular mortality (Milajerdi et al., 2019), or vascular function (Surma et al., 2025). One review was assessed as having serious methodological limitations and was not considered further (Surma et al., 2025) – see **Appendix C – Characteristics of supplementary systematic reviews** for further details.

One systematic review examined the dose response relationship between sodium intake and risk of hypertension from cohort studies (Filippini et al., 2022). The review was assessed as being at high risk of bias due to incomplete search strategies and a lack of clarity about whether data extraction was performed in duplicate. Although 11 studies were included, only 6 studies (N=10,882 participants) measured sodium intake using 24-hour urinary measures. Subgroup analysis of these 6 studies found a linear relationship between urinary sodium and hypertension risk, with a risk ratio of 1.04 (95% CI 0.93, 1.16) and 1.11 (95% CI 0.98, 1.26) at intakes of 4 g/day and 6g/day, compared with 2 g/day (See Figure 2).

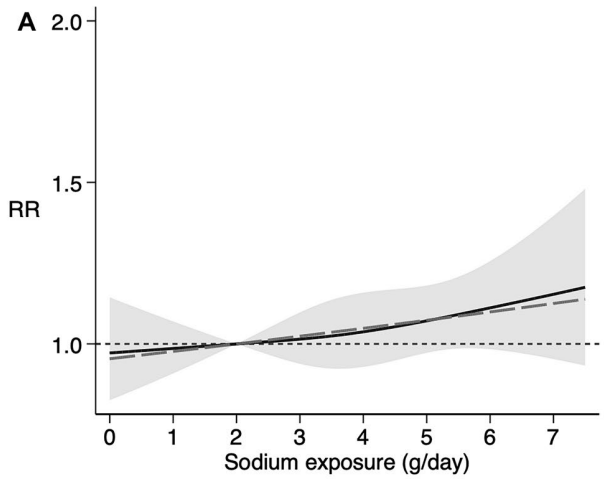

Figure 2 - Figure from Filippini et al (2022) showing dose-response modelling using 2 g/day as reference value. from analysis of dose-response across 6 studies measuring 24-hour urinary sodium and hypertension risk

Zhao et al. (2022) conducted a systematic review to explore the association between 24-hour urinary sodium excretion and cardiovascular disease risk. It was assessed as being at high risk of bias due to exclusion of non-English studies, inadequacies in the reported search strategies, and a lack of clarity about the number of reviewers involved in risk of bias assessment. Although studies 'assessing the relationship of 24-hour urinary excretion with CVD risk' was a stated inclusion criterion, only 4 of the 9 included studies collected 24-hour urine samples with the remaining measuring spot- or overnight urine samples. Furthermore, the authors report their results as a risk ratio although studies that measured hazard ratios were included. The included studies varied in median duration from 4.7 To 19.1 years and in the CVD end points measured (with measures ranging from 'heart failure' to composite measures combining CV mortality, myocardial infarction, stroke, and hospitalisation for congestive heart failure). Consequently, HRs may not be equivalent to RR across studies, and this decision may have introduced inconsistency.

Dose response analysis limited to studies that measured 24-hour urinary excretion found a linear association between sodium excretion and CVD risk, with every 1,000 mg/day sodium increase associated with a 4% increase in CVD risk (RR 1.04, 95% CI 1.01 to 1.07, p=0.02). However, due to the review's methodological limitations, the heterogeneity across studies, and the small number of studies included in the analysis, these findings should be interpreted with caution.

One systematic review at high risk of bias examined the dose-response relationship between dietary sodium exposure and all-cause and cardiovascular mortality from prospective observational studies (Milajerdi et al., 2019). Concerns around risk of bias included the exclusion of non-English language studies, insufficient information about the search strategy employed or processes for minimising error in data extraction and risk of bias assessment, and residual unexplained heterogeneity across most outcomes.

Milajerdi et al. (2019) identified eight studies that measured 24-hour urinary sodium, with median intakes ranging from 2,047 to 5,659 and follow-up duration ranging from 4.6 to 20 years. Dose-response analysis revealed a significant, non-linear association between urinary sodium excretion and CVD mortality, with a greater association with higher intakes. Although the authors noted this risk increased with intakes above 2,400 mg/day ($p<0.001$), data below this

threshold were limited (1 of 8 studies) and median intakes for most other studies (5 of 8 studies) clustered around 4,000 – 5,000 mg/day. Consequently, the model estimates may be imprecise for intakes below 4,000 mg/day and the proposed threshold of 2,400 mg/day may imply a level of precision that is not supported by the available data. No significant non-linear association was observed for all-cause mortality.

Children

Evidence underpinning international recommendations

The EFSA and AHRQ reviews did not consider other cardiovascular outcomes in children and adolescents aside from blood pressure.

Supplementary evidence

One supplementary systematic review explored the association between dietary intakes of various nutrients and arterial stiffness in children and adolescents (Leed et al., 2023). Although the review was assessed as being at high risk of bias, the only concerns identified related to the exclusion of non-English language studies and conference abstracts with the review otherwise well-conducted. The authors sought interventional, cohort and cross-sectional studies, and identified a single cross-sectional study that evaluated the relationship between sodium intake and arterial stiffness. The study was conducted in a mixed sample of 614 children and adults aged 10 to 24 years residing in the USA; the method for measuring sodium exposure was not reported. Higher sodium was associated with poorer outcomes, including a positive association with carotid-femoral pulse-wave velocity and augmentation index, and a significant inverse association with brachial artery distensibility.

Kidney disease

Adults

Evidence underpinning international recommendations

Evidence from both RCTs and observational studies was insufficient to draw conclusions about the effects of sodium intake on renal outcomes. Both the EFSA (2019) and AHRQ (2018) reviews identified a single observational study (the PREVEND study, at moderate risk of bias) that followed 5,315 Dutch adults without chronic kidney disease for a median of 10.3 years to evaluate the relationship between sodium intake and kidney function (estimated glomerular filtration rate) (Kieneker et al., 2016). No association between 24-hour urinary sodium excretion and chronic kidney disease risk was observed (adjusted HR per 50 mmol/d increase = 0.97, 95% CI 0.89 to 1.07).

Supplementary evidence

No eligible supplementary systematic reviews were identified that examined the relationship between sodium intake and chronic kidney disease. Although one potentially relevant systematic review was identified (Hodson & Cooper, 2023), the review focused on people with diabetes rather than the generally healthy population, and consequently did not meet inclusion criteria.

Derivation of draft NRVs

Extrapolation and scaling

There is insufficient evidence in children and adolescents to support NRV derivation and consequently values must be extrapolated from adult values. For sodium, values are extrapolated based on relative energy requirements. This is consistent with the approaches used to derive previous sodium NRVs for children and adolescents in Australia and New Zealand (NHMRC, 2006b) and other international approaches (EFSA, 2019; NASEM, 2019), along with the NHMRC Methodological Framework for deriving NRVs (NHMRC, 2026).

Rationale for scaling approach

Energy requirements reflect needs for basal metabolism, physical activity, thermoregulation and growth, and integrate both maintenance and growth processes which drive overall nutrient turnover. Higher energy requirements must be met by higher food intakes, and habitual diet patterns and food quantity are key drivers of sodium intake. Therefore, sodium intake tends to scale with energy requirements/food intake.

In comparison, body weight scaling is not appropriate for sodium because metabolic processes (including renal function and extracellular fluid regulation) do not scale linearly with body weight. Children have higher energy expenditure relative to body weight, and different body composition and extracellular fluid distribution. Weight-based scaling is likely to over- or under-estimate needs, particularly in early childhood (high metabolic rate per kg) or adolescence (rapid growth, changing composition).

Surface area/allometric scaling is also not appropriate in this context. This method of scaling assumes that requirements for nutrients involved in metabolism (e.g. energy, protein turnover, micronutrients linked to enzymatic processes) scale relative to metabolic body size or surface area, rather than body weight alone. However, for sodium requirement is driven by losses (via urinary, sweat and faecal routes), not metabolic turnover. These losses depend on:

- intake (via homeostatic excretion)
- diet composition
- environment (e.g. temperature, sweating)
- kidney function

They do not follow a consistent allometric relationship with body weight or surface area. Furthermore, homeostatic regulation of sodium means that rather than being a fixed requirement aligned with ‘metabolic demand’, sodium requirements exist within a range of intakes that are compatible with physiological regulation.

In summary, energy-based scaling was applied because energy requirements integrate the major determinants of nutrient utilisation—maintenance metabolism, physical activity, and growth—while also acting as a proxy for food intake and, therefore, electrolyte exposure.

Adequate Intake

Adults

The AHRQ (2018) review sought evidence from low sodium dose trials that reported no adverse effects for the purposes of establishing Adequate Intake recommendations. Four of the identified RCTs were conducted in Australia or New Zealand and reported sodium intakes ranging from 851 to 1,578 mg/day (Beard et al., 1982; Parker et al., 1990; Sciarrone et al., 1992; Todd et al., 2012). The risk of bias -as reported by Newberry et al. (2018) - varied across studies with 2 studies low (Parker et al., 1990; Sciarrone et al., 1992), 1 moderate (Todd et al., 2012) and 1 high (Beard et al., 1982) risk of bias. Two studies - one conducted in Australia and one in New Zealand - reported no adverse outcomes with mean intakes of around 1,230 mg/day (Sciarrone et al., 1992; Todd et al., 2012).

Furthermore, although balance studies are not sufficiently reliable for establishing recommendations, they provide a useful benchmark of requirements. The one balance study identified that adequately measured losses and intake found positive balance with intakes of 1,300 mg/day among 11 – 14 year old adolescents (Palacios et al., 2004). Although this evidence is not directly generalisable to adults, energy requirements in this group are similar to adult energy requirements and it may therefore provide a useful benchmark. Other balance data suggests that intakes of 1,525 mg/day result in positive balance except under sustained, extreme environmental conditions (Allsopp et al., 1998).

Finally, data collected in 2016/17 and 2020 from a sample of 549 Victorian adults aged 18–65 years reported 24-hour urinary sodium excretion (Bolton et al., 2020). Percentile estimates derived from the original study dataset indicated a 1st percentile urinary sodium excretion of 807mg/d, and 5th and 10th percentile values of 1,209 mg/day and 1,489 mg/day, respectively (Grimes, 2026).

Collectively, these data from balance studies and primary data collected in the Australian or New Zealand context support establishment of an AI in the range 851 to 1,500 mg/day (Allsopp et al., 1998; Beard et al., 1982; Bolton et al., 2020; Palacios et al., 2004; Parker et al., 1990; Sciarrone et al., 1992; Todd et al., 2012). However, there is considerable uncertainty around these estimates. The AI was set at 920 mg/day to align with the current upper bound of the adult AI range, given that:

- the available evidence is very uncertain and there is no evidence to suggest that intakes of 920 mg/day are insufficient to meet adult physiological requirements, and
- one trial in the Australian context found no adverse effects with mean sodium intake of 851mg/day (Beard et al., 1982)
- alignment with existing recommendations supports consistent public health messaging regarding the harms of excessive sodium intake. This avoids confusion that may arise if the AI were increased, which may be misinterpreted as a need for higher intake levels in a context where population intakes already exceed requirements and – for many individuals – chronic disease risk reduction targets
- contemporary Australian 24-hour urinary sodium excretion data indicate that a sodium intake of 920 mg/d falls within the lower tail of the observed distribution (between the 1st and 5th percentiles), supporting that intakes at this level are observed in apparently healthy, free-living adults.

Pregnancy

Although there is a small additional requirement of sodium associated with foetal and maternal tissue accretion over the course of pregnancy, this is minimal and readily accommodated by normal homeostatic mechanisms, including increased renal sodium conservation. Consistent with approaches taken by NASEM (2019) and EFSA (2019), no distinct dietary sodium requirement for pregnancy is specified, and recommendations during pregnancy are aligned with those for non-pregnant adults. This reflects the absence of evidence demonstrating increased dietary needs in pregnancy and the capacity for physiological regulation to maintain sodium balance across a wide range of intakes.

Lactation

Sodium is excreted in breast milk during lactation; however, the concentration of sodium in milk is regulated by physiological mechanisms within the mammary gland, largely determined by electrochemical gradients rather than maternal dietary intake. As a result, maternal sodium intake has limited influence on the sodium content of breast milk. On this basis, both NASEM (2019) and ESFA (2019) concluded that there is no evidence to suggest that sodium requirements during lactation differ from those of non-pregnant, non-lactating adults. Accordingly, no separate requirement is specified, and sodium recommendations for lactating females are aligned with those for the general adult population.

Children and adolescents

The evidence for sodium requirements in children and adolescents is very limited, and consequently values must be extrapolated from adult values based on relative energy requirements, using the formula:

$AI_{child} = AI_{adult} \times (EER_{child} / EER_{adult})$, with the following inputs:

$AI_{adult} = 920$, with EER values per Table 13.

Table 11 - Reference EER values for adults and children to inform extrapolation

	EER
Adult	10.3
Children and adolescents	
1 to under 4 years	4.4
4 to under 9 years	6.4
9 to under 14 years	9.0
14 to under 18 years	11.1
Alternative age groupings	
12 to under 24 months	3.9
2 to under 5 years	5.2
5 to under 12 years	7.2
12 to under 18 years	10.0

Values were rounded with a view to ensuring adequacy among younger children and smoothing transitions between age groupings. For the standard age groupings, values for younger children (aged under 9 for standard age groupings; aged under 5 for alternative age groupings) were rounded up to the nearest 50 mg. For the standard age groupings, values for older aged children were rounded down to the nearest 50 mg (9 to under 14 year olds) or to align with adult recommendations (14 to under 18 year olds). For the alternative age groupings, values for children aged 5 to under 12 years were rounded up to the nearest 100 mg to smooth transitions

and ensure that requirements for older children within the age bracket were met. Values for older children (12 to under 18 years) were rounded up to align with adult values, to ensure requirements for older children within the age bracket were met.

Calculations and resulting values (both un-rounded and rounded) are provided in Table 14 below.

Table 12 - Scaling calculations and rounding adjustment for child AI values

Age group	Calculated AI_{child}	Rounding	Final AI_{child}
Standard age groups:			
1 to under 4 years	390	**10**	400
4 to under 9 years	569	**31**	600
9 to under 14 years	801	**-1**	800
14 to under 18 years	991	**-71**	920
Alternative age groups:			
12 to under 24 months	345	**5**	350
2 to under 5 years	460	**40**	500
5 to under 12 years	639	**61**	700
12 to under 18 years	895	**25**	920

Chronic Disease Risk Reduction

Adults

This 2,000 mg/day threshold was established in 2017 based on a meta-analysis suggesting that if population sodium intakes were reduced from the then average of 3,600 mg/day to 2,000 mg/day, reductions in average population blood pressure could be achieved. (Department of Health, 2017). The present evidence review suggests that the evidence for the relationship between sodium intake and chronic disease risk remains largely unchanged since the 2017 review. Retaining the current recommendation of 2,000mg/day maintains consistent public health messaging about the need to reduce sodium intakes to reduce chronic disease risk, aligns with values from comparable international jurisdictions, and is feasible to achieve from Australian and New Zealand diets. This also aligns with WHO recommendations that adult intakes should not exceed 2,000 mg/day to reduce chronic disease risk (World Health Organization, 2012).

Critically, this recommendation reflects a pragmatic population target selected in the context of a continuous intake–risk relationship, in which reduced sodium intakes are consistently associated with lower blood pressure.

Pregnancy

Chronic hypertension increases the risk of hypertensive disorders during pregnancy, and consequently the risk of adverse pregnancy and birth outcomes. Australian clinical guidance recommends that individuals planning pregnancy optimise blood pressure prior to conception through management of modifiable risk factors including weight, diet, physical activity and smoking. Although some guidance notes the importance of maintaining a lower dietary sodium intake as part of cardiovascular risk reduction, this advice is not specific to pregnancy and reflects standard management recommendations for individuals with chronic hypertension rather than pregnancy-specific dietary requirements. There is no current recommendation for pregnant individuals with high blood pressure to restrict sodium intake during pregnancy for the prevention or management of hypertensive disorders, and available

evidence on the effect of sodium reduction on these outcomes in pregnancy is limited and uncertain.(Lowe et al., 2014)

There is no evidence to suggest that pregnant adults differ in sensitivity to sodium exposure compared with non-pregnant adults. Consistent with the NASEM (2019) and EFSA (2019) recommendations, the CDRR (formerly the SDT) for pregnant adults is aligned with those for the general adult population.

Lactation

There is no evidence that sensitivity to sodium exposure differs during lactation compared with non-lactating adults. Consistent with the NASEM (2019) and EFSA (2019) recommendations, the CDRR (formerly the SDT) for lactating adults is aligned with those for the general adult population.

Children and adolescents

There is insufficient evidence among children and adolescents to support NRV derivation. The decision to set a CDRR for children was based on the linear relationship of sodium intake and blood pressure in adults, the early development of food and taste preferences that are maintained from children to adults and the high levels of hypertension in Australian and New Zealand adults.

Values for children and adolescents are extrapolated from adult values based on relative energy requirements, using the formula:

$CDRR_{child} = CDRR_{adult} \times (EER_{child} / EER_{adult})$, with the following inputs:

$CDRR_{adult} = 2{,}000$

EER values for children and adolescents per Table 13 on page 54.

Values were rounded up - except in the 14 to 18 years group - to allow sufficient buffer between the AI and CDRR, and to smooth transitions between age groupings. Values for 14 to 18 year olds were rounded down to align with the adult CDRR.

Table 13 - Scaling calculations and rounding adjustment for child CDRR values

Age group	Calculated $CDRR_{child}$	Rounding	Final $CDRR_{child}$
Standard age groups:			
1 to under 4 years	848	102	950
4 to under 9 years	1237	13	1,250
9 to under 14 years	1741	9	1,750
14 to under 18 years	2154	-154	2,000
Alternative age groups:			
12 to under 24 months	750	100	850
2 to under 5 years	1000	100	1100
5 to under 12 years	1388	112	1500
12 to under 18 years	1945	5	1950

Upper Levels

Children and adolescents

There is insufficient evidence upon which to base a UL in children and adolescents, and a UL in adults has not been set (the former adult UL was revoked in favour of an SDT in 2017). The current ULs for children and adolescents will be revoked in favour of establishing a CDRR value (formerly the SDT) in this population. This also better reflects the nature of health risk associated with high sodium intake in childhood and adolescence, which is one of increased risk of chronic disease (CDRR) rather than one of acute toxic effects (UL).

Benchmarking

International comparisons

Adequate Intake

Proposed AI values are compared with international values in Table 17. Across almost all populations, the proposed AI values for Australia and New Zealand are lower than the AIs set by comparable international jurisdictions (except for AIs in younger children relative to the D-A-CH recommendations). This primarily reflects the selection of a lower adult AI for Australia and New Zealand, from which child values have been extrapolated.

However, there is substantial uncertainty in the evidence underpinning sodium requirements, and in most jurisdictions the AI represents a pragmatic estimate rather than a value based on robust evidence. As such, the lack of alignment with international values is not considered problematic.

Table 14 - Comparison of proposed AI values alongside recommendations from comparable international jurisdictions

<table>
<tr><th>Age (years)</th><th>Aust/NZ – Proposed AI (mg/day)</th><th>Aust/NZ - Current (NHMRC 2006) AI (mg/day)</th><th>European Union (EFSA 2019) ‘Safe and Adequate’ (mg/day)*</th><th>United States (NASEM 2018) AI (mg/day)</th><th>Nordic and Baltic (NNR 2023) AI (mg/day)</th><th>Germany, Austria, Switzerland (DACH 2013) AI (mg/day)</th></tr>
<tr><td colspan="7">Adults</td></tr>
<tr><td>18 +years</td><td>920</td><td>460-920</td><td>2,000*</td><td>1,500</td><td>1,500</td><td>1,500^</td></tr>
<tr><td colspan="7">Children and adolescents</td></tr>
<tr><td>1 yr</td><td rowspan="3">400</td><td rowspan="3">200-400</td><td rowspan="3">1,100</td><td rowspan="3">800</td><td rowspan="17">Not set or not reported</td><td rowspan="3">400</td></tr>
<tr><td>2 yr</td></tr>
<tr><td>3 yr</td></tr>
<tr><td>4 yr</td><td rowspan="5">600</td><td rowspan="5">300-600</td><td rowspan="3">1,300</td><td rowspan="5">1,000</td><td rowspan="3">500</td></tr>
<tr><td>5 yr</td></tr>
<tr><td>6 yr</td></tr>
<tr><td>7 yr</td><td rowspan="3">1,700</td><td rowspan="3">750</td></tr>
<tr><td>8 yr</td></tr>
<tr><td>9 yr</td><td rowspan="5">800</td><td rowspan="5">400-800</td><td rowspan="5">1,200</td></tr>
<tr><td>10 yr</td><td rowspan="3">1,100</td></tr>
<tr><td>11 yr</td><td rowspan="6">2,000</td></tr>
<tr><td>12 yr</td></tr>
<tr><td>13 yr</td><td rowspan="2">1,400</td></tr>
<tr><td>14 yr</td><td rowspan="4">920</td><td rowspan="4">460-920</td><td rowspan="4">1,500</td></tr>
<tr><td>15 yr</td><td rowspan="3">1,500</td></tr>
<tr><td>16 yr</td></tr>
<tr><td>17 yr</td></tr>
</table>

*EFSA derived a ‘safe and adequate’ value that is not directly comparable to an AI value

Chronic disease risk reduction

The proposed CDRR values for Australia and New Zealand are well-aligned with international values from comparable jurisdictions, as shown in Table 18.

Table 15 - Comparison of proposed CDRR values alongside recommendations from comparable international jurisdictions

<table>
<tr><th>Age (years)</th><th>Aust/NZ – Proposed CDRR (mg/day)</th><th>European Union (EFSA 2019) CDRR (mg/day)*</th><th>United States (NASEM 2018) CDRR (mg/day)</th><th>Nordic and Baltic (NNR 2023) CDRR (mg/day)</th><th>Germany, Austria, Switzerland (DACH 2013) CDRR (mg/day)</th><th>WHO Guidelines (WHO 2012) CDRR (mg/day)</th></tr>
<tr><td colspan="7">Adults</td></tr>
<tr><td>18+ yr</td><td>2,000</td><td>2,000</td><td>2,300</td><td>2,300</td><td>2,400</td><td>2,000</td></tr>
<tr><td colspan="7">Children and adolescents</td></tr>
<tr><td>1 yr</td><td rowspan="3">950</td><td rowspan="3">1,100*</td><td rowspan="3">1,200</td><td rowspan="3">1,100</td><td rowspan="17">Not specified</td><td>Not specified</td></tr>
<tr><td>2 yr</td><td rowspan="11">No specific value provided

For children aged 2–15 years, WHO recommends adjusting the adult dose (2,000 mg/day) downward based on energy requirements.</td></tr>
<tr><td>3 yr</td></tr>
<tr><td>4 yr</td><td rowspan="5">1,250</td><td rowspan="3">1,300*</td><td rowspan="5">1,500</td><td rowspan="3">1,400</td></tr>
<tr><td>5 yr</td></tr>
<tr><td>6 yr</td></tr>
<tr><td>7 yr</td><td rowspan="3">1,700*</td><td rowspan="3">1,700</td></tr>
<tr><td>8 yr</td></tr>
<tr><td>9 yr</td><td rowspan="5">1,750</td><td rowspan="4">1,800</td></tr>
<tr><td>10 yr</td></tr>
<tr><td>11 yr</td><td rowspan="4">2,000*</td><td rowspan="3">2,300</td></tr>
<tr><td>12 yr</td></tr>
<tr><td>13 yr</td></tr>
<tr><td>14 yr</td><td rowspan="4">2,000</td><td rowspan="4">2,300</td></tr>
<tr><td>15 yr</td><td rowspan="3">2,300</td></tr>
<tr><td>16 yr</td><td rowspan="2">2,000</td></tr>
<tr><td>17 yr</td></tr>
</table>

*EFSA derived a ‘safe and adequate’ value that – whilst not strictly a CDRR recommendation, is comparable to a CDRR

Food and diet modelling

Food modelling data (NHMRC, 2011) developed to inform the 2013 revision to the Australian Guide to Healthy Eating were extracted for comparison with NRV recommendations. This modelling drew on several complementary approaches, including analysis of core food groups, assessment of dietary patterns consistent with the 1998 Australian Dietary Guidelines (current at that time), and quantitative modelling of Foundation and Total Diets. Together, these approaches were used to identify food group combinations capable of meeting nutrient requirements across age and sex groups while accommodating varying energy needs and dietary patterns. Extracted data are presented in Table 19 (adults), Table 20 (during pregnancy), Table 21 (during lactation) and Table 22 (children and adolescents).

Several factors and limitations should be considered when interpreting these modelling data. Firstly, modelling did not take account for discretionary use of salt. Foundation diet models also did not include any discretionary food[4] choices, which present significant sources of dietary sodium with around 35 to 45% of sodium coming from discretionary foods (Bolton et al., 2020; Grimes, Riddell, et al., 2017; O'Halloran et al., 2016). Limited discretionary foods (in relation to overall energy targets) were included within the Total Diets modelled. Patterns of eating have also likely changed substantially since these models were created.

Modelling was also undertaken prior to implementation of the Healthy Food Partnerships (HFP) program, and estimates do not account for any associated reduction in the sodium content of food, with an evaluation estimating a 4.3% reduction in the sodium content of participating products (ABS, 2025). Furthermore, these estimates may not capture the broader food environment, including availability of lower sodium products.

In the tables that follow, estimated dietary sodium intakes below the current or proposed adequate intake for a given population are highlighted purple and those above the current SDT or proposed CDRR are highlighted orange. Modelled intakes from 7-day Total Diet were higher than the age-relevant SDT or UL for many age groups – in particular for those with high energy requirement levels. Where modelled intakes exceed recommendations, it is typically by a considerable margin, and the estimated impact of the HFP on sodium food content (4.3%) and individual intakes (14.8 mg/day) (ABS, 2025) is likely to be insufficient to bring intakes within the recommended levels. Current SDT (adults) and UL (children and adolescents) recommendations may therefore be unachievable for some population groups without ongoing efforts to reduce sodium within the food supply, or via alternative interventions such as low-sodium salt substitution.

[4] Discretionary foods are defined as "foods and drinks not necessary to provide the nutrients the body needs, but that may add variety." National Health and Medical Research Council, N. (2013). *Australian Dietary Guidelines - Educator Guide*. Canberra Retrieved from https://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/n55b_eat_for_health_educators_guide.pdf

Adults

The 2011 modelling data suggests that the current adult AI (460-920 mg/day) is achievable within the range of diets modelled, and it is likely that an increased AI of 1,500 would also be achievable when comparing intakes from total diet, and also factoring in discretionary salt use. However, total diet modelling suggests that intakes may exceed the current SDT (2,000 mg/day) for many of the total diets modelled, except for in females with mid-level energy requirements.

Table 16 - Food Modelling Data – Adults (Source: (NHMRC, 2011)

Age group (years)	Core food groups (mg/day)	Intake from AGTHE98^ *(Core foods using whole dietary approach)* (mg/day)		Foundation diets								7 day Total Diets			
				Overall (mg/day)		Intake from rice-based diets (mg/day)		Intake from pasta-based diets (mg/day)		Intake from lacto-ovo-vego diets (mg/day)		Mid energy level (average height, light-moderate activity) (mg/day)		High energy level (tallest, highest activity) (mg/day)	
	All	F	M	F	M	F	M	F	M	F	M	F	M	F	M
19-30 yr	700	1,223 to 2182	1,606 to 2,756	1405	1411	926	998	1159	1338	1411	1296	1711 to 1986	1865 to 2213	2239 to 2550	2270 to 2799
31-50 yr				1395	1452	919	1044	1140	1381	1452	1318	1580 to 1836	1854 to 2180	1928 to 2150	2258 to 2656
51-70 yr		1,223 to 1,798	1,222 to 2,181	1330	1502	1030	1053	1074	1298	1502	1342	1482 to 1817	1769 to 2066	1933 to 2421	2018 to 2576
70+ yr				1178	1265	1014	980	988	1208	1265	1176	1444 to 1602	1507 to 2025	1877 to 2142	1949 to 2365

F = Females; M= Males; ^AGTHE98 age groupings were 19-60y and 60y+

Pregnancy

Similar to adults, 7-day Total Diets for pregnant and lactating females exceeded the current SDT (2,000 mg/day) for all age groups and energy requirement levels, and individuals are unlikely to be able to meet the recommendations without additional interventions targeting the food supply or discretionary salt use (eg. low-sodium salt substitution).

Table 17 - Food modelling data – pregnant females (NHMRC, 2011)

Age group (years)	Core food groups (mg/day)	Intake from AGTHE98^ (mg/day)	Foundation diets – overall (mg/day)	7 day total diets - mid energy level	7 day total diets - high energy level
14-18 yr	813	1275 to 1674	2042	2316 to 2539	2525 to 2783
19-30 yr			1824	1997 to 2266	2314 to 2682
31-50 yr			1824		

^AGTHE98 age groupings were 19-60y and 60y+

Lactation

Table 18 - Food modelling data – lactating females (NHMRC, 2011)

Age group (years)	Core food groups (mg/day)	Intake from AGTHE98^ (mg/day)	Intake foundation diets – overall (mg/day)	7 day total diets - mid energy level	7 day total diets - high energy level
14-18 yr	1059	1545 to 1929	2041	2332 to 2540	2561 to 2810
19-30 yr			1783	2013 to 2173	2243 to 2644
31-50 yr			1762		

^AGTHE98 age groupings were 19-60y and 60y+

Children and adolescents

Modelling for 7-day Total Diets suggests that intakes of sodium less than the current UL are achievable – although only just - for most children with light to moderate activity, except for those aged 2 to 3 years. However, for children with the highest energy needs modelled intakes from 7-day Total Diets exceed the current UL for all children except those aged 9-11 (NHMRC, 2011). For diets with cereal intakes in the upper range, all children had estimated sodium intakes above the age-relevant UL.

Table 19 - Food modelling data – children and adolescents (NHMRC, 2011)

Age group (years)	Core food groups^ (mg/day)	Intake from AGTHE98^ (mg/day)	Foundation diets								7-day Total Diet			
			Overall (mg/day)		Intake from rice-based diets (mg/day)		Intake from pasta-based diets (mg/day)		Intake from lacto-ovo-vego diets (mg/day)		Mid energy level (average height, light-moderate activity) (mg/day)		High energy level (tallest, highest activity) (mg/day)	
	All	All	F	M	F	M	F	M	F	M	F	M	F	M
13-23 mo	NR	NR	701	716	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
2 - 3 yr	NR	NR	806	821	NR	NR	NR	NR	666	798	849 to 946	950 to 1077	1027 to 1178	1196 to 1329
4 - 8 yr	441^	1321 to 1705	952	1007	NR	NR	NR	NR	776	865	1090 to 1282	1131 to 1406	1408 to 1621	1529 to 1790
9 - 11 yr	556^	1571 to 2147	1189	1175	831	751	1048	989	1054	916	1231 to 1458	1330 to 1434	1502 to 1811	1613 to 1987
12 - 13 yr	688^	1504 to 2654	1379	1456	1017	970	1204	1094	1107	1124	1470 to 1749	1563 to 1878	1819 to 2127	1978 to 2184
14 - 18 yr			1723	1635	1151	1062	1414	1271	1579	1375	1770 to 2137	2005 to 2296	2241 to 2559	2499 to 2644

^ Core food group and AGHTE98 modelling age groups: 4-7y; 8-11y; 12-18y; NR=Not reported

Proposed recommendations

A side-by-side comparison of proposed values is presented at Table 20.

