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Urinary sodium excretion, dietary sources of sodium intake and knowledge and practices around salt use in a group of healthy Australian women

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Abstract

Objective: Strategies that aim to facilitate reduction of the salt content of foods in Australia are hampered by sparse and outdated data on habitual salt intakes. This study assessed habitual sodium intake through urinary excretion analyses, and identified food sources of dietary sodium, as well as knowledge and practices related to salt use in healthy women. Methods: Cross-sectional, convenient sample of 76 women aged 20 to 55 years, Wollongong, NSW. Data included a 24 hour urine sample, three-day food diary and a self-administered questionnaire. Results: Mean Na excretion equated to a NaCl (salt) intake of 6.41 (SD=2.61) g/day; 43% had values /day. Food groups contributing to dietary sodium were: bread and cereals (27%); dressings/sauces (20%); meat/egg-based dishes (18%); snacks/desserts/extras (11%); and milk and dairy products (11%). Approximately half the sample reported using salt in cooking or at the table. Dietary practices reflected a high awareness of salt-related health issues and a good knowledge of food sources of sodium. Conclusion: These findings from a sample of healthy women in the Illawarra indicate that dietary sodium intakes are lower in this group than previously reported in Australia. However, personal food choices and high levels of awareness of the salt reduction messages are not enough to achieve more stringent dietary targets of foods.

Keywords

salt, women, group, dietary, healthy, urinary, australian, sources, excretion, intake, knowledge, practices, around, sodium

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Results: Mean Na excretion equated to a NaCl (salt) intake of 6.41 (SD=2.61) g/day; 43% had values <6 g/day. Food groups contributing to dietary sodium were: bread and cereals (27%); dressings/sauces (20%); meat/egg-based dishes (18%); snacks/desserts/extras (11%); and milk and dairy products (11%). Approximately half the sample reported using salt in cooking or at the table. Dietary practices reflected a high awareness of salt-related health issues and a good knowledge of food sources of sodium.

Conclusion: These findings from a sample of healthy women in the Illawarra indicate that dietary sodium intakes are lower in this group than previously reported in Australia. However, personal food choices and high levels of awareness of the salt reduction messages are not enough to achieve more stringent dietary targets of <4 g salt per day.

Implications: Urinary Na excretion data are required from a larger nationally representative sample to confirm habitual salt intakes. The bread and cereals food group are an obvious target for sodium reduction strategies in manufactured foods.

Key words: salt, dietary sodium, consumer perceptions, urinary sodium excretion, Australian women.

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Decreasing salt intake, with the aim of decreasing chronic illness, is an important public health intervention. High blood pressure, linked with high salt intake, affects 3.7 million Australians[1] and is a major risk factor for cardiovascular disease, the leading cause of death for Australians.[2] A modest reduction in salt in both hypertensive and normotensive individuals has been found to have a significant and, from a population perspective, important effect on lowering blood pressure.[3]

If salt intake of the population can be decreased, such important health gains can be achieved with relatively small economic commitment.[4] A 15% reduction in salt intake in 23 developing countries has been estimated to result in a saving of 13.8 million lives over a 10 year period (2006–2015), at low cost of US$0.40/0.50 – 1.00 per person per year.[4]

Reducing salt in the diet requires knowledge of current salt intake of the population, foods that are major contributors of salt and people's behaviour regarding adding or avoiding salt in their diets. However, available Australian information is limited. One of the few Australian studies to use the gold standard method[5] of 24 hour urinary sodium excretion to assess salt intake was conducted over a decade ago in Hobart in 1995. That study estimated that only 6% of men and 36% of women were meeting the national sodium target of 100 mmol/day or 6 g sodium chloride (salt) equivalent and reported an average salt intake of 7–10 g/day.[6]

More recent Australian studies have reported mixed levels. The Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Human Nutrition Unit reported a salt (NaCl) intake of 10.6 g/day (men) and 8.0 g/day (women), based on urinary Na excretion data obtained from volunteers participating in weight loss studies over the past five years.[7] Margerison and Nowson (2006)[8] also found similar salt intakes based on high urinary Na concentrations. These results are comparable to those from the UK, where salt intakes of 9.7 g for men and 7.7 g for women (8.6 g/day for total sample) have recently been reported[9] and are similar to urinary sodium surveys conducted by the Food Standards Authority in 2006 and 2007 in England[10] and in Wales[11] (9.0 g/day and 8.1 g/day respectively). However, Food Standards Australia New Zealand (FSANZ)[12] recently reported a lower figure than previously reported. Using

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dietary modeling based on estimated food intakes from the 1995 National Nutrition Survey, together with updated food composition data for the NaCl content of Australian foods, they estimated that Australians aged two years and older consume an average of 5.5 grams of salt (2,150 mg Na) per day.

