

Salt reduction initiatives around the world

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Objective To provide an overview of national salt reduction initiatives around the world, describe core characteristics and develop a framework for future strategy development.

Methods National strategies were identified from existing reviews and from searches of the literature and relevant websites. Standardized information was extracted about governance and strategy development, baseline assessments and monitoring and implementation.

Results Thirty-two country salt reduction initiatives were identified. The majority of activity was in Europe (19 countries). Most countries (27) had maximum population salt intake targets, ranging from 5 to 8 g/person per day. Twenty-six of the 32 strategies were led by government, five by nongovernment organizations and one by industry. Twenty-eight countries had some baseline data on salt consumption and 18 had data on sodium levels in foods. Twenty-eight countries were working with the food industry to reduce salt in foods, 10 had front-of-pack labelling schemes and 28 had consumer awareness or behaviour change programs. Five countries had demonstrated an impact, either on population salt consumption, salt levels in foods or consumer awareness. These strategies were led by government and were multifaceted including food reformulation, consumer awareness initiatives and labelling actions.

Introduction

It is now widely accepted that reducing salt consumption will lead to lower blood pressure levels resulting in significant health benefits [1–7], and centrally implemented national salt reduction strategies are projected to be highly cost-effective in the prevention of noncommunicable diseases [6,8–10]. Since 2007, the World Health Organization (WHO) has been supporting the development of national salt reduction strategies by establishing networks in partnership with regional organizations around the world [11–13].

Three recent reviews have summarized the characteristics of a range of salt reduction initiatives globally [12–14] and there is an increasing number of reports of national initiatives [9,15,16]. With growing evidence of impact [17] and cost-effectiveness [6,18] it is increasingly important that policy makers have guidance about optimal programme design. This study builds upon prior work by systematically documenting information about existing salt reduction initiatives with a view to informing the future development of national programmes. The specific objectives were to identify all ongoing national

Conclusion This is the first review to concisely summarize the most important elements of the many existing salt reduction programmes and highlight the characteristics most likely to be important to programme efficacy. For most countries, implementing a national salt reduction programme is likely to be one of simplest and most cost-effective ways of improving public health. *J Hypertens* 29:1043–1050 © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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Abbreviations: AWASH, Australian Division of World Action on Salt and Health; CASH, Consensus on Salt and Health; FSAI, Food Standards Agency Ireland; GDA, Guideline Daily Amount; NGO, nongovernment organization; UK FSA, United Kingdom Food Standards Agency; WASH, World Action on Salt and Health; WHO, World Health Organization

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salt reduction initiatives, collate standard information about each initiative, and develop a framework to guide future action.

Methods

Search strategy

Existing reviews reporting on national salt reduction programmes [12–14] were used to compile a list of countries with strategies in place. This was supplemented by information from the World Action on Salt and Health (WASH) website and Medline and Google searches using ‘salt’ or ‘sodium’ and ‘strategy’ or ‘programme’ or ‘initiative’ or ‘action plan’. For each of the final papers identified we searched the reference lists for reports of other relevant initiatives.

Inclusion/exclusion criteria

Strategies that were clearly national in approach and sought to achieve population-wide salt reduction were included. Strategies were eligible irrespective of whether they were led by a nongovernmental organization (NGO), the government, the food industry or another

credible party. Interventions undertaken with the primary purpose of expanding the scientific evidence-base, rather than implementing a salt reduction initiative, were excluded.

Data extraction

For each country, standard information relating to core characteristics of the national salt reduction strategy was extracted (given below). The core characteristics were based on those previously identified by existing reviews and included: leadership and strategic approach, baseline assessments and monitoring and implementation strategies. The information sought about each of these characteristics was extracted according to standardized definitions.