Consideration should be given to the relative proximity of the AI and CDRR values, as insufficient separation between lower and upper reference values may limit the practical range within which individual dietary variation can occur. It shows that the proposed values are sufficiently distanced to support a range of intakes between the AI and CDRR.

Table 20 - Side-by-side comparison of proposed NRVs for adequacy and chronic disease risk reduction

Population		AI	CDRR	UL
Adults (including pregnancy and lactation)				
	18+ years	920	2,000	Not set
Children and adolescents				
	1 to under 4 years	400	950	Not set
	4 to under 9 years	600	1,250	Not set
	9 to under 14 years	800	1,750	Not set
	14 to under 18 years	920	2,000	Not set
Children and adolescents (alternative age groupings)				
	12 to under 24 months	350	850	Not set
	2 to under 5 years	500	1,100	Not set
	5 to under 12 years	700	1,500	Not set
	12 to under 18 years	920	1,950	Not set

References

AIHW. (2022). *Australian Burden of Disease Study: impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2018*. https://www.aihw.gov.au/reports/burden-of-disease/illness-death-indigenous-2018

AIHW. (2024). *Australian Burden of Disease Study 2024*. https://www.aihw.gov.au/reports/burden-of-disease/australian-burden-of-disease-study-2024

AIHW. (2025). *Heart, stroke and vascular disease: Australian facts*. https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts

Allen, J. C., Keller, R. P., Archer, P., & Neville, M. C. (1991). Studies in human lactation: milk composition and daily secretion rates of macronutrients in the first year of lactation. *Am J Clin Nutr*, *54*(1), 69-80. https://doi.org/10.1093/ajcn/54.1.69

Allsopp, A. J., Sutherland, R., Wood, P., & Wootton, S. A. (1998). The effect of sodium balance on sweat sodium secretion and plasma aldosterone concentration. *Eur J Appl Physiol Occup Physiol*, *78*(6), 516-521. https://doi.org/10.1007/s004210050454

Australian Bureau of Statistics. (2022). *Hypertension and high measured blood pressure* (https://www.abs.gov.au/statistics/health/health-conditions-and-risks/hypertension-and-high-measured-blood-pressure/latest-release

Australian Bureau of Statistics. (2023a). *National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey: Food and Nutrients, 2023* (https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/national-aboriginal-and-torres-strait-islander-nutrition-and-physical-activity-survey/latest-release#about-the-survey

Australian Bureau of Statistics. (2023b). *National Nutrition and Physical Activity Survey: Food and nutrients* (https://www.abs.gov.au/statistics/health/food-and-nutrition/food-and-nutrients/2023

Australian Bureau of Statistics. (2023c). *National Nutrition and Physical Activity Survey: Usual nutrient intakes* (ABS. https://www.abs.gov.au/statistics/health/food-and-nutrition/usual-nutrient-intakes/2023

Australian Bureau of Statistics, A. (2025). *Healthy Food Partnership Reformulation Program: Wave 1, four-year progress*. ABS Retrieved from https://www.abs.gov.au/articles/healthy-food-partnership-reformulation-program-wave-1-four-year-progress

Australian Government. (2026). *Proposal on mandating the HSR system*. Retrieved 09/07/2026 from https://www.healthstarrating.gov.au/monitoring-and-reviews/proposal-mandating-hsr-system

Australian Institute of Health and Welfare. (2026a). *Heart, stroke and vascular disease: Australian facts*. Canberra, ACT: AIHW Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts

Australian Institute of Health and Welfare. (2026b). *Hypertension in Australia*. Canberra, ACT: AIHW Retrieved from https://www.aihw.gov.au/reports/risk-factors/hypertension/

Bablani, L., Ni Mhurchu, C., Neal, B., Skeels, C. L., Staub, K. E., & Blakely, T. (2020). The impact of voluntary front-of-pack nutrition labelling on packaged food reformulation: A difference-in-differences analysis of the Australasian Health Star Rating scheme. *PLoS Med*, *17*(11), e1003427. https://doi.org/10.1371/journal.pmed.1003427

Bauer, J., & Gerss, J. (2011). Longitudinal analysis of macronutrients and minerals in human milk produced by mothers of preterm infants. *Clin Nutr*, *30*(2), 215-220. https://doi.org/10.1016/j.clnu.2010.08.003

Beard, T. C., Cooke, H. M., Gray, W. R., & Barge, R. (1982). Randomised controlled trial of a no-added-sodium diet for mild hypertension. *Lancet*, *2*(8296), 455-458. https://doi.org/10.1016/s0140-6736(82)90491-3

Beard, T. C., Hornsby, H., Dwyer, T., Woodward, D. R., Ball, P. J., & von Witt, R. J. (1997). The Hobart Salt Study 1995: few meet national sodium intake target. *Medical Journal of Australia*, *166*(8), 404-407. https://doi.org/https://doi.org/10.5694/j.1326-5377.1997.tb123189.x

Bennett, G., Bardon, L. A., & Gibney, E. R. (2022). A Comparison of Dietary Patterns and Factors Influencing Food Choice among Ethnic Groups Living in One Locality: A Systematic Review. *Nutrients*, *14*(5), 941. https://www.mdpi.com/2072-6643/14/5/941

Bhana, N., Utter, J., & Eyles, H. (2018). Knowledge, Attitudes and Behaviours Related to Dietary Salt Intake in High-Income Countries: a Systematic Review. *Current nutrition reports*, *7*(4), 183-197. https://doi.org/10.1007/s13668-018-0239-9

Bhat, S., Marklund, M., Henry, M. E., Appel, L. J., Croft, K. D., Neal, B., & Wu, J. H. Y. (2020). A Systematic Review of the Sources of Dietary Salt Around the World. *Adv Nutr*, *11*(3), 677-686. https://doi.org/10.1093/advances/nmz134

Blomhoff, R., Andersen, R., Arnesen, E., Christensen, J., Eneroth, H., Erkkola, M., Gudanaviciene, I., Høyer-Lund, A., Lemming, E., Meltzer, H., Pitsi, T., Siksna, I., Thorsdottir, I., & Trolle, E. (2023). *Nordic Nutrition Recommendations 2023*. https://doi.org/10.6027/nord2023-003

Bolton, K. A., Webster, J., Dunford, E. K., Jan, S., Woodward, M., Bolam, B., Neal, B., Trieu, K., Reimers, J., Armstrong, S., Nowson, C., & Grimes, C. (2020). Sources of dietary sodium and implications for a statewide salt reduction initiative in Victoria, Australia. *Br J Nutr*, *123*(10), 1165-1175. https://doi.org/10.1017/s000711452000032x

Boorman, J., Cunningham, J., Mackerras, D. (2008). *Salt Intake from Processed Food and Discretionary Use in Australia*. ACT, Australia: FSANZ Retrieved from https://www.foodstandards.gov.au/sites/default/files/consumer/nutrition/salthowmuch/Documents/Salt_Intake_5.pdf

Butte, N. F., Garza, C., Johnson, C. A., Smith, E. O., & Nichols, B. L. (1984). Longitudinal changes in milk composition of mothers delivering preterm and term infants. *Early Hum Dev*, *9*(2), 153-162. https://doi.org/10.1016/0378-3782(84)90096-3

Campbell, N. R. C., He, F. J., Tan, M., Cappuccio, F. P., Neal, B., Woodward, M., Cogswell, M. E., McLean, R., Arcand, J., MacGregor, G., Whelton, P., Jula, A., L'Abbe, M. R., Cobb, L. K., & Lackland, D. T. (2019). The International Consortium for Quality Research on Dietary Sodium/Salt (TRUE) position statement on the use of 24-hour, spot, and short duration (<24 hours) timed urine collections to assess dietary sodium intake. *J Clin Hypertens (Greenwich)*, *21*(6), 700-709. https://doi.org/10.1111/jch.13551

Carley Grimes. (2026). Unpublished analysis of 2016-17 data supplied in correspondence. In N. P. Team (Ed.).

Chen, X., & Wang, Y. (2008). Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. *Circulation*, *117*(25), 3171-3180. https://doi.org/10.1161/circulationaha.107.730366

Cheng, J., Thorndike, A. N., & Yi, S. (2025). Racial and Ethnic Differences in Sodium Sources and Sodium Reduction Behaviors Among US Adults: NHANES 2017 to 2020 Prepandemic. *Journal of the American Heart Association*, *14*(11), e037997. https://doi.org/10.1161/JAHA.124.037997

Chong, M. F.-F. (2022). Dietary trajectories through the life course: opportunities and challenges. *British Journal of Nutrition*, *128*(1), 154-159. https://doi.org/10.1017/S0007114522001295

Consolazio, C. F., Matoush, L. O., Nelson, R. A., Harding, R. S., & Canham, J. E. (1963). Excretion of Sodium, Potassium, Magnesium and Iron in Human Sweat and the Relation of Each to

Balance and Requirements. *The Journal of nutrition*, *79*(4), 407-415. https://doi.org/https://doi.org/10.1093/jn/79.4.407

Coyle, D., Shahid, M., Dunford, E., Ni Mhurchu, C., McKee, S., Santos, M., Popkin, B., Trieu, K., Marklund, M., Neal, B., & Wu, J. (2021). Estimating the potential impact of Australia's reformulation programme on households' sodium purchases. *BMJ Nutrition, Prevention & Health*, *4*(1). https://doi.org/10.1136/bmjnph-2020-000173

Coyle, D. H., Huang, L., Hu, M., Ghammachi, N., Pettigrew, S., & Wu, J. H. Y. (2025). Assessing the impact of voluntary food reformulation targets: Mid-point assessment of Australia's voluntary sodium and saturated fat reduction policy. *European journal of clinical nutrition*, *79*(10), 1060-1065. https://doi.org/10.1038/s41430-025-01647-5

de Mestral, C., Mayén, A.-L., Petrovic, D., Marques-Vidal, P., Bochud, M., & Stringhini, S. (2017). Socioeconomic determinants of sodium intake in adult populations of high-income countries: a systematic review and meta-analysis. *American journal of public health*, *107*(4), e1-e12.

Department of Health. (2017). *Australian and New Zealand Nutrient Reference Values for Sodium: Supporting Document 2 - Statistical Analyses*. Retrieved from https://www.eatforhealth.gov.au/sites/default/files/2022-10/2017_Sodium_SD2_-_Statistical_Analyses.pdf

Dewey, K. G., Finley, D. A., & Lönnerdal, B. (1984). Breast milk volume and composition during late lactation (7-20 months). *J Pediatr Gastroenterol Nutr*, *3*(5), 713-720. https://doi.org/10.1097/00005176-198411000-00014

Dewey, K. G., & Lönnerdal, B. (1983). Milk and nutrient intake of breast-fed infants from 1 to 6 months: relation to growth and fatness. *J Pediatr Gastroenterol Nutr*, *2*(3), 497-506. https://doi.org/10.1097/00005176-198302030-00018

Earle, N. J., Poppe, K. K., Doughty, R. N., Rolleston, A., Kerr, A. J., & Legget, M. E. (2018). Clinical Characteristics and Burden of Risk Factors Among Patients With Early Onset Acute Coronary Syndromes: The ANZACS-QI New Zealand National Cohort (ANZACS-QI 17). *Heart Lung Circ*, *27*(5), 568-575. https://doi.org/10.1016/j.hlc.2017.04.010

Elijovich, F., Weinberger, M. H., Anderson, C. A., Appel, L. J., Bursztyn, M., Cook, N. R., Dart, R. A., Newton-Cheh, C. H., Sacks, F. M., & Laffer, C. L. (2016). Salt Sensitivity of Blood Pressure: A Scientific Statement From the American Heart Association. *Hypertension*, *68*(3), e7-e46. https://doi.org/10.1161/hyp.0000000000000047

Ereman, R. R., Lönnerdal, B., & Dewey, K. G. (1987). Maternal sodium intake does not affect postprandial sodium concentrations in human milk. *J Nutr*, *117*(6), 1154-1157. https://doi.org/10.1093/jn/117.6.1154

European Food Safety Authority. (2019). Dietary Reference Values for Sodium. *EFSA Journal*, *17*(9), :e05778. https://doi.org/https://doi.org/10.2903/j.efsa.2019.5778

Eyles, H., Grey, J., Jiang, Y., Umali, E., McLean, R., Te Morenga, L., Neal, B., Rodgers, A., Doughty, R. N., & Ni Mhurchu, C. (2023). Effectiveness of a Sodium-Reduction Smartphone App and Reduced-Sodium Salt to Lower Sodium Intake in Adults With Hypertension: Findings From the Salt Alternatives Randomized Controlled Trial [Original Paper]. *JMIR Mhealth Uhealth*, *11*, e43675. https://doi.org/10.2196/43675

Eyles, H., Rapson, J., Fuavao, K., Jiang, Y., Kira, G., Wall, C., Skeaff, S., Grimes, C., & McLean, R. M. (2025). Sodium, potassium and iodine excretion and blood pressure of New Zealand school children: a cross-sectional study and comparison with recommended guidelines. *BMJ Nutr Prev Health*, *8*(2), e001255. https://doi.org/10.1136/bmjnph-2025-001255

Eyles, H. C., & Cleghorn, C. L. (2022). Dietary sources of sodium across the diverse New Zealand adult population. *Prev Med Rep*, *29*, 101927. https://doi.org/10.1016/j.pmedr.2022.101927

Eyles, H. C., & Cleghorn, C. L. (2022). Dietary sources of sodium across the diverse New Zealand adult population. *Preventive Medicine Reports*, *29*, 101927. https://doi.org/https://doi.org/10.1016/j.pmedr.2022.101927

Filippi, J. P. D., Kaanders, H., & Hoftnan, A. (1981). SODIUM IN DIET AND MILK OF BREASTFEEDING WOMEN. *Acta Paediatrica*, *70*(3), 417-418. https://doi.org/https://doi.org/10.1111/j.1651-2227.1981.tb16576.x

Filippini, T., Malavolti, M., Whelton, P. K., Naska, A., Orsini, N., & Vinceti, M. (2021a). Blood Pressure Effects of Sodium Reduction: Dose-Response Meta-Analysis of Experimental Studies. *Circulation*, *143*(16), 1542-1567. https://doi.org/10.1161/circulationaha.120.050371

Filippini, T., Malavolti, M., Whelton, P. K., Naska, A., Orsini, N., & Vinceti, M. (2021b). Blood Pressure Effects of Sodium Reduction:Dose-Response Meta-Analysis of Experimental Studies. *Circulation*, *143*(16), 1542-1567. https://doi.org/doi:10.1161/CIRCULATIONAHA.120.050371

Filippini, T., Malavolti, M., Whelton, P. K., & Vinceti, M. (2022). Sodium Intake and Risk of Hypertension: A Systematic Review and Dose-Response Meta-analysis of Observational Cohort Studies. *Curr Hypertens Rep*, *24*(5), 133-144. https://doi.org/10.1007/s11906-022-01182-9

Food Standards Australia and New Zealand. (2023). *Processed foods*. FSANZ Retrieved from https://www.foodstandards.gov.au/consumer/our-safe-food-supply/processed-foods

Food Standards Australia and New Zealand. (2026, 22/04/2026). *Health Star Rating System*. Retrieved 09/07/2026 from https://www.foodstandards.gov.au/consumer/labelling/Health-Star-Rating-System

Food Standards Australia New Zealand, F. (2015, 26/11/2025). *How much sodium do Australians eat?* FSANZ. Retrieved 31/03/2026 from https://www.foodstandards.gov.au/consumer/nutrition/sodium-salt/salthowmuch

Food Standards Australia New Zealand, F. (2019, 26/11/2025). *How much sodium is in Australian foods?* FSANZ. Retrieved 31/03/2026 from https://www.foodstandards.gov.au/consumer/nutrition/sodium-salt/sodiumhowmuch

Fuavao, K., Mhurchu, C. N., Swinburn, B., Nosa, V., de Castro, T. G., & Eyles, H. (2023). The Major Packaged Food Sources of Sodium for New Zealand Children and Trends in the Sodium Content of Commonly Consumed Foods. *Medical Sciences Forum*, *18*(1), 24. https://www.mdpi.com/2673-9992/18/1/24

Garza, C., Johnson, C. A., Smith, E. O., & Nichols, B. L. (1983). Changes in the nutrient composition of human milk during gradual weaning. *Am J Clin Nutr*, *37*(1), 61-65. https://doi.org/10.1093/ajcn/37.1.61

Gomes, S., Mackay, S., Gerritsen, S., & Eyles, H. (2024). The development of sodium reduction targets for New Zealand fast foods and a comparison with the current sodium contents of products. *J Nutr Sci*, *13*, e41. https://doi.org/10.1017/jns.2024.35

Graudal, N. A., Hubeck-Graudal, T., & Jurgens, G. (2020). Effects of low sodium diet versus high sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride. *Cochrane Database Syst Rev*, *12*(12), Cd004022. https://doi.org/10.1002/14651858.CD004022.pub5

Grimes, C. A., Bolton, K. A., Trieu, K., Reimers, J., Armstrong, S., Bolam, B., Beckford, K., Santos, J. A., Rosewarne, E., Dunford, E. K., Jan, S., Webster, J., Neal, B., Nowson, C., & Woodward, M. (2023). Evaluation of a state-wide intervention on salt intake in primary schoolchildren living in Victoria, Australia. *Public Health Nutr*, *26*(7), 1456-1467. https://doi.org/10.1017/s1368980023000332

Grimes, C. A., Campbell, K. J., Riddell, L. J., & Nowson, C. A. (2013). Is socioeconomic status associated with dietary sodium intake in Australian children? A cross-sectional study. *BMJ Open*, *3*(2). https://doi.org/10.1136/bmjopen-2012-002106

Grimes, C. A., Kelley, S. J., Stanley, S., Bolam, B., Webster, J., Khokhar, D., & Nowson, C. A. (2017). Knowledge, attitudes and behaviours related to dietary salt among adults in the state of Victoria, Australia 2015. *BMC Public Health*, *17*(1), 532. https://doi.org/10.1186/s12889-017-4451-0

Grimes, C. A., Lim, K., Clark, L., Woodward, M., Szymlek-Gay, E. A., Zheng, M., Nowson, C. A., & Bolton, K. A. (2026). Sodium, potassium and blood pressure in Australian schoolchildren: exploring differences by sex and weight status-a cross-sectional study. *Hypertens Res*, *49*(3), 938-948. https://doi.org/10.1038/s41440-025-02489-1

Grimes, C. A., Riddell, L. J., Campbell, K. J., Beckford, K., Baxter, J. R., He, F. J., & Nowson, C. A. (2017). Dietary intake and sources of sodium and potassium among Australian schoolchildren: results from the cross-sectional Salt and Other Nutrients in Children (SONIC) study. *BMJ Open*, *7*(10), e016639. https://doi.org/10.1136/bmjopen-2017-016639

Gross, S. J., David, R. J., Bauman, L., & Tomarelli, R. M. (1980). Nutritional composition of milk produced by mothers delivering preterm. *J Pediatr*, *96*(4), 641-644. https://doi.org/10.1016/s0022-3476(80)80729-3

He, F. J., & MacGregor, G. A. (2010). Reducing population salt intake worldwide: from evidence to implementation. *Prog Cardiovasc Dis*, *52*(5), 363-382. https://doi.org/10.1016/j.pcad.2009.12.006

Health, Q. D. o. (2022). *Nutrition Standards for Meals and Menus (Revised 2022)*. Statewide Foodservices Network Retrieved from https://www.health.qld.gov.au/__data/assets/pdf_file/0030/156288/qh-nutrition-standards.pdf#:~:text=TheQueenslandHealthNutritionStandards,thenutritionalrequirementsofpatientsC

Heer, M., Baisch, F., Kropp, J., Gerzer, R., & Drummer, C. (2000). High dietary sodium chloride consumption may not induce body fluid retention in humans. *Am J Physiol Renal Physiol*, *278*(4), F585-595. https://doi.org/10.1152/ajprenal.2000.278.4.F585

Heer, M., Frings-Meuthen, P., Titze, J., Boschmann, M., Frisch, S., Baecker, N., & Beck, L. (2009). Increasing sodium intake from a previous low or high intake affects water, electrolyte and acid-base balance differently. *Br J Nutr*, *101*(9), 1286-1294. https://doi.org/10.1017/s0007114508088041

Hodson, E. M., & Cooper, T. E. (2023). Altered dietary salt intake for preventing diabetic kidney disease and its progression. *Cochrane Database Syst Rev*, *1*(1), Cd006763. https://doi.org/10.1002/14651858.CD006763.pub3

Holbrook, J. T., Patterson, K. Y., Bodner, J. E., Douglas, L. W., Veillon, C., Kelsay, J. L., Mertz, W., & Smith, J. C., Jr. (1984). Sodium and potassium intake and balance in adults consuming self-selected diets. *Am J Clin Nutr*, *40*(4), 786-793. https://doi.org/10.1093/ajcn/40.4.786

Holt, C. (1993). Interrelationships of the concentrations of some ionic constituents of human milk and comparison with cow and goat milks. *Comp Biochem Physiol Comp Physiol*, *104*(1), 35-41. https://doi.org/10.1016/0300-9629(93)90005-o

Hörnell, A., & Lagström, H. (2024). Infant feeding-a scoping review for Nordic Nutrition Recommendations 2023. *Food Nutr Res*, *68*. https://doi.org/10.29219/fnr.v68.10456

Huang, L., Trieu, K., Yoshimura, S., Neal, B., Woodward, M., Campbell, N. R. C., Li, Q., Lackland, D. T., Leung, A. A., Anderson, C. A. M., MacGregor, G. A., & He, F. J. (2020). Effect of dose and duration of reduction in dietary sodium on blood pressure levels: systematic review and meta-analysis of randomised trials. *Bmj*, *368*, m315. https://doi.org/10.1136/bmj.m315

Huang, L., Trieu, K., Yoshimura, S., Woodward, M., Campbell, N., Lackland, D., Leung, A., Anderson, C. A. M., MacGregor, G., Neal, B., & He, F. (2019). Impact of dose and duration of dietary salt reduction on blood pressure levels: Systematic review and meta-analysis

of randomised trials. *European heart journal*, *40*, 989. https://doi.org/10.1093/eurheartj/ehz748.0446

Institute for Health Metrics and Evaluation. (2024). *Global Burden of Disease (GBD) results tool* (https://vizhub.healthdata.org/gbd-results/

Jeong, S., Hunter, S. D., Cook, M. D., Grosicki, G. J., & Robinson, A. T. (2024). Salty Subjects: Unpacking Racial Differences in Salt-Sensitive Hypertension. *Current Hypertension Reports*, *26*(1), 43-58. https://doi.org/10.1007/s11906-023-01275-z

Jula, A. (2024). Sodium - a systematic review for Nordic Nutrition Recommendations 2023. *Food Nutr Res*, *68*. https://doi.org/10.29219/fnr.v68.10319

Keenan, B. S., Buzek, S. W., Garza, C., Potts, E., & Nichols, B. L. (1982). Diurnal and longitudinal variations in human milk sodium and potassium: implication for nutrition and physiology. *Am J Clin Nutr*, *35*(3), 527-534. https://doi.org/10.1093/ajcn/35.3.527

Khokhar, D., Nowson, C. A., Margerison, C., Bolam, B., & Grimes, C. A. (2018). Knowledge and Attitudes Are Related to Selected Salt-Specific Behaviours among Australian Parents. *Nutrients*, *10*(6). https://doi.org/10.3390/nu10060720

Kieneker, L. M., Bakker, S. J., de Boer, R. A., Navis, G. J., Gansevoort, R. T., & Joosten, M. M. (2016). Low potassium excretion but not high sodium excretion is associated with increased risk of developing chronic kidney disease. *Kidney Int*, *90*(4), 888-896. https://doi.org/10.1016/j.kint.2016.07.012

Kirkendall, A. M., Connor, W. E., Abboud, F., Rastogi, S. P., Anderson, T. A., & Fry, M. (1976). The effect of dietary sodium chloride on blood pressure, body fluids, electrolytes, renal function, and serum lipids of normotensive man. *J Lab Clin Med*, *87*(3), 411-434.

Kodama, N., Morikuni, E., Matsuzaki, N., Yoshioka, Y. H., Takeyama, H., Yamada, H., Kitajima, H., & Nishimuta, M. (2005). Sodium and potassium balances in Japanese young adults. *J Nutr Sci Vitaminol (Tokyo)*, *51*(3), 161-168. https://doi.org/10.3177/jnsv.51.161

Land, M. A., Neal, B. C., Johnson, C., Nowson, C. A., Margerison, C., & Petersen, K. S. (2018). Salt consumption by Australian adults: a systematic review and meta-analysis. *The Medical journal of Australia*, *208*(2), 75-81. https://doi.org/10.5694/mja17.00394

Land, M. A., Webster, J., Christoforou, A., Johnson, C., Trevena, H., Hodgins, F., Chalmers, J., Woodward, M., Barzi, F., Smith, W., Flood, V., Jeffery, P., Nowson, C., & Neal, B. (2014). The association of knowledge, attitudes and behaviours related to salt with 24-hour urinary sodium excretion. *Int J Behav Nutr Phys Act*, *11*(1), 47. https://doi.org/10.1186/1479-5868-11-47

Leed, A., Sheridan, E., Baker, B., Bamford, S., Emmanouilidis, E., Stewart, F., Ostafe, K., Sarwari, M., Lim, K., Zheng, M., Islam, S. M. S., Bolton, K. A., & Grimes, C. A. (2023). Dietary Intake and Arterial Stiffness in Children and Adolescents: A Systematic Review. *Nutrients*, *15*(9). https://doi.org/10.3390/nu15092092

Lemons, J. A., Moye, L., Hall, D., & Simmons, M. (1982). Differences in the composition of preterm and term human milk during early lactation. *Pediatr Res*, *16*(2), 113-117. https://doi.org/10.1203/00006450-198202000-00007

Lerchl, K., Rakova, N., Dahlmann, A., Rauh, M., Goller, U., Basner, M., Dinges, D. F., Beck, L., Agureev, A., Larina, I., Baranov, V., Morukov, B., Eckardt, K. U., Vassilieva, G., Wabel, P., Vienken, J., Kirsch, K., Johannes, B., Krannich, A.,...Titze, J. (2015). Agreement between 24-hour salt ingestion and sodium excretion in a controlled environment. *Hypertension*, *66*(4), 850-857. https://doi.org/10.1161/hypertensionaha.115.05851

Leyvraz, M., Chatelan, A., da Costa, B. R., Taffé, P., Paradis, G., Bovet, P., Bochud, M., & Chiolero, A. (2018). Sodium intake and blood pressure in children and adolescents: a systematic review and meta-analysis of experimental and observational studies. *Int J Epidemiol*, *47*(6), 1796-1810. https://doi.org/10.1093/ije/dyy121

Lowe, S., Bowyer, L., Lust, K., McMahon, L., Morton, M., North, R., Paech, M., & Said, J. (2014). *Guideline for the Management of Hypertensive Disorders of Pregnancy*.

https://ranzcog.edu.au/wp-content/uploads/SOMANZ-Hypertensive-Disorders-Pregnancy.pdf
Luzardo, L., Noboa, O., & Boggia, J. (2015). Mechanisms of Salt-Sensitive Hypertension. *Curr Hypertens Rev*, *11*(1), 14-21. https://doi.org/10.2174/1573402111666150530204136
Mahmood, L., Flores-Barrantes, P., Moreno, L. A., Manios, Y., & Gonzalez-Gil, E. M. (2021). The Influence of Parental Dietary Behaviors and Practices on Children's Eating Habits. *Nutrients*, *13*(4). https://doi.org/10.3390/nu13041138
Mason, K., Toohey, F., Gott, M., & Moeke-Maxwell, T. (2019). Māori: living and dying with cardiovascular disease in Aotearoa New Zealand. *Curr Opin Support Palliat Care*, *13*(1), 3-8. https://doi.org/10.1097/spc.0000000000000404
McCallum, L., Lip, S., & Padmanabhan, S. (2015). The hidden hand of chloride in hypertension. *Pflugers Arch*, *467*(3), 595-603. https://doi.org/10.1007/s00424-015-1690-8
McLean, R., Edmonds, J., Williams, S., Mann, J., & Skeaff, S. (2015). Balancing Sodium and Potassium: Estimates of Intake in a New Zealand Adult Population Sample. *Nutrients*, *7*(11), 8930-8938. https://doi.org/10.3390/nu7115439
McLean, R., Williams, S., & Mann, J. (2014). Monitoring population sodium intake using spot urine samples: validation in a New Zealand population. *Journal of human hypertension*, *28*(11), 657-662. https://doi.org/10.1038/jhh.2014.10
McLean, R. M., Farmer, V. L., Nettleton, A., Cameron, C. M., Cook, N. R., Woodward, M., & Campbell, N. R. C. (2018). Twenty-Four-Hour Diet recall and Diet records compared with 24-hour urinary excretion to predict an individual's sodium consumption: A Systematic Review. *J Clin Hypertens (Greenwich)*, *20*(10), 1360-1376. https://doi.org/10.1111/jch.13391
McLean, R. M., Williams, S. M., Te Morenga, L. A., & Mann, J. I. (2018). Spot urine and 24-h diet recall estimates of dietary sodium intake from the 2008/09 New Zealand Adult Nutrition Survey: a comparison. *Eur J Clin Nutr*, *72*(8), 1120-1127. https://doi.org/10.1038/s41430-018-0176-0
McMahon, E., Webster, J., O'Dea, K., & Brimblecombe, J. (2015). Dietary sodium and iodine in remote Indigenous Australian communities: will salt-reduction strategies increase risk of iodine deficiency? A cross-sectional analysis and simulation study. *BMC Public Health*, *15*, 1318. https://doi.org/10.1186/s12889-015-2686-1
Meng, Y., Mynard, J. P., Smith, K. J., Juonala, M., Urbina, E. M., Niiranen, T., Daniels, S. R., Xi, B., & Magnussen, C. G. (2024). Pediatric Blood Pressure and Cardiovascular Health in Adulthood. *Curr Hypertens Rep*, *26*(11), 431-450. https://doi.org/10.1007/s11906-024-01312-5
Metcalf, P., Scragg, R., Schaaf, D., Dyall, L., Black, P., & Jackson, R. (2008). Dietary intakes of European, Maori, Pacific and Asian adults living in Auckland: The Diabetes, Heart and Health Study. *Australian and New Zealand journal of public health*, *32*, 454-460. https://doi.org/10.1111/j.1753-6405.2008.00279.x
Mhurchu, C. N., Eyles, H., & Choi, Y. H. (2017). Effects of a Voluntary Front-of-Pack Nutrition Labelling System on Packaged Food Reformulation: The Health Star Rating System in New Zealand. *Nutrients*, *9*(8). https://doi.org/10.3390/nu9080918
Milajerdi, A., Djafarian, K., & Shab-Bidar, S. (2019). Dose-response association of dietary sodium intake with all-cause and cardiovascular mortality: a systematic review and meta-analysis of prospective studies. *Public Health Nutr*, *22*(2), 295-306. https://doi.org/10.1017/s1368980018002112
Monro, D., Hu, N., & McLean, R. M. (2025). Food Reformulation in New Zealand: A Success Story of Reducing the Sodium Content in Bread from 2003 to 2023. *Nutrients*, *17*(22), 3627. https://www.mdpi.com/2072-6643/17/22/3627
Moreno, S. V., Grimes, C., Bolton, K. A., Uddin, R., Siopis, G., Maddison, R., & Islam, S. M. S. (2024). The burden of cardiovascular disease attributable to high dietary sodium intake

in Australia between 1990 and 2019. *J Hypertens*, *42*(7), 1163-1172. https://doi.org/10.1097/hjh.0000000000003699

Morriss, F. H., Jr., Brewer, E. D., Spedale, S. B., Riddle, L., Temple, D. M., Caprioli, R. M., & West, M. S. (1986). Relationship of human milk pH during course of lactation to concentrations of citrate and fatty acids. *Pediatrics*, *78*(3), 458-464.