Studies that have explored people's knowledge of salt and health, their salt reduction activities or that have examined which foods are major contributors of salt in the Australian diet, are also scarce. Data from other developed countries, such as the UK, estimate that about three-quarters of sodium intake comes from food processing, about 15% is discretionary (half that is contributed by table salt and half by added salt in cooking), 10-11% is naturally occurring (inherent) in foods, while less than one per cent is provided by water.[13] An Australian study estimated that the main contributors of dietary salt in 94 middle-aged adults were breads and cereals (38%), meat and meat products/dishes (17%), milk products/dishes (11%), and savoury sauce/condiments (9%).[14] An evaluation of the reported sodium content of Australian food products, assessed using food labeling information,[15] reported that 53% of food products investigated had sodium levels above targets established by the UK Food Standards Agency (2008).[16] Food sub-categories with less than 20% of products meeting the targets included white bread, wholemeal bread, cream cheese, low fibre breakfast cereal, savoury snack biscuits, hot dogs, sausages, canned soup, canned beans and spaghetti and canned vegetables.[15]

Strategies to reduce salt in the food supply are needed to support individuals' actions to reduce salt intake. More than two decades ago, Greenfield and colleagues (1984) suggested that a relatively easy way to lower habitual sodium intakes in Australians would be to encourage the food industry to use less sodium.[17] Since that time, some attempts have been made to gradually reduce the sodium content of processed foods,[18,19] but little is known of the impact, as regular monitoring has not occurred.

Knowledge of which foods are the major contributors of salt in the Australian diet could assist the food industry to target those foods for salt reduction. Some studies have been undertaken testing consumer flavour acceptance of salt reduced products.[20,21] Sudden, large reductions in salt content were less acceptable to consumers[22] than small to moderate changes,[23] which may lead to a preference for a lower salt diet,[24-26] and may not be detected by consumers.[27] Lowering the sodium content of bread by about one-third, accompanied by a two-fold to three-fold increase of the nutritionally favourable potassium and magnesium, can produce an acceptable dark European-type bread.[21] More recent studies by Charlton et al.[28,29] report on substitution in the diet of a sodium-reduced brown bread that achieved a clinically significant blood pressure reduction in free-living people with hypertension from low socioeconomic backgrounds.

This study aimed to assess 24 hour urinary sodium excretion of healthy Australian women and determine their knowledge, attitudes and practices related to salt use.

Methods

A convenience sample of 78 women, aged 19 to 56 years, was recruited from workplaces in Wollongong, NSW through advertisements and e-mail correspondence. Exclusion criteria included major illnesses, use of antihypertensive medication and/or diuretics, pregnancy or lactation, and formal training in nutrition. Permission to conduct the study was sought from the City Council management, and approval granted by the Human Ethics Research Committee of the University of Wollongong.

A single 24 hour collection of urinary excretion was obtained. Urinary sodium was assessed using the indirect ion specific electrode method. Samples that had volumes of 500 mL/24 hours or less were not included in the analyses as these were considered to be incomplete ($n = 2$).

Participants completed a three-day food diary, which incorporated specific questions on discretionary salt use (frequency and type of salt), at the same time as when the urine was collected, with one of the days of recording coinciding. Dietary data were entered into the FoodWorks 2007 nutrient analysis software program (Xyris, Version 5, Brisbane, Australia) and analysed using AUSNUT 1999 and AusBrands database of Food Standards Australia New Zealand for mean daily intake of energy, macronutrients, micronutrients and sodium intake.