Core characteristics of salt reduction programmes:

- (1) Leadership and strategic approach:
 - (a) Leadership – the organization leading or coordinating the programme (government, NGO or industry).
 - (b) Dietary targets – presence of an agreed national population target for salt consumption with target amount.
 - (c) Programme specificity – whether the strategy was salt-specific or a part of a broader health programme.
 - (d) NGO/advocacy action – the presence of consumer/advocacy organizations working on salt (yes/no).
- (2) Baseline assessments and monitoring:
 - (a) Salt intakes – estimated mean baseline salt intakes when available with results from direct assays of 24-h urine samples provided if available and estimates modelled from dietary data if not. When ranges are provided these either represent data for women (lower) and men (higher) or the results of different surveys.
 - (b) Salt levels in foods – whether countries had recorded salt levels in processed foods (yes/no).
 - (c) Consumer awareness – whether countries had a baseline measure of consumer awareness or behaviours (yes/no).
 - (d) Monitoring – whether or not monitoring systems are in place in relation to each of these criteria. When an impact had been demonstrated the relevant criteria were in bold.
- (3) Implementation strategies:
 - (a) Food reformulation – whether the programme included work with the food industry to reformulate foods and whether the approach was voluntary or mandatory (voluntary/mandatory/planned/none).
 - (b) Consumer behaviour – whether there was a consumer awareness campaign and whether this was led by a NGO or Government.
 - (c) Labelling – whether any new front-of-pack labelling scheme such as warnings (W), traffic

lights (TL), percentage daily intake or Guideline Daily Amount (%DI), or healthy choice scheme (Logo) had been introduced as part of the salt reduction programme and whether this was voluntary or mandatory (Vol/Man).

Analysis

The key characteristics of each country were summarized in tabular formats and an analysis of the characteristics of different strategies provided. The countries with evidence of impact on an objective measure of effectiveness (population salt levels, salt content of foods or consumer knowledge) were reviewed with regard to their particular characteristics. The information obtained was used to develop a framework as a tool to guide the design of future salt reduction programmes.

Results

Thirty-two national salt reduction initiatives were identified, 19 in Europe, six in the Americas and seven in the Western Pacific Region. There were no salt reduction strategies identified in Africa.

Leadership and strategic approach

Leadership of the salt reduction programme lies with central government in 26 countries, an NGO in five (all in the Western Pacific Region) and with industry in one country (Table 1). Population targets for dietary salt intake had been established in 27 countries. These ranged from 5 to 8 g/person per day although most were 5 or 6 g/person per day (25 countries). In 16 countries the programmes were stand-alone salt reduction strategies and in the remainder were part of a broader approach to the improvement of food and nutrition.

In addition to their leadership role in five countries, NGO or advocacy organizations were active in salt reduction in another 15. There are also many more organizations committed to salt reduction in countries that do not have a coordinated national programme. WASH now has 379 members in 80 countries and has been instrumental in promoting and supporting NGOs to take action around the world. The establishment of World Salt Awareness Week has provided a focus for media activities engaging national advocacy groups such as Heart Foundations, Hypertension Societies and a range of different consumer organizations around the world.

Baseline assessment and monitoring

Seven countries have estimates of average daily population salt intake based on analysis of 24-h urine samples, 21 indirect estimates obtained through modelling of dietary data, one an estimate for which the methodological basis was unclear and three no estimate of daily salt consumption at all (Table 2).

In most cases the extent to which the data are truly nationally representative is questionable with many data

Table 1 Leadership and strategic approach

	Leadership	Dietary target for daily salt intake set (g/person per day)	Salt-specific programme	NGO/advocacy action
Argentina	Government	Yes (6 g)	Yes	No
Australia	NGO	Yes (6 g)	Yes	Yes
Barbados	Government	Yes (6 g)	No	Yes
Belgium	Government	Yes (6 g)	No	Yes
Brazil	Government	Yes (5 g)	Yes	Yes
Bulgaria	Government	Yes (5 g)	No	No
Canada	Government	Yes (6 g)	Yes	Yes
Chile	Government	No	Yes	Yes
China	NGO	Yes (6 g)	Yes	Yes
Cyprus	Government	Yes (5 g)	No	No
Denmark	Government	Yes (5 g)	Yes	No
Fiji	Government	Yes (5 g)	Yes	Yes
Finland	Government	Yes (7/6 g^a)	No	No
France	Government	Yes (8 g)	No	Yes
Hungary	Government	Yes (5 g)	No	No
Ireland	Government	Yes (6 g)	Yes	No
Italy	Government	No	No	Yes
Japan	NGO	Yes (6 g)	Yes	Yes
Latvia	Government	Yes (5 g)	Yes	No
Lithuania	Government	Yes (5 g)	No	No
Malaysia	NGO	No	Yes	Yes
Netherlands	Industry	Yes (6 g)	No	Yes
New Zealand	NGO	No	Yes	Yes
Norway	Government	Yes (5 g)	No	No
Poland	Government	Yes (6 g)	No	Yes
Portugal	Government	Yes (6 g)	No	No
Singapore	Government	No	Yes	Yes
Slovenia	Government	Yes (5 g)	Yes	No
Spain	Government	Yes (5 g)	No	Yes
Switzerland	Government	Yes (8 g)	No	Yes
UK	Government	Yes (6 g)	No	Yes
USA	Government	Yes (6 g)	Yes	Yes