Motil, K. J., Kertz, B., & Thotathuchery, M. (1997). Lactational performance of adolescent mothers shows preliminary differences from that of adult women. *J Adolesc Health*, *20*(6), 442-449. https://doi.org/10.1016/s1054-139x(97)00036-0

National Academies of Sciences, E., and Medicine. (2019). *Dietary Reference Intakes for Sodium and Potassium* (H. M. Oria M, Stallings VA,, Ed.). National Academies Press (US). https://www.ncbi.nlm.nih.gov/sites/books/NBK545445/

National Health and Medical Research Council, N. (2006a). *Evidence Appendix for the 2006 Nutrient Reference Values for Australia and New Zealand*. Canberra, ACT

National Health and Medical Research Council, N. (2006b). *Nutrient Reference Values for Australia and New Zealand*. Canberra: NHMRC Retrieved from https://www.nhmrc.gov.au/about-us/publications/nutrient-reference-values-australia-and-new-zealand-including-recommended-dietary-intakes

National Health and Medical Research Council, N. (2011). A Modelling System to Inform the Revision of the Australian Guide to Healthy Eating. In N. National Health and Medical Research Council (Ed.). Canberra, ACT.

National Health and Medical Research Council, N. (2013). *Australian Dietary Guidelines - Educator Guide*. Canberra Retrieved from https://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/n55b_eat_for_health_educators_guide.pdf

National Health and Medical Research Council, N. (2019). *Policy on the Disclosure of Interests Requirements for Prospective and Appointed NHMRC Committee Members*. Retrieved from https://www.nhmrc.gov.au/sites/default/files/documents/attachments/publications/policy-on-the-disclosure-of-interests-requirements.pdf

National Health and Medical Research Council, N. (2026). *Methodological Framework for the Review of Nutrient Reference Values*. Canberra, ACT: NHMRC Retrieved from URL TBC ONCE PUBLISHED

Ndanuko, R. N., Ibrahim, R., Hapsari, R. A., Neale, E. P., Raubenheimer, D., & Charlton, K. E. (2021). Association between the Urinary Sodium to Potassium Ratio and Blood Pressure in Adults: A Systematic Review and Meta-Analysis. *Adv Nutr*, *12*(5), 1751-1767. https://doi.org/10.1093/advances/nmab036

New Zealand Food Safety. (2018). *New Zealand Total Diet Study 2016*. Retrieved from https://www.mpi.govt.nz/dmsdocument/43663-2016-NZ-Total-Diet-Study-without-Appendices-report-

Newberry, S. J., Chung, M., Anderson, C. A. M., Chen, C., Fu, Z., Tang, A., Zhao, N., Booth, M., Marks, J., Hollands, S., Motala, A., Larkin, J., Shanman, R., & Hempel, S. (2018). Sodium and Potassium Intake: Effects on Chronic Disease Outcomes and Risks. In. Agency for Healthcare Research and Quality (US).

Nowson, C., Lim, K., Land, M. A., Webster, J., Shaw, J. E., Chalmers, J., Flood, V., Woodward, M., & Grimes, C. (2018). Salt intake and dietary sources of salt on weekdays and weekend days in Australian adults. *Public Health Nutr*, *21*(12), 2174-2182. https://doi.org/10.1017/s1368980017004104

NSW Government Agency for Clincal Innovation. (2026). *Nutrient Goal Standard for adult patients*. Retrieved from https://aci.health.nsw.gov.au/projects/nutrition-standards/adult/nutrient-goals#sodium

O'Halloran, S. A., Grimes, C. A., Lacy, K. E., Nowson, C. A., & Campbell, K. J. (2016). Dietary sources and sodium intake in a sample of Australian preschool children. *BMJ Open*, *6*(2), e008698. https://doi.org/10.1136/bmjopen-2015-008698

Oliver, W. J., Neel, J. V., Grekin, R. J., & Cohen, E. L. (1981). Hormonal adaptation to the stresses imposed upon sodium balance by pregnancy and lactation in the Yanomama Indians, a culture without salt. *Circulation*, *63*(1), 110-116. https://doi.org/10.1161/01.cir.63.1.110

Organization, W. H. (2012). Report of the Formal Meeting of Member States to conclude the work on the comprehensive global monitoring framework, including indicators, and a set of voluntary global targets for the prevention and control of noncommunicable diseases. *World Health Organization: Geneva, Switzerland*, *6*.

Palacios, C., Wigertz, K., Martin, B. R., Jackman, L., Pratt, J. H., Peacock, M., McCabe, G., & Weaver, C. M. (2004). Sodium retention in black and white female adolescents in response to salt intake. *J Clin Endocrinol Metab*, *89*(4), 1858-1863. https://doi.org/10.1210/jc.2003-031446

Parker, M., Puddey, I. B., Beilin, L. J., & Vandongen, R. (1990). Two-way factorial study of alcohol and salt restriction in treated hypertensive men. *Hypertension*, *16*(4), 398-406. https://doi.org/10.1161/01.hyp.16.4.398

Perez, V., & Chang, E. T. (2014). Sodium-to-potassium ratio and blood pressure, hypertension, and related factors. *Adv Nutr*, *5*(6), 712-741. https://doi.org/10.3945/an.114.006783

Perrin, M. T., Fogleman, A. D., Newburg, D. S., & Allen, J. C. (2017). A longitudinal study of human milk composition in the second year postpartum: implications for human milk banking. *Matern Child Nutr*, *13*(1). https://doi.org/10.1111/mcn.12239

Petersen, K. S., Malta, D., Rae, S., Dash, S., Webster, J., McLean, R., Thout, S. R., Campbell, N. R. C., & Arcand, J. (2020). Further evidence that methods based on spot urine samples should not be used to examine sodium-disease relationships from the Science of Salt: A regularly updated systematic review of salt and health outcomes (November 2018 to August 2019). *J Clin Hypertens (Greenwich)*, *22*(10), 1741-1753. https://doi.org/10.1111/jch.13958

Picciano, M. F., Calkins, E. J., Garrick, J. R., & Deering, R. H. (1981). Milk and mineral intakes of breastfed infants. *Acta Paediatr Scand*, *70*(2), 189-194. https://doi.org/10.1111/j.1651-2227.1981.tb05540.x

Pitkin, R. M., Kaminetzky, H. A., Newton, M., & Pritchard, J. A. (1972). Maternal nutrition. A selective review of clinical topics. *Obstet Gynecol*, *40*(6), 773-785.

Rosewarne, E., Santos, J. A., Hoek, A., Grimes, C., Nowson, C., Webster, J., & Bolton, K. A. (2021). Are there socio-demographic differences in salt behaviours and fruit and vegetable consumption in Australian adults? A nationally representative cross-sectional survey. *Nutrition journal*, *20*(1), 77. https://doi.org/10.1186/s12937-021-00734-0

Sacks, F. M., Svetkey, L. P., Vollmer, W. M., Appel, L. J., Bray, G. A., Harsha, D., Obarzanek, E., Conlin, P. R., Miller, E. R., 3rd, Simons-Morton, D. G., Karanja, N., & Lin, P. H. (2001). Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med*, *344*(1), 3-10. https://doi.org/10.1056/nejm200101043440101

Sciarrone, S. E., Beilin, L. J., Rouse, I. L., & Rogers, P. B. (1992). A factorial study of salt restriction and a low-fat/high-fibre diet in hypertensive subjects. *J Hypertens*, *10*(3), 287-298. https://doi.org/10.1097/00004872-199203000-00013

Shim, J. S., Oh, K., & Kim, H. C. (2014). Dietary assessment methods in epidemiologic studies. *Epidemiol Health*, *36*, e2014009. https://doi.org/10.4178/epih/e2014009

Stein, L. J., Cowart, B. J., & Beauchamp, G. K. (2012). The development of salty taste acceptance is related to dietary experience in human infants: a prospective study. *Am J Clin Nutr*, *95*(1), 123-129. https://doi.org/10.3945/ajcn.111.014282

Sterns, R. H. (2015). Disorders of Plasma Sodium — Causes, Consequences, and Correction. *New England Journal of Medicine*, *372*(1), 55-65. https://doi.org/doi:10.1056/NEJMra1404489

Stolarz-Skrzypek, K., Kuznetsova, T., Thijs, L., Tikhonoff, V., Seidlerová, J., Richart, T., Jin, Y., Olszanecka, A., Malyutina, S., Casiglia, E., Filipovský, J., Kawecka-Jaszcz, K., Nikitin, Y., & Staessen, J. A. (2011). Fatal and nonfatal outcomes, incidence of hypertension, and blood pressure changes in relation to urinary sodium excretion. *Jama*, *305*(17), 1777-1785. https://doi.org/10.1001/jama.2011.574

Strohm, D., Bechthold, A., Ellinger, S., Leschik-Bonnet, E., Stehle, P., & Heseker, H. (2018). Revised Reference Values for the Intake of Sodium and Chloride. *Ann Nutr Metab*, *72*(1), 12-17. https://doi.org/10.1159/000484355

Subar, A. F., Freedman, L. S., Tooze, J. A., Kirkpatrick, S. I., Boushey, C., Neuhouser, M. L., Thompson, F. E., Potischman, N., Guenther, P. M., Tarasuk, V., Reedy, J., & Krebs-Smith, S. M. (2015). Addressing Current Criticism Regarding the Value of Self-Report Dietary Data. *J Nutr*, *145*(12), 2639-2645. https://doi.org/10.3945/jn.115.219634

Surma, S., Surma, S., Banach, M., Pruc, M., Pruc, M., Szarpak, L., Szarpak, L., Banach, M., Banach, M., & Banach, M. (2025). Dietary salt on vascular function: a meta-analysis. *Arch. Med. Sci.*, *21*(4), 1631-1635. https://doi.org/10.5114/aoms/209720

Todd, A. S., Macginley, R. J., Schollum, J. B., Williams, S. M., Sutherland, W. H., Mann, J. I., & Walker, R. J. (2012). Dietary sodium loading in normotensive healthy volunteers does not increase arterial vascular reactivity or blood pressure. *Nephrology (Carlton)*, *17*(3), 249-256. https://doi.org/10.1111/j.1440-1797.2011.01550.x

Truchet, S., & Honvo-Houéto, E. (2017). Physiology of milk secretion. *Best Pract Res Clin Endocrinol Metab*, *31*(4), 367-384. https://doi.org/10.1016/j.beem.2017.10.008

United States Institute of Medicine, U. I. (2005). *Dietary Reference Intakes for water, potassium, sodium, chloride, and sulfate*. Washington (DC): The National Academies Press

University of Otago and Ministry of Health. (2011). *A Focus on Nutrition: Key findings of the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: Ministry of Health Retrieved from https://www.health.govt.nz/system/files/2011-10/a-focus-on-nutrition-v2.pdf

Wack, R. P., Lien, E. L., Taft, D., & Roscelli, J. D. (1997). Electrolyte composition of human breast milk beyond the early postpartum period. *Nutrition*, *13*(9), 774-777. https://doi.org/10.1016/s0899-9007(97)00187-1

Wang, N. X., McLean, R. M., Cameron, C., & Skeaff, S. A. (2023). The quantification of sodium intake from discretionary salt intake in New Zealand using the lithium-tagged salt method [Original Research]. *Frontiers in nutrition*, *Volume 9 - 2022*. https://doi.org/10.3389/fnut.2022.1065710

Wang, N. X., Skeaff, S., Cameron, C., Fleming, E., & McLean, R. M. (2022). Sodium in the New Zealand diet: proposed voluntary food reformulation targets will not meet the WHO goal of a 30% reduction in total sodium intake. *Eur J Nutr*, *61*(6), 3067-3076. https://doi.org/10.1007/s00394-022-02864-5

Wang, P., Deger, M. S., Kang, H., Ikizler, T. A., Titze, J., & Gore, J. C. (2017). Sex differences in sodium deposition in human muscle and skin. *Magn Reson Imaging*, *36*, 93-97. https://doi.org/10.1016/j.mri.2016.10.023

Wheeler, A., Rahiri, J.-L., Ellison-Lupena, R., Hanchard, S., Brewer, K. M., Paynter, J., Winter-Smith, J., Selak, V., Ameratunga, S., Grey, C., & Harwood, M. (2025). Assessing the gaps in cardiovascular disease risk assessment and management in primary care for Māori and Pacific peoples in Aotearoa New Zealand— a systematic review. *The Lancet Regional Health – Western Pacific*, *56*. https://doi.org/10.1016/j.lanwpc.2025.101511

Wilson, N., Cleghorn, C., Nghiem, N., & Blakely, T. (2023). Prioritization of intervention domains to prevent cardiovascular disease: a country-level case study using global burden of

disease and local data. *Population Health Metrics*, *21*(1), 1. https://doi.org/10.1186/s12963-023-00301-1

World Health Organisation. (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. https://iris.who.int/server/api/core/bitstreams/15f51d0a-bfbd-43ad-a637-73778feb57e3/content

World Health Organisation. (2026, 11/05/2026). *Sodium reduction*. Retrieved 09/06/2026 from https://www.who.int/news-room/fact-sheets/detail/sodium-reduction

World Health Organization, W. (2012). *Guideline: Sodium Intake for Adults and Children*. WHO. https://www.who.int/publications/i/item/9789241504836

World Health Organization, W. (2026). *Cardiovascular diseases*. Retrieved 31/03/2026 from https://www.who.int/health-topics/cardiovascular-diseases

Zhao, D., Li, H. M., Li, C. X., & Zhou, B. (2022). 24-Hour Urinary Sodium Excretion Association with Cardiovascular Events: A Systematic Review and Dose-Response Meta-Analysis. *Biomed Environ Sci*, *35*(10), 921-930. https://doi.org/10.3967/bes2022.119

Appendix A – Assessment of guideline suitability

Administrative and technical criteria for assessing existing nutrient reference values

Title/Reference:

National Academies of Sciences, Engineering, and Medicine. 2019. Dietary Reference Intakes for Sodium and Potassium. Washington, DC: The National Academies Press. https://doi.org/10.17226/25353.

Assessment:

February 2024 by NHMRC Project Team

Overall guidance/advice development process

Criteria	Yes/No/ NA	Comment	Page #
Are the administrative processes (e.g. the NRV development process and associated governance, principles and procedures) documented and publicly available?	Mostly Yes	Methodologies are outlined in detail, but some of the administrative procedures are unclear (see below)	NA
Are the key stages of the organisation's NRV development processes compatible with NHMRC processes? (i.e., relevant and useful, transparent, overseen by a guideline development group/committee, COI management, focussed on health-related outcomes, evidence informed, actionable recs, up to date and accessible)	Mostly Yes	Development process is broadly compatible with NHMRC 2016 Standards: Relevant and useful, transparent, overseen by a guideline development group, procedures for conflict of interest declaration and management, focussed on health-related outcomes, evidence informed, actionable recommendations, accessible. Although not up to date, within 5 year time period at the time of checklist completion (see below).	NA
Was the work overseen by an expert advisory committee?	Yes	Committee to Review the Dietary Reference Intakes for Sodium and Potassium – membership is listed	v
Are potential conflicts of interest of committee members declared, managed and/or reported?	Yes	The report has biographical sketches of committee members but no explicit mention of a conflict of interest process. CoI processes are managed under a general National Academies policy. The AHRQ report used by the committee has a declaration that none of the authors had conflicts of interest.	NASEM 2003 COI Policy.pdf

Criteria	Yes/No/ NA	Comment	Page #
Are funding sources declared?	Yes	Details are provided – most funding is between government departments, but the WK Kellogg Foundation and Kellogg Health Public fund also contributed. These are charitable organisations, with independent boards, but still hold shares in the food company.	ii
Was there public consultation on this work? if yes, is the public consultation documented and/or published?	Yes	Open meeting Dec 6th 2017 – targeted and public Public workshop Mar 7th 2018 – targeted and public, included a session for public comment Open meeting Mar 9th 2018 - targeted and public The request seemed to be for the public to provide comment and sources early in the process, though p.450 also notes "*This public call for information was in addition to the existing public comment mechanism, in which the public could provide written comments for the committee's consideration throughout the duration of the study*." Results of public consultation do not seem to be available, but the agendas for the meetings are. AHRQ report was available for public consultation for 4 weeks. Comments are publicly available. Recommendations are not open for public consultation before the publication of the report (NASEM has a FACA exemption from Congress to do this work).	Appendix B pp 425-429 p. 450 AHRQ(2018)-sodium-potassium-disposition-comments.pdf
Was the guidance/advice developed or updated recently?	yes	Evidence was assessed in 2018 – published 2019. This checklist completed in 2024 (Feb), i.e. within 5 years of publication.	

Evidence review parameters

Criteria	Yes/No/ NA	Comment	Page #
Are decisions about scope, definitions and evidence review parameters documented and publicly available?	Yes	Clear in AHRQ report. Available in the main NASEM report, but slightly harder to find details (in Appendix D and E).	
Were clinical/research questions articulated and PICO criteria outlined appropriate to the topic?	Yes	8 questions were articulated for the AHRQ Systematic review. Numbers 1-4 relate to sodium, 5-8 to potassium. P – adults, children, older, pregnant, lactating (sub-pops = hypertension, diabetes, obesity and renal health status) I/C – dietary sodium intake O – blood pressure, cardiovascular, kidney disease, coronary, stroke Committee considered additional indicators (outcomes), and those chosen were based on expert judgment and scoping reviews. Additional searches for headache; then blood lipids; bone health; catecholamines; type 2 diabetes, glucose intolerance, and insulin sensitivity; and plasma renin activity. (NB some of the outcomes may be more relevant for the potassium component of the review.)	Box 1-3, p.30

Criteria	Yes/No/ NA	Comment	Page #
Does the organisation use or adopt review findings or risk assessments from other organisations?	Yes	AHRQ Systematic Review = Agency for Healthcare Research and Quality systematic review, Sodium and Potassium Intake: Effects on Chronic Disease Outcomes and Risks (Newberry et al., 2018) The 2018 draft EFSA report on sodium was mined for references – this is the report as available for public comment and included the evidence, but not NRVs.	
what process was used to critically assess these external findings?		AHRQ Systematic Review assessed by committee with AMSTAR 2 – but then additional analyses were used in many of the final decisions for the Chronic Disease Risk Reduction Intake (CDRR). SR for additional topics were also assessed with AMSTAR-2.	
Did the organisation undertake their own systematic literature review?	Yes	Searches based on the AHRQ strategy for Headache. Only in PubMed. For the other additional searches started by searching Medline and Cochrane database – 2013 onwards – for SR. For topics where no SR was found primary searches were conducted in Ovid MEDLINE – 2003 to 2018 (i.e. since previous report), only English and humans.	Appendix E, p.486 onwards
Has the evidence report been reviewed by experts independent from the review authors? (e.g. peer review or committee review)?	Yes	The AHRQ Systematic Review was peer reviewed and reviewed by the committee. The consensus study report (main report) was independently reviewed by people chosen for their "diverse perspectives and technical expertise".	
Does the organisation use or undertake systematic literature review methods to identify and select data underpinning the advice?	Yes	The AHRQ Systematic Review methods are based on the AHRQ Methods Guide and had a protocol. Methods reported follow standard SR methods (e.g., more than one data base searched, clear inclusion/exclusion criteria, two reviewers for screening etc.) NASEM general methods based on the *Guiding Principles for Developing Dietary Reference Intakes Based on Chronic Disease; and* the *DRI organizing framework*. For scoping and additional questions – inclusion/exclusion are clear and two reviewers independently reviewed at ti/abs	
are the methods used documented clearly?	Yes	The main NASEM report skips around a bit because of all the details (many in Appendices).	
are inclusion/exclusion criteria used to select or exclude certain studies from the review?	Yes	AHRQ inclusion/exclusion criteria are clearly stated in Table 1 of that report (starting p.46/8 as listed on doc). Details relating to the additional questions are provided in Appendix E. A PRISMA flowchart is provided in the AHRQ Systematic Review.	PRISMA flow chart - AHRQ p.64 Inclusion /exclusion for additional questions p. 490 and tables in Appendix E

Criteria	Yes/No/ NA	Comment	Page #
is justification of inclusion/exclusion criteria provided?	Partly Yes	AHRQ justified English only "to ensure that sufficient study detail was provided and accessible to assess study quality fairly" (p.46) For NASEM dates seem to be based on "since last review", others do not seem to be specifically justified but relate to the questions (e.g., appropriate study type, humans etc).	

Evidence search

Criteria	Yes/No/ NA	Comment	Page #
Are databases and other sources of evidence specified?	Yes	See below	
Does the literature search cover at least more than one scientific database as well as additional sources (which may include government reports and grey literature)?	Yes	AHRQ Systematic Review used Pubmed, Embase, Cochrane Library, Cochrane CENTRAL, CINAHL, Web of Science, references of prior reviews, hand search of grey lit, and expert recommendations. Pubmed was used for the scoping searches and headache. Medline and Cochrane for other additional searches for SR. Ovid Medline for additional primary references.	p.453 (appendix D) p.486 onward (appendix E) AHRQ vii/p.18
Is the date range of the literature search specified and justified?	Yes	AHRQ – from past report search date to date of search (2017). PubMed, Web of Science: 2003 – 2017 (search date) Embase, CINAHL, Cochrane CENTRAL: 2011- 2017 (search date) (NB studies included in the earlier reports were also included where they met the current inclusion criteria.) Scoping searches and additional questions varied depending on most recent IOM report – either 2003, or 2012. NASEM committee re-ran the AHRQ searches up to June 2018 in PubMed.	
Are search terms and/or search strings specified?	Yes	Table D-2 for general, footnotes in the report for details. AHRQ Systematic Review Appendix A	

Critical appraisal methods and tools

Criteria	Yes/No/ NA	Comment	Page #
Is risk of bias of individual studies assessed and taken into consideration?	Yes	RoB is assessed for the studies in the AHRQ report, and for additional studies included in the NASEM report. See below for details. AHRQ used RoB as part of consideration of Strength of Evidence (similar domains to GRADE). Main NASEM report considered RoB as part of modified GRADE for setting Chronic Disease Risk Reduction Intake (CDRR) and RoB when considering evidence for setting AIs.	
if yes, what tools are used? if no, was any other method used to assess study quality?		AHRQ Systematic Review used a modified version of Cochrane RoB for RCTs, and Newcastle Ottawa for observational studies. Intake method was considered under RoB (multiple 24h urinary or 24 dietary recall = best). Overall score based on addition. For CDRR the Committee checked RoB and decided to only include RCTs in the primary analyses with examination of low RoB observational studies as supporting/not supporting the conclusions. For the scoping work RoB was not formally assessed, but information about key components that would affect RoB were collected during data collection. For additional topics AMSTAR was used to assess SRs, and the modified version of Cochrane RoB was used for the additional studies to align with the AHRQ report.	Appendix C (p.431) gives more detail of RoB domains and criteria. See also p.508 (Appendix E) relating to additional studies.
Does the organisation use a systematic or some other methodological approach to synthesise the evidence (i.e. to assess and summarise the information provided in the studies)?	Yes	AHRQ Systematic Review has forest plots, along with meta-analyses. The Committee conducted sub-group analyses and meta-regression to develop CDRR, and forest plots are also shown for these (ch 10). Where possible, intake-response (dose-response) relationships were also examined.	
Does the organisation assess the overall certainty of the evidence and reach recommendations?	Yes	GRADE is used to assess the evidence from the AHRQ Systematic Review to develop CDRR, but with a slight variation to terminology (strength of evidence instead of certainty). For cases where the Committee conducted meta-regression, the strength of evidence was also reassessed. AIs then developed based on CDRR and other evidence.	

Derivation of nutrient reference values

Criteria	Yes/No/ NA	Comment	Page #
Is the method selected to calculate NRV(s) documented and justified? (factorial, dose response or risk assessment)	Yes	Committee concludes "*There is no sensitive biomarker that can be used to characterize the distribution of sodium requirements in the apparently healthy population.*" Calculation was of CDRR first, and then AIs after also looking at CDRR (not enough information was available to calculate EAR/RDAs). No UL was calculated given the CDRR and available information. Both causal relationships and intake-response (dose-response), were examined for CDRR, with cardiovascular and hypertension as indicators and blood pressure as surrogate indicator. Meta-regressions were used for each and then a model relating them to each other. "*Based on the lowest level of sodium intakes studied in the DASH-Sodium feeding trial and other sodium reduction trials and on the best-designed balanced study, a sodium AI of 1,500 mg/d (65 mmol/d) is appropriate for adults at normal ambient temperatures and not engaged in high-intensity physical activity.*" (p.233) "*The committee expressed the sodium CDRR as the lowest intake level for which there was sufficient evidence to characterize chronic disease risk reduction. (p.331).* "*The committee concludes that there is insufficient evidence of sodium toxicity risk within the apparently healthy population to establish a sodium Tolerable Upper Intake Level (UL).*" (p.259) "*the absence of a sodium UL does not necessarily mean excessive sodium intakes pose no risks, but rather likely reflects a lack of evidence on adverse toxicological effects*." (p.259)	
Are the algorithms and calculations clearly documented and explained?	Yes	For CDRR and AIs the committee considered the distribution of available evidence, including meta-regressions. The value was then extrapolated for children (1-18) based on Sedentary Estimated Energy Requirements (EERs) compared to the adult value of 2,000 kcal/d. This was done for AIs and CDRR – Formula is given only in words, but translates to = (rounded child value EER/adult EER) x adult CDRR or AI, then rounded to the nearest 100mg/d There were no differences for older adults or pregnant or lactating people, given scant evidence available did not suggest differences. Information for infants was based on sodium in breast milk for 0-6mths, and then breast milk + food for 7-11mths. NB infants are out of scope for the current review.	CH 10 for CDRR (children p.336-338), Ch 8 for AIs (children p. p.231, older p.233, pregnant/ lactating p.235) Ch 9 for UL (summary p.259)
Are the assumptions and reference data (intake, body weights for age groups etc) used for the calculations clearly documented and explained?	Yes	Age categories used were those from the previous IOM reports. Scaling was done based on sedentary energy rather than weight or anything else, based on studies showing that sodium intake is related to energy intake.	

Criteria	Yes/No/ NA	Comment	Page #
Is there justification for the choice of uncertainty and safety factors?	Yes	No uncertainty factors are used in calculations. The CDRR is calculated based on the range of available data and included the use of GRADE to consider certainty (strength of evidence). Safety data and adverse effects were considered in the decision not to set a UL. The UL was considered in context of the CDRR and a decision was made not to set a UL.	p.259 for summary
Is justification provided for any clinical/chronic endpoints selected as indictors/outcomes? (Details of endpoints to be provided in a supplementary table.)	Yes	The Committee considered cardiovascular and hypertension as indicators and blood pressure as a surrogate indicator. Justification is provided. Other indicators were considered but not used in developing the CDRR or AIs.	
Is justification provided for the value selected for the reference point^? (including mechanistic evidence, health outcome data, key events, balance studies) ^ refence point is usually the baseline value to which any scaling and uncertainty factors are applied.	Yes	Committee assessed the strength of evidence that reducing sodium reduces chronic disease risk between 2,300-4,100 mg/d (100-178mml/d) as high (p.312-13). Committee assessed the strength of evidence that reducing sodium reduces chronic disease risk between 4,100-5,000 mg/d as moderate (-1 indirectness; p.317-18). Committee assessed the strength of evidence that reducing sodium reduces chronic disease risk between 1,000-2,300 mg/d as low (-1 inconsistency, -1 indirectness; p.324) *"The committee concludes there is moderate to high strength of evidence for both a causal relationship and an intake–response relationship between sodium and several interrelated chronic disease indicators: cardiovascular disease, hypertension, systolic blood pressure, and diastolic blood pressure. Evidence from these indicators can be synthesized to inform the development of a sodium Chronic Disease Risk Reduction Intake (CDRR)."* P.327 The information about where the available evidence for different values for each endpoint was used to decide on the final CDRR value of 2,300 mg/d which the committee characterised as "*as the lowest intake level for which there was sufficient evidence to characterize chronic disease risk reduction*. (p.331) For AIs "*The committee therefore determined that the sodium AI for adults could be derived from trials with sodium intakes less than 2,300 mg/d (100 mmol/d) and that the strongest designed balance study could provide insight as to whether the selected sodium AI value was appropriate*." (p.229) "*Based on the lowest level of sodium intakes studied in the DASH-Sodium feeding trial and other sodium reduction trials and on the best-designed balanced study, a sodium AI of 1,500 mg/d (65 mmol/d) is appropriate for adults at normal ambient temperatures and not engaged in high-intensity physical activity."* (p.233)	
Is the population group generalisable to the Australian and New Zealand population? Where are the underlying studies from	Yes	It is mostly unclear where the trials are from without reading the original articles, but it seems that primary evidence from Balance Studies: White and Black American's (p.212), other studies considered British, German and Russian (ethnicity unclear) and Japanese AIs: mostly USA (White and Non-White), China, also considered South-Africa, Europe, New Zealand CDRR: mostly USA (White and Non-White), China, also considered Scandinavian countries, Japan	

Criteria	Yes/No/ NA	Comment	Page #
If scaling was applied – was the method described, along with an appropriate rationale for the chosen method?	Yes		e.g., p331
Is the method used appropriate for Australian and New Zealand populations?	Probably Yes	If we have a different sedentary estimated energy requirements (EER) that may need to be input into the formula which might change the results. Aus/NZ values for EER look much higher, which would therefore give a higher sodium intake. That may or may not be appropriate.	
Are the processes used when expert judgement is applied documented and published? (Evidence to decision process used to obtain final conclusions).	Yes	The Committee describe the steps they take for each decision throughout the report. There was no formal EtD process used, but things like the food context and usual intakes are considered, and these also relate to acceptability and feasibility.	

Suitability for adopting vs adapting

Criteria	Suitability assessment	Comment	Page #
How does the Australian and New Zealand context (e.g. food system, dietary patterns, intakes, status) compare with the jurisdiction in which the NRV under consideration was developed?	Probably suitable to adapt	Land et al (2018) – Australian consumption is 3750mg sodium/day (9.6g salt) - no decrease between 1989 and 2015. National Health and Nutrition Examination Survey for USA – median value for males ≥ 19 is approx. 4,000 mg/d and for females ≥ 19 is approx. 2,900 mg/d Canadian Community Health Survey–Nutrition 2015 – median value for males ≥ 19 is approx. 3,100 mg/d and for females ≥ 19 is approx. 2,300 mg/d Both suggest the majority of people have intakes above the CDRR, although the overall intakes are lower in Canada than the USA, lower in females and lower in older adults than younger adults. Ch 11 (context and EtD) of the NASEM report states: "*Typical salt concentrations in bread are around 2 percent of the flour weight.*" (p.383) – This would equate to 2g (2,000 mg) per 100g – significantly higher than the average sodium content of 408mg/100g (range: 233 – 660g) reported in 2017 (per the George Institute's *Key Findings Report: Changes in sodium levels of bread products in Australia (2010-2017),* available from: https://strokefoundation.org.au/media/ubgc3y2n/final-key-findings-report.pdf). This suggests the USA may have higher salt in processed/bought food than Aus/NZ which may impact generalisability. The evidence base underpinning recommendations could be used with guideline recommendations adapted to suit the Aus/NZ nutrition context.	Children Table 11-2, p.372 and table 11-3, p.373 Adults table 11-5, p.376 Infants Table 11-1 p.371

Overall conclusions

NASEM have considered evidence from the results of a systematic review by the Agency for Healthcare Research and Quality (AHRQ) designed to answer their questions, as well as conducting supplementary searches for additional outcomes, and to check for any new studies. Evidence on the relationship between sodium intake and cardiovascular risk, hypertension and blood pressure (as a surrogate indicator) was considered as well as balance studies to develop first a Chronic Disease Risk Reduction intake (CDRR; 2,300 mg/d) and then Adequate Intake values (AIs; 1,500 mg/d). The evidence did not support the derivation of an Estimated Average Requirement (EAR), so a Recommended Dietary Allowance (RDA) could not be derived. Values for children were derived from adult values based on sedentary Estimated Energy Requirements (EER), and for infants based on sodium in breast milk. There was insufficient evidence to make separate recommendations for older adults or people who are pregnant or lactating, so these are set at the same level for all adults. It is noted that intakes among most of the USA and Canadian population exceed the CDRR. A UL was not set as the available evidence did not suggest a toxicity level within the healthy population, but instead supporting increasing ill-effects with increasing intakes above the CDRR.