Sodium intake was calculated according to amounts provided per day from the following composite food groups (combined by grouping similar food items): Bread, cereal, rice, pasta, noodles (bread and cereal group); meat/egg based dishes; dairy products; snacks/desserts/extras/fruits/vegetables/legumes; fish; spreadable fat; nuts and seeds.

Body weight and percentage body fat was measured in an upright position in minimal clothing and without shoes, using scales with a bioelectrical impedance component (Tanita TBF-622). Blood pressure (BP) was measured using an automatic blood pressure monitor (DINAMAP™ XL Vital Signs Monitor) on three occasions, according to standard protocol recommended by the American Heart Association.[30] The average of the second two measurements was used.

A questionnaire was developed to assess consumers' attitudes regarding and behaviour towards sodium and salt information on food packaging, influences on their food choice behaviour and their knowledge of the salt content of various commonly consumed foods. Participants were asked to rate a list of everyday foods regarding whether they thought the foods were high, medium or low in salt/sodium content. Items were adapted from a consumer survey conducted by Australian World Action on Salt and Health (AWASH) in 2007.[31]

Statistical analyses

All statistical analyses were conducted using SPSS for Windows (Version 15.0, 2006, SPSS Inc, Chicago, IL). Urinary sodium excretion values were compared against NHMRC (2006) reference values for both the Suggested Dietary Target of 4 g of salt (1,600 mg of sodium) per day and an Upper Level of intake of 6 g of salt (2,300 mg of sodium) per day,[32] as well as the WHO (2007) population target of 5 g/day of salt (2,000 mg sodium).[33] Results were expressed as mean (standard deviation (SD)) with the level of significance reported at $P<0.05$ for all comparisons. Paired differences in Na estimates from the three-day diet histories and the urinary Na excretion analyses were compared using a Wilcoxon paired t-test and Spearman correlation coefficients determined between the two measures.

Results

Participant characteristics are shown in Table 1. Mean Na excretion was 2,718 (1610) mg/24hr (range = 230 – 6896 mg/24/hr), which equated to a mean salt intake of 6.41 g/day; 43% had values >6 g/day (Table 2). No association with age was found.

Consumer survey

Knowledge and practices relating to salt intake

Knowledge about sources of salt in the Australian diet was good. Most participants (88%) identified processed foods, such as breads, breakfast cereals, tinned foods and takeaway foods, as the major sources of salt in the diet and most participants could correctly identify which foods were high in salt content (Table 3). However, few participants could correctly identify the maximum recommended intake of salt per day as being 6 g (5 %) and most participants (77 %) reported that they did not know the recommended intake levels. Participants who used salt either during cooking (68 %) or added to foods at the table (67.5 %) reported using it only sometimes. Almost a third never used discretionary salt. Sixty per cent (n = 66) of participants reported using iodised salt at home either often/always (29 %) or sometimes (31 %), while 18 % (n = 14) did not know of it. Of those who did not use iodised salt, the main reason provided was that they did not use any type of salt at home.

Regarding health-related knowledge about salt, 62% of participants knew that the salt/sodium in their diet worsens their health. Almost all participants (97%) thought that salty food consumption can cause high blood pressure, and 88% and 72% identified the link between salt intake and heart attacks and stroke, respectively. When asked about who should be responsible for helping the public reduce their salt intake, most participants felt it was their own responsibility (60%), followed by the food industry (26%), and government (10%). Only one participant felt that the doctor should provide such a role.

Food purchasing behaviour

Regarding food purchasing behaviour generally, 49% and 45% of participants either often or sometimes, respectively, checked food labels while shopping, while almost all (96 %) reported that the information on food labels affected their purchasing choices either often (47%) or sometimes (49%). Three-quarters of the women reported that they looked at salt/sodium information on food packaging when shopping, either often (19.5%) or sometimes (56%), while 70% reported that the salt/sodium content provided on food labels affected their decision whether or not to purchase a product, either often (12%) or sometimes (58%). Eighty-one per cent tried to buy 'low salt' foods while 79% tried to purchase

Table 1: Characteristics of participants (n = 76).