Countries in bold are countries with evidence of programme efficacy. NGO, nongovernmental organization. ^a 7 g for men and 6 g for women.

derived from convenience samples or other selected populations. In addition, the predominance of estimates based on dietary survey data, rather than the gold standard 24-h urine assays [19–23] means that many are likely to be underestimates [24]. Eighteen countries currently have data on salt levels in foods but only four countries have measures of consumer knowledge and/or behaviour in regard to salt.

Plans for monitoring of one parameter or another are present in many countries with the salt content of processed foods the target in most [25,26]. The databases utilized for this purpose vary from generic food composition databases set up to monitor broader changes to the food supply through to salt-specific databases designed for this sole objective [25]. NGOs and advocacy organizations have been substantively involved in monitoring by providing independent third party evaluations of programme efficacy by establishing nutrient composition databases, undertaking surveys on salt levels in foods, ranking companies in terms of commitments to action and monitoring government activity against commitments [5,25,27].

Implementation strategies

Implementation strategies vary between countries (Table 3). The great majority (26 countries) have a

voluntary programme of food reformulation in place and two (Argentina and Portugal) have plans for mandatory reformulation programs. The strategies used to encourage the industry to reformulate foods vary but targets are a common feature. For example, the European Union (EU) Framework has suggested a target 16% reduction in the salt levels of processed foods over 4 years and many member states have signed up to this approach. The UK has set individual targets for approximately 85 different food categories as has New York City which is coordinating the US national approach. Canada has established draft targets with timelines for some foods and is working on the rest.

Most programmes (28 countries) also have planned or existing initiatives to raise consumer awareness about the issue of salt and health with some led by government and others by NGOs. Nine countries have implemented initiatives on labelling directly related to salt reduction. These include traffic lights (UK), warnings (Finland), percentage daily intake (%DI) or guideline daily amount (GDA) (several EU countries, Australia and New Zealand) and logos (the Nordic countries, Australia, New Zealand and Canada). Schemes provide information to consumers about healthier choices but also potentially encourage food companies to reformulate products [28]. Finland attributes much of the success of its national salt

Table 2 Baseline assessments and monitoring

	Salt intakes levels documented (g/person per day)	Salt levels in foods documented	Consumer behaviours documented	Monitoring ongoing or planned
Argentina	12.5 (dietary survey)	No	No	No
Australia	6.5–12.0 (24h urine)	Yes	Yes	SI/SL/CA
Barbados	12–15 (unknown)	Yes	No	SI/SL
Belgium	11 (24-h urine)	Yes	No	SI/SL
Brazil	9.6 (dietary survey)	Yes	No	SL
Bulgaria	12 (dietary survey)	Yes	No	SL
Canada	7.8 (dietary survey)	Yes	Yes	SI/SL/CA
Chile	10 (dietary survey)	(Planned)	No	No
China	12 (dietary survey)	No	No	No
Cyprus	–	No	No	No
Denmark	7–11 (24-h urine)	Yes	No	SL
Fiji	5.2–5.4 (dietary survey)	(Planned)	(Planned)	SI/SL
Finland	7.6–10 (24-h urine)	Yes	No	SI/SL
France	8.4 (dietary survey)	Yes	No	SI/SL
Hungary	16–18 (dietary survey)	Yes	No	SL
Ireland	10 (dietary survey)	Yes	Yes	SL/CA
Italy	10.8 (dietary survey)	(Planned)	No	No
Japan	13.2 (dietary survey)	No	No	SI
Latvia	–	Yes	No	SL
Lithuania	11 (dietary survey)	No	No	No
Malaysia	6.4 (dietary survey)	No	No	No
Netherlands	7.6–9.7 (24-h urine)	Yes	No	SL
New Zealand	5.4–7.6 (dietary survey)	Yes	No	SL
Norway	10 (dietary survey)	No	No	No
Poland	–	No	No	No
Portugal	11.9 (dietary survey)	No	No	No
Singapore	8.8 (dietary survey)	Yes	?	No
Slovenia	12 (dietary survey)	Yes	No	SL
Spain	5.4 (dietary survey)	No	No	No
Switzerland	8.1–10.6 (24-h urine)	(Planned)	No	No
UK	9.5 (24-h urine)	Yes	Yes	SI(8.6)^a/SL/CA
USA	8.6 (dietary survey)	Yes	No	UA/SL