Administrative and technical criteria for assessing existing nutrient reference values

Title/Reference:

EFSA NDA Panel (EFSA Panel on Nutrition, Novel Foods and Food Allergens), Turck D, Castenmiller J, de Henauw S, Hirsch-Ernst K-I, Kearney J, Knutsen HK, Maciuk A, Mangelsdorf I, McArdle HJ, Pelaez C, Pentieva K, Siani A, Thies F, Tsabouri S, Vinceti M, Aggett P, Fairweather-Tait S, Martin A, Przyrembel H, Ciccolallo L, de Sesmaisons-Lecarré A, Martinez SV, Martino L and Naska A, 2019. **Scientific Opinion on the dietary reference values for sodium**. *EFSA Journal* 2019;17(9):5778, 191 pp. https://doi.org/10.2903/j.efsa.2019.5778

Assessment by ONHMRC:

13 February 2024

Overall guidance/advice development process

Criteria	Yes/No/ NA	Comment	Page #
Are the administrative processes (e.g. the NRV development process and associated governance, principles and procedures) documented and publicly available?	Yes	Yes – they've outlined their methodologies associated with assessment in detail.	
Are the key stages of the organisation's NRV development processes compatible with NHMRC processes? (i.e., relevant and useful, transparent, overseen by a guideline development group/committee, COI management, focussed on health-related outcomes, evidence informed, actionable recs, up to date and accessible)	Yes	It is broadly compatible with NHMRC 2016 Standards: Relevant and useful, transparent, overseen by a Guideline Development Group, Conflicts of Interest (COI) management procedures, focussed on health-related outcomes, evidence informed, actionable recommendations, up to date and accessible.	
Was the work overseen by an expert advisory committee?	Yes	European Food Safety Authority NDA Panel – Panel members are listed	2
Are potential conflicts of interest of committee members declared, managed and/or reported?	Yes	Open EFSA (europa.eu). Management policies for COI are found Here. Some Declarations of Interest for some ex-members are not publicly available anymore (more than 5 years old).	2

Criteria	Yes/No/ NA	Comment	Page #
Are funding sources declared?	Yes	It is noted that this report was requested by the European Commission. EFSA, as an agency of the European Union, is strictly funded by public funds, almost entirely from the EU budget. Budget is published annually here: Statement of revenue and expenditure for the 2023 financial year	
Was there public consultation on this work? if yes, is the public consultation documented and/or published?	Yes	Yes – September 2017 and 3 April to 22 May 2019. Outcomes available here: https://www.efsa.europa.eu/en/supporting/pub/en-1679	9
Was the guidance/advice developed or updated recently?	Yes	2019 – within 5 years of checklist completion.	

Evidence review parameters

Criteria	Yes/No/ NA	Comment	Page #
Are decisions about scope, definitions and evidence review parameters documented and publicly available?	Yes	Yes they reviewed evidence from balance studies on sodium and on the relationship between sodium intake and health outcomes, in particular cardiovascular disease (CVD)-related endpoints and bone health, was reviewed. A protocol was published prior to the search.	
Were clinical/research questions articulated and PICO criteria outlined appropriate to the topic?	Yes	5 questions were articulated and are outlined in the protocol at Annex A. A PICO is outlined for each sub-question.	
Does the organisation use or adopt review findings or risk assessments from other organisations?	Yes	To inform its decisions, the Panel considered recent reports from national and international bodies (WHO, 2012a, 2012d, 2012c, 2012b; IOM, 2013; Nordic Council of Ministers, 2014), a preparatory systematic review which aimed to identify scientific data for this task (Eeuwijk et al., 2013), and recent systematic reviews and meta-analyses on selected health outcomes (see below). EFSA did undertake their own review for the derivation of NRVs.	8
what process was used to critically assess these external findings?	n/a	N/A – external findings were used to supplement findings from own review.	
Did the organisation undertake their own systematic literature review?	Yes	EFSA undertook reviews as outlined in a research protocol in Annex A page 29.	Annex A, p. 29
Has the evidence report been reviewed by experts independent from the review authors? (e.g. peer review or committee review)?	Yes	EFSA have contracted some reviews and the expert committee have assessed reviews independently.	
Does the organisation use or undertake systematic literature review methods to identify and select data underpinning the advice?	Yes	A Protocol was established and published before commencement.	Annex A

Criteria	Yes/No/ NA	Comment	Page #
are the methods used documented clearly?	Yes	Refer to protocol (Annex A) and Annex B report.	
are inclusion/exclusion criteria used to select or exclude certain studies from the review?	Yes	Yes criteria are outlined for each subquestion against the PICO in the protocol at Annex A.	
is justification of inclusion/exclusion criteria provided?	Yes	Yes criteria are outlined for each subquestion against the PICO in the protocol at Annex A. Justification for exclusion criteria is also outlined in Annex A.	

Evidence search

Criteria	Yes/No/ NA	Comment	Page #
Are databases and other sources of evidence specified?	Yes	Pubmed, Cochrane library, Embase, Cochrane CENTRAL, Medline, CINAHL the Cochrane Hypertension Specialised Register and Clinicaltrials.gov	9
Does the literature search cover at least more than one scientific database as well as additional sources (which may include government reports and grey literature)?	Yes	The Panel considered recent reports from national and international bodies (WHO, 2012a, 2012d, 2012c, 2012b; IOM, 2013; Nordic Council of Ministers, 2014), a preparatory systematic review which aimed to identify scientific data for this task (Eeuwijk et al., 2013), Two resources indexing PhD theses.	
Is the date range of the literature search specified and justified?	Yes	Table 9 in Annex A (p. 19) specifies the date range searched and rationale. Searches for RCTs were date limited for two sub-questions, to supplement studies identified by recent systematic reviews (Gardual et al 2017 and Adler et al 2014) which were used as sources of relevant studies. No time restriction were applied for observational studies or for RCTs for remaining sub-questions for which existing SRs had not been identified. Searches were up to February 2018 and October 2018 as depicted in the PRISMA charts (Appendix G of EFSA recommendations).	Appendix G of EFSA recommendations.
Are search terms and/or search strings specified?	Yes	Outlined in the protocol (Appendix D of Annex A).	Appendix D of Annex A.

Critical appraisal methods and tools

Criteria	Yes/No/ NA	Comment	Page #
Is risk of bias of individual studies assessed and taken into consideration?	Yes	The internal validity or risk of bias (RoB) of each individual study included in the assessment was appraised using a customised version of the Office of Health Assessment and Translation (OHAT) RoB tool developed by the US National Toxicology Program (NTP) (OHAT-NTP, 2015) which is suitable for both RCTs and observational studies.	

Criteria	Yes/No/ NA	Comment	Page #
if yes, what tools are used? if no, was any other method used to assess study quality?		Office of Health Assessment and Translation (OHAT) RoB tool developed by the US National Toxicology Program (NTP) (OHAT-NTP, 2015)	
Does the organisation use a systematic or some other methodological approach to synthesise the evidence (i.e. to assess and summarise the information provided in the studies)?	Yes	Meta-analysis of trials of effects of sodium reduction on SBP and DBP. Dose response modelling	
Does the organisation assess the overall certainty of the evidence and reach recommendations?	Yes	3.8 of Annex A protocol states: "Once the individual studies are appraised for internal validity and after synthesising the evidence, for each sub-question, outcome and line of evidence (i.e. RCTs separately from observational studies), the uncertainty in the body of evidence will be discussed, by considering factors such as the consistency of results, the precision of effect/association estimates and/or dose–response models, the internal validity and external validity (directness, generalisability, applicability) of the included studies." p. 9 of the Guidance states: The principles of the EFSA Scientific Committee guidance documents on uncertainties analysis and on the use of weight of evidence approaches in scientific assessments (EFSA Scientific Committee et al., 2017; EFSA Scientific Committee et al., 2018a; EFSA Scientific Committee et al., 2018b) were applied. Expert judgement was used to weigh the available evidence and take account of the associated uncertainties by means of a formal expert knowledge elicitation (EKE). The EKE allows a representation of the uncertainty about the quantity (parameter) of interest using a probability distribution.	Refer to Annex A, s3.8 and to page 9 of the EFSA Guidelines

Derivation of nutrient reference values

Criteria	Yes/No/ NA	Comment	Page #
Is the method selected to calculate NRV(s) documented and justified? (factorial, dose response or risk assessment)	Partially yes	The Panel considered that there are no appropriate biomarkers of sodium status that can be used for deriving DRVs for sodium. The Panel acknowledged substantial uncertainties associated with evidence for sodium requirements (balance studies) and cardiovascular disease risk reduction. They elected to set a single 'safe and adequate' value (ie. neither an AI nor an SDT or CDDR) that reflects a compromise between the different types of evidence and risks. The 'safe and adequate' value was based on evidence from sodium balance studies and dose-response modelling for SBP, but derived using an Expert knowledge elicitation (EKE) based on probability using the roulette method (EFSA 2014). The method was clearly documented and justified, although it may not align with NHMRC's objectives of establishing both an AI and SDT.	9 ('integration of the available evidence and derivation of DRVs) Appendix M (p. 187) of Guideleines
Are the algorithms and calculations clearly documented and explained?	Yes	The following question was used for the EKE: *What is the lowest level of sodium intake at which the risk of chronic disease (i.e. stroke, CHD) is minimised in the majority (≥ 97.5%) of the general population of adults*? Nature of EKE process is that it is deliberative and pragmatic rather than fully quantitative, so calculations and algorithms are not explicit, although EKE probabilities for sodium balance and SBP are documented in figures. Resulting derivation described on pp. 43-47.	pp. 43-47
Are the assumptions and reference data (intake, body weights for age groups etc) used for the calculations clearly documented and explained?	Yes	The age categories proposed by the EFSA NDA Panel (2010) were applied. For each age category, the Panel decided to set a single value for boys and girls and the average of the values calculated for both sexes was taken (Table 11). There is a lack of data from which an AR could be derived for infants (Section 5.4). Upwards extrapolation from the estimated sodium intake of fully breast-fed infants during the first 6 months of life of 120 mg/day (Section 2.3.4.4), based on ARs for energy of infants aged 3 months (2.0 MJ/day for men and women (EFSA NDA Panel, 2013a)) and 9 months (2.8 MJ/day for men and women (EFSA NDA Panel, 2013b)), results in an estimated sodium intake of 168 mg/day. After rounding to the closest 0.1, an AI of 0.2 g/day is proposed for infants aged 7–11 months.	
Is there justification for the choice of uncertainty and safety factors?	Partially Yes, partially N/A	NRVs derived by group consensus using EKE so no Uncertainty Factor or safety factor formally applied. However, these concepts were built into the consensus approach, with the elicitation focused on the *lowest* level of sodium intake at which the risk of chronic disease (i.e. stroke, CHD) is minimised in the general population. Experts expressed the probability that each of the proposed ranges of sodium intake might include the 'true' level of interest. Therefore, the probability distribution reflects the uncertainty about the level elicited. It does NOT represent the probability (or risk) of sodium 'imbalance' associated to a given range of sodium intake. Ranges that did not receive any probability are not retained in the figure.	pp. 43-47

Criteria	Yes/No/ NA	Comment	Page #
Is justification provided for any clinical/chronic endpoints selected as indictors/outcomes? (Details of endpoints to be provided in a supplementary table.)	Yes	Annex A documents the various outcomes of interest and the rationale for selecting them as end points. The Panel considers that relevant data to inform the setting of DRVs for sodium is provided by: (i) balance studies on sodium (Section 5.2); and (ii) studies informing the relationship between sodium intake and blood pressure level or CVD risk. The Panel considered other relevant endpoints, however these were ultimately excluded from the evidence base used to inform DRV establishment due to the low certainty of evidence or difficulties with interpreting the results relative to sodium.	Annex A, section *2.4 selection of health outcomes*. See also Guidelines section *5 Criteria (endpoints) on which to base dietary reference values*
Is justification provided for the value selected for the reference point^? (including mechanistic evidence, health outcome data, key events, balance studies) ^ refence point is usually the baseline value to which any scaling and uncertainty factors are applied.	Yes	From the literature reviewed in Section 5, there is strong evidence for a positive relationship between sodium and blood pressure levels, which is an established risk factor for CVD risk. The meta-regression dose–response modelling provided evidence for a linear relationship between blood pressure and UNa in the range covered by the eligible studies (ca. 50–200 mmol/day) (Section 5.5.1.2); any increase in blood pressure level is considered adverse. The Panel used the cumulative uncertainty density functions to integrate the evidence and associated uncertainties and derive a reference value for sodium (see Figure 3). The Panel considered that: A sodium intake of 2.0 g/day represents a level of sodium for which there is sufficient confidence that it is associated within a reduced risk of CVD in the general adult population. A sodium intake of 2.0 g/day is likely to allow most of the general population to maintain sodium balance. Therefore, the Panel considers that 2.0 g of sodium/day is a safe and adequate intake for the general EU population of adults.	See Guidelines Section 5.5.1.2
Is the population group generalisable to the Australian and New Zealand population? Where are the underlying studies from?	Yes	Studies were conducted in a range of countries and population groups that are generalisable to the Australian and New Zealand populations. Though included studies do not mention First Nations peoples.	
If scaling was applied – was the method described, along with an appropriate rationale for the chosen method?	Yes	Reference values for children are extrapolated from the reference value for adults based on the energy requirements of the age groups and applying a growth factor. For infants over 6 months of age, an AI is derived by extrapolating the estimated sodium intake of fully breast-fed infants during the first 6 months of life based on the energy requirement of the respective age groups.	
Is the method used appropriate for Australian and New Zealand populations?	Yes		

Criteria	Yes/No/ NA	Comment	Page #
Are the processes used when expert judgement is applied documented and published? (Evidence to decision process used to obtain final conclusions).	Yes	The EKE used the roulette method. This is a formal approach that allows the experts to draw their own distribution of uncertainty on the parameter to be estimated by placing different numbers of plastic counters along the range of possible parameter values conveniently split in subintervals. The judgements were elicited following the Sheffield protocol, in which experts first make separate judgements about the distribution, then share and discuss their distributions, and finally develop a consensus distribution and document their reasoning (EFSA, 2014) Methods are comprehensively described in Appendix M (p. 187) of Guidelines	p. 9 of Guidelines. Appendix M (p. 187) of Guidelines

Suitability for adopting vs adapting

Criteria	Suitability assessment	Comment	Page #
How does the Australian and New Zealand context (e.g. food system, dietary patterns, intakes, status) compare with the jurisdiction in which the NRV under consideration was developed?	Suitable to probably suitable	Analysis presented in EFSA review suggests that intakes in Western Europe and Australia / New Zealand are comparable, ranging from 3.4-3.8g/day (see p. 23 of Guidelines). The Panel notes that sodium chloride added during industrial food processing, discretionary use or food preservation is the major source of dietary sodium in Western diets. This is also true for Australia and New Zealand. The use of an 'safe and adequate intake' instead of separate AI and CDRR values limits the suitability of NRV recommendations for adaptation or adoption, although the evidence base underpinning NRV values has been collected and analysed in a manner aligned with NHMRC requirements.	

Overall conclusions

EFSA have undertaken an extensive search of the evidence for areas where there is a recognised association between levels of sodium and health outcomes. They have given justification for the choice of outcomes and endpoints to use. Evidence on the relationship between sodium intake and level of blood pressure and risk of CVD as well as data from balance studies are used as a basis to determine a safe and adequate intake of sodium of 2.0 g/day for the general population of adults. While other health outcomes (bone health) were investigated, there was not enough evidence to base values on. There is awareness that the mean/median intake of sodium in European adult populations exceeds this value and recommend this value be used to set population goals for reduction in sodium intake.

EFSA did consider the NASEM report and its recommendation of 1.5g/day as an AI. The NASEM also established a Chronic Disease Risk Reduction Intake (CDRR) for sodium, defined as the lowest level of intake for which there was sufficient strength of evidence to characterise a chronic disease risk reduction. In the sodium intake range of 2.3–4.1 g/day (100–178 mmol/day), the strength of evidence was considered high that reducing sodium intake reduces chronic disease risk, based on evidence of reduction in cardiovascular disease incidence, reduction in hypertension incidence, and lowering of systolic and diastolic blood pressure.

The Panel considers that the available evidence cannot be used to determine the sodium requirement nor its distribution in the population (see Section 5); so, an AR and population reference intake (PRI) for sodium cannot be established.

Appendix B – Methods for supplementary evidence searches

Systematic reviews published since 2018

Eligible systematic reviews were those that were published after 1 January 2018, evaluated the relationship between sodium intake and a health outcome of interest, and aligned with the requirements outlined in Table B1. Results from reviews that most closely aligned with the pre-specified review inclusion criteria, or those at low risk of bias, were prioritised for extraction and synthesis.

Table B1 - Review inclusion criteria

Study designs	Systematic reviews published since 1 January 2018 reporting findings from randomised controlled trials and prospectively designed and controlled studies (including quasi-randomised studies and prospective cohort studies). Reviews including a broader range of studies were eligible for inclusion if findings from eligible study designs were separately synthesised. For children and adolescents, systematic reviews including cross-sectional studies and case-control studies will also be considered as supportive evidence, where insufficient evidence is identified from other study designs.
Population	Studies in adults (aged 18+), pregnant and lactating people, and children and adolescents (aged 1 to under 18 years) are eligible for inclusion. Studies in infants <12 months are excluded. Studies recruiting samples based on a specific health condition were excluded, with the exception of hypertensive populations.
Intervention / exposure and comparators	Comparison of higher vs lower sodium intake, measured using 24 hour urinary sodium excretion. Reviews including a broader range of sodium exposure measurement methods were eligible for inclusion if findings from studies that used 24 hour urinary measures were separately synthesised. In children and adolescents, studies measuring intake using overnight urine collection or select dietary assessment methods (standardised 24-hour dietary recalls or food records) are eligible, if there is insufficient evidence from studies that use 24 hour urinary excretion.
Primary outcomes	Systolic blood pressure (all populations) Arterial stiffness (children and adolescents)
Secondary outcomes	Diastolic blood pressure, mean arterial pressure, blood lipids, cardiovascular and renal disease end points
Timing	Intervention / follow-up period is at least 4 weeks for blood pressure and blood lipid outcomes, and 6 months for disease end points.

Searches and screening

Database searches of PubMed, Epistemonikos and the Cochrane library were undertaken to identify eligible reviews. Reference list searching was also undertaken

Search strategies

PubMed

PubMed was searched on 10 November 2025 using the following search string:

("sodium"[Mesh] OR sodium[tiab] OR salt[tiab])

AND

("blood pressure"[Mesh] OR cardiovascular[tiab] OR “blood pressure”[tiab] OR “systolic”[tiab] OR “SBP”[tiab])

AND

("systematic"[filter] OR "meta-analysis"[pt] OR "meta-analysis as topic"[mh] OR "meta analy*"[tw] OR metanaly*[tw] OR metaanaly*[tw] OR "met analy*"[tw] OR "integrative research"[tiab] OR "integrative review*"[tiab] OR "integrative overview*"[tiab] OR "research integration*"[tiab] OR "research overview*"[tiab] OR "collaborative review*"[tiab] OR "collaborative overview*"[tiab] OR "systematic review"[pt] OR "systematic reviews as topic"[mh] OR "systematic review*"[tiab] OR "technology assessment*"[tiab] OR "technology overview*"[tiab] OR "technology appraisal*"[tiab] OR "Technology Assessment, Biomedical"[mh] OR HTA[tiab] OR HTAs[tiab] OR "comparative efficacy"[tiab] OR "comparative effectiveness"[tiab] OR "outcomes research"[tiab] OR "indirect comparison*"[tiab] OR "Bayesian comparison"[tiab] OR (("indirect treatment"[tiab] OR "mixed-treatment"[tiab]) AND comparison*[tiab]) OR Embase*[tiab] OR Cinahl*[tiab] OR "systematic overview*"[tiab] OR "methodological overview*"[tiab] OR "methodologic overview*"[tiab] OR "methodological review*"[tiab] OR "methodologic review*"[tiab] OR "quantitative review*"[tiab] OR "quantitative overview*"[tiab] OR "quantitative synthes*"[tiab] OR "pooled analy*"[tiab] OR Cochrane[tiab] OR Medline[tiab] OR Pubmed[tiab] OR Medlars[tiab] OR handsearch*[tiab] OR "hand search*"[tiab] OR "meta-regression*"[tiab] OR metaregression*[tiab] OR "data synthes*"[tiab] OR "data extraction"[tiab] OR "data abstraction*"[tiab] OR "mantel haenszel"[tiab] OR peto[tiab] OR "der-simonian"[tiab] OR dersimonian[tiab] OR "fixed effect*"[tiab] OR "multiple treatment comparison"[tiab] OR "mixed treatment meta-analys*"[tiab] OR "umbrella review*"[tiab] OR (("multiple paramet*"[tiab]) AND ("evidence synthesis"[tiab])) OR (("multi-paramet*"[tiab]) AND ("evidence synthesis"[tiab])) OR ((multiparameter*[tiab]) AND ("evidence synthesis"[tiab])) OR "Cochrane Database Syst Rev"[Journal] OR "health technology assessment winchester, england"[Journal] OR "Evid Rep Technol Assess (Full Rep)"[Journal] OR "Evid Rep Technol Assess (Summ)"[Journal] OR "Int J Technol Assess Health Care"[Journal] OR "GMS Health Technol Assess"[Journal] OR "Health Technol Assess (Rockv)"[Journal] OR "Health Technol Assess Rep"[Journal])

AND

("2018/01/01"[Date - Publication] : "3000"[Date - Publication])

Epistemonikos

(title:((title:(sodium) OR abstract:(sodium)) OR (title:(salt) OR abstract:(salt)) AND (title:(blood pressure) OR abstract:(blood pressure)) OR (title:(systolic BP) OR abstract:(systolic BP)) OR (title:(SBP) OR abstract:(SBP)))

Filters:

Year from 2018 – 2025

Publication type: Systematic Review

Date of search: 25 Nov 2025

Cochrane library

([mh sodium] OR sodium:ti,ab OR salt:ti,ab) AND ([mh "blood pressure"] OR cardiovascular:ti,ab OR "blood pressure":ti,ab OR systolic:ti,ab OR SBP:ti,ab)

Filter: published from 01/01/2018 – 25//11/2025

Screening and study selection

The results of searches and screening are presented as a PRISMA flow diagram in Figure B1.

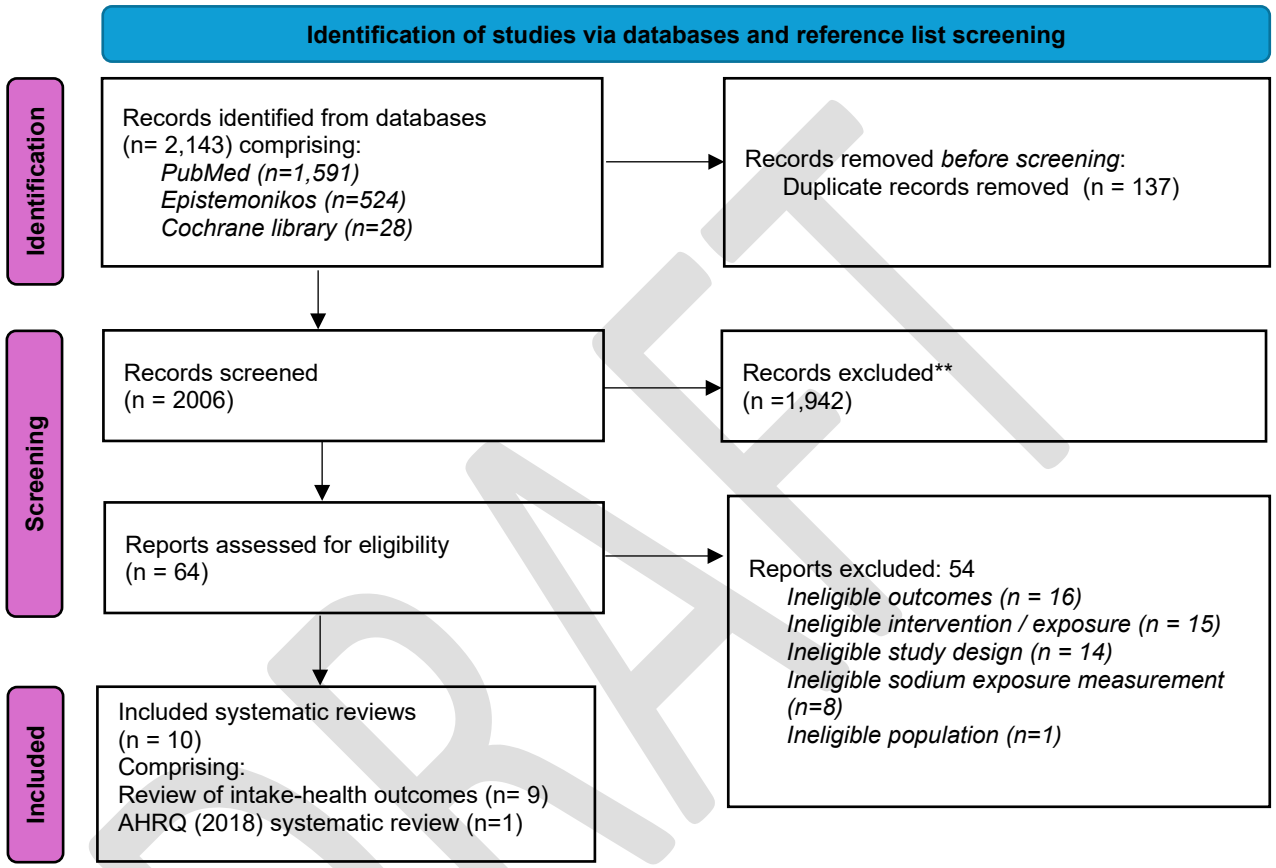

Figure B1 - PRISMA flow diagram showing results of searches, screening and final number of included studies. *Format source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71*

Data extraction and risk of bias assessment

Data extraction and risk of bias assessment was undertaken by KSR Evidence applying the Cochrane Risk of Bias in Systematic Reviews (ROBIS) tool. Extracted data and risk of bias assessments are reported at **Appendix C – Characteristics of supplementary systematic reviews**.