Characteristic	Mean (SD)
Age (mean (SD)	38.3 (10.6) y
Range	19 – 56
Education (% subjects)	
- High school completion	13 %
- TAFE/apprenticeship	21 %
- University degree	32 %
- Postgraduate degree	35 %
BMI (mean (SD))	24.0 (3.5)
BMI categories (% subjects)	
- Underweight (%)	1.3
- Desirable weight (%)	62.7
- Overweight (%)	29.3
- Obese (%)	5.3
% Body fat (mean (SD))	30.4 % (6.4)
Blood pressure (mean (SD))	
Systolic BP (mmHg)	109 (12)
Diastolic BP (mmHg)	65 (9)

Table 2: Twenty-four hour urinary excretion and mean reported dietary intake of sodium.[a]

	24-hour urinary Na (mg/day)	Dietary Na (mg/day)
Mean (SD)	2,562 (1,044)	2,718 (1,610)
Range	874-5681	230-6896
25th percentile	1,754	2,058
Median	2,438	2,498
75th percentile	3,203	3,005
24hr urinary Na excretion (mg/day)	**N**	**% subjects**
Within recommended levels		
< 6 g salt/day (2,300 mg Na/day)[b]	43	57.3 %
< 5 g salt/day (2,000 mg Na/day)[c]	25	34.7 %
< 4 g salt/day (1,600 mg Na/day)[d]	14	19.4 %

Notes: a) N = 72 subjects with both urinary and dietary Na data
b) NHMRC (2005) Nutrient Reference Values (Upper Level)[32]
c) WHO (2007) population target[33]
d) NHMRC (2005) Nutrient Reference Values (Suggested dietary target)[32]

Table 3: Knowledge of foods that are high in salt content (n=77).

	Salt content (% sample)			
	High	Medium	Low	Do not know
White sandwich bread	16.9	**64.9**[a]	16.9	1.3
Full cream milk	2.5	11.4	**75.7**	9.1
Premium bacon	**96.1**	3.9	0	0
Pizza	**88.6**	3.8	1.3	3.8
Fresh carrot	**0**	1.3	**92.4**	3.8
White rice	1.3	19.5	**72.7**	6.5
Peanut butter	**50.6**	42.9	2.6	3.9
Corn flakes	**26.0**	55.8	13.0	5.2
Tomato sauce	**66.2**	28.6	3.9	1.3
Margarine	27.3	**57.1**	11.7	3.9
Vegemite	**80.5**	15.6	1.3	2.6

Note: a) Bold type indicates correct answer.

'no added salt' foods. Eighty-two per cent of participants reported looking for the Heart Foundation tick when shopping, and 80.5% reported that the tick on a food label affected whether or not they purchased a product (26% often; 54.5% sometimes).

Dietary intake data

Mean daily macro and micronutrient intake is shown in Table 4. With the exception of saturated fat intake, macronutrient energy profiles reflect a dietary pattern in line with suggested dietary targets.[32]

Dietary sources of high sodium intake

The contribution of food groups to total sodium intake is presented in Table 5. Foods from the bread and cereals group were the main contributor to total reported dietary sodium intake (29%), followed by meat and egg-based dishes, dressings and sauces, then snacks and desserts (Figure 1).

The group mean difference between urinary Na excretion and reported dietary Na intake in the 72 subjects that had both measures was 48 (1,172) mg/day (Wilcoxon paired t-test; p=0.645). Expressed as a percentage difference, the three-day food record tended to over-estimate urinary Na excretion by a mean of 16.8 % (SD = 56.2). Spearman correlation coefficient between dietary and urinary Na was r=0.185 (P=0.120). Mean dietary Na/K ratio of the total diet (0.85 (0.08)) fell below the World Health Organization (2005)[34] recommendation of 1. The Na/K ratio of the individual food groups is shown in Table 5.