Countries in bold are countries with evidence of programme efficacy. CA, consumer awareness to be monitored; SI, salt intakes to be estimated; SL, salt levels in foods to be monitored. ^aMonitoring in UK indicates mean 24-h excretion has fallen to 8.6 g/person per day.

reduction programme to the use of mandatory warnings on high salt foods, which in conjunction with labelling to identify lower salt products, provided consumers with very clear direction about optimal food choices.

Countries that have demonstrated an impact and the key characteristics of their initiatives

Five countries, Finland [14], France, Ireland [29], Japan [30] and the UK [15] have demonstrated some impact of their salt reduction initiatives. In four cases this includes evidence of changes in population salt consumption, in another four changes in the salt levels in foods and in two changes in consumer awareness.

Finland

Finland commenced efforts to reduce salt in 1978 and by 2002 had demonstrated a 3 g reduction in average population salt intake (from 12 to 9 g/person per day). During the same period there was a corresponding 60% fall in coronary heart disease and stroke mortality [31,32]. Key characteristics include: strong leadership through the Finnish National Nutrition Council with clear population targets; regular monitoring of population salt consumption using 24-h urinary assessments and dietary survey data; mass media campaigns and education of healthcare personnel; extensive stakeholder and community involvement; voluntary cooperation with the food industry to

reduce salt including the use of Pansalt (a reduced sodium salt substitute); and mandatory warning labels for foods high in salt which drove many high salt foods from the supermarket shelves [33].

United Kingdom

The UK Food Standards Agency (FSA) started working with the food industry in 2003 and launched its consumer education campaign in 2005. By 2008 the UK had achieved an average 0.9 g/person per day reduction in daily salt consumption [17], which is predicted to be saving some 6000 lives a year. Salt levels have been reduced in key food products by between 25 and 45% [34] and there has been an increase in consumer awareness and parallel changes in consumer behaviour relating to salt usage and purchasing of foods [14]. Key characteristics include strong leadership from the UK government through the FSA and the Department of Health. The UK programme benefits from baseline data on salt intake, salt levels in foods and consumer awareness with clear and consistent mechanisms for monitoring each. In addition the programme benefits from established targets for salt levels in all foods; engagement of stakeholders in the development and implementation of the strategy; and an integrated three-pronged approach based upon working with the food industry, a well funded advertising and social marketing campaign and the introduction of

Table 3 Implementation strategies

	Food reformulation	Consumer education	Front-of-pack labelling
Argentina	Mandatory (planned)	–	–
Australia	Voluntary	NGO	%DI/Logo (Vol)
Barbados	Voluntary	Government	–
Belgium	Voluntary	Government	–
Brazil	Voluntary	–	–
Bulgaria	Voluntary	–	–
Canada	Voluntary	NGO	Logo (Vol)
Chile	Planned	Government	W (Man)
China	None	Government	–
Cyprus	Voluntary	Government	–
Denmark	Voluntary	Government	Logo (Man)
Fiji	Voluntary	Government	–
Finland	Voluntary	NGO	W (Man)
France	Voluntary	Government	–
Hungary	Voluntary	Planned	–
Ireland	Voluntary	Government	%DI (Vol)
Italy	Voluntary	–	–
Japan	None	NGO	–
Latvia	Voluntary	Planned	–
Lithuania	Voluntary	Planned	–
Malaysia	Voluntary	NGO	–
Netherlands	Voluntary	NGO	%DI/Logo (Vol)
New Zealand	Voluntary	NGO	%DI/Logo (Vol)
Norway	Voluntary	Planned	–
Poland	Voluntary	Planned	–
Portugal	Mandatory (planned)	Government	–
Singapore	Voluntary	Government	Logo (Vol)
Slovenia	Voluntary	Planned	–
Spain	Voluntary (bread)	Government	–
Switzerland	Planned	Planned	–
UK	Voluntary	Government	TL/%DI (Vol)
USA	Voluntary	NGO	–

Countries in bold are countries with evidence of programme efficacy. %DI, percentage daily intake labelling (or guideline daily amount in some countries); Man, mandatory; NGO, nongovernmental organization; dashes indicate not aware of programme in place; TL, traffic light labelling; Vol, voluntary.

traffic light labels indicating whether foods are high or low in salt. Monitoring includes publishing the industries' commitments and achievements so that stakeholders can see the progress that is being made.