Appendix C – Characteristics of supplementary systematic reviews

Review Characteristics

Reference	Review objectives	Search date	Populations (P), Interventions/Exposures (I/E), Comparators (C), Outcomes (O) and Types of Studies (TS)	Included studies, participants	Risk of Bias
Blood pressure in adults					
Filippini et al. (2021b)	To explore the effect of sodium intake on blood pressure across a wide range of exposures	Database inception to 12 October 2020	P: Participants with and without hypertension but excluding secondary hypertension I/E/C: Low vs high sodium exposure including sodium reduction compared with normal diet or sodium reduction followed by supplementation with sodium or placebo tablets. Change in sodium intake measured using 24-hour urinary sodium excretion before and after the intervention O: SBP or DBP TS: RCTs with a minimum duration of intervention of 4 weeks	85 trials, >10,000 participants	*D1: HIGH* *D2: UNCLEAR* *D3: LOW* *D4: LOW* ***OVERALL: HIGH***
Graudal et al. (2020)	To assess the effects of low- versus high-dietary sodium intake on systolic blood pressure (SBP) and diastolic blood pressure (DBP), and blood concentrations of renin, aldosterone, catecholamines, cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglyceride.	Database inception to 11 April 2018	P: Healthy people or people with hypertension I/E/C: Low vs high sodium intake; low intake defined as low sodium diet or placebo tablets, high intake defined as high sodium diet or salt tablets. Sodium intake measured using 24-hour urine collection or estimated from a sample of at least 8 hours. O: SBP, DBP and blood concentrations of renin, aldosterone, catecholamines, cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglyceride. TS: RCTs; no minimum trial period but additional sub-group analyses performed in studies of at least 7 days duration.	195 trials, 12,296 participants	*D1: LOW* *D2: LOW* *D3: LOW* *D4: LOW* ***OVERALL: LOW***

Reference	Review objectives	Search date	Populations (P), Interventions/Exposures (I/E), Comparators (C), Outcomes (O) and Types of Studies (TS)	Included studies, participants	Risk of Bias
Huang et al. (2020)	To examine the dose-response relation between reduction in dietary sodium and blood pressure change and to explore the impact of intervention duration	Database inception to 21 January 2019	P: Adult populations aged 18 years and over excluding pregnant females, or individuals with confounding chronic conditions such as chronic kidney disease or heart failure. I/E/C: Low vs high sodium intake, measured using 24-hour urinary sodium excretion O: SBP, DBP TS: RCTs; no minimum trial period but additional sub-group analyses performed in studies of at least 2 weeks duration	133 trials, 12,197 participants	*D1: LOW* *D2: LOW* *D3: LOW* *D4: LOW* ***OVERALL: LOW***
Blood pressure in children					
Leyvraz et al. (2018)	To examine the association between sodium intake and blood pressure in children and adolescents	Database inception to 9 March 2017	P: Children or adolescents aged between 0 and 18 years, excluding those in hospital or with any clinical conditions. I/E/C: Comparison or low vs high sodium intake or exposure. No minimum criteria for measuring sodium intake were specified, although studies that reported 24-hour urine collection were judged to be of higher quality. O: SBP, DBP TS: RCTs, non-randomized trials of intereventions (NRSIs), non-controlled trials, crossover trials, cohort studies, case–control studies and cross-sectional studies were included. Ecological studies, case series, case reports, reviews, meta-analyses, policy papers, comments, congress proceedings and animal studies were excluded. Studies of 7 days or less in duration were excluded.	96 reports of 85 studies, 58,531 participants	*D1: HIGH* *D2: LOW* *D3: LOW* *D4: UNCLEAR* ***OVERALL: HIGH***

Reference	Review objectives	Search date	Populations (P), Interventions/Exposures (I/E), Comparators (C), Outcomes (O) and Types of Studies (TS)	Included studies, participants	Risk of Bias
Other cardiovascular outcomes in adults					
Filippini et al. (2022)	To assess the relationship between sodium intake and hypertension risk in cohort studies	Database inception to 21 January 2022	P: Participants without hypertension at baseline I/E/C: Higher vs lower sodium exposure levels; measured using 24-hour urinary excretion or dietary assessment. O: Hypertension incidence TS: Cohort studies, not further described.	11 studies, >100,000 participants	*D1: LOW* *D2: HIGH* *D3: UNCLEAR* *D4: LOW* ***OVERALL: HIGH***
Milajerdi et al. (2019)	To investigate the dose–response association of dietary sodium intake with all-cause and cardiovascular disease mortality	Database inception to August 2017	P: Population age ≥18 years excluding pregnant females or studies in patients with renal diseases, heart failure, cancers, liver diseases, hypertension, cystic fibrosis and chronic obstructive pulmonary disease. I/E/C: Differing levels of sodium intake. Studies measuring sodium intake using both urinary excretion and dietary intake were eligible. O: All-cause or cardiovascular disease mortality, presented as a hazard ratio (HR) or relative risk (RR) with 95% CI of all-cause or/and CVD mortality TS: Prospective cohort studies were sought; RCTs, crossover, cross-sectional and review studies, letters, comments and non-English language articles were excluded.	21 studies, 222,189 participants	*D1: HIGH* *D2: UNCLEAR* *D3: UNCLEAR* *D4: HIGH* ***OVERALL: HIGH***

Reference	Review objectives	Search date	Populations (P), Interventions/Exposures (I/E), Comparators (C), Outcomes (O) and Types of Studies (TS)	Included studies, participants	Risk of Bias
Surma et al. (2025)	To assess the influence of dietary salt intake or urinary sodium excretion on vascular function parameters.	Database inception to January 2025	P: Adult human participants. I/E/C: Low vs high dietary salt intake, assessed using dietary questionnaires or 24-hour urinary sodium excretion. O: Markers of vascular structure and function: carotid intima-media thickness, carotid-femoral pulse wave velocity, and augmentation index. TS: Randomized controlled trials (RCTs), cohort studies, and cross-sectional studies of any duration.	5 studies that measured urinary sodium, 1,984 participants	*D1: HIGH* *D2: HIGH* *D3: HIGH* *D4: HIGH* ***OVERALL: HIGH***
Zhao et al. (2022)	To evaluate the association between 24-hour sodium excretion and cardiovascular disease risk	Database inception to 7 June 2021	P: No target population or age group were specified. Studies in people with kidney disease were excluded. I/E/C: low vs high sodium excretion; low-level excretion defined as < 4 g and high-level excretion ≥ 4 g. Eligible measurement methods included spot urine and 24-hour samples; sub-group analyses reported for 24-hour measurement. O: Endpoints of either combined or single CV events (incidence and mortality) TS: Cohort studies providing adjusted effect estimates and 95% confidence intervals.	9 studies, 645,006 participants	*D1: HIGH* *D2: HIGH* *D3: UNCLEAR* *D4: LOW* ***OVERALL: HIGH***

Reference	Review objectives	Search date	Populations (P), Interventions/Exposures (I/E), Comparators (C), Outcomes (O) and Types of Studies (TS)	Included studies, participants	Risk of Bias
Other cardiovascular outcomes in children and adolescents					
Leed et al. (2023)	To determine whether various dietary factors are associated with arterial stiffness in the paediatric population	Database inception to 4 March 2022	P: Studies in generally healthy children and /or adolescents excluding participants with chronic or genetic disease; studies in overweight or obese participants were included. Studies in participants aged over 18 years were included if the mean age of the sample was <18 years. I/E/C: O: Arterial stiffness, measured as pulse-wave velocity, augmentation index and carotid or brachial artery distensibility TS: Studies that used a cross-sectional, cohort or intervention study design were included.	1 study examined sodium exposure, 614 participants	*D1: HIGH* *D2: LOW* *D3: LOW* *D4: LOW* ***OVERALL: HIGH***

Risk of bias assessments (ROBIS)

Reference	Domain 1 - Study Eligibility Criteria	Domain 2 - Identification and Selection of Studies	Domain 3 - Data Collection and Study Appraisal	Domain 4 - Synthesis and Findings	Overall Risk of Bias	NHMRC Comment
Blood pressure in adults						
Filippini et al. (2021b)	LOW *No concerns*	UNCLEAR *Full search strategies reported although limitations noted, e.g. no free text terms in Embase searches.*	UNCLEAR *No. reviewers involved in RoB assessment and data extraction not reported.*	LOW *No concerns*	**HIGH**	Concerns about RoB relate to limited searches of Embase, although searches appeared otherwise robust (included backward and forward citation searching, searches of PubMed, EMBASE and Cochrane CENTRAL); duplicate screening at Ti/Abs and full text described, however the number of reviewers involved in RoB assessment and data extraction not reported. These limitations raise concerns about whether some studies may have been missed (due to search limitations) or the risk of data extraction errors. However, in view of the large number of studies identified and consistency of findings with other well-conducted reviews, these concerns are not so significant as to exclude the review entirely.
Graudal et al. (2020)	LOW *No concerns*	LOW *No concerns*	LOW *No concerns*	LOW *No concerns*	**LOW**	Although the systematic review was well conducted based on Cochrane review methods, the broad inclusion criteria adopted (sodium intake based on 8h urinary measures; studies of any duration) and approach to analysis (grouped by race and hypertensive status; heterogeneity in the magnitude of sodium reduction across studies not accounted for in analysis) raise concerns about the robustness of findings for the purposes of public health decision making.
Huang et al. (2020)	LOW *No concerns*	LOW *No concerns*	LOW *No concerns*	LOW *No concerns*	**LOW**	Well-conducted systematic review

Reference	Domain 1 - Study Eligibility Criteria	Domain 2 - Identification and Selection of Studies	Domain 3 - Data Collection and Study Appraisal	Domain 4 - Synthesis and Findings	Overall Risk of Bias	NHMRC Comment
Blood pressure in children						
Leyvraz et al. (2018)	HIGH *Conference proceedings were excluded along with publications not in English, French, German or Spanish.* *Detail was missing in the protocol concerning the planned analyses.*	LOW	LOW	UNCLEAR *Analyses stated as pre-defined were performed, but detail was missing in the protocol concerning the planned analyses.*	**HIGH**	Concerns about RoB relate to the exclusion of conference abstracts and studies published in languages other than English, French, German, or Spanish. Given the analytic decisions made (e.g. limiting dose-response to 'high quality measurement' rather than more conventional risk of bias judgements), the lack of detail in pre-specified analyses is a major limitation. The review findings should be interpreted with caution in view of the review's risk of bias.
Other cardiovascular outcomes in adults						
Filippini et al. (2022)	LOW *No concerns*	HIGH *Search strategy deficiencies identified*	UNCLEAR *No. reviewers involved in data extraction not reported.*	LOW	**HIGH**	Concerns about RoB relate to inadequacies in the search strategy employed and a lack of clarity about whether duplicate data extraction was undertaken. These limitations raise concerns about whether some studies may have been missed (due to search limitations) or the risk of data extraction errors. These concerns are not so significant as to exclude the review entirely, although findings should be interpreted with caution in view of the review's risk of bias.
Milajerdi et al. (2019)	HIGH *Non-English language articles were excluded.*	UNCLEAR *A list of databases searched and search terms were provided, but full search strategies not reported.*	UNCLEAR *No. reviewers involved in data extraction and risk of bias assessment not reported.*	HIGH *Residual unexplained heterogeneity.*	**HIGH**	Concerns about RoB relate to the exclusion of non-English language studies, insufficient information about database searches, processes for minimising error in data extraction and risk of bias assessment, and residual unexplained heterogeneity across most outcomes. These limitations raise concerns about whether some studies may have been missed or the risk of errors in data extraction and RoB assessment. Heterogeneity is also a concern. These concerns

Reference	Domain 1 - Study Eligibility Criteria	Domain 2 - Identification and Selection of Studies	Domain 3 - Data Collection and Study Appraisal	Domain 4 - Synthesis and Findings	Overall Risk of Bias	NHMRC Comment
						are not so significant as to exclude the review entirely, although findings should be interpreted with caution in view of the review's risk of bias.
Surma et al. (2025)	HIGH *Conference abstracts were excluded.*	HIGH *Did not report full details of the search strategy or no. reviewers involved in study selection.*	HIGH *No. reviewers involved in data extraction not reported and risk of bias assessment not performed.*	HIGH *No adequate attempts were made to explore high heterogeneity across comparisons. Findings were not robust, and potential biases in included studies not accounted for.*	**HIGH**	Significant concerns about the risk of bias including regarding the comprehensiveness of searches, methods for extracting data, assessing study methodological quality and the overall robustness of review findings. The review is assessed as being of insufficient quality to inform recommendations.
Zhao et al. (2022)	HIGH Non-English publications were excluded	HIGH The reported search strategy was inadequate	UNCLEAR No. reviewers involved in the risk of bias assessment was not reported	LOW	**HIGH**	RoB assessment raises concerns about whether some studies may have been missed (due to exclusion of non-English studies and search strategy limitations) or of errors in RoB assessment. These concerns are not so significant as to exclude the review entirely, although findings should be interpreted with caution in view of the review's risk of bias.
Other cardiovascular outcomes in children and adolescents						
Leed et al. (2023)	HIGH *Limited to studies published in English and excluded conference abstracts*	LOW	LOW	LOW	**HIGH**	The review was well-conducted with the only limitations identified during RoB assessment being the exclusion of non-English studies and conference abstracts. Although these decisions may have led to the omission of relevant studies, these concerns are not significant enough to preclude the use of the review to inform decision making.

Appendix D - Evidence-to-Decision Tables

Evidence-to-Decision Framework – Sodium requirements for nutritional adequacy

Background

Sodium - function and dietary sources

Sodium is an essential mineral that plays a central role in maintaining the body's fluid balance and supporting normal cellular function. Sodium balance is maintained through closely integrated hormonal and neural control systems, with the kidneys playing a central role in homeostasis, adjusting sodium excretion to maintain stable plasma sodium concentration despite large day-to-day variation in intake. Hormones such as aldosterone and angiotensin regulate how much sodium is conserved or lost in urine, while thirst and water retention respond to changes in blood concentration and volume. In healthy individuals, these systems are highly effective, with hyponatraemia (low sodium concentration in blood) typically occurring in the context of disorders of water or electrolyte balance rather than due to inadequate dietary sodium intake (EFSA,2019). In contrast, long-term high sodium intake is strongly linked to increased systolic blood pressure, which is an independent risk factor for cardiovascular disease morbidity and mortality.

Sodium is present in small amounts in all unprocessed foods, including meat and fish (between 30 and 150mg per 100g) and fruits and vegetables (less than 50mg per 100g) (EFSA,2019). However, the predominant source of dietary sodium is through the addition of sodium chloride or 'salt' to foods during manufacturing or processing, cooking or at the table. It has previously been estimated that 80% of Australians' dietary sodium comes from processed foods, with 20% coming from salt used in cooking or added at the table (Boorman, 2008; FSANZ, 2015). Data from the 2023-24 National Nutrition and Physical Activity Survey suggests that almost four in five (78.1%) Australians aged 2 years and over added salt during food preparation or cooking, and almost half (45.5%) added salt at the table (ABS, 2023b). Leading food groups contributing to sodium intake were cereal-based mixed dishes (24.6%), bread and bread rolls (7.0%), processed meat (5.2%), poultry-based mixed dishes (5.2%) and pastries (4.4%)(ABS, 2023b).

Criteria for measuring sodium intake

In healthy people, most dietary sodium is excreted via urine (around 90%), with some sodium lost in sweat and faeces (He & MacGregor, 2010). Estimating sodium intake based on sodium excretion from a 24-hour urine sample is generally considered to be the most robust method (McLean, Farmer, et al., 2018). Methods such as spot urine collection or timed collection (for example, overnight) are subject to greater intra-person variability than 24-hour urine collections and are not considered to be reliable biomarkers of individual sodium intake (Campbell et al., 2019).

Dietary assessment methods have known limitations for estimating nutrient intake, including potential for recall or social desirability bias (Shim et al., 2014; Subar et al., 2015). In addition to these known limitations, there are specific challenges with dietary assessment of sodium. Dietary surveys often fail to include or accurately quantify sodium chloride added to foods during cooking and at the table. Food composition tables may not reflect the sodium content of all foods available in the food supply, including new products and product reformulation.

ADULTS

Options for recommendations under consideration

OPTION 1: Maintain current AI recommendations, updating adult age groupings to align with new reference groups			OPTION 2: Increased AI and updates to adult age groupings to align with new reference groups, *E.g. could select a single value from 1,000 to 1,500 or maintain a range similar to current recommendations.*		
Males	**AI (mg/day)**	**AI (mmol/day)**	**Males**	**AI (mg/day)**	**AI (mmol/day)**
18 to under 30 years	*460 - 920*	*20-40*	18 to under 30 years	*1,000*	*43*
30 to under 50 years	*460 - 920*	*20-40*	30 to under 50 years	*1,000*	*43*
50 to under 65 years	*460 - 920*	*20-40*	50 to under 65 years	*1,000*	*43*
65 to under 75 years	*460 - 920*	*20-40*	65 to under 75 years	*1,000*	*43*
75 years and older	*460 - 920*	*20-40*	75 years and older	*1,000*	*43*
Females	**AI (mg/day)**	**AI (mmol/day)**	**Females**	**AI (mg/day)**	**AI (mg/day)**
18 to under 30 years	*460 - 920*	*20-40*	18 to under 30 years	*1,000*	*43*
30 to under 50 years	*460 - 920*	*20-40*	30 to under 50 years	*1,000*	*43*
50 to under 65 years	*460 - 920*	*20-40*	50 to under 65 years	*1,000*	*43*
65 to under 75 years	*460 - 920*	*20-40*	65 to under 75 years	*1,000*	*43*
75 years and older	*460 - 920*	*20-40*	75 years and older	*1,000*	*43*

Health evidence profile and supporting information

Among the balance studies identified in adults, no studies rigorously measured both intake and losses. There is also significant variability across balance studies, with negative balance reported with intakes from 230 to 2,210 mg/day (3 studies), and positive balance reported with intakes ranging from 1,525 to 15,180 mg/day in adults (8 studies).One balance study that comprehensively measured losses from sweat, faeces and urine reported neutral balance with intakes of 1,525 mg/day under heat stress conditions (40ºC for 10hrs/day for 5 days) whereas strong positive balance was observed under more typical environmental conditions (25ºC for 3 days)(Allsopp et al., 1998). However, this study was limited by imprecise intake measurement. One balance study that adequately measured losses and intake among 11-14 year old adolescents found positive balance with intakes of 1,300 mg/day (Palacios et al., 2004). Although this evidence is not directly generalisable to adults, energy requirements in this group are similar to adult energy requirements and it may therefore provide a useful benchmark.

Eight RCTs were identified with low sodium intake (below 1,800 mg/day) in which no deficiency symptoms were recorded, the majority among hypertensive or pre-hypertensive groups. Four of the identified RCTs were conducted in Australia or New Zealand and reported sodium intakes ranging from 851 to 1,578 mg/day (Beard et al., 1982; Parker et al., 1990; Sciarrone et al., 1992; Todd et al., 2012). Two studies - one conducted in Australia and one in New Zealand - reported no adverse outcomes with mean intakes of around 1,230 mg/day (Sciarrone et al., 1992; Todd et al., 2012).

Finally, contemporary Australian 24-hour urinary sodium excretion data indicate that a sodium intake of 920 mg/d falls within the lower tail of the observed distribution (between the 1st and 5th percentiles), supporting that intakes at this level are observed in apparently healthy, free-living adults (Grimes, 2026).

Collectively, these data support establishment of an AI in the range 851 to 1,500 mg/day, however there is considerable uncertainty around these estimates.

Sodium intake in Australia and New Zealand

There is uncertainty about the median sodium intake among adults in Australia and New Zealand. Where available, national nutrition data is based on dietary recall and does not factor in discretionary salt. Based on 24-hour urinary measures reported by studies among a convenience sample of the population, intake may be significantly higher than national data suggests. Based on the body of evidence, it is reasonable to estimate that population intakes exceed 3,000 mg/day in adults in both countries. Even among older women – who typically have the lowest sodium intakes of the adult population – Australian data estimates intake at 1,780 mg/day. These data suggest that adults in Australia and New Zealand have no difficulty in achieving adequate sodium intake from dietary sources.

Benchmarking against comparable international jurisdictions

The US NASEM established an adult AI value of 1,500 mg/day for healthy adults not engaged in high-intensity physical activity, based on:

- the Dietary Approaches to Stop Hypertension (DASH) sodium-reduction trial in 412 participants, which reported no symptoms of deficiency among participants with a mean intake of 1,449 mg/day (Sacks et al., 2001)
- a balance study reporting that intakes of 1,525 mg/day resulted in either neutral (extreme heat conditions) or positive balance (typical environmental conditions).

The US AI value of 1,500 mg/day was adopted by the 2023 Nordic Nutrition Recommendations.

Instead of establishing an AI, EFSA established a 'safe and adequate' intake; a hybrid NRV reflecting a level of intake that is sufficient for maintaining sodium balance, and associated with a reduced risk of adverse health effects. The value of 2,000 mg/day was selected for all adults, however it should be noted that this value is not directly comparable with an AI, being – per definition – in excess of that required for requirement alone.

Age (years)	Aust/NZ – Potential change AI (mg/day)	Aust/NZ - Current (NHMRC 2006) AI (mg/day)	European Union (EFSA 2019) 'Safe and Adequate' (mg/day)*	United States (NASEM 2018) AI (mg/day)	Nordic and Baltic (NNR 2023) AI (mg/day)	Germany, Austria, Switzerland (DACH 2013) AI (mg/day)
Adults 18 +years:	1,000*	460-920	2,000*	1,500	1,500	1,500^

^ D-A-CH age grouping for adults is 19 years and older

* Value of 1,000 mg/day is notional. Any value between current range of 460 – 920 mg and 1,500 mg/day potentially under consideration.

Balance of effects (benefits and harms)

The basis for current AI recommendations is not robust nor methodologically sound, with values based on data from three individuals or based on restricted diets which may not represent typical intakes and may not account for individual variability within the population. Consequently, even if the current values are to be retained, they must be supported by more robust evidence aligned with the conceptual basis for deriving an Adequate Intake (AI) recommendation.

Several factors should be considered when weighing the body of evidence to derive an AI. Firstly, the AI is not the same as an EAR. Whereas the EAR and RDI reflect estimated requirements of half (EAR) and almost all (97.5% RDI) of apparently healthy individuals within a population group, the AI represents the average daily nutrient intake level by a group of apparently healthy people (NHMRC 2025). Because an AI is typically derived from the average intake of apparently healthy populations, the location of an AI on the requirement distribution may be higher than where the RDI falls, that is, it may be higher than requirements for most individuals within the population. In the context of sodium, this circumstance presents some challenges, with current average intakes in Australia and New Zealand typically exceeding recommendations for reducing the risk of chronic disease. Therefore, it is not appropriate to

establish the AI based on local population data, which would embed an increased risk of chronic disease within adequacy recommendations (ie. the population does not meet the requirement of an 'apparently healthy' population due to the increased chronic disease risk that accompanies higher population sodium intakes).

Although the lower bound of the current AI (460 mg/day) may be too low to reflect adequate population intakes, the upper bound (920 mg/day) is not inconsistent with the available evidence, with low sodium dose trials finding no adverse outcomes with mean intakes in the range of 851 and 1,794 mg/day (Newberry et al., 2018).

In establishing an AI, key public health objectives must also be considered. The limited available data suggest that most Australian and New Zealand adults have sodium intakes that exceed the current Suggested Dietary Target (SDT) of 2,000 mg/day, and hyponatraemia is primarily driven by clinical factors rather than low dietary sodium intake. Therefore, overwhelmingly the potential for harm from dietary sodium exposure comes from excessive intakes and the increased risk of elevated blood pressure, rather than inadequate intakes. Cardiovascular disease remains a leading cause of death and morbidity in Australia and New Zealand, with both high blood pressure and dietary risks leading factors for total CVD burden (AIHW, 2025; IHME, 2024). These contextual factors reinforce the need to establish an AI at a value that ensures that requirements for adequacy are met, without undermining the broader public health messaging regarding the benefits of reduced sodium intake for chronic disease prevention.

If the AI were raised, there is potential for healthy individuals with low sodium intakes to interpret this as their intakes being 'inadequate' and increasing intake unnecessarily. Additional consideration should be given to not excessively narrowing the interval between the AI and the proposed Chronic Disease Risk Reduction value (CDRR previously SDT), to allow sufficient flexibility in the range of diets that individuals may consume to meet these requirements.

Certainty of the evidence

There is a lack of robust evidence to support recommendations about sodium intake requirements for avoiding deficiency. The body of evidence from balance studies have notable limitations for reliably estimating sodium requirements, including significant variability across studies, and methodological limitations of balance studies.

The Agency for Healthcare Research and Quality (AHRQ 2018) found low certainty evidence from 3 RCTs that sodium reduction has no effect on blood lipids. However, no quantitative analysis was reported. The evidence was rated 'insufficient' for a range of other outcomes (dizziness, headache, insulin sensitivity, muscle cramping).

Values, preferences and feasibility (consumers, communities)

Values and preferences

No relevant factors regarding individual values and preferences have been identified in respect of establishing an Adequate Intake.

Feasibility

Relevant food modelling data from 2011 are shown at Table 23. The limitations of this modelling should be considered, including that it may not reflect current eating patterns, or changes in the food supply (including sodium reduction in a range of food products). The data suggest that across the range of

diets modelled, most exceed the current Adequate Intake of 460-920 mg/day. Notably, intakes from foundation diets – which do not include discretionary food nor discretionary salt – are around 1,000 to 1,300 mg/day. This may suggest that it is less feasible (although not impossible) to achieve a nutritionally balanced diet with sodium intakes aligned with the lower bound of the current AI range (460mg/day). This modelling should be interpreted with caution given the significant time elapsed since modelling was undertaken, and noting changes in both dietary patterns and sodium in the food supply since this time. This modelling predates the Healthy Food Partnership (HFP) program, so it does not reflect any reformulation-related reductions in sodium in the food supply, with associated reductions in the sodium content of participating products estimated at 4.3% (ABS, 2025).

Table 21 - Food modelling data in adults (NHMRC 2011)

Age group (years)	Core food groups (mg/day)	Intake from AGTHE98^ *(Core foods using whole dietary approach)* (mg/day)		Foundation diets								7 day Total Diets			
				Overall (mg/day)		Intake from rice-based diets (mg/day)		Intake from pasta-based diets (mg/day)		Intake from lacto-ovo-vego diets (mg/day)		Mid energy level (average height, light-moderate activity) (mg/day)		High energy level (tallest, highest activity) (mg/day)	
	All	F	M	F	M	F	M	F	M	F	M	F	M	F	M
19-30 yr	700	1,223 to 2182	1,606 to 2,756	1405	1411	926	998	1159	1338	1411	1296	1711 to 1986	1865 to 2213	2239 to 2550	2270 to 2799
31-50 yr				1395	1452	919	1044	1140	1381	1452	1318	1580 to 1836	1854 to 2180	1928 to 2150	2258 to 2656
51-70 yr		1,223 to 1,798	1,222 to 2,181	1330	1502	1030	1053	1074	1298	1502	1342	1482 to 1817	1769 to 2066	1933 to 2421	2018 to 2576
70+ yr				1178	1265	1014	980	988	1208	1265	1176	1444 to 1602	1507 to 2025	1877 to 2142	1949 to 2365

Resource impacts

Retaining the current values for adults has no material implications. Although adult age groupings are being adjusted to align with new NRVs age groupings (see Methodological Framework; NHMRC 2025), the adult AIs are the same for all age groups so there is no material impact of this change. Consequently, this minor change to age groupings should have no implications for regulators, including FSANZ (food and food products) and TGA (supplements).

In contrast, increasing the recommended AI for adults may have implications for regulators, including FSANZ (food and food products) and the TGA (supplements). However, if an increase is recommended, views can be sought during targeted/stakeholder consultation and considered when determining final NRVs.

Other factors (health equity impacts, sustainability, nutrient interactions)

Equity impacts

Equity impacts relating to sodium consumption predominantly relate to excess sodium consumption among vulnerable groups. Consequently no specific considerations have been identified relevant to achieving an Adequate Intake.

Other nutrients

Sodium is widespread in the basic food supply and consequently the AI must also factor in the balanced nutrient intake for other essential nutrients across the diet as a whole. Establishing the AI at a level that can only be achieved with a restricted dietary intake may have adverse impacts on the ability to achieve requirements for other essential nutrients. The food modelling data above suggests that this may be a relevant factor for intakes on the lower bound of current recommendations (460 mg/day).

Although sodium interacts closely with potassium, chloride and calcium, these nutrient interactions are not sufficiently characterised to inform sodium NRV establishment (EFSA, 2019; NASEM, 2019).

Decision

An AI of 920 mg/day to be established to align with the current upper bound of the adult AI range, for the following reasons:

- there is no evidence to suggest that intakes at this level are insufficient to meet physiological requirements
- this level exceeds the lowest mean intake reported by RCTs showing no adverse effects of low sodium intake (851 mg/day reported in Beard et al. (1982))
- alignment with existing recommendations supports consistent public health messaging regarding the harms of excessive sodium intake. This avoids confusion that may arise if the AI were increased, which may be misinterpreted as a need for higher intake levels in a context where population intakes already exceed requirements and – for many individuals – chronic disease risk reduction targets
- contemporary Australian 24-hour urinary sodium excretion data indicate that a sodium intake of 920 mg/d falls within the lower tail of the observed distribution (between the 1st and 5th percentiles), supporting that intakes at this level are observed in apparently healthy, free-living adults (Grimes, 2026).

PREGNANCY

Although there is a small additional requirement of sodium associated with foetal and maternal tissue accretion over the course of pregnancy, this is minimal and readily accommodated by normal homeostatic mechanisms, including increased renal sodium conservation. Consistent with approaches taken by NASEM (2019) and EFSA (2019), no distinct dietary sodium requirement for pregnancy is specified, and recommendations are aligned with those for non-pregnant adults. This reflects the absence of evidence demonstrating increased dietary needs in pregnancy and the capacity for physiological regulation to maintain sodium balance across a wide range of intakes.

LACTATION

Sodium is excreted in breast milk during lactation; however, the concentration of sodium in milk is regulated by physiological mechanisms within the mammary gland, largely determined by electrochemical gradients rather than maternal dietary intake. As a result, maternal sodium intake has limited influence on the sodium content of breast milk. On this basis, both NASEM (2019) and ESFA (2019) concluded that there is no evidence to suggest that sodium requirements during lactation differ from those of non-pregnant, non-lactating adults. Accordingly, no separate requirement is specified, and sodium recommendations for lactating women are aligned with those for the general adult population.

CHILDREN AND ADOLESCENTS

Options for recommendations under consideration

OPTION 1: Maintain current AI recommendations, include additional school-age groupings in Appendix.			OPTION 2: Increased AI (extrapolated from adult recommendations), include additional school-age groupings in Appendix.		
	AI (mg/day)	**AI (mmol/day)**		**AI (mg/day)**	**AI (mg/day)**
1 to under 4 years	*200 - 400*	*9-17*	1 to under 4 years	*400*	*17*
4 to under 9 years	*300 – 600*	*13-26*	4 to under 9 years	*600*	*26*
9 to under 14 years	*400 – 800*	*17-34*	9 to under 14 years	*800*	*34*
14 to under 18 years	*460 - 920*	*20-40*	14 to under 18 years	*920*	*40*
Alternative school-age groupings			**Alternative school-age groupings**		
12 to under 24 months	*200 – 350*	*9 – 15*	12 to under 24 months	*350*	*15*
2 to under 5 years	*250 – 500*	*11 – 22*	2 to under 5 years	*500*	*22*
5 to under 12 years	*350 – 700*	*15 – 30*	5 to under 12 years	*700*	*30*
12 to under 18 years	*450 - 920*	*20 - 40*	12 to under 18 years	*920*	*40*

Health evidence profile and supporting information

The evidence for sodium requirements in children and adolescents is very limited, with only a single balance study identified in girls aged 11 to 15 years. The study had robust measurement of intake and losses, and found positive balance with intakes between 1,300 and 4,000 mg/day (Palacios et al., 2004). However, both NASEM (2019) and EFSA (2019) have raised concerns about the validity of balance studies for determining sodium requirements, concluding that they could not be used to derive sodium requirements, although they provide supportive evidence about the intake level that is adequate for null sodium balance.

Due to this lack of evidence, Adequate Intakes in children and adolescents must be extrapolated from adult values.

Consistent with previous approaches and the US NASEM (2019) methods, values for children and adolescents in Australia and New Zealand have been extrapolated on the basis of relative energy requirements, using the formula:

$AI_{child} = AI_{adult} \times (EER_{child} / EER_{adult})$

Calculations and resulting values (both un-rounded and rounded) are provided in Table 24 below. This includes new alternative age groupings which are to be included in future NRV iterations to facilitate reporting of usual intake data from national nutrition survey results against NRV recommendations. These recommendations will be presented in a separate appendix to prevent confusion amongst stakeholders about which are the prevailing recommendations for each age group.

Table 22 - Data inputs and resulting extrapolation of adult values (current vs proposed) to children and adolescents

Age group	A Current AI_{adult}	B Alternative AI_{adult}	C EER_{child}	D EER_{adult}	E = A x (C/D) Calculated current AI_{child}	F = E + rounding Current Rounded AI_{child}	G = B x (C/D) Calculated Alternative AI_{child}	H = G + rounding Alternative Rounded AI_{child}
1 to under 4 years	460 - 920	920	4.4	10.3	195 – 390	**200 - 400**	390	**400**
4 to under 9 years			6.4		284 – 569	**300 - 600**	569	**600**
9 to under 14 years			9.0		401 – 801	**400-800**	801	**800**
14 to under 18 years			11.1		495 - 991	**460-920**	991	**920**
Alternative age groupings								
12 to under 24 months	460 - 920	920	3.9	10.3	172 – 345	**200 – 350**	345	**350**
2 to under 5 years			5.2		230 – 460	**250 – 500**	460	**500**
5 to under 12 years			7.2		319 – 639	**350 – 700**	639	**700**
12 to under 18 years			10.0		447 - 895	**450 - 920**	895	**920**

Sodium intake in Australia and New Zealand

Recent national data from Australia found mean intakes of 1,521 mg/day for 2–4 year olds; 2,188 mg/day for 5–11 year olds; and 2,903 mg/day for 12–17 year olds. However, these estimates are derived from 24-hour dietary recall and do not include discretionary added salt and are likely to underestimate true intake. Consistent with this limitation, data from Australian studies using 24-hour urinary sodium excretion report substantially higher intakes (approximately 2,369 to 2,440 mg/day among children aged 4–12 years).

In New Zealand, sodium intake data for children are primarily derived from the 2016 New Zealand Total Diet Study (NZTDS), which uses modelled diets and food composition data. Estimated intakes range from 1,361 mg/day (1–3 years) to 2,877 mg/day (boys aged 11–14 years), with all age groups exceeding 100% of the UL (121–144%). Although modelled, these estimates are supported by the limited available biomarker data: a 24-hour urinary sodium study in children aged 8–13 years reported a mean intake of 2,420 mg/day.

Overwhelmingly the available data suggest that the predominant public health concern in Australia and New Zealand is not low or inadequate sodium intakes, but high intakes and the associated risk of chronic disease.

Benchmarking against comparable international jurisdictions

There is some variability across international recommendations for adequacy in children and adolescents, as shown in Table 25. However, as all values have been derived from adult values, this variation arises from differing adult reference values, or the application of differing approaches or inputs during extrapolation. For example, the US NASEM, NNR and D-A-CH values are all extrapolated from an adult value of 1,500. However, the D-A-CH values are notably lower, as they were extrapolated using relative body weight and applying a growth factor, whereas the US NASEM extrapolated using relative energy requirements. In contrast, the value from EFSA represents a 'safe and adequate' intake which is a hybrid measure encompassing adequate intake and chronic disease risk reduction; while presented for completeness, it is not directly comparable to an adequate intake value. Values for children were extrapolated based on relative energy requirements plus allowing for a growth factor.

The current AI range for Australia and New Zealand is notably lower than NRVs from comparable jurisdictions, particularly for the lower bound of requirements.