Discussion

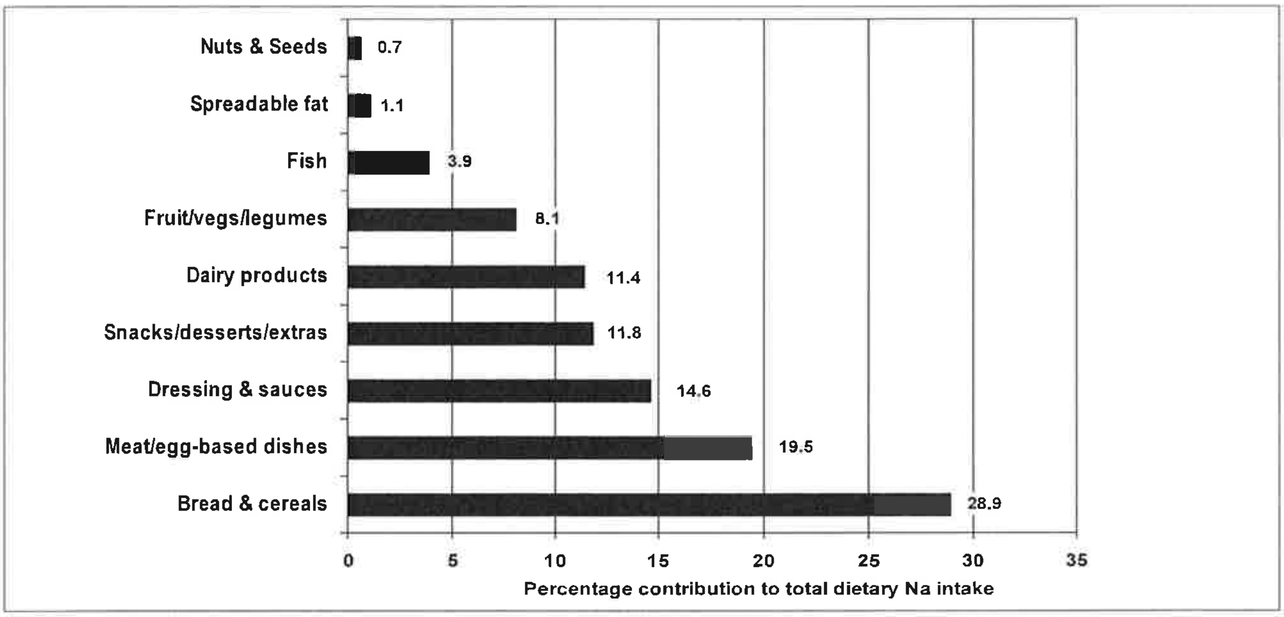
Urinary Na excretion data provide an estimate of total Na intake from all sources, including salt (NaCl) in processed foods and discretionary salt use, naturally occurring sodium in foods, as well as sodium from non-NaCl sodium-containing ingredients.

Table 4: Mean daily dietary intake of study participants.

Nutrient	Mean (SD)	Recommended Dietary intake (RDI)/ Suggested Dietary Target[32]
Macronutrients		
Energy (kJ)	8,415 (1,803)	
Protein (g)	88.5 (21.6)	
Total Fat (g)	74.4 (23.5)	
- Saturated fat (g)	27.7 (9.8)	
- Polyunsaturated fat (g)	11.7 (5.0)	
- Monounsaturated fat (g)	27.9 (11.2)	
Carbohydrate (g)	223 (56)	
Alcohol (g)	11.3 (12.8)	
Fibre (g)	24.5 (7.0)	At least 25 g/day
Cholesterol (mg)	256 (114)	
Macronutrient profile (% total energy intake)		
Protein (%E)	18.0 (3.1)	15 – 25 % E[a]
Total fat (%E)	32.5 (6.2)	< 35 % E[a]
Saturated fat (%E)	12.1 (3.1)	<10 % E[a]
Polyunsaturated fat (%E)	5.2 (1.3)	
Monounsaturated fat (%E)	12.1 (2.0)	
Carbohydrate (%E)	45.0 (7.0)	
Alcohol (%E)	2.9 (1.1)	
Micronutrients		
Thiamin (mg)	1.64 (0.69)	1.1
Riboflavin (mg)	2.13 (0.92)	1.1
Niacin-equivalents (mg)	41.0 (11.8)	14
Vitamin C (mg)	132 (77)	45
Total vitamin A equivalents (ug)	1,047 (761)	700
Sodium (mg)	2,637 (1235)	2,300[b]
Potassium (mg)	3,311 (1105)	2,800[c]
Magnesium (mg)	354 (123)	320
Calcium (mg)	895 (358)	1,000
Phosphorus (mg)	1,539 (411)	1,000
Iron (mg)	13.9 (5.6)	18
Zinc (mg)	11.0 (3.3)	8

Notes: *a) Suggested Dietary Targets*
b) Upper Level
c) Average Intake (AI)

Figure 1: Percentage contribution of food groups to total dietary sodium intake.