Ireland

Ireland published its scientific report on salt in 2005 and shortly thereafter the Irish Food Standards Agency (FSAI) initiated a salt reduction initiative. The initial goals for selected food products were achieved by 2008 including reducing the salt in breads by 10%, sauces by 15% and soups by 10%. More challenging reformulation targets have since been set. An evaluation of the consumer education campaign showed that more than half the people surveyed claimed to be changing their behaviours related to salt. The Irish strategy was modelled closely on the UK approach with leadership from the government through the Irish Food Safety Promotion Board supported by the Irish Heart Foundation. Mandatory limits for the salt content of foods have been established such that manufacturers can claim 'low salt', 'very low salt' or 'salt free' on packaging.

France

The French Food Safety Authority recommended a reduction in population salt consumption in 2000 and

has since reported a decline in intake provided by foods from 8.1 to 7.7 g/day in the overall adult population. The French salt industry has also reported a 15% reduction in sales of salt to food manufacturers between 2001 and 2006 and a parallel 5% reduction in the sales of household salt. Key characteristics of the French approach have been a focus on bread (although bread is one of the few products in which salt levels have not declined) and salt messages disseminated as part of broader nutrition campaigns. There is regular monitoring of salt levels in foods and population salt intake level is estimated through dietary surveys and modelling.

Japan

The Japanese Government initiated a campaign to reduce salt intake in the 1960s through a sustained public education programme. Prior to that deaths from stroke in Japan were among the highest in the world, and it became apparent that certain regions, particularly the north, were consuming as much as 18 g/day of salt. The stroke rates in Japanese prefectures were showed to be directly related to the amounts of salt consumed [35]. Over the following decade average salt intake was reduced from 13.5 to 12.1 g/day with a parallel fall in blood pressure in adults and children, and an 80% reduction in stroke mortality despite large adverse changes in a range of other cardiovascular risk factors. In the absence of any sustained government programme there are indications that salt intakes are once again gradually rising in Japan [30].

Discussion

The research identified the key characteristics of a large number of national salt reduction initiatives which has informed the establishment of a framework (Table 4) for guiding the future development of programmes. Most regions of the world (except Africa) now have programmes in place and the increasing number suggests that the adverse effects of salt on health are now widely recognized. Most strategies are led by government organizations, involve industry-led food reformulation of food, have clear daily intake targets, and have strong communication strategies designed to change consumer behaviour.

Advocacy organizations have, and continue, to play a significant role in establishing national programmes. A primary function of advocacy groups has been to place salt reduction on the government's agenda. Advocacy organizations have played a key role in the UK (CASH) and Australia (AWASH). In countries where advocacy is less well developed (such as Singapore and Malaysia), a global advocacy group, WASH, has worked with local members to put salt reduction on the government agenda.

Most countries have industry reformulation of processed and catered foods at the core of their salt reduction efforts and this reflects the economically developed nature of those countries with programmes in place. In developed

Table 4 Framework describing main actions and specific tasks in the development of national salt reduction strategies