Table 23 - Comparison of Adequate Intake recommendations for Australia and New Zealand (current and potential revised) against NRVs from comparable international jurisdictions

	Australia & New Zealand (NHMRC, 2006b)		United States (NASEM, 2019)	European Union (EFSA, 2019)	NNR 2023 (Blomhoff et al., 2023)	D-A-CH Germany, Austria & Switzerland (Strohm et al., 2018)
	Potential revised AI	Current AI	AI	'Safe and Adequate'[#]	AI	AI
Age group	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day
1 yr	400	200-400	800	1,100	NS	400
2 yr						
3 yr						
4 yr	600	300-600	1,000	1,300		500
5 yr						
6 yr						
7 yr				1,700		750
8 yr						
9 yr	800	400-800	1,200			
10 yr						1,100
11 yr						
12 yr						
13 yr				2,000		1,400
14 yr	920	460-920	1,500			
15 yr						1,500^
16 yr						
17 yr						

Balance of effects (benefits and harms)

By definition, the AI does not represent a true requirement; rather, it reflects an adequate intake based on observed intakes in apparently healthy populations and may exceed the needs of most individuals. However, for sodium using observed population intakes among children and adolescents to set an Adequate Intake is problematic, as current average intakes are high (exceeding recommendations) and associated with increased chronic disease risk. The evidence for sodium requirements in children and adolescents is limited and methodologically weak, and does not provide a strong empirical basis for determining requirements.

The prevailing determinant of AI recommendations in children and adolescents is therefore the adult AI, from which values for children and adolescents can be extrapolated. There is some allowance for rounding to smooth transitions between age groupings.

In this context, recommendations for children must balance ensuring adequacy of intake, and avoiding unintended endorsement of higher intakes that could increase long-term risk (e.g. elevated blood pressure and cardiovascular disease). There should also be a sufficient interval between adequacy values and the CDRR to allow flexibility in dietary patterns.

Certainty of the evidence

There is insufficient evidence from balance studies and other sources to guide a recommendation about sodium requirements in children and adolescents.

Values, preferences and feasibility (consumers, communities)

Values and preferences

Most Australian and New Zealand children consume sodium in amounts in excess of current recommendations and sodium is widely available within the local food supply. Consequently, the broader public health challenge lies in supporting the population to achieve intakes within the recommended levels to prevent chronic disease. No specific factors regarding values and preferences have been identified in respect of establishing an Adequate Intake.

Feasibility

Data from food modelling are presented at Table 26. Although the modelling data suggest that it is very feasible for children to achieve intakes greater than required for adequacy, in most cases the modelled intakes substantially exceed the AI. This may suggest that it is less feasible (though not impossible) to achieve intakes aligned with the lower range of the AI recommendation. This modelling should be interpreted with caution given the significant time elapsed since modelling was undertaken, and noting changes in both dietary patterns and sodium in the food supply since this time. This modelling predates the Healthy Food Partnership (HFP) program, so it does not reflect any reformulation-related reductions in sodium in the food supply, with associated reductions in the sodium content of participating products estimated at 4.3% (ABS, 2025).

Table 24 - Estimated sodium intake based on food modelling data for children and adolescents (NHMRC, 2011)

Age group (years)	Core food groups ^ (mg/day)	Intake from AGTHE98^ (mg/day)	Foundation diets								7-day Total Diet			
			Overall (mg/day)		Intake from rice-based diets (mg/day)		Intake from pasta-based diets (mg/day)		Intake from lacto-ovo-vego diets (mg/day)		Mid energy level (average height, light-moderate activity) (mg/day)		High energy level (tallest, highest activity) (mg/day)	
	All	All	F	M	F	M	F	M	F	M	F	M	F	M
13-23 mo	NR	NR	701	716	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
2 - 3 yr	NR	NR	806	821	NR	NR	NR	NR	666	798	849 to 946	950 to 1077	1027 to 1178	1196 to 1329
4 - 8 yr	441^	1321 to 1705	952	1007	NR	NR	NR	NR	776	865	1090 to 1282	1131 to 1406	1408 to 1621	1529 to 1790
9 - 11 yr	556^	1571 to 2147	1189	1175	831	751	1048	989	1054	916	1231 to 1458	1330 to 1434	1502 to 1811	1613 to 1987
12 - 13 yr	688^	1504 to 2654	1379	1456	1017	970	1204	1094	1107	1124	1470 to 1749	1563 to 1878	1819 to 2127	1978 to 2184
14 - 18 yr			1723	1635	1151	1062	1414	1271	1579	1375	1770 to 2137	2005 to 2296	2241 to 2559	2499 to 2644

Resource impacts

There are no resource impacts associated with retaining the current AI values.

In contrast, revising the recommended AI may have implications for policy makers to ensure appropriate public health standards, interventions and messaging and regulators, including FSANZ (food and food products) and the TGA (supplements). However, if an increase is recommended, views can be sought during targeted/stakeholder consultation and considered when determining final NRVs.

Other factors (health equity impacts, sustainability, nutrient interactions)

Equity impacts

Equity impacts relating to sodium consumption predominantly relate to excess sodium consumption among vulnerable groups. Consequently no specific considerations have been identified relevant to achieving an Adequate Intake.

Other nutrients

Sodium is widespread in the basic food supply and consequently the Adequate Intake must also support achievement of balanced nutrient intake across all essential nutrients from whole diets. Establishing the AI at a level that can only be achieved with a highly restricted dietary intake may have adverse impacts on the ability to achieve requirements for other essential nutrients.

Although sodium interacts closely with potassium, chloride and calcium, these nutrient interactions are not sufficiently characterised to inform sodium NRV establishment (EFSA, 2019; NASEM, 2019).

Decision

Values to be extrapolated from the adult AI of 920mg/day in the absence of sufficient evidence from which to derive a recommendation for children and adolescents.

References

Australian Bureau of Statistics. (2023). *National Nutrition and Physical Activity Survey: Food and nutrients* (https://www.abs.gov.au/statistics/health/food-and-nutrition/food-and-nutrients/2023

Beard, T. C., Cooke, H. M., Gray, W. R., & Barge, R. (1982). Randomised controlled trial of a no-added-sodium diet for mild hypertension. *Lancet*, *2*(8296), 455-458. https://doi.org/10.1016/s0140-6736(82)90491-3

Blomhoff, R., Andersen, R., Arnesen, E., Christensen, J., Eneroth, H., Erkkola, M., Gudanaviciene, I., Høyer-Lund, A., Lemming, E., Meltzer, H., Pitsi, T., Siksna, I., Thorsdottir, I., & Trolle, E. (2023). *Nordic Nutrition Recommendations 2023*. https://doi.org/10.6027/nord2023-003

Boorman, J., Cunningham, J., Mackerras, D. (2008). *Salt Intake from Processed Food and Discretionary Use in Australia*. ACT, Australia: FSANZ Retrieved from https://www.foodstandards.gov.au/sites/default/files/consumer/nutrition/salthowmuch/Documents/Salt_Intake_5.pdf

Campbell, N. R. C., He, F. J., Tan, M., Cappuccio, F. P., Neal, B., Woodward, M., Cogswell, M. E., McLean, R., Arcand, J., MacGregor, G., Whelton, P., Jula, A., L'Abbe, M. R., Cobb, L. K., & Lackland, D. T. (2019). The International Consortium for Quality Research on Dietary Sodium/Salt (TRUE) position statement on the use of 24-hour, spot, and short duration (<24 hours) timed urine collections to assess dietary sodium intake. *J Clin Hypertens (Greenwich)*, *21*(6), 700-709. https://doi.org/10.1111/jch.13551

European Food Safety Authority. (2019). Dietary Reference Values for Sodium. *EFSA Journal*, *17*(9), :e05778. https://doi.org/https://doi.org/10.2903/j.efsa.2019.5778

Food Standards Australia New Zealand, F. (2015, 26/11/2025). *How much sodium do Australians eat?* FSANZ. Retrieved 31/03/2026 from https://www.foodstandards.gov.au/consumer/nutrition/sodium-salt/salthowmuch

He, F. J., & MacGregor, G. A. (2010). Reducing population salt intake worldwide: from evidence to implementation. *Prog Cardiovasc Dis*, *52*(5), 363-382. https://doi.org/10.1016/j.pcad.2009.12.006

McLean, R. M., Farmer, V. L., Nettleton, A., Cameron, C. M., Cook, N. R., Woodward, M., & Campbell, N. R. C. (2018). Twenty-Four-Hour Diet recall and Diet records compared with 24-hour urinary excretion to predict an individual's sodium consumption: A Systematic Review. *J Clin Hypertens (Greenwich)*, *20*(10), 1360-1376. https://doi.org/10.1111/jch.13391

National Academies of Sciences, E., and Medicine. (2019). *Dietary Reference Intakes for Sodium and Potassium* (H. M. Oria M, Stallings VA,, Ed.). National Academies Press (US). https://www.ncbi.nlm.nih.gov/sites/books/NBK545445/

National Health and Medical Research Council, N. (2006). *Nutrient Reference Values for Australia and New Zealand*. Canberra: NHMRC Retrieved from https://www.nhmrc.gov.au/about-us/publications/nutrient-reference-values-australia-and-new-zealand-including-recommended-dietary-intakes

Palacios, C., Wigertz, K., Martin, B. R., Jackman, L., Pratt, J. H., Peacock, M., McCabe, G., & Weaver, C. M. (2004). Sodium retention in black and white female adolescents in response to salt intake. *J Clin Endocrinol Metab*, *89*(4), 1858-1863. https://doi.org/10.1210/jc.2003-031446

Parker, M., Puddey, I. B., Beilin, L. J., & Vandongen, R. (1990). Two-way factorial study of alcohol and salt restriction in treated hypertensive men. *Hypertension*, *16*(4), 398-406. https://doi.org/10.1161/01.hyp.16.4.398

Sacks, F. M., Svetkey, L. P., Vollmer, W. M., Appel, L. J., Bray, G. A., Harsha, D., Obarzanek, E., Conlin, P. R., Miller, E. R., 3rd, Simons-Morton, D. G., Karanja, N., & Lin, P. H. (2001). Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med*, *344*(1), 3-10. https://doi.org/10.1056/nejm200101043440101

Sciarrone, S. E., Beilin, L. J., Rouse, I. L., & Rogers, P. B. (1992). A factorial study of salt restriction and a low-fat/high-fibre diet in hypertensive subjects. *J Hypertens*, *10*(3), 287-298. https://doi.org/10.1097/00004872-199203000-00013

Shim, J. S., Oh, K., & Kim, H. C. (2014). Dietary assessment methods in epidemiologic studies. *Epidemiol Health*, *36*, e2014009. https://doi.org/10.4178/epih/e2014009

Strohm, D., Bechthold, A., Ellinger, S., Leschik-Bonnet, E., Stehle, P., & Heseker, H. (2018). Revised Reference Values for the Intake of Sodium and Chloride. *Ann Nutr Metab*, *72*(1), 12-17. https://doi.org/10.1159/000484355

Subar, A. F., Freedman, L. S., Tooze, J. A., Kirkpatrick, S. I., Boushey, C., Neuhouser, M. L., Thompson, F. E., Potischman, N., Guenther, P. M., Tarasuk, V., Reedy, J., & Krebs-Smith, S. M. (2015). Addressing Current Criticism Regarding the Value of Self-Report Dietary Data. *J Nutr*, *145*(12), 2639-2645. https://doi.org/10.3945/jn.115.219634

Todd, A. S., Macginley, R. J., Schollum, J. B., Williams, S. M., Sutherland, W. H., Mann, J. I., & Walker, R. J. (2012). Dietary sodium loading in normotensive healthy volunteers does not increase arterial vascular reactivity or blood pressure. *Nephrology (Carlton)*, *17*(3), 249-256. https://doi.org/10.1111/j.1440-1797.2011.01550.x

Evidence-to-Decision Framework – Chronic Disease Risk Reduction target for sodium

Background

Sodium - function and dietary sources

Sodium is an essential mineral that plays a central role in maintaining the body's fluid balance and supporting normal cellular function. Sodium balance is maintained through closely integrated hormonal and neural control systems, with the kidneys playing a central role in homeostasis, adjusting sodium excretion to maintain stable plasma sodium concentration despite large day-to-day variation in intake. Hormones such as aldosterone and angiotensin regulate how much sodium is conserved or lost in urine, while thirst and water retention respond to changes in blood concentration and volume. In healthy individuals, these systems are highly effective; these homeostatic mechanisms mean that acute effects of sodium excess from dietary intake are uncommon, typically arising from high sodium chloride ingestion (e.g. self-poisoning) or from clinical parenteral nutrition. Indeed, hypernatremia (high serum sodium concentration) typically results from dehydration rather than high sodium intake.

Sodium is present in small amounts in all unprocessed foods, including meat and fish (between 30 and 150mg per 100g) and fruits and vegetables (less than 50mg per 100g) (EFSA,2019). However, the predominant source of dietary sodium is through the addition of sodium chloride or 'salt' to foods during manufacturing or processing, cooking or at the table. It has previously been estimated that 80% of Australians' dietary sodium comes from processed foods, with 20% coming from salt used in cooking or added at the table (Boorman, 2008; FSANZ, 2015). Data from the 2023-24 National Nutrition and Physical Activity Survey suggests that almost four in five (78.1%) Australians aged 2 years and over added salt during food preparation or cooking, and almost half (45.5%) added salt at the table (ABS, 2023b). Leading food groups contributing to sodium intake were cereal-based mixed dishes (24.6%), bread and bread rolls (7.0%), processed meat (5.2%), poultry-based mixed dishes (5.2%) and pastries (4.4%)(ABS, 2023b).

Health effects of excess

Acute sodium toxicity is rare but may occur in situations of very high sodium exposure, most often involving ingestion (such as deliberate self-poisoning) or parenteral administration in clinical settings. Hypernatraemia - a high serum sodium concentration above 145 mmol/L - is generally associated with inadequate fluid balance (e.g. dehydration) rather than excessive sodium intake.

However, sustained high sodium intake increases the risk of chronic disease, and is strongly associated with elevated blood pressure - a major risk factor for cardiovascular and kidney disease - along with other outcomes including gastric cancer, obesity, osteoporosis and Meniere's disease (EFSA, 2019; NASEM, 2019; Newberry et al., 2018; WHO, 2026).

The primary end point for establishing a sodium chronic disease risk reduction (CDRR) target is blood pressure, with strong evidence of a relationship between increasing sodium intake and elevated blood pressure which is in turn a key risk factor for a range of cardiovascular disease outcomes. Other relevant end points include other cardiovascular outcomes including arterial stiffness, blood lipids and cardiovascular disease, as well as kidney function or kidney disease.

Criteria for measuring sodium intake

In healthy people, most dietary sodium is excreted via urine (around 90%), with some sodium lost in sweat and faeces (He & MacGregor, 2010). Estimating sodium intake based on sodium excretion from a 24-hour urine sample is generally considered to be the most robust method (McLean, Farmer, et al., 2018). Methods such as spot urine collection or timed collection (for example, overnight) are subject to greater intra-person variability than 24-hour urine collections and are not considered to be reliable biomarkers of individual sodium intake (Campbell et al., 2019).

Dietary assessment methods have known limitations for estimating nutrient intake, including potential for recall or social desirability bias (Shim et al., 2014; Subar et al., 2015). In addition to these known limitations, there are specific challenges with dietary assessment of sodium. Dietary surveys often fail to include or accurately quantify sodium chloride added to foods during cooking and at the table. Food composition tables may not reflect the sodium content of all foods available in the food supply, including new products and product reformulation.

ADULTS

Options for recommendations under consideration

OPTION 1: Maintain current CDRR (formerly SDT) recommendations, updating adult age groupings to align with new reference groups			OPTION 2: Increase CDRR (formerly SDT) recommendations, updating adult age groupings to align with new reference groups, E.g.		
Males	**CDRR (mg/day)**	**CDRR (mmol/day)**	**Males**	**CDRR (mg/day)**	**CDRR (mmol/day)**
18 to under 30 years	*2000*	*86*	18 to under 30 years	*2,300*	*100*
30 to under 50 years	*2000*	*86*	30 to under 50 years	*2,300*	*100*
50 to under 65 years	*2000*	*86*	50 to under 65 years	*2,300*	*100*
65 to under 75 years	*2000*	*86*	65 to under 75 years	*2,300*	*100*
75 years and older	*2000*	*86*	75 years and older	*2,300*	*100*
Females	**CDRR (mg/day)**	**CDRR (mmol/day)**	**Females**	**CDRR (mg/day)**	**CDRR (mg/day)**
18 to under 30 years	*2000*	*86*	18 to under 30 years	*2,300*	*100*
30 to under 50 years	*2000*	*86*	30 to under 50 years	*2,300*	*100*
50 to under 65 years	*2000*	*86*	50 to under 65 years	*2,300*	*100*
65 to under 75 years	*2000*	*86*	65 to under 75 years	*2,300*	*100*
75 years and older	*2000*	*86*	75 years and older	*2,300*	*100*

Health evidence profile and supporting information

The systematic literature review underpinning the 2017 sodium NRVs found a reduction of 2 mm Hg in systolic blood pressure when mean sodium excretion was lowered from about 3,500 mg/day to 2,100 mg/day (when corrected to the Australia and New Zealand population) (Department of Health, 2017), and on this basis the current SDT was established at 2,000 mg/day.

Evidence from systematic reviews published since this time – and including meta-analyses, dose-response analyses and meta-regressions - suggests a consistent relationship between modest reductions in dietary sodium and reduced systolic blood pressure (SBP) over the long-term. SBP is an independent risk factor for cardiovascular disease.

High sodium diet appears to have greater effects on SBP in hypertensive populations. The estimated effect varied across reviews, depending on the review inclusion criteria and analysis method adopted:

- Filippini et al. (2021a) (high risk of bias) reported reductions in SBP of 5.56mmHg (95% CI -4.52 to -6.59) for every 100 mmol/day reduction in urinary sodium excretion (85 RCTs; N>10,000)
- Huang et al. (2020) (low risk of bias) reported reductions in SBP of -2.13 mm Hg (95% CI -0.85 to -3.40) for every 50 mmol/day reduction in urinary sodium excretion in studies greater than 2 weeks in duration (58 data points; N=9,196)
- EFSA (2019) (risk of bias not assessed) reported that SBP increased by 5.3 mm Hg (95% CI 3.6 to 6.9) for every 100mmol/day increase in urinary sodium excretion (32 RCTs, 68 data points; N =NR)
- Agency for Healthcare Research and Quality (AHRQ 2018) (risk of bias not assessed) reported that reducing sodium intake significantly decreased SBP (MD –3.23 mm Hg, 95% CI –4.07 to –2.38; 47 RCTs, N=NR) (Newberry et al., 2018)
- Graudal et al. (2020) (low risk of bias) found that lower sodium intake resulted in reductions in SBP across 'white', 'black' and Asian populations with or without hypertension, although the reduction was not statistically significant for the normotensive Asian group.

There remains insufficient evidence to characterise a level of sodium intake at which there is not a corresponding increase in blood pressure. Consequently, the sodium NRV for chronic disease risk reduction should be established based on a precautionary approach and pragmatic factors, including consideration of the evidence for the relative benefits and harms, alongside factors relevant to the Australian and New Zealand context.

Sodium intake in Australia and New Zealand

National nutrition data from Australia – based on dietary recall – estimate mean daily intake at 2,384 mg/day, with higher intakes in males and younger adults. With This analysis may underestimate total sodium intakes, as it only accounts for sodium naturally present in foods or added during processing. Based on responses about additional salt use, 78.1% people aged 2 years and over added salt while cooking or preparing food and 45.5% added salt to food at the table. A systematic review of Australian studies reporting 24-hour urinary sodium measures suggests that intakes may be substantially higher - equivalent to around 3,800 mg/day (Land et al., 2018). A similar pattern is evident in New Zealand; no national intake data are available and results from national modelling suggest intakes of around 2,500 mg/day among adults. However, studies reporting 24-hour urinary sodium excretion suggest intakes between 3,200 and 3,400 mg/day (McLean et al., 2015; McLean et al., 2014; Wang et al., 2023).

National data suggests that almost two thirds of Australian adults (65.6% or 12.9 million) have daily sodium intakes that exceed the SDT of 2000 mg/day in 2023 (ABS,2023c), whilst estimates from a smaller convenience sample of New Zealand adults report even higher rates with intakes with 77% of those sampled exceeding 2,300 mg/day in (McLean et al., 2015). Collectively, these data indicate that excess sodium intake is common across adult populations in both countries, with higher intakes among men and younger adults.

Benchmarking against comparable international jurisdictions

In 2017, the sodium SDT for Australia and New Zealand was increased from 1,600 mg/day to 2,000 mg/day and the adult UL was changed from 2,300 mg/day to 'not determined' reflecting the inability to identify a single point of sodium exposure below which there is low risk. These changes aimed to provide a more realistic targeted approach that represents a total diet that meets all nutritional requirements and prevents chronic disease, given the current food supply. The current CDRR (formerly SDT) recommendation is presented at Table 27, along with recommendations from comparable international jurisdictions for benchmarking purposes. Critically, the current recommendation was not based on a physiological threshold or reference study, rather it represented a pragmatic population target selected in the context of a continuous intake–risk relationship, in which lower sodium intake is consistently associated with lower blood pressure.

In 2019, the US NASEM established its CDRR for sodium at 2,300 mg/day (NASEM, 2019). This recommendation was based on evidence from sodium reduction trials and cardiovascular outcomes including incident cardiovascular disease, hypertension, and blood pressure (SBP and DBP). It noted that while sodium intakes below the CDRR of 2,300 mg/day are expected to demonstrate a further lowering effect on blood pressure, the relationship between further reductions in blood pressure and chronic disease risk could not be characterised (NASEM, 2019).

The NASEM CDRR of 2,300 mg/day was also adopted by the 2023 Nordic Nutrition Recommendations (Blomhoff et al., 2023).

EFSA established a 'safe and adequate' intake; a hybrid NRV reflecting a level of intake that is sufficient for maintaining sodium balance, and associated with a reduced risk of adverse health effects. The value of 2,000 mg/day was selected for all adults, using an Expert Knowledge Elicitation approach that considered evidence for the relationship between sodium reduction and blood pressure levels or CVD risk, and levels required to maintain null sodium balance. Collectively, this evidence was then integrated to arrive at a final recommendation (EFSA, 2019).

Table 25 - Adult SDT (or CDRR) recommendations from comparable international jurisdictions

Age (years)	Aust/NZ – Potential increase to CDRR (mg/day)	Aust/NZ - Current (NHMRC 2006) CDRR (mg/day)	European Union (EFSA 2019) 'Safe and Adequate intake' (mg/day)*	United States (NASEM 2018) CDRR (mg/day)	Nordic and Baltic (NNR 2023) CDRRI (mg/day)	Germany, Austria, Switzerland (DACH 2013) CDRR (mg/day)	WHO Guidelines (WHO 2012) CDRR (mg/day)
Adults 18 +years:	2,300	2,000	2,000*	2,300	2,300	2,400^	2,000

*EFSA has not set a CDRR, instead opting to set a 'safe and adequate' intake that incorporates requirements and chronic disease risk reduction principles.

^ D-A-CH age grouping for adults is 19 years and older

Balance of effects (benefits and harms)

It has been suggested that there may be limited benefit to salt reduction in 'white' normotensive populations due to concerns about the effects of sodium reduction on hormones and plasma lipids (Graudal et al., 2020). However, these findings likely reflect the inclusion of studies of short duration with other

reviews concluding that these effects likely represent short-term metabolic effects, noting that they are not observed in trials of longer duration (Huang et al., 2020). No other adverse effects with intakes below 2,000 mg/day have been reported in the reviews examined.

In contrast, the burden of cardiovascular disease in Australia and New Zealand is substantial, with blood pressure and dietary risks significant factors. Over one in ten (11.6% or 3.0 million) Australians reported having hypertension in 2022. Three in four (74.5%) Australians with high measured blood pressure did not report having hypertension (ABS 2023c). 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 New Zealand adults had measured high blood pressure 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).

Maintaining the current CDRR (formerly SDT) of 2,000 mg/day presents stability in public health recommendations and aligns with the available evidence which suggests the risk of elevated blood pressure increases with increased sodium intake at all levels.

Key public health objectives relevant to the Australian and New Zealand context must also be considered. Data suggest that most Australian (65.6%) and New Zealand adults have sodium intakes exceeding the SDT. Therefore, the overwhelming public health concern is the chronic disease risk associated with high dietary sodium. Cardiovascular disease remains a leading cause of death and morbidity in Australia and New Zealand, with both high blood pressure and dietary risks leading factors for total CVD burden (AIHW, 2025; IHME, 2024). These contextual factors reinforce the need to establish the CDRR at a value that promotes public health.

The CDRR (formerly SDT) was last reviewed in 2017 and at this time, the recommendation was increased from 1,600 to 2,000 mg/day. This review has identified no significant evidence published since this time to alter the underpinning evidence base. Consequently, a change to the CDRR from 2,000 mg/day should only be made if there are public health context factors to justify this shift.

Certainty of the evidence

There is moderate certainty evidence that sodium reduction lowers SBP in both hypertensive and normotensive individuals, with the evidence downgraded due to inconsistency (Newberry et al., 2018). Evidence also suggests that there is a linear relationship between higher sodium intake and increased SBP, and there does not appear to be a single level of sodium intake at which the risk becomes elevated.

Values, preferences and feasibility (consumers, communities)

Values and preferences

Evidence suggests a lack of awareness of dietary sodium recommendations, dietary sources of sodium, and the relationship between salt and sodium among populations from high-income countries (Bhana et al., 2018). Although most of those surveyed are aware of the risks associated with high salt intake, many are unaware of current recommended intake levels, or of how their own salt intake compares with recommendations (Grimes, Kelley, et al., 2017; Land et al., 2014). Across studies, respondents were supportive of the need for individual dietary change to address the health risks associated with excessive salt consumption. Consequently, it may be reasonably assumed that there is community support for maintaining a CDRR that is protective of health, even if such recommendations rely on individual dietary change or other interventions to achieve a level of intake aligned with requirements.

Feasibility

Australian food modelling undertaken in 2011 estimated sodium intakes across foundation and total diets (NHMRC, 2011). Discretionary salt was not included, so intakes are likely to underestimate actual consumption for most people. Foundation diets also excluded discretionary foods, while total diets included only limited discretionary choices. This modelling should be interpreted with caution given the significant time elapsed since modelling was undertaken, and noting changes in both dietary patterns and sodium in the food supply since this time. This modelling predates the Healthy Food Partnership (HFP) program, so it does not reflect any reformulation-related reductions in sodium in the food supply, with associated reductions in the sodium content of participating products estimated at 4.3% (ABS, 2025). Since 2011–12, the proportion of Australian adults who had a usual sodium intake above the SDT has decreased for males (from 84.8% to 79.9%) but remained similar for females (54.2% and 51.2%) indicating it is feasible to reduce sodium intake, albeit slowly.

Food modelling data for adults are presented in Table 28; cells are highlighted orange where modelling suggests intakes exceeding the current SDT. These data suggest that sodium intakes are likely to exceed the current SDT (2,000 mg/day) in many of the total diets modelled, except for females with mid-level energy requirements. Exceedances are often substantial, and the estimated impact of the HFP on sodium content (4.3%) and individual intakes (14.8 mg/day) (ABS, 2025) is unlikely to be sufficient to reduce the modelled intakes to within the recommended SDT. The current SDT may therefore be unachievable for some groups without further sodium reduction in the food supply or other interventions such as low-sodium salt substitution.

By contrast, increasing the SDT to 2,300 mg/day would establish a more achievable target, with modelled 7-day total diet intakes for all adults with mid-level energy requirements remaining below this level. However, the feasibility of this increase must be balanced against the associated health impacts, given the linear relationship between sodium intake and blood pressure.

Table 26 - Food Modelling Data – Adults (Source: (NHMRC, 2011)

Age group (years)	Core food groups (mg/day)	Intake from AGTHE98^ *(Core foods using whole dietary approach)* (mg/day)		Foundation diets								7 day Total Diets			
				Overall (mg/day)		Intake from rice-based diets (mg/day)		Intake from pasta-based diets (mg/day)		Intake from lacto-ovo-vego diets (mg/day)		Mid energy level (average height, light-moderate activity) (mg/day)		High energy level (tallest, highest activity) (mg/day)	
	All	F	M	F	M	F	M	F	M	F	M	F	M	F	M
19-30 yr	700	1,223 to 2182	1,606 to 2,756	1405	1411	926	998	1159	1338	1411	1296	1711 to 1986	1865 to 2213	2239 to 2550	2270 to 2799
31-50 yr				1395	1452	919	1044	1140	1381	1452	1318	1580 to 1836	1854 to 2180	1928 to 2150	2258 to 2656
51-70 yr		1,223 to 1,798	1,222 to 2,181	1330	1502	1030	1053	1074	1298	1502	1342	1482 to 1817	1769 to 2066	1933 to 2421	2018 to 2576
70+ yr				1178	1265	1014	980	988	1208	1265	1176	1444 to 1602	1507 to 2025	1877 to 2142	1949 to 2365

F = Females; M= Males; ^AGTHE98 age groupings were 19-60y and 60y+

Resource impacts

Retaining the level for CDRR (formerly SDT) values for adults has no material resource implications. Although adult age groupings are being adjusted to align with new NRVs age groupings (see Methodological Framework; NHMRC 2025), the CDRR value is the same for all adult groups so there is no material impact of this change. Consequently, this minor change to age groupings should have no implications for regulators, including FSANZ (food and food products) and TGA (supplements).

In contrast, any change to the CDRR (SDT) value may have implications for regulators, including FSANZ (food and food products) and the TGA (supplements). It may also have implications for evaluation of public health policy, programs and interventions, such as the Healthy Food Partnership Reformulation Program. If this option is pursued, views on the resource impacts should be sought during targeted/stakeholder consultation and considered when determining final NRVs.

Other factors (health equity impacts, sustainability, nutrient interactions or other nutrient considerations)

Equity impacts

Available data from a range of sources including dietary recall, urinary sodium excretion measures and modelling approaches suggests that sodium intakes are higher among population groups experiencing social and health disadvantage, including Indigenous Australians, adults from lower socioeconomic backgrounds, and Pacific populations in New Zealand. These groups are more likely to exceed recommended intake levels and have a higher burden of cardiovascular disease. No intake data are available for Māori populations, although they experience a substantially higher burden of cardiovascular disease for which dietary risk factors are a major contributor. Across both countries, these priority groups also experience higher rates of cardiovascular disease and related risk factors, including hypertension, meaning that higher sodium exposure may contribute to existing health inequities. Evidence also suggests there are racial disparities in salt-sensitive blood pressure, although the mechanism for this effect is not well understood (Jeong et al., 2024).

Collectively, this evidence highlights the need to ensure that sodium recommendations support ongoing reductions in intake among populations with the greatest exposure and highest disease burden.

Other nutrients

Government guidance and modelling for institutional meal provision indicate that achieving nutritionally balanced meals with sodium intakes aligned with current recommendations may be challenging within existing food systems (Queensland Health, 2022; NSW Government Agency for Clincal Innovation, 2026).

Although sodium interacts closely with potassium, chloride and calcium, these nutrient interactions are not sufficiently characterised to inform sodium NRV establishment (EFSA, 2019; NASEM, 2019).

Decision

Retain current CDRR (formerly SDT) of 2,000mg/day in adults (including during pregnancy and lactation).

The evidence review suggests that the evidence for the relationship between sodium intake and chronic disease risk remains largely unchanged from the last date of review (2017). Retaining the current CDRR of 2,000mg/day maintains consistent public health messaging about the need to reduce sodium intakes to reduce chronic disease risk, aligns with values from comparable international jurisdictions, and is feasible to achieve from Australian and New Zealand diets.