This study did not attempt to distinguish between the various sources of Na but rather report on total urinary Na excretion, which extrapolated to a salt (NaCl) intake of 6.4 g per day. This is considerably lower than data from other Australian studies[6-8] and the UK[9] and is also lower than intakes recently reported in a national survey of Australian children (2,623–3,672 mg/day for girls and boys, respectively aged 14–16 years).[35]

However, our findings are consistent with those reported by Food Standards Australia New Zealand, who estimated that Australians aged two years and older consume an average of 5.5 g of salt (2,150 mg Na) per day.[12] Sodium chloride intakes from processed foods and those contributed from discretionary use were investigated by FSANZ. Processed foods contributed an average of 4.8 g NaCl per day, while mean discretionary NaCl intake in salt users was estimated to be 1.0 g per day, together contributing between 3.8g (2–3 year age group) and 6.4 g (14–29 year) salt (NaCl) per day.

The relatively small sample size of women in our study, together with the high educational level of the participants, limits generalisability of the findings to the broader Australian population. It is likely that salt consumption patterns vary substantially between age, sex and socioeconomic groups in the country. The World Health Organization (2007) recommends that, assuming a standard deviation of 24 hour urinary sodium excretion of about 60 mmol/day (1.38 g/day), a minimum sample size of 100 participants (for either groups of men or women) is required to ensure sufficient power for a 24 hour urinary sodium excretion calculation to be generalisable to the study population.[33] However, due to the large day-to-day variability in urinary sodium excretion,[36] precision would be improved by obtaining more than one 24 hour urine collection from each individual. A nationally representative survey of 24 hour urinary Na excretion values is required to provide conclusive data on habitual current salt intakes in the Australian population in order to identify evidence-based and achievable targets for population-based sodium reduction strategies and to enable better targeting of salt-related health messages. The Department of Health and Ageing's Australian Health Survey[37] planned to commence in 2010 provides an ideal opportunity for collection of such data.

The results of the present study indicate that for this group of individuals, dietary sodium intake, while better than reported in other studies, was still generally higher than recommended. The National Health and Medical Research Council (NHMRC) (2006) define a suggested Dietary Target of four grams of salt (1,600 mg of sodium) per day and an Upper Level of intake of six grams of salt (2,300 mg of sodium) per day.[32] The World Health Organization (2007) recommends a population target of 5 g/day of salt (2,000 mg sodium) per day.[33] According to these three reference values, 57%, 19% and 35% of women, respectively, had urinary Na values within the recommended ranges. It would be anticipated that men, who generally have higher intakes of all foods, including processed foods, than women and certain sub-groups of the population would have even less likelihood of achieving such dietary targets and improving their health outcomes.

To assist populations to reduce their sodium intake levels, effective public communication is required. Only a small number of participants could correctly identify the recommended upper salt intake target of 6 g/day in this study. This indicates that consumers may be confused about salt intake recommendations. Health promotion messages tend to be based on salt, rather than sodium, recommendations but food labelling provides sodium values. The women in this study reported high levels of checking food labels for salt intake and being influenced by this information when making food purchases. This reinforces that communication strategies should be consistent in their portrayal of sodium/salt intake requirements.

This study identified that the bread and cereals food group, followed by meat/egg-based dishes provided half of the total Na intake. Other food groups, such as fruits/vegetables/legumes, fish, spreadable fat and nuts/seeds each provided less than 10% total sodium. Our data are similar to another Australian study reported by Margerison et al.[14] in which breads and cereals contributed 38% of total sodium intake, followed by meat and meat products/dishes (17%). Our data are also similar to UK data that cereals and cereal products (including bread, breakfast cereals, biscuits and cakes), followed by meat and meat products, soups, pickles, sauces and baked beans are the main contributors to dietary salt intake.[38] Similar data have also been reported from the US.[39] In

Table 5: Contribution of food groups to total dietary Na intake, expressed for the total group and per 1,000 kJ for consumers (mean (SD)).