Actions	Specific tasks
Establish roles	Leadership and strategic approach Identify relevant stakeholders Identify appropriate lead – government or NGO Identify different roles for main stakeholders
Mobilize support	Involve stakeholders in strategy development (advisory group, launch meetings, written consultations, one to one meetings) Promote the evidence and ensure clear agreement Appoint a 'salt champion' or figurehead
Adopt targets Develop strategy	Establish population salt consumption target Decide whether to develop salt specific strategy or integrate salt into broader nutrition strategy Consult on proposals and timescale Dedicate staff and resources
Agree regulatory measures	Decide voluntary or mandatory for reductions and information on labels Discuss and agree process for implementation. Baseline assessment and monitoring
Monitor salt intakes, salt levels in foods and consumer awareness	Establish mechanisms for accurate measurement of population salt consumption Establish database to monitor composition of food products Conduct surveys of consumer awareness Publish baseline and regular updates Implementation strategies
Develop programme of work with the food industry	Identify main sources of salt in the diet and reductions required Establish clear product specific targets Obtain high level commitment and individual company action plans Establish cross industry agreements Monitor progress and report regularly
Raise consumer awareness	Promote targets and dietary guidelines Use consumer research to identify appropriate messages for campaign Identify communication channels and target groups Develop and pilot materials Evaluate progress and report regularly Implementation strategies (cont)
Labelling	Introduce labelling of sodium content (or salt equivalent) if not in place Do consumer research into most effective schemes Introduce front-of-pack labelling scheme such as traffic light labels or salt warnings on front of pack
Advocacy actions	Join WASH and participate in World Salt Awareness Week Identify clear campaign objectives and develop strategy to achieve them Utilize the media to raise awareness Develop a web-site and campaign materials Organize conferences and meetings Draft background briefing papers for state and federal government Organize politician briefings and hold regular one to one meetings with relevant officials Make submissions to relevant consultations

countries processed and catered foods contribute 75–80% of salt in the diet with the remainder either added at the table or during cooking, or naturally occurring. In developing countries, such as China, the same focus would be reasonable for many urban areas, but in rural regions where most dietary sodium derives from salt added during cooking [36] alternate intervention strategies such as salt substitution [37] are likely to be more effective.

Clearly identified salt content targets for food categories provide for a level playing field and facilitate industry progress towards lower salt levels in a broad range of processed and catered foods. Mandatory legislative tools have been used infrequently for the implementation of targets, or any other aspect of a salt reduction initiative, with most countries relying on voluntary programmes. Both mandatory and voluntary programmes appear to have potential provided that there are clear mechanisms for monitoring and penalties for noncompliance [38]. Voluntary measures are typically easier and faster to implement and allow greater flexibility, although legis-

lation once in place clearly has enormous potential if correctly framed. The UK provides a good example of how voluntary programmes can function with the UK FSA presiding over a comprehensive target setting process involving all stakeholders followed by objective monitoring and reporting of progress. Examples of effective legislation are for the control of salt levels in bread in Portugal and the requirement for high salt warnings on salty foods in Finland. NGOs can play an important role in monitoring and vary in their approach to this. In the UK, CASH has adopted a fairly combative style issuing 'name and shame' media releases and constantly calling for tougher government action to hold companies to account. By contrast, AWASH in Australia has adopted a more collaborative approach using media opportunities primarily to raise awareness of salt and to try and make it a government and industry priority.

It is important to note that no country has achieved, or is likely to achieve, a significant fall in population salt consumption if the salt reduction programme is restricted to consumer education, and uptake is left to consumer

choice. Whereas it is possible to educate consumers to make better food choices and adopt other healthier behaviours, it is resource-intensive, time-consuming and typically of only limited efficacy [39]. Even in the wealthiest countries in the world cost will prohibit the implementation of such programmes. For maximum impact and cost-effective delivery of health gain, national salt reduction efforts must be delivered centrally through changes to the environment that make it easy for the population as a whole to consume less salt. In most countries this will mean a focus on the food industry and reformulation of products towards lower salt with the goal being to reduce the salt content of every salty product progressively in small incremental steps. Providing low salt alternatives without category-wide reductions in salt content is not acceptable since such products are typically very different in taste, will not be purchased by consumers and will be rapidly discontinued by manufacturers and retailers.

The work reported here builds on the growing body of literature about the practical aspects of salt reduction strategies [12–14,36] by systematically documenting existing programmes and their key characteristics. As such it makes an important contribution to our understanding of the different elements of salt reduction strategies around the world and the components most important to success or failure. Much of the data reported here derive from the grey literature, reflecting the government/NGOs leadership of most salt reduction programmes, and from studies that are frequently limited in scope, that provide incomplete regional coverage and are of varied analytic quality. Although it is unlikely that any major national salt reduction programmes have been missed, it was possible to collate only selected information in a truly standardized manner. Future work could usefully add to the literature by making a more in-depth assessment of each core characteristic studied allowing better insight into the comparative nature of the various national salt reduction programmes identified. Nonetheless, the study concisely summarizes the most important elements of the many programmes in place and highlights the characteristics most likely to be important to programme efficacy.