PREGNANCY

Chronic hypertension increases the risk of hypertensive disorders during pregnancy, and consequently the risk of adverse pregnancy and birth outcomes. Australian clinical guidance recommends that individuals planning pregnancy optimise blood pressure prior to conception through management of modifiable risk factors including weight, diet, physical activity and smoking. Although some guidance notes the importance of maintaining a lower dietary sodium intake as part of cardiovascular risk reduction, this advice is not specific to pregnancy and reflects standard management recommendations for individuals with chronic hypertension rather than pregnancy-specific dietary requirements. There is no current recommendation for pregnant individuals with high blood pressure to restrict sodium intake during pregnancy for the prevention or management of hypertensive disorders, and available evidence on the effect of sodium reduction on these outcomes in pregnancy is limited and uncertain.(Lowe et al., 2014)

There is no evidence to suggest that pregnant adults differ in sensitivity to sodium exposure compared with non-pregnant adults. Consistent with the NASEM (2019) and EFSA (2019) recommendations, the CDRR for pregnant adults is aligned with those for the general adult population.

LACTATION

There is no evidence that sensitivity to sodium exposure differs during lactation compared with non-lactating adults. Consistent with the NASEM (2019) and EFSA (2019) recommendations, the CDRR for lactating adults is aligned with those for the general adult population.

Options for recommendations under 0consideration

OPTION 1: Extrapolate a CDRR based on the adult CDRR (current or increased value), with recommendations for current and alternative school age groupings			OPTION 2: Maintain the current UL and include recommendations for current and alternative school age groupings.		
	CDRR (mg/day)	CDRR (mmol/day)		UL (mg/day)	UL (mmol/day)
1 to under 4 years	*950*	*41*	1 to under 4 years	*1,000*	*43*
4 to under 9 years	*1,250*	*54*	4 to under 9 years	*1,400*	*60*
9 to under 14 years	*1,750*	*76*	9 to under 14 years	*2,000*	*86*
14 to under 18 years	*2,000*	*86*	14 to under 18 years	*2,300*	*100*
Alternative school-age groupings			Alternative school-age groupings		
12 to under 24 months	*850*	*37*	12 to under 24 months	*850*	*37*
2 to under 5 years	*1,100*	*48*	2 to under 5 years	*1,150*	*50*
5 to under 12 years	*1,500*	*65*	5 to under 12 years	*1,600*	*70*
12 to under 18 years	*1,950*	*85*	12 to under 18 years	*2,200*	*96*

Health evidence profile and supporting information

Systematic reviews on the relationship between sodium and blood pressure in children and adolescents report inconsistent findings depending on the review inclusion criteria and analytical approach adopted. Both the Leyvraz (2018) and AHRQ (2018) reviews included RCTs and controlled observational studies; however the Leyvraz review included a broader range of study designs including cross-sectional studies and single-arm or shorter duration experimental studies. In contrast, the AHRQ review restricted inclusion to interventions of at least 4 weeks duration, aligning with the a priori criteria for this evidence evaluation.

Although observational studies - including cross-sectional designs - were permitted as supportive evidence for children and adolescents in the current evidence evaluation, the quantitative pooling of fundamentally different study designs in the Leyvraz analysis limited the interpretability of findings. Overall,

there is no consistent evidence that lower sodium intake reduces blood pressure in children; further high-quality studies are required to clarify this relationship.

Arterial stiffness in children was also identified as a primary outcome for this review. However, only a single cross-sectional study examining the relationship between sodium and arterial stiffness in children was identified. The evidence is therefore insufficient to derive an NRV.

Due to this lack of evidence, a CDRR for children and adolescents could be extrapolated from adult values. Consistent with previous approaches and the US NASEM (2019) methods, values for children and adolescents in Australia and New Zealand have been extrapolated on the basis of relative energy requirements, using the following formulas:

UL_{child} = 2006 UL_{adult} x (EER_{child}/ EER_{adult}) or $CDRR_{child}$ = $CDRR_{adult}$ x (EER_{child}/ EER_{adult})

Calculations and resulting values (both un-rounded and rounded) are provided in Table 29 below. This includes new alternative age groupings which are to be included in future NRV iterations to facilitate reporting of usual intake data from national nutrition survey results against NRV recommendations. These recommendations will be presented in a separate appendix to prevent confusion amongst stakeholders about which are the prevailing recommendations for each age group.

Table 27 - Data inputs and resulting extrapolation of adult values (current vs proposed) to children and adolescents

	A	B	C	D	E	F = A x (D/E)	G = F + rounding	H = B x (D/E)	H = G + rounding	I = C x (D/E)	J = I + rounding
						Extrapolated from current CDRR (2,000 mg/day)		Extrapolated from alternative CDRR (2,300 mg/day)		Extrapolated from former adult UL (2,300 mg/day)	
Age group	**Current $CDRR_{adult}$**	**Alternative $CDRR_{adult}$**	**Former (2006) UL_{adult}**	**EER_{child}**	**EER_{adult}**	**Calculated (unrounded) $CDRR_{child}$**	**Final (rounded) $CDRR_{child}$**	**Calculated (unrounded) $CDRR_{child}$**	**Final (rounded) $CDRR_{child}$**	**Calculated (unrounded) UL_{child}**	**Final (rounded) UL_{child}**
1 to <4 yr	2,000	2,300	2,300	4.4	10.3	848	**950**	975	**950**	975	**1,000**
4 to <9 yr				6.4		1,237	**1,250**	1,422	**1,400**	1,422	**1,400**
9 to <14 yr				9.0		1,741	**1,750**	2,003	**2,000**	2,003	**2,000**
14 to <18 yr				11.1		2,154	**2,000**	2,477	**2,300**	2,477	**2,300**
Alternative age groupings											
12 to <24 mo	2,000	2,300	2,300	3.9	10.3	750	**850**	862	**850**	862	**850**
2 to <5 yr				5.2		1,000	**1,100**	1,150	**1,150**	1,150	**1,150**
5 to <12 yr				7.2		1,388	**1,500**	1,600	**1,600**	1,600	**1,600**
12 to <18 yr				10.0		1,945	**1,950**	2,200	**2,200**	2,200	**2,200**

Sodium intake in Australia and New Zealand

Australian national intake data report mean intakes of 1,521 mg/day for 2-4 year olds; 2,188 mg/day for 5–11 year olds; and 2,903 mg/day for 12-17 year olds. However, these estimates are derived from 24-hour dietary recall and are likely to underestimate true intake as it only accounts for sodium naturally present in foods or added during processing. Based on responses about additional salt use, 78.1% people aged 2 years and over added salt while cooking or preparing food and 45.5% added salt to food at the table. Consistent with this limitation, data from Australian studies using 24-hour urinary sodium excretion report substantially higher intakes (approximately 2,369 to 2,440 mg/day among children aged 4–12 years).

In New Zealand, sodium intake data for children are primarily derived from the 2016 New Zealand Total Diet Study (NZTDS), which uses modelled diets and food composition data. Estimated intakes range from 1,361 mg/day (1–3 years) to 2,877 mg/day (boys aged 11–14 years), with all age groups exceeding 100% of the UL (121–144%). Although modelled, these estimates are supported by the limited available biomarker data: a 24-hour urinary sodium study in children aged 8–13 years reported a mean intake of 2,420 mg/day.

Although data on the proportion of children exceeding the current UL is not provided, mean intakes exceed the UL for all age groups in both Australia and New Zealand. Urinary biomarker studies from Australia indicate that approximately 70% of children exceed the UL, with a study in New Zealand similarly reporting that 2 in 3 children had intakes exceeding 2,000 mg/day.

Benchmarking against comparable international jurisdictions

Recommended CDRR NRVs in children and adolescents are similar across international jurisdictions, with minor variation arising due to differences in the adult reference values from which child values have been extrapolated (Table 30). The US NASEM and NNR 2023 recommendations are both extrapolated from an adult value of 2,300 mg/day whereas the EFSA values are extrapolated from a ‘safe and adequate’ intake of 2,000 mg/day. Although the EFSA measure encompasses both adequate intake and chronic disease risk reduction, it is broadly comparable to a CDRR.

Extrapolating child values from both the current CDRR (2,000 mg/day) and higher potential CDRR (2,300 mg/day) derives CDRR values that broadly align with international values. Although recommendations for younger children are notably lower than for comparable jurisdictions, extrapolation from the adult value of 2,000mg/day based on energy requirements aligns with WHO recommendations (WHO,2012).

Table 28 – Comparison of child and adolescent chronic disease risk reduction recommendations across comparable jurisdictions

<table>
<tr><th>Age (years)</th><th>Aust/NZ – Proposed change CDRR options (mg/day)</th><th>Aust/NZ -Current (NHMRC 2006) UL (mg/day)</th><th>European Union (EFSA 2019) CDRR (mg/day)*</th><th>United States (NASEM 2018) CDRR (mg/day)</th><th>Nordic and Baltic (NNR 2023) CDRR (mg/day)</th><th>Germany, Austria, Switzerland (DACH 2013) CDRR (mg/day)</th><th>WHO Guidelines (WHO 2012) CDRR (mg/day)</th></tr>
<tr><td>1 yr</td><td rowspan="3">950</td><td rowspan="3">1,000</td><td rowspan="3">1,100*</td><td rowspan="3">1,200</td><td rowspan="3">1,100</td><td rowspan="16">Not specified</td><td>Not specified</td></tr>
<tr><td>2 yr</td><td rowspan="8">No specific value provided

For children aged 2–15 years, WHO recommends adjusting the adult dose (2,000 mg/day) downward based on energy requirements.</td></tr>
<tr><td>3 yr</td></tr>
<tr><td>4 yr</td><td rowspan="5">1,250 or 1,400</td><td rowspan="5">1,400</td><td rowspan="3">1,300*</td><td rowspan="4">1,500</td><td rowspan="3">1,400</td></tr>
<tr><td>5 yr</td></tr>
<tr><td>6 yr</td></tr>
<tr><td>7 yr</td><td rowspan="4">1,700*</td><td rowspan="4">1,700</td></tr>
<tr><td>8 yr</td></tr>
<tr><td>9 yr</td><td rowspan="5">1,750 or 2,000</td><td rowspan="5">2,000</td><td rowspan="4">1,800</td></tr>
<tr><td>10 yr</td></tr>
<tr><td>11 yr</td><td rowspan="6">2,000*</td><td rowspan="3">2,300</td></tr>
<tr><td>12 yr</td></tr>
<tr><td>13 yr</td></tr>
<tr><td>14 yr</td><td rowspan="4">2,000 or 2,300</td><td rowspan="4">2,300</td><td rowspan="3">2,300</td></tr>
<tr><td>15 yr</td><td rowspan="3">2,300</td></tr>
<tr><td>16 yr</td><td rowspan="2">2,000</td></tr>
<tr><td>17 yr</td></tr>
</table>

*EFSA has not set a CDRR instead opting to set a 'safe and adequate' intake that incorporates both adequate requirement and chronic disease risk reduction principles.
^ D-A-CH age grouping for adults is 19 years and older

Balance of effects (benefits and harms)

The NHMRC's Methodological Framework for developing NRVs suggests that there should be at least moderate certainty evidence of chronic disease risk reduction to establish a CDRR value (NHMRC, 2026). Whilst moderate certainty evidence exists among the adult population, there is greater uncertainty about the benefits of a low sodium diet for reducing chronic disease risk among children. This is consistent with the NASEM (2017) approach to CDRR.

Nevertheless, significant contextual factors weigh in favour of establishing a CDRR for children to support long-term health. This includes evidence that dietary patterns consumed in childhood can help shape food acceptance and preferences throughout the life course (Chong, 2022; Hörnell & Lagström, 2024; Mahmood et al., 2021), in particular an association between dietary salt exposure in infancy and development of salty-taste acceptance (Stein et al., 2012). Furthermore, although there is uncertainty about the relationship between sodium intake and blood pressure in childhood, studies suggest that

blood pressure and cardiovascular disease risk tracks from early childhood into adulthood (Chen & Wang, 2008). On this basis, the US NASEM (2019) determined that establishing a CDRR in children was appropriate, to ensure that the NRVs were protective over the life course.

In contrast to a CDRR, a UL is defined as "the highest mean daily nutrient intake level likely to pose no adverse (toxic) health effects to individuals in the general population" (National Health and Medical Research Council, 2026). A UL is calculated based on toxicological adverse effects – that is, adverse events that occur at a distinct threshold that differentiates 'safe' and 'unsafe' intakes. However, in the case of sodium this distinction is difficult, in view of the progressive and continuous relationship between sodium intake and blood pressure.

The current UL in children is extrapolated from the 2006 UL in adults which was set at 2,300 mg/day on the basis that there were low levels of hypertension observed with intakes below this threshold (NHMRC, 2006b). However, the adult UL was replaced with a SDT (now CDRR) in 2017, to recognise that the risk of high sodium exposure relates to increased chronic disease risk. In view of these considerations, establishing a CDRR instead of a UL in children and adolescents may more accurately reflect the nature of the harm associated with higher sodium intake.

Certainty of the evidence

The AHRQ (2018) review found low strength of evidence for a lack of beneficial effect of sodium reduction on systolic blood pressure in children. The evidence for a relationship between sodium intake and arterial stiffness is uncertain, comprising a single cross-sectional study.

Values, preferences and feasibility (consumers, communities)

Values and preferences

Evidence suggests that although the public have a good understanding of the risks associated with high salt intake, they may lack understanding of current recommendations or of how their own intake compares with these. (Bhana et al., 2018; Grimes, Kelley, et al., 2017; Land et al., 2014). Despite high salt consumption within the general population, two thirds of parents believed that their intakes were equal to or below the recommended daily limits highlighting potential gaps in this knowledge (Khokhar et al., 2018).

A survey in 837 Australian parents found that most parents are aware that high salt intake is harmful to health (91%), and around 3 in 4 understand that this risk also applies to child health (77%). Although many parents agreed that it was important to reduce salt in their child's diet, one in two still added salt during cooking or at the table. Greater awareness of the impacts of salt on child health was associated with lower discretionary salt use (Khokhar et al., 2018).

Feasibility

Food modelling data for children and adolescents is presented in Table 31. Modelling for 7-day Total Diets indicates that intakes of sodium less than the current UL are achievable – although only just - for most children with light to moderate activity, except for those aged 2 to 3 years. However, for children with the highest energy needs modelled intakes from 7-day Total Diets exceed the current UL for all children except those aged 9-11 (NHMRC, 2011). For diets with cereal intakes in the upper range, all children had estimated sodium intakes above the age-relevant UL. If the current CDRR (formerly SDT) is adopted – and extrapolated to children – it is likely that even more of the modelled diets will exceed the NRV recommendation, owing to the adult CDRR of 2,000 mg/day being lower than the previous adult UL or 2,300 mg/day from which current ULs have been derived. This modelling should be interpreted with

caution given the significant time elapsed since modelling was undertaken, and noting changes in both dietary patterns and sodium in the food supply since this time. This modelling predates the Healthy Food Partnership (HFP) program, so it does not reflect any reformulation-related reductions in sodium in the food supply, with associated reductions in the sodium content of participating products estimated at 4.3% (ABS, 2025).

Table 29 - Food modelling data - children and adolescents (NHMRC, 2011)

Age group (years)	Core food groups^ (mg/day)	Intake from AGTHE98^ (mg/day)	Foundation diets								7-day Total Diet			
			Overall (mg/day)		Intake from rice-based diets (mg/day)		Intake from pasta-based diets (mg/day)		Intake from lacto-ovo-vego diets (mg/day)		Mid energy level (average height, light-moderate activity) (mg/day)		High energy level (tallest, highest activity) (mg/day)	
	All	All	F	M	F	M	F	M	F	M	F	M	F	M
13-23 mo	NR	NR	701	716	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
2 - 3 yr	NR	NR	806	821	NR	NR	NR	NR	666	798	849 to 946	950 to 1077	1027 to 1178	1196 to 1329
4 - 8 yr	441^	1321 to 1705	952	1007	NR	NR	NR	NR	776	865	1090 to 1282	1131 to 1406	1408 to 1621	1529 to 1790
9 - 11 yr	556^	1571 to 2147	1189	1175	831	751	1048	989	1054	916	1231 to 1458	1330 to 1434	1502 to 1811	1613 to 1987
12 - 13 yr	688^	1504 to 2654	1379	1456	1017	970	1204	1094	1107	1124	1470 to 1749	1563 to 1878	1819 to 2127	1978 to 2184
14 - 18 yr			1723	1635	1151	1062	1414	1271	1579	1375	1770 to 2137	2005 to 2296	2241 to 2559	2499 to 2644

^ Core food group and AGHTE98 modelling age groups: 4-7y; 8-11y; 12-18y; NR=Not reported

Resource impacts

Retaining the current UL recommendations for children and adolescents has no material resource implications.

In contrast, any change to these recommendations may have implications for regulators, including FSANZ (food and food products) and the TGA (supplements). It may also have implications for evaluation of public health policy, programs and interventions, such as the Healthy Food Partnership Reformulation Program. If this option is pursued, views on the resource impacts should be sought during targeted/stakeholder consultation and considered when determining final NRVs.

Other factors (health equity impacts, sustainability, nutrient interactions)

Equity impacts

Australian studies indicate that children from lower socioeconomic backgrounds consume around 200 to 230mg/day more sodium than those from higher socioeconomic groups. Compared with the general population, data suggests that intakes are higher among younger Indigenous children and Pacific children residing in New Zealand; no specific data is available for Māori children. Collectively, this evidence indicates that children from disadvantaged populations are exposed to higher sodium intakes early in life, highlighting the importance of ensuring that dietary guidance and public health strategies support equitable reductions in intake across all groups.

Other nutrients

As per the Evidence-to-Decision table in adults, consideration must be given to the feasibility of achieving intakes of sodium within recommendations whilst achieving nutritional adequacy across the range of other essential nutrients. Although sodium interacts closely with potassium, chloride and calcium, these nutrient interactions are not sufficiently characterised to inform sodium NRV establishment (EFSA, 2019; NASEM, 2019).

Decision

CDRR values to be extrapolated from the adult CDRR (formerly the SDT) of 2,000 mg/day for respective child and adolescent age groupings.

A CDRR best reflects the nature of risk from high sodium intakes, which is an increasing risk of chronic disease with increasing sodium intakes. There is moderate certainty evidence of an increased risk of chronic disease with high sodium intakes among adults, and sufficient public health grounds to warrant adopting a protective CDRR recommendation among children. There is insufficient evidence to derive a UL in children and adolescents.

References

AIHW. (2022). *Australian Burden of Disease Study: impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2018*. https://www.aihw.gov.au/reports/burden-of-disease/illness-death-indigenous-2018

AIHW. (2024). *Australian Burden of Disease Study 2024*. https://www.aihw.gov.au/reports/burden-of-disease/australian-burden-of-disease-study-2024

AIHW. (2025). *Heart, stroke and vascular disease: Australian facts*. https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts

Allen, J. C., Keller, R. P., Archer, P., & Neville, M. C. (1991). Studies in human lactation: milk composition and daily secretion rates of macronutrients in the first year of lactation. *Am J Clin Nutr*, *54*(1), 69-80. https://doi.org/10.1093/ajcn/54.1.69

Allsopp, A. J., Sutherland, R., Wood, P., & Wootton, S. A. (1998). The effect of sodium balance on sweat sodium secretion and plasma aldosterone concentration. *Eur J Appl Physiol Occup Physiol*, *78*(6), 516-521. https://doi.org/10.1007/s004210050454

Australian Bureau of Statistics. (2022). *Hypertension and high measured blood pressure* (https://www.abs.gov.au/statistics/health/health-conditions-and-risks/hypertension-and-high-measured-blood-pressure/latest-release

Australian Bureau of Statistics. (2023a). *National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey: Food and Nutrients, 2023* (https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/national-aboriginal-and-torres-strait-islander-nutrition-and-physical-activity-survey/latest-release#about-the-survey

Australian Bureau of Statistics. (2023b). *National Nutrition and Physical Activity Survey: Food and nutrients* (https://www.abs.gov.au/statistics/health/food-and-nutrition/food-and-nutrients/2023

Australian Bureau of Statistics. (2023c). *National Nutrition and Physical Activity Survey: Usual nutrient intakes* (ABS. https://www.abs.gov.au/statistics/health/food-and-nutrition/usual-nutrient-intakes/2023

Australian Bureau of Statistics, A. (2025). *Healthy Food Partnership Reformulation Program: Wave 1, four-year progress*. ABS Retrieved from https://www.abs.gov.au/articles/healthy-food-partnership-reformulation-program-wave-1-four-year-progress

Australian Government. (2026). *Proposal on mandating the HSR system*. Retrieved 09/07/2026 from https://www.healthstarrating.gov.au/monitoring-and-reviews/proposal-mandating-hsr-system

Australian Institute of Health and Welfare. (2026a). *Heart, stroke and vascular disease: Australian facts*. Canberra, ACT: AIHW Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts

Australian Institute of Health and Welfare. (2026b). *Hypertension in Australia*. Canberra, ACT: AIHW Retrieved from https://www.aihw.gov.au/reports/risk-factors/hypertension/

Bablani, L., Ni Mhurchu, C., Neal, B., Skeels, C. L., Staub, K. E., & Blakely, T. (2020). The impact of voluntary front-of-pack nutrition labelling on packaged food reformulation: A difference-in-differences analysis of the Australasian Health Star Rating scheme. *PLoS Med*, *17*(11), e1003427. https://doi.org/10.1371/journal.pmed.1003427

Bauer, J., & Gerss, J. (2011). Longitudinal analysis of macronutrients and minerals in human milk produced by mothers of preterm infants. *Clin Nutr*, *30*(2), 215-220. https://doi.org/10.1016/j.clnu.2010.08.003

Beard, T. C., Cooke, H. M., Gray, W. R., & Barge, R. (1982). Randomised controlled trial of a no-added-sodium diet for mild hypertension. *Lancet*, *2*(8296), 455-458. https://doi.org/10.1016/s0140-6736(82)90491-3

Beard, T. C., Hornsby, H., Dwyer, T., Woodward, D. R., Ball, P. J., & von Witt, R. J. (1997). The Hobart Salt Study 1995: few meet national sodium intake target. *Medical Journal of Australia*, *166*(8), 404-407. https://doi.org/https://doi.org/10.5694/j.1326-5377.1997.tb123189.x

Bennett, G., Bardon, L. A., & Gibney, E. R. (2022). A Comparison of Dietary Patterns and Factors Influencing Food Choice among Ethnic Groups Living in One Locality: A Systematic Review. *Nutrients*, *14*(5), 941. https://www.mdpi.com/2072-6643/14/5/941

Bhana, N., Utter, J., & Eyles, H. (2018). Knowledge, Attitudes and Behaviours Related to Dietary Salt Intake in High-Income Countries: a Systematic Review. *Current nutrition reports*, *7*(4), 183-197. https://doi.org/10.1007/s13668-018-0239-9

Bhat, S., Marklund, M., Henry, M. E., Appel, L. J., Croft, K. D., Neal, B., & Wu, J. H. Y. (2020). A Systematic Review of the Sources of Dietary Salt Around the World. *Adv Nutr*, *11*(3), 677-686. https://doi.org/10.1093/advances/nmz134

Blomhoff, R., Andersen, R., Arnesen, E., Christensen, J., Eneroth, H., Erkkola, M., Gudanaviciene, I., Høyer-Lund, A., Lemming, E., Meltzer, H., Pitsi, T., Siksna, I., Thorsdottir, I., & Trolle, E. (2023). *Nordic Nutrition Recommendations 2023*. https://doi.org/10.6027/nord2023-003

Bolton, K. A., Webster, J., Dunford, E. K., Jan, S., Woodward, M., Bolam, B., Neal, B., Trieu, K., Reimers, J., Armstrong, S., Nowson, C., & Grimes, C. (2020). Sources of dietary sodium and implications for a statewide salt reduction initiative in Victoria, Australia. *Br J Nutr*, *123*(10), 1165-1175. https://doi.org/10.1017/s000711452000032x

Boorman, J., Cunningham, J., Mackerras, D. (2008). *Salt Intake from Processed Food and Discretionary Use in Australia*. ACT, Australia: FSANZ Retrieved from https://www.foodstandards.gov.au/sites/default/files/consumer/nutrition/salthowmuch/Documents/Salt_Intake_5.pdf

Butte, N. F., Garza, C., Johnson, C. A., Smith, E. O., & Nichols, B. L. (1984). Longitudinal changes in milk composition of mothers delivering preterm and term infants. *Early Hum Dev*, *9*(2), 153-162. https://doi.org/10.1016/0378-3782(84)90096-3

Campbell, N. R. C., He, F. J., Tan, M., Cappuccio, F. P., Neal, B., Woodward, M., Cogswell, M. E., McLean, R., Arcand, J., MacGregor, G., Whelton, P., Jula, A., L'Abbe, M. R., Cobb, L. K., & Lackland, D. T. (2019). The International Consortium for Quality Research on Dietary Sodium/Salt (TRUE) position statement on the use of 24-hour, spot, and short duration (<24 hours) timed urine collections to assess dietary sodium intake. *J Clin Hypertens (Greenwich)*, *21*(6), 700-709. https://doi.org/10.1111/jch.13551

Carley Grimes. (2026). Unpublished analysis of 2016-17 data supplied in correspondence. In N. P. Team (Ed.).

Chen, X., & Wang, Y. (2008). Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. *Circulation*, *117*(25), 3171-3180. https://doi.org/10.1161/circulationaha.107.730366

Cheng, J., Thorndike, A. N., & Yi, S. (2025). Racial and Ethnic Differences in Sodium Sources and Sodium Reduction Behaviors Among US Adults: NHANES 2017 to 2020 Prepandemic. *Journal of the American Heart Association*, *14*(11), e037997. https://doi.org/10.1161/JAHA.124.037997

Chong, M. F.-F. (2022). Dietary trajectories through the life course: opportunities and challenges. *British Journal of Nutrition*, *128*(1), 154-159. https://doi.org/10.1017/S0007114522001295

Consolazio, C. F., Matoush, L. O., Nelson, R. A., Harding, R. S., & Canham, J. E. (1963). Excretion of Sodium, Potassium, Magnesium and Iron in Human Sweat and the Relation of Each to Balance and Requirements. *The Journal of nutrition*, *79*(4), 407-415. https://doi.org/https://doi.org/10.1093/jn/79.4.407

Coyle, D., Shahid, M., Dunford, E., Ni Mhurchu, C., McKee, S., Santos, M., Popkin, B., Trieu, K., Marklund, M., Neal, B., & Wu, J. (2021). Estimating the potential impact of Australia's reformulation programme on households' sodium purchases. *BMJ Nutrition, Prevention & Health*, *4*(1). https://doi.org/10.1136/bmjnph-2020-000173

Coyle, D. H., Huang, L., Hu, M., Ghammachi, N., Pettigrew, S., & Wu, J. H. Y. (2025). Assessing the impact of voluntary food reformulation targets: Mid-point assessment of Australia's voluntary sodium and saturated fat reduction policy. *European journal of clinical nutrition*, *79*(10), 1060-1065. https://doi.org/10.1038/s41430-025-01647-5

de Mestral, C., Mayén, A.-L., Petrovic, D., Marques-Vidal, P., Bochud, M., & Stringhini, S. (2017). Socioeconomic determinants of sodium intake in adult populations of high-income countries: a systematic review and meta-analysis. *American journal of public health*, *107*(4), e1-e12.