Food group	Total group	Intake of participants who consumed foods from that food group	
	Total Na per day from food group (mg/day)	Na per 1,000 kJ	Na/K ratio
Bread, cereal, rice, pasta, noodles	723 (90)	352[a] (19)	2.26 (0.05)
Meat/egg-based dishes	487 (191)	474[b] (688)	1.50 (1.40)
Dressing and sauces[c]	336 (256)	2117[d] (75)	17.11 (0.83)
Snacks/desserts/extra	296 (1651)	293[a] (584)	2.86 (2.86)
Dairy products	284 (212)	258[a] (51)	0.96 (0.04)
Fruits/vegetables/legumes	202 (11)	149[a] (13)	0.15 (0.03)
Fish	97 (330)	454[e] (75)	1.81 (0.83)
Spreadable fat	27 (57)	228[f] (40.9)	48.4 (5.64)
Nuts and Seeds	18 (44)	48[g] (51)	0.20 (0.22)

Note: a) n = 74; b) n = 73; c) Includes added salt. d) n = 71; e) n = 33; f) n = 57; g) n = 45.

our study, the finding that spreadable fats (margarine) contributed a minimal amount (1.1%) to Na intakes is perhaps surprising, but when the average daily Na intake of consumers of that food category (rather than the total group) was investigated as a function of total energy intake, sodium provided by margarine was similar to that provided from the snack foods category. This highlights the necessity to consider both group level dietary intake data, as well as the contribution of foods at the level of the individual.

It is important that country and culture-specific dietary data are used to determine the main contributors to total Na intake in various populations. For example, a study from South Africa demonstrated that the bread and cereals food group was by far the largest contributor of non-discretionary dietary sodium intake (46–49%) in the population.[40] Marked differences were found between ethnic groups in the country and between urban-rural settings in terms of the major important food sources of sodium. Some of the differences were explained by a greater reliance on processed foods by certain sectors of the population, compared to other groups, in which maize meal (naturally low in sodium) remains the staple food item. Dietary information such as this provides the basis for the targeting of specific commonly eaten foods in population-based non-pharmacological approaches to lowering blood pressure.

Since compliance with advice to restrict dietary Na in adults, over the long-term, appears to be poor,[41] an important way to decrease salt intake on a population level is through the reduction of Na content of processed foods. However, recent examination of the salt content of foods in Australia, based on declaration of sodium content on food labels, has found no appreciable decrease in salt in processed foods in the period 2005 to 2007.[15] Prior attempts by the Australian food industry to reduce salt intake have been via the Tick program of the Heart Foundation, which reportedly removed 235 tonnes of salt from the Australian food supply through manufacturers reformulating breakfast cereals.[18] This program, which allows display of the easily recognisable tick logo on foods that comply with Heart Foundation dietary guidelines for various categories of foodstuffs, provides signposting for consumers wishing to choose healthier options of foods in product ranges. Data from the present study identify that foods from the bread and cereals group are an obvious target for sodium reduction. Research targeting reduced salt breads has been reported recently[28,29] but is yet to demonstrate an impact in the food supply. Targets to reduce sodium content in bread to below 450 mg/100 g have recently been set by the Heart Foundation of New Zealand.[42] However, Grimes et al.[15] found that Australian breads, at least white and multigrain, already fell below 450 mg/100 g. Those authors suggested that Australian bread manufacturers aim for a lower target of 400 mg/100 g, which is in line with the UK Food Standards Authority (2012) recommendations.[43]

Other countries are also reporting progress in lowering the salt content of processed foods. In the UK, the Food Standards Authority (FSA), together with the Department of Health, have developed a model to demonstrate the types of reductions that would need to be made in various categories of processed foods to ensure that the 6 g salt/day population average target intake is achieved by 2010.[43] A Portuguese study has demonstrated that salt intake can be reduced by approximately half through making available processed foods with a reduced salt content at the same time as providing the population with information on how to reduce salt intake, particularly from processed sources.[44] Avoidance of processed foods altogether would obviously lower sodium intake, however, this is difficult in most developed countries, as traditional staple-based or predominantly whole foods diets are no longer followed.