A number of recently reported modelling exercises have highlighted once again the potential value of national salt reduction strategies and their capacity to substantially reduce the epidemic of noncommunicable diseases affecting developed and developing countries around the world [35,40–42]. Broad-based coalitions of government agencies, nongovernmental organizations, academics and the food industry offer the most effective way forward for national salt reduction programmes but require strong leadership and industry collaboration. Almost every nation in the world will have an average population salt intake above the 1–2 g/person per day required for optimum health. For the vast majority of

these, implementing a national salt reduction programme is likely to be one of simplest and most cost-effective ways of improving public health [6,8].

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References

- 1 James W, Ralph A, Sanchez-Castillo C. The dominance of salt in manufactured food in the sodium intake of affluent societies. *Lancet* 1987; **1**:426–429.
- 2 Law MR, Frost CD, Wald NJ. By how much does dietary salt reduction lower blood pressure? III - Analysis of data from trials of salt reduction. *BMJ* 1991; **302**:819–824.
- 3 Law MR, Frost CD, Wald NJ. By how much does dietary salt reduction lower blood pressure? I Analysis of observational data among populations. *BMJ* 1991; **302**:811–816.
- 4 Law MR, Frost CD, Wald NJ. By how much does dietary salt reduction lower blood pressure? II Analysis of observational data within populations. *BMJ* 1991; **302**:815–819.
- 5 MacGregor GA, Sever PS. Salt: overwhelming evidence but still no action: can a consensus be reached with the food industry? CASH (Consensus Action on Salt and Hypertension). *BMJ* 1996; **312**:1287–1289.
- 6 Asaria P, Chisholm D, Mathers C, Ezzati M, Beaglehole R. Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. *Lancet* 2007; **370**:2044–2053.
- 7 National Health and Medical Research Council. *Dietary guidelines for Australian adults: Commonwealth of Australia*; 2003.
- 8 Murray C, Lauer J, Hutubessy R, Niessen L, Tomijima N, Rodgers R, *et al.* Effectiveness and costs of interventions to lower systolic blood pressure and cholesterol: a global and regional analysis on reduction of cardiovascular-disease risk. *Lancet* 2003; **361**:717–725.
- 9 World Health Organisation. *Reducing salt intake in populations*. Geneva: World Health Organisation; 2007.
- 10 Webster J, Dunford E, Chalmers J, Corbett S, Neal B. Cost benefit of salt reduction to complement existing clinical hypertension programs. High Blood Pressure Research Council 2009 Annual Scientific Meeting. December 2009.
- 11 World Health Organisation Regional Office For Europe. WHO European action plan for food and nutrition policy 2007-2012: Action Networks. 2008; http://www.euro.who.int/nutrition/ActionPlan/20080516_1. Accessed 23rd November 2009.
- 12 Penney S. Dropping the Salt: practical steps countries are taking to prevent chronic noncommunicable diseases through population-wide dietary salt reduction. Canada: Public Health Agency of Canada, Pan American Health Organisation, CARMEN;2009.
- 13 Webster J. Salt reduction in the Western Pacific Region: strategies for action. <http://www.georgeinstitute.org/global-health-landscape> Accessed 8th October 2010.
- 14 European Commission. *Collated information on salt reduction in the EU*. Brussels; 2008.
- 15 UK Food Standards Agency. Salt. 2007; <http://www.food.gov.uk/healthierating/salt/>. Accessed 12 July 2010.
- 16 Agence Française de Sécurité Sanitaire des Aliments. Agence Française de Sécurité Sanitaire des Aliments. 2007; <http://www.afssa.fr/>. Accessed 13 July 2010.
- 17 National Centre for Social Research and Medical Research Council Human Nutrition Research. An assessment of dietary sodium levels among adults (aged 19-64) in the UK general population in 2008, based on analysis of dietary sodium in 24 h urine samples.2008.
- 18 Bibbins-Domingo K, Chertow GM, Coxson PG, Moran A, Lightwood JM, Pletcher MJ, *et al.* Projected effect of dietary salt reductions on future cardiovascular disease. *N Engl J Med* 2010; **362**:590–599.