Department of Health. (2017). *Australian and New Zealand Nutrient Reference Values for Sodium: Supporting Document 2 - Statistical Analyses*. Retrieved from https://www.eatforhealth.gov.au/sites/default/files/2022-10/2017_Sodium_SD2_-_Statistical_Analyses.pdf

Dewey, K. G., Finley, D. A., & Lönnerdal, B. (1984). Breast milk volume and composition during late lactation (7-20 months). *J Pediatr Gastroenterol Nutr*, *3*(5), 713-720. https://doi.org/10.1097/00005176-198411000-00014

Dewey, K. G., & Lönnerdal, B. (1983). Milk and nutrient intake of breast-fed infants from 1 to 6 months: relation to growth and fatness. *J Pediatr Gastroenterol Nutr*, *2*(3), 497-506. https://doi.org/10.1097/00005176-198302030-00018

Earle, N. J., Poppe, K. K., Doughty, R. N., Rolleston, A., Kerr, A. J., & Legget, M. E. (2018). Clinical Characteristics and Burden of Risk Factors Among Patients With Early Onset Acute Coronary Syndromes: The ANZACS-QI New Zealand National Cohort (ANZACS-QI 17). *Heart Lung Circ*, *27*(5), 568-575. https://doi.org/10.1016/j.hlc.2017.04.010

Elijovich, F., Weinberger, M. H., Anderson, C. A., Appel, L. J., Bursztyn, M., Cook, N. R., Dart, R. A., Newton-Cheh, C. H., Sacks, F. M., & Laffer, C. L. (2016). Salt Sensitivity of Blood Pressure: A Scientific Statement From the American Heart Association. *Hypertension*, *68*(3), e7-e46. https://doi.org/10.1161/hyp.0000000000000047

Ereman, R. R., Lönnerdal, B., & Dewey, K. G. (1987). Maternal sodium intake does not affect postprandial sodium concentrations in human milk. *J Nutr*, *117*(6), 1154-1157. https://doi.org/10.1093/jn/117.6.1154

European Food Safety Authority. (2019). Dietary Reference Values for Sodium. *EFSA Journal*, *17*(9), :e05778. https://doi.org/https://doi.org/10.2903/j.efsa.2019.5778

Eyles, H., Grey, J., Jiang, Y., Umali, E., McLean, R., Te Morenga, L., Neal, B., Rodgers, A., Doughty, R. N., & Ni Mhurchu, C. (2023). Effectiveness of a Sodium-Reduction Smartphone App and Reduced-Sodium Salt to Lower Sodium Intake in Adults With Hypertension: Findings From the Salt Alternatives Randomized Controlled Trial [Original Paper]. *JMIR Mhealth Uhealth*, *11*, e43675. https://doi.org/10.2196/43675

Eyles, H., Rapson, J., Fuavao, K., Jiang, Y., Kira, G., Wall, C., Skeaff, S., Grimes, C., & McLean, R. M. (2025). Sodium, potassium and iodine excretion and blood pressure of New Zealand school children: a cross-sectional study and comparison with recommended guidelines. *BMJ Nutr Prev Health*, *8*(2), e001255. https://doi.org/10.1136/bmjnph-2025-001255

Eyles, H. C., & Cleghorn, C. L. (2022). Dietary sources of sodium across the diverse New Zealand adult population. *Prev Med Rep*, *29*, 101927. https://doi.org/10.1016/j.pmedr.2022.101927

Eyles, H. C., & Cleghorn, C. L. (2022). Dietary sources of sodium across the diverse New Zealand adult population. *Preventive Medicine Reports*, *29*, 101927. https://doi.org/https://doi.org/10.1016/j.pmedr.2022.101927

Filippi, J. P. D., Kaanders, H., & Hoftnan, A. (1981). SODIUM IN DIET AND MILK OF BREASTFEEDING WOMEN. *Acta Paediatrica*, *70*(3), 417-418. https://doi.org/https://doi.org/10.1111/j.1651-2227.1981.tb16576.x

Filippini, T., Malavolti, M., Whelton, P. K., Naska, A., Orsini, N., & Vinceti, M. (2021a). Blood Pressure Effects of Sodium Reduction: Dose-Response Meta-Analysis of Experimental Studies. *Circulation*, *143*(16), 1542-1567. https://doi.org/10.1161/circulationaha.120.050371

Filippini, T., Malavolti, M., Whelton, P. K., Naska, A., Orsini, N., & Vinceti, M. (2021b). Blood Pressure Effects of Sodium Reduction:Dose-Response Meta-Analysis of Experimental Studies. *Circulation*, *143*(16), 1542-1567. https://doi.org/doi:10.1161/CIRCULATIONAHA.120.050371

Filippini, T., Malavolti, M., Whelton, P. K., & Vinceti, M. (2022). Sodium Intake and Risk of Hypertension: A Systematic Review and Dose-Response Meta-analysis of Observational Cohort Studies. *Curr Hypertens Rep*, *24*(5), 133-144. https://doi.org/10.1007/s11906-022-01182-9

Food Standards Australia and New Zealand. (2023). *Processed foods*. FSANZ Retrieved from https://www.foodstandards.gov.au/consumer/our-safe-food-supply/processed-foods

Food Standards Australia and New Zealand. (2026, 22/04/2026). *Health Star Rating System*. Retrieved 09/07/2026 from https://www.foodstandards.gov.au/consumer/labelling/Health-Star-Rating-System

Food Standards Australia New Zealand, F. (2015, 26/11/2025). *How much sodium do Australians eat?* FSANZ. Retrieved 31/03/2026 from https://www.foodstandards.gov.au/consumer/nutrition/sodium-salt/salthowmuch

Food Standards Australia New Zealand, F. (2019, 26/11/2025). *How much sodium is in Australian foods?* FSANZ. Retrieved 31/03/2026 from https://www.foodstandards.gov.au/consumer/nutrition/sodium-salt/sodiumhowmuch

Fuavao, K., Mhurchu, C. N., Swinburn, B., Nosa, V., de Castro, T. G., & Eyles, H. (2023). The Major Packaged Food Sources of Sodium for New Zealand Children and Trends in the Sodium Content of Commonly Consumed Foods. *Medical Sciences Forum*, *18*(1), 24. https://www.mdpi.com/2673-9992/18/1/24

Garza, C., Johnson, C. A., Smith, E. O., & Nichols, B. L. (1983). Changes in the nutrient composition of human milk during gradual weaning. *Am J Clin Nutr*, *37*(1), 61-65. https://doi.org/10.1093/ajcn/37.1.61

Gomes, S., Mackay, S., Gerritsen, S., & Eyles, H. (2024). The development of sodium reduction targets for New Zealand fast foods and a comparison with the current sodium contents of products. *J Nutr Sci*, *13*, e41. https://doi.org/10.1017/jns.2024.35

Graudal, N. A., Hubeck-Graudal, T., & Jurgens, G. (2020). Effects of low sodium diet versus high sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride. *Cochrane Database Syst Rev*, *12*(12), Cd004022. https://doi.org/10.1002/14651858.CD004022.pub5

Grimes, C. A., Bolton, K. A., Trieu, K., Reimers, J., Armstrong, S., Bolam, B., Beckford, K., Santos, J. A., Rosewarne, E., Dunford, E. K., Jan, S., Webster, J., Neal, B., Nowson, C., & Woodward, M. (2023). Evaluation of a state-wide intervention on salt intake in primary schoolchildren living in Victoria, Australia. *Public Health Nutr*, *26*(7), 1456-1467. https://doi.org/10.1017/s1368980023000332

Grimes, C. A., Campbell, K. J., Riddell, L. J., & Nowson, C. A. (2013). Is socioeconomic status associated with dietary sodium intake in Australian children? A cross-sectional study. *BMJ Open*, *3*(2). https://doi.org/10.1136/bmjopen-2012-002106

Grimes, C. A., Kelley, S. J., Stanley, S., Bolam, B., Webster, J., Khokhar, D., & Nowson, C. A. (2017). Knowledge, attitudes and behaviours related to dietary salt among adults in the state of Victoria, Australia 2015. *BMC Public Health*, *17*(1), 532. https://doi.org/10.1186/s12889-017-4451-0

Grimes, C. A., Lim, K., Clark, L., Woodward, M., Szymlek-Gay, E. A., Zheng, M., Nowson, C. A., & Bolton, K. A. (2026). Sodium, potassium and blood pressure in Australian schoolchildren: exploring differences by sex and weight status-a cross-sectional study. *Hypertens Res*, *49*(3), 938-948. https://doi.org/10.1038/s41440-025-02489-1

Grimes, C. A., Riddell, L. J., Campbell, K. J., Beckford, K., Baxter, J. R., He, F. J., & Nowson, C. A. (2017). Dietary intake and sources of sodium and potassium among Australian schoolchildren: results from the cross-sectional Salt and Other Nutrients in Children (SONIC) study. *BMJ Open*, *7*(10), e016639. https://doi.org/10.1136/bmjopen-2017-016639

Gross, S. J., David, R. J., Bauman, L., & Tomarelli, R. M. (1980). Nutritional composition of milk produced by mothers delivering preterm. *J Pediatr*, *96*(4), 641-644. https://doi.org/10.1016/s0022-3476(80)80729-3

He, F. J., & MacGregor, G. A. (2010). Reducing population salt intake worldwide: from evidence to implementation. *Prog Cardiovasc Dis*, *52*(5), 363-382. https://doi.org/10.1016/j.pcad.2009.12.006

Health, Q. D. o. (2022). *Nutrition Standards for Meals and Menus (Revised 2022)*. Statewide Foodservices Network Retrieved from https://www.health.qld.gov.au/__data/assets/pdf_file/0030/156288/qh-nutrition-standards.pdf#:~:text=TheQueenslandHealthNutritionStandards,thenutritionalrequirementsofpatientsC

Heer, M., Baisch, F., Kropp, J., Gerzer, R., & Drummer, C. (2000). High dietary sodium chloride consumption may not induce body fluid retention in humans. *Am J Physiol Renal Physiol*, *278*(4), F585-595. https://doi.org/10.1152/ajprenal.2000.278.4.F585

Heer, M., Frings-Meuthen, P., Titze, J., Boschmann, M., Frisch, S., Baecker, N., & Beck, L. (2009). Increasing sodium intake from a previous low or high intake affects water, electrolyte and acid-base balance differently. *Br J Nutr*, *101*(9), 1286-1294. https://doi.org/10.1017/s0007114508088041

Hodson, E. M., & Cooper, T. E. (2023). Altered dietary salt intake for preventing diabetic kidney disease and its progression. *Cochrane Database Syst Rev*, *1*(1), Cd006763. https://doi.org/10.1002/14651858.CD006763.pub3

Holbrook, J. T., Patterson, K. Y., Bodner, J. E., Douglas, L. W., Veillon, C., Kelsay, J. L., Mertz, W., & Smith, J. C., Jr. (1984). Sodium and potassium intake and balance in adults consuming self-selected diets. *Am J Clin Nutr*, *40*(4), 786-793. https://doi.org/10.1093/ajcn/40.4.786

Holt, C. (1993). Interrelationships of the concentrations of some ionic constituents of human milk and comparison with cow and goat milks. *Comp Biochem Physiol Comp Physiol*, *104*(1), 35-41. https://doi.org/10.1016/0300-9629(93)90005-o

Hörnell, A., & Lagström, H. (2024). Infant feeding-a scoping review for Nordic Nutrition Recommendations 2023. *Food Nutr Res*, *68*. https://doi.org/10.29219/fnr.v68.10456

Huang, L., Trieu, K., Yoshimura, S., Neal, B., Woodward, M., Campbell, N. R. C., Li, Q., Lackland, D. T., Leung, A. A., Anderson, C. A. M., MacGregor, G. A., & He, F. J. (2020). Effect of dose and duration of reduction in dietary sodium on blood pressure levels: systematic review and meta-analysis of randomised trials. *Bmj*, *368*, m315. https://doi.org/10.1136/bmj.m315

Huang, L., Trieu, K., Yoshimura, S., Woodward, M., Campbell, N., Lackland, D., Leung, A., Anderson, C. A. M., MacGregor, G., Neal, B., & He, F. (2019). Impact of dose and duration of dietary salt reduction on blood pressure levels: Systematic review and meta-analysis of randomised trials. *European heart journal*, *40*, 989. https://doi.org/10.1093/eurheartj/ehz748.0446

Institute for Health Metrics and Evaluation. (2024). *Global Burden of Disease (GBD) results tool* (https://vizhub.healthdata.org/gbd-results/

Jeong, S., Hunter, S. D., Cook, M. D., Grosicki, G. J., & Robinson, A. T. (2024). Salty Subjects: Unpacking Racial Differences in Salt-Sensitive Hypertension. *Current Hypertension Reports*, *26*(1), 43-58. https://doi.org/10.1007/s11906-023-01275-z

Jula, A. (2024). Sodium - a systematic review for Nordic Nutrition Recommendations 2023. *Food Nutr Res*, *68*. https://doi.org/10.29219/fnr.v68.10319

Keenan, B. S., Buzek, S. W., Garza, C., Potts, E., & Nichols, B. L. (1982). Diurnal and longitudinal variations in human milk sodium and potassium: implication for nutrition and physiology. *Am J Clin Nutr*, *35*(3), 527-534. https://doi.org/10.1093/ajcn/35.3.527

Khokhar, D., Nowson, C. A., Margerison, C., Bolam, B., & Grimes, C. A. (2018). Knowledge and Attitudes Are Related to Selected Salt-Specific Behaviours among Australian Parents. *Nutrients*, *10*(6). https://doi.org/10.3390/nu10060720

Kieneker, L. M., Bakker, S. J., de Boer, R. A., Navis, G. J., Gansevoort, R. T., & Joosten, M. M. (2016). Low potassium excretion but not high sodium excretion is associated with increased risk of developing chronic kidney disease. *Kidney Int*, *90*(4), 888-896. https://doi.org/10.1016/j.kint.2016.07.012

Kirkendall, A. M., Connor, W. E., Abboud, F., Rastogi, S. P., Anderson, T. A., & Fry, M. (1976). The effect of dietary sodium chloride on blood pressure, body fluids, electrolytes, renal function, and serum lipids of normotensive man. *J Lab Clin Med*, *87*(3), 411-434.

Kodama, N., Morikuni, E., Matsuzaki, N., Yoshioka, Y. H., Takeyama, H., Yamada, H., Kitajima, H., & Nishimuta, M. (2005). Sodium and potassium balances in Japanese young adults. *J Nutr Sci Vitaminol (Tokyo)*, *51*(3), 161-168. https://doi.org/10.3177/jnsv.51.161

Land, M. A., Neal, B. C., Johnson, C., Nowson, C. A., Margerison, C., & Petersen, K. S. (2018). Salt consumption by Australian adults: a systematic review and meta-analysis. *The Medical journal of Australia*, *208*(2), 75-81. https://doi.org/10.5694/mja17.00394

Land, M. A., Webster, J., Christoforou, A., Johnson, C., Trevena, H., Hodgins, F., Chalmers, J., Woodward, M., Barzi, F., Smith, W., Flood, V., Jeffery, P., Nowson, C., & Neal, B. (2014). The association of knowledge, attitudes and behaviours related to salt with 24-hour urinary sodium excretion. *Int J Behav Nutr Phys Act*, *11*(1), 47. https://doi.org/10.1186/1479-5868-11-47

Leed, A., Sheridan, E., Baker, B., Bamford, S., Emmanouilidis, E., Stewart, F., Ostafe, K., Sarwari, M., Lim, K., Zheng, M., Islam, S. M. S., Bolton, K. A., & Grimes, C. A. (2023). Dietary Intake and Arterial Stiffness in Children and Adolescents: A Systematic Review. *Nutrients*, *15*(9). https://doi.org/10.3390/nu15092092

Lemons, J. A., Moye, L., Hall, D., & Simmons, M. (1982). Differences in the composition of preterm and term human milk during early lactation. *Pediatr Res*, *16*(2), 113-117. https://doi.org/10.1203/00006450-198202000-00007

Lerchl, K., Rakova, N., Dahlmann, A., Rauh, M., Goller, U., Basner, M., Dinges, D. F., Beck, L., Agureev, A., Larina, I., Baranov, V., Morukov, B., Eckardt, K. U., Vassilieva, G., Wabel, P., Vienken, J., Kirsch, K., Johannes, B., Krannich, A.,...Titze, J. (2015). Agreement between 24-hour salt ingestion and sodium excretion in a controlled environment. *Hypertension*, *66*(4), 850-857. https://doi.org/10.1161/hypertensionaha.115.05851

Leyvraz, M., Chatelan, A., da Costa, B. R., Taffé, P., Paradis, G., Bovet, P., Bochud, M., & Chiolero, A. (2018). Sodium intake and blood pressure in children and adolescents: a systematic review and meta-analysis of experimental and observational studies. *Int J Epidemiol*, *47*(6), 1796-1810. https://doi.org/10.1093/ije/dyy121

Lowe, S., Bowyer, L., Lust, K., McMahon, L., Morton, M., North, R., Paech, M., & Said, J. (2014). *Guideline for the Management of Hypertensive Disorders of Pregnancy*. https://ranzcog.edu.au/wp-content/uploads/SOMANZ-Hypertensive-Disorders-Pregnancy.pdf

Luzardo, L., Noboa, O., & Boggia, J. (2015). Mechanisms of Salt-Sensitive Hypertension. *Curr Hypertens Rev*, *11*(1), 14-21. https://doi.org/10.2174/1573402111666150530204136

Mahmood, L., Flores-Barrantes, P., Moreno, L. A., Manios, Y., & Gonzalez-Gil, E. M. (2021). The Influence of Parental Dietary Behaviors and Practices on Children's Eating Habits. *Nutrients*, *13*(4). https://doi.org/10.3390/nu13041138

Mason, K., Toohey, F., Gott, M., & Moeke-Maxwell, T. (2019). Māori: living and dying with cardiovascular disease in Aotearoa New Zealand. *Curr Opin Support Palliat Care*, *13*(1), 3-8. https://doi.org/10.1097/spc.0000000000000404

McCallum, L., Lip, S., & Padmanabhan, S. (2015). The hidden hand of chloride in hypertension. *Pflugers Arch*, *467*(3), 595-603. https://doi.org/10.1007/s00424-015-1690-8

McLean, R., Edmonds, J., Williams, S., Mann, J., & Skeaff, S. (2015). Balancing Sodium and Potassium: Estimates of Intake in a New Zealand Adult Population Sample. *Nutrients*, *7*(11), 8930-8938. https://doi.org/10.3390/nu7115439

McLean, R., Williams, S., & Mann, J. (2014). Monitoring population sodium intake using spot urine samples: validation in a New Zealand population. *Journal of human hypertension*, *28*(11), 657-662. https://doi.org/10.1038/jhh.2014.10

McLean, R. M., Farmer, V. L., Nettleton, A., Cameron, C. M., Cook, N. R., Woodward, M., & Campbell, N. R. C. (2018). Twenty-Four-Hour Diet recall and Diet records compared with 24-hour urinary excretion to predict an individual's sodium consumption: A Systematic Review. *J Clin Hypertens (Greenwich)*, *20*(10), 1360-1376. https://doi.org/10.1111/jch.13391

McLean, R. M., Williams, S. M., Te Morenga, L. A., & Mann, J. I. (2018). Spot urine and 24-h diet recall estimates of dietary sodium intake from the 2008/09 New Zealand Adult Nutrition Survey: a comparison. *Eur J Clin Nutr*, *72*(8), 1120-1127. https://doi.org/10.1038/s41430-018-0176-0

McMahon, E., Webster, J., O'Dea, K., & Brimblecombe, J. (2015). Dietary sodium and iodine in remote Indigenous Australian communities: will salt-reduction strategies increase risk of iodine deficiency? A cross-sectional analysis and simulation study. *BMC Public Health*, *15*, 1318. https://doi.org/10.1186/s12889-015-2686-1

Meng, Y., Mynard, J. P., Smith, K. J., Juonala, M., Urbina, E. M., Niiranen, T., Daniels, S. R., Xi, B., & Magnussen, C. G. (2024). Pediatric Blood Pressure and Cardiovascular Health in Adulthood. *Curr Hypertens Rep*, *26*(11), 431-450. https://doi.org/10.1007/s11906-024-01312-5

Metcalf, P., Scragg, R., Schaaf, D., Dyall, L., Black, P., & Jackson, R. (2008). Dietary intakes of European, Maori, Pacific and Asian adults living in Auckland: The Diabetes, Heart and Health Study. *Australian and New Zealand journal of public health*, *32*, 454-460. https://doi.org/10.1111/j.1753-6405.2008.00279.x

Mhurchu, C. N., Eyles, H., & Choi, Y. H. (2017). Effects of a Voluntary Front-of-Pack Nutrition Labelling System on Packaged Food Reformulation: The Health Star Rating System in New Zealand. *Nutrients*, *9*(8). https://doi.org/10.3390/nu9080918

Milajerdi, A., Djafarian, K., & Shab-Bidar, S. (2019). Dose-response association of dietary sodium intake with all-cause and cardiovascular mortality: a systematic review and meta-analysis of prospective studies. *Public Health Nutr*, *22*(2), 295-306. https://doi.org/10.1017/s1368980018002112

Monro, D., Hu, N., & McLean, R. M. (2025). Food Reformulation in New Zealand: A Success Story of Reducing the Sodium Content in Bread from 2003 to 2023. *Nutrients*, *17*(22), 3627. https://www.mdpi.com/2072-6643/17/22/3627

Moreno, S. V., Grimes, C., Bolton, K. A., Uddin, R., Siopis, G., Maddison, R., & Islam, S. M. S. (2024). The burden of cardiovascular disease attributable to high dietary sodium intake in Australia between 1990 and 2019. *J Hypertens*, *42*(7), 1163-1172. https://doi.org/10.1097/hjh.0000000000003699

Morriss, F. H., Jr., Brewer, E. D., Spedale, S. B., Riddle, L., Temple, D. M., Caprioli, R. M., & West, M. S. (1986). Relationship of human milk pH during course of lactation to concentrations of citrate and fatty acids. *Pediatrics*, *78*(3), 458-464.

Motil, K. J., Kertz, B., & Thotathuchery, M. (1997). Lactational performance of adolescent mothers shows preliminary differences from that of adult women. *J Adolesc Health*, *20*(6), 442-449. https://doi.org/10.1016/s1054-139x(97)00036-0

National Academies of Sciences, E., and Medicine. (2019). *Dietary Reference Intakes for Sodium and Potassium* (H. M. Oria M, Stallings VA,, Ed.). National Academies Press (US). https://www.ncbi.nlm.nih.gov/sites/books/NBK545445/

National Health and Medical Research Council, N. (2006a). *Evidence Appendix for the 2006 Nutrient Reference Values for Australia and New Zealand*. Canberra, ACT

National Health and Medical Research Council, N. (2006b). *Nutrient Reference Values for Australia and New Zealand*. Canberra: NHMRC Retrieved from https://www.nhmrc.gov.au/about-us/publications/nutrient-reference-values-australia-and-new-zealand-including-recommended-dietary-intakes

National Health and Medical Research Council, N. (2011). A Modelling System to Inform the Revision of the Australian Guide to Healthy Eating. In N. National Health and Medical Research Council (Ed.). Canberra, ACT.

National Health and Medical Research Council, N. (2013). *Australian Dietary Guidelines - Educator Guide*. Canberra Retrieved from https://www.eatforhealth.gov.au/sites/default/files/files/the_guidelines/n55b_eat_for_health_educators_guide.pdf

National Health and Medical Research Council, N. (2019). *Policy on the Disclosure of Interests Requirements for Prospective and Appointed NHMRC Committee Members*. Retrieved from https://www.nhmrc.gov.au/sites/default/files/documents/attachments/publications/policy-on-the-disclosure-of-interests-requirements.pdf

National Health and Medical Research Council, N. (2026). *Methodological Framework for the Review of Nutrient Reference Values*. Canberra, ACT: NHMRC Retrieved from URL TBC ONCE PUBLISHED

Ndanuko, R. N., Ibrahim, R., Hapsari, R. A., Neale, E. P., Raubenheimer, D., & Charlton, K. E. (2021). Association between the Urinary Sodium to Potassium Ratio and Blood Pressure in Adults: A Systematic Review and Meta-Analysis. *Adv Nutr*, *12*(5), 1751-1767. https://doi.org/10.1093/advances/nmab036

New Zealand Food Safety. (2018). *New Zealand Total Diet Study 2016*. Retrieved from https://www.mpi.govt.nz/dmsdocument/43663-2016-NZ-Total-Diet-Study-without-Appendices-report-

Newberry, S. J., Chung, M., Anderson, C. A. M., Chen, C., Fu, Z., Tang, A., Zhao, N., Booth, M., Marks, J., Hollands, S., Motala, A., Larkin, J., Shanman, R., & Hempel, S. (2018). Sodium and Potassium Intake: Effects on Chronic Disease Outcomes and Risks. In. Agency for Healthcare Research and Quality (US).

Nowson, C., Lim, K., Land, M. A., Webster, J., Shaw, J. E., Chalmers, J., Flood, V., Woodward, M., & Grimes, C. (2018). Salt intake and dietary sources of salt on weekdays and weekend days in Australian adults. *Public Health Nutr*, *21*(12), 2174-2182. https://doi.org/10.1017/s1368980017004104

NSW Government Agency for Clincal Innovation. (2026). *Nutrient Goal Standard for adult patients*. Retrieved from https://aci.health.nsw.gov.au/projects/nutrition-standards/adult/nutrient-goals#sodium

O'Halloran, S. A., Grimes, C. A., Lacy, K. E., Nowson, C. A., & Campbell, K. J. (2016). Dietary sources and sodium intake in a sample of Australian preschool children. *BMJ Open*, *6*(2), e008698. https://doi.org/10.1136/bmjopen-2015-008698

Oliver, W. J., Neel, J. V., Grekin, R. J., & Cohen, E. L. (1981). Hormonal adaptation to the stresses imposed upon sodium balance by pregnancy and lactation in the Yanomama Indians, a culture without salt. *Circulation*, *63*(1), 110-116. https://doi.org/10.1161/01.cir.63.1.110

Organization, W. H. (2012). Report of the Formal Meeting of Member States to conclude the work on the comprehensive global monitoring framework, including indicators, and a set of voluntary global targets for the prevention and control of noncommunicable diseases. *World Health Organization: Geneva, Switzerland*, *6*.

Palacios, C., Wigertz, K., Martin, B. R., Jackman, L., Pratt, J. H., Peacock, M., McCabe, G., & Weaver, C. M. (2004). Sodium retention in black and white female adolescents in response to salt intake. *J Clin Endocrinol Metab*, *89*(4), 1858-1863. https://doi.org/10.1210/jc.2003-031446

Parker, M., Puddey, I. B., Beilin, L. J., & Vandongen, R. (1990). Two-way factorial study of alcohol and salt restriction in treated hypertensive men. *Hypertension*, *16*(4), 398-406. https://doi.org/10.1161/01.hyp.16.4.398

Perez, V., & Chang, E. T. (2014). Sodium-to-potassium ratio and blood pressure, hypertension, and related factors. *Adv Nutr*, *5*(6), 712-741. https://doi.org/10.3945/an.114.006783

Perrin, M. T., Fogleman, A. D., Newburg, D. S., & Allen, J. C. (2017). A longitudinal study of human milk composition in the second year postpartum: implications for human milk banking. *Matern Child Nutr*, *13*(1). https://doi.org/10.1111/mcn.12239

Petersen, K. S., Malta, D., Rae, S., Dash, S., Webster, J., McLean, R., Thout, S. R., Campbell, N. R. C., & Arcand, J. (2020). Further evidence that methods based on spot urine samples should not be used to examine sodium-disease relationships from the Science of Salt: A regularly updated systematic review of salt and health outcomes (November 2018 to August 2019). *J Clin Hypertens (Greenwich)*, *22*(10), 1741-1753. https://doi.org/10.1111/jch.13958

Picciano, M. F., Calkins, E. J., Garrick, J. R., & Deering, R. H. (1981). Milk and mineral intakes of breastfed infants. *Acta Paediatr Scand*, *70*(2), 189-194. https://doi.org/10.1111/j.1651-2227.1981.tb05540.x

Pitkin, R. M., Kaminetzky, H. A., Newton, M., & Pritchard, J. A. (1972). Maternal nutrition. A selective review of clinical topics. *Obstet Gynecol*, *40*(6), 773-785.

Rosewarne, E., Santos, J. A., Hoek, A., Grimes, C., Nowson, C., Webster, J., & Bolton, K. A. (2021). Are there socio-demographic differences in salt behaviours and fruit and vegetable consumption in Australian adults? A nationally representative cross-sectional survey. *Nutrition journal*, *20*(1), 77. https://doi.org/10.1186/s12937-021-00734-0

Sacks, F. M., Svetkey, L. P., Vollmer, W. M., Appel, L. J., Bray, G. A., Harsha, D., Obarzanek, E., Conlin, P. R., Miller, E. R., 3rd, Simons-Morton, D. G., Karanja, N., & Lin, P. H. (2001). Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med*, *344*(1), 3-10. https://doi.org/10.1056/nejm200101043440101

Sciarrone, S. E., Beilin, L. J., Rouse, I. L., & Rogers, P. B. (1992). A factorial study of salt restriction and a low-fat/high-fibre diet in hypertensive subjects. *J Hypertens*, *10*(3), 287-298. https://doi.org/10.1097/00004872-199203000-00013

Shim, J. S., Oh, K., & Kim, H. C. (2014). Dietary assessment methods in epidemiologic studies. *Epidemiol Health*, *36*, e2014009. https://doi.org/10.4178/epih/e2014009

Stein, L. J., Cowart, B. J., & Beauchamp, G. K. (2012). The development of salty taste acceptance is related to dietary experience in human infants: a prospective study. *Am J Clin Nutr*, *95*(1), 123-129. https://doi.org/10.3945/ajcn.111.014282

Sterns, R. H. (2015). Disorders of Plasma Sodium — Causes, Consequences, and Correction. *New England Journal of Medicine*, *372*(1), 55-65. https://doi.org/doi:10.1056/NEJMra1404489

Stolarz-Skrzypek, K., Kuznetsova, T., Thijs, L., Tikhonoff, V., Seidlerová, J., Richart, T., Jin, Y., Olszanecka, A., Malyutina, S., Casiglia, E., Filipovský, J., Kawecka-Jaszcz, K., Nikitin, Y., & Staessen, J. A. (2011). Fatal and nonfatal outcomes, incidence of hypertension, and blood pressure changes in relation to urinary sodium excretion. *Jama*, *305*(17), 1777-1785. https://doi.org/10.1001/jama.2011.574

Strohm, D., Bechthold, A., Ellinger, S., Leschik-Bonnet, E., Stehle, P., & Heseker, H. (2018). Revised Reference Values for the Intake of Sodium and Chloride. *Ann Nutr Metab*, *72*(1), 12-17. https://doi.org/10.1159/000484355

Subar, A. F., Freedman, L. S., Tooze, J. A., Kirkpatrick, S. I., Boushey, C., Neuhouser, M. L., Thompson, F. E., Potischman, N., Guenther, P. M., Tarasuk, V., Reedy, J., & Krebs-Smith, S. M. (2015). Addressing Current Criticism Regarding the Value of Self-Report Dietary Data. *J Nutr*, *145*(12), 2639-2645. https://doi.org/10.3945/jn.115.219634

Surma, S., Surma, S., Banach, M., Pruc, M., Pruc, M., Szarpak, L., Szarpak, L., Banach, M., Banach, M., & Banach, M. (2025). Dietary salt on vascular function: a meta-analysis. *Arch. Med. Sci.*, *21*(4), 1631-1635. https://doi.org/10.5114/aoms/209720

Todd, A. S., Macginley, R. J., Schollum, J. B., Williams, S. M., Sutherland, W. H., Mann, J. I., & Walker, R. J. (2012). Dietary sodium loading in normotensive healthy volunteers does not increase arterial vascular reactivity or blood pressure. *Nephrology (Carlton)*, *17*(3), 249-256. https://doi.org/10.1111/j.1440-1797.2011.01550.x

Truchet, S., & Honvo-Houéto, E. (2017). Physiology of milk secretion. *Best Pract Res Clin Endocrinol Metab*, *31*(4), 367-384. https://doi.org/10.1016/j.beem.2017.10.008

United States Institute of Medicine, U. I. (2005). *Dietary Reference Intakes for water, potassium, sodium, chloride, and sulfate*. Washington (DC): The National Academies Press

University of Otago and Ministry of Health. (2011). *A Focus on Nutrition: Key findings of the 2008/09 New Zealand Adult Nutrition Survey*. Wellington: Ministry of Health Retrieved from https://www.health.govt.nz/system/files/2011-10/a-focus-on-nutrition-v2.pdf

Wack, R. P., Lien, E. L., Taft, D., & Roscelli, J. D. (1997). Electrolyte composition of human breast milk beyond the early postpartum period. *Nutrition*, *13*(9), 774-777. https://doi.org/10.1016/s0899-9007(97)00187-1

Wang, N. X., McLean, R. M., Cameron, C., & Skeaff, S. A. (2023). The quantification of sodium intake from discretionary salt intake in New Zealand using the lithium-tagged salt method [Original Research]. *Frontiers in nutrition*, *Volume 9 - 2022*. https://doi.org/10.3389/fnut.2022.1065710

Wang, N. X., Skeaff, S., Cameron, C., Fleming, E., & McLean, R. M. (2022). Sodium in the New Zealand diet: proposed voluntary food reformulation targets will not meet the WHO goal of a 30% reduction in total sodium intake. *Eur J Nutr*, *61*(6), 3067-3076. https://doi.org/10.1007/s00394-022-02864-5

Wang, P., Deger, M. S., Kang, H., Ikizler, T. A., Titze, J., & Gore, J. C. (2017). Sex differences in sodium deposition in human muscle and skin. *Magn Reson Imaging*, *36*, 93-97. https://doi.org/10.1016/j.mri.2016.10.023

Wheeler, A., Rahiri, J.-L., Ellison-Lupena, R., Hanchard, S., Brewer, K. M., Paynter, J., Winter-Smith, J., Selak, V., Ameratunga, S., Grey, C., & Harwood, M. (2025). Assessing the gaps in cardiovascular disease risk assessment and management in primary care for Māori and Pacific peoples in Aotearoa New Zealand— a systematic review. *The Lancet Regional Health – Western Pacific*, *56*. https://doi.org/10.1016/j.lanwpc.2025.101511

Wilson, N., Cleghorn, C., Nghiem, N., & Blakely, T. (2023). Prioritization of intervention domains to prevent cardiovascular disease: a country-level case study using global burden of disease and local data. *Population Health Metrics*, *21*(1), 1. https://doi.org/10.1186/s12963-023-00301-1

World Health Organisation. (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. https://iris.who.int/server/api/core/bitstreams/15f51d0a-bfbd-43ad-a637-73778feb57e3/content
World Health Organisation. (2026, 11/05/2026). *Sodium reduction*. Retrieved 09/06/2026 from https://www.who.int/news-room/fact-sheets/detail/sodium-reduction
World Health Organization, W. (2012). *Guideline: Sodium Intake for Adults and Children*. WHO. https://www.who.int/publications/i/item/9789241504836
World Health Organization, W. (2026). *Cardiovascular diseases*. Retrieved 31/03/2026 from https://www.who.int/health-topics/cardiovascular-diseases
Zhao, D., Li, H. M., Li, C. X., & Zhou, B. (2022). 24-Hour Urinary Sodium Excretion Association with Cardiovascular Events: A Systematic Review and Dose-Response Meta-Analysis. *Biomed Environ Sci*, *35*(10), 921-930. https://doi.org/10.3967/bes2022.119