As would be expected from the fairly high educational level of this sample of women, their dietary intake patterns were largely in line with the suggested dietary targets of the NHMRC[32] and their macronutrient profiles are similar to those of Australian women generally.[45] However, in terms of absolute intakes, the present sample reported energy intakes that were substantially lower than those reported by women of a similar age who participated in the National Nutrition Survey (1995), 8,415 kJ/day compared with 10,296-13,276 kJ/day.[45] A lower energy intake may reflect a lower food intake overall, including less processed foods, and hence the lower than expected Na levels. Thus the message of reducing energy intake to achieve weight reduction may have the added benefit of lower salt intakes, a positive flow-on effect of other public health messages.

Other messages that have an impact on public health also need to be considered in conjunction with the message to reduce salt intake. At the same time as consumers are being urged to lower salt intakes, iodine deficiency has re-emerged in some parts of Australia,[46-51] resulting in the government mandating iodine fortification of bread (introduced in New Zealand in 2008 and in Australia in late 2009) and allowing nutrient content claims for iodine to be made on bread.[52] There is a potential for the two public health messages, namely salt reduction and increased iodine consumption through iodised salt in fortified bread, to be confusing to consumers. Two-thirds of participants in the current study reported using iodised salt at home and most knew of iodised salt. However, this does not reflect national data on iodised salt sales in Australia. Despite being available for sale in Australia since the 1960s, iodised sales have remained low, at about 10% of total edible salt sales, with only a slight increase (5.2%) in national iodised salt sales after a brief period of media coverage associated with the Australian National Iodine Nutrition Study in school children in 2003 and 2004.[53] The accuracy of reporting on use of iodised salt is further questioned when the urinary iodine status of women is considered. The present sample of women had urinary iodine concentrations indicative of mild iodine deficiency, with 40% having UIC <50 μg/L (moderate deficiency) (reported elsewhere).[54]

Other limitations of this study relate to the accuracy of dietary reporting. Measurement of dietary sodium, either on a population or individual level, is fraught with methodological difficulties due to high intra- and inter-subject variability in both added salt use and in dietary intake of high-salt processed foods.[55,56] It has been estimated that 81 days of dietary recording would be required to estimate an individual's intake within 10% of the observed mean for sodium.[57] A study of hypertensives in which dietary intake of sodium was manipulated and accuracy of dietary reporting assessed against 24 hour urinary sodium estimations found that urinary sodium excretion was underestimated by 34% at baseline and by 47% after three months of following a prescribed diet.[58] The authors concluded that urinary sodium excretion is the preferred method to accurately assess sodium intake. However, our study found surprisingly good agreement between 24 hour urinary and dietary Na data for the group, which suggests that identification of food sources of sodium can be assumed to have some construct validity. Reasons for this may be related to the detailed information that participants received about how to accurately complete their three-day food records, taking into account added salt used in cooking and at the table, as well as detail related to recording of recipes and branded products used. Our approach was to use dietary intake assessments to identify important food sources of sodium in the diet, while the urinary data provides a more accurate indication of total sodium intake.

Conclusions

Twenty-four hour urinary Na excretion data from a small non-representative sample of healthy women from one regional area suggest a mean salt intake of 6.4 g per day, which is lower than previously reported in other groups in Australia and that is closely aligned with the NHMRC upper level of intake recommendations for salt of 6 g/day. Little comment can be made of what may account for these lower than expected values. It could be that existing attempts by individuals and the food industry have achieved some success in lowering salt intakes in Australia. This observation was supported by the high levels of awareness of the salt reduction messages demonstrated by women in this study, although knowledge of actual recommended targets was poor. The bread and cereals food group was the highest contributor to total Na intake in these women's diets, supporting consideration of these foods as a focus for future sodium reduction strategies. A nationally representative sample of 24 hour urinary Na excretion values would be required to provide definitive data on salt intake in the Australian population and to act as a baseline against which to monitor the impact of future salt reduction initiatives.

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