- 19 Bentley B. A review of methods to measure dietary sodium intake. *J Cardiovasc Nurs* 2006; **21**:63–67.
- 20 Hunter D. Biochemical indicators of dietary intake. In: Willet W, editor. *Nutritional epidemiology*. Oxford: Oxford University Press; 1998; 174-243.
- 21 Bates CJ, Thurnham DI. *Biochemical markers of nutrient intake. Design concepts in nutritional epidemiology*. Oxford: Oxford University Press; 1991; 192-265.
- 22 Bingham S. The dietary assessment of individuals; methods, accuracy, new techniques and recommendations. *Nutr Abstr Rev A Hum Exp* 1987; **57**:705–742.
- 23 Ministry of Health, Fiji School of Medicine, Ministry of Education, Divisional Health Services. Iodine Report. 2004.
- 24 Espeland MA, Kumanyika S, Wilson AC, Reboussin DM, Easter L, Self M, et al. Statistical issues in analyzing 24-h dietary recall and 24-h urine collection data for sodium and potassium intakes. *Am J Epidemiol* 2001; **153**:996–1006.
- 25 Webster J, Dunford E, Neal B. A systematic survey of the sodium contents of processed foods. *Am J Clin Nutr* 2010; **91**:413–420.
- 26 Food Standards Agency. Processed Food Databank. 2006; <http://www.food.gov.uk/science/surveillance/fsisbranch2006/fsis1306>. Accessed 12 November 2009.
- 27 Grimes GA, Nowson CA, Lawrence M. An evaluation of the reported sodium content of Australian food products. *Int J Food Sci Technol* 2008; **43**:2219–2229.
- 28 BMRB Social Research. Comprehension and use of UK nutrition signpost labelling schemes. 2009; <http://www.food.gov.uk/multimedia/pdfs/pmpreport.pdf>. Accessed 12 July 2010.
- 29 Food Safety Authority of Ireland. Salt commitments and updates, August 2009–August 2010. 2010; http://www.fsai.ie/science_and_health/salt_commitments_and_updates.html Accessed 4 August 2010.
- 30 World Action on Salt and Health. Japan Salt Action Summary. 2008; <http://www.worldactiononsalt.com/action/asia.htm>. Accessed 12 July 2010.
- 31 Laatikainen T, Pietinen P, Valsta L, Sundvall J, Reinivuo H, Tuomilehto J. Sodium in the Finnish diet: 20-year trends in urinary sodium excretion among the adult population. *Eur J Clin Nutr* 2006; **60**:965–970.
- 32 Puska P, Vartiainen E, Tuomilehto J, Salomaa V, Nissinen A. Changes in premature deaths in Finland: successful long-term prevention of cardiovascular diseases. *Bull World Health Organization* 1998; **76**:419–425.
- 33 Pietinen P, Valsta LM, Hirvonen T, Sinkko H. Labelling the salt content in foods: a useful tool in reducing sodium intake in Finland. *Public Health Nutr* 2008; **11**:335–340.
- 34 Food Standards Agency. Food industry activity. <http://www.food.gov.uk/healthiereating/salt/industry>. Accessed 4 August 2010.
- 35 He FJ, MacGregor GA. A comprehensive review on salt and health and current experience of worldwide salt reduction programmes. *J Hum Hypertens* 2009; **23**:363–384.
- 36 Brown IJ, Tzoulaki I, Candeias V, Elliott P. Salt intakes around the world: implications for public health. *Int J Epidemiol* 2009; **38**:791–813.
- 37 The China Salt Substitute Study Collaborative Group. Salt substitution: a low cost strategy for blood pressure control among rural Chinese: a randomized controlled trial. *J Hypertens* 2007; **25**:2011–2018.
- 38 Webster J. Signalling change: working with the private food sector to improve nutrition: a comparative analysis of national strategies in the UK and the Netherlands. 2006.
- 39 Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; **346**:393–403.
- 40 Institute of Medicine. *Strategies to reduce sodium intake in the United States*. Washington, US; 2010.
- 41 New Zealand Heart Foundation. *Reducing our sodium footprint: project HeartSafe situational analysis*. 2010.
- 42 Mohan S, Campbell NR, Willis K. Effective population-wide public health interventions to promote sodium reduction. *CMAJ* 2009; **181**:605–609.