



Review

Setting targets for salt levels in foods: A five-step approach for low- and middle-income countries



Shauna M. Downs^{a,b}, Anthea Christoforou^{c,d}, Wendy Snowdon^e, Elizabeth Dunford^{b,d}, Peter Hoejskov^e, Branka Legetic^f, Norm Campbell^g, Jacqui Webster^{b,d,*}

^a Institute of Human Nutrition and Earth Institute, Columbia University, New York, NY 10027, United States

^b University of Sydney, Camperdown, Sydney, NSW 2006, Australia

^c University of Toronto, 563 Spadina Crescent, Toronto, Ontario M5S 2J7, Canada

^d The George Institute for Global Health, The University of Sydney, Camperdown, Sydney, NSW 2000, Australia

^e World Health Organization, P.O. Box 113, Suva, Fiji

^f Pan American Health Organization–World Health Organization, Washington, DC, United States

^g Libin Cardiovascular Institute, University of Calgary, 2500 University Drive Northwest, Calgary, AB T2N 1N4, Canada

ARTICLE INFO

Article history:

Received 7 January 2015

Received in revised form 31 May 2015

Accepted 20 June 2015

Available online 13 July 2015

Keywords:

Low- and middle-income countries

Sodium reduction

Food policy

Food industry

ABSTRACT

Eighty percent of non-communicable diseases (NCDs) occur in low- and middle-income countries (LMICs). In the Global Action Plan to prevent and control NCDs, the World Health Organization has set a target to reduce mean population salt intakes by 30% by 2025. To achieve this target, salt levels in prepared and processed foods must be reduced. In this paper we propose a step-wise approach for setting targets for salt levels in foods for LMICs, as the basis for voluntary or mandatory policy interventions. The five steps are: (1) identifying the foods which contribute to salt in the diet; (2) agreeing which foods to set targets for; (3) establishing the target levels; (4) stakeholder engagement; (5) establishing monitoring mechanisms. A case study of the process of establishing regional targets in the Pacific Islands is also provided. LMICs with limited resources should establish maximum upper limits for salt for the product categories, which together contribute the majority of salt in the diet. Targets should be standardized (e.g., salt per 100 g of product) and have clear timelines. As well as being the basis for voluntary or mandatory levels for salt levels in foods, targets can also be used to inform labeling and taxation policy. In order to have the most significant effect on population salt intake in LMICs, these policy interventions will need to be combined with consumer-facing strategies aimed at changing behaviours and investment in research and development to support effective implementation.

© 2015 Elsevier Ltd. All rights reserved.

Introduction

Heart disease and stroke cause one in four deaths worldwide (Lozano et al., 2012) and 80% of cardiovascular disease deaths occur in low- and middle-income countries (LMICs) (World Health Organization, 2010). In the most recent global burden of disease study, high blood pressure was the leading risk factor

contributing to the global disease burden (Lim et al., 2012). A major risk factor for high blood pressure is excess dietary salt consumption (Elliott et al., 1996). Most populations worldwide consume high levels of dietary salt – often exceeding dietary recommendations (Brown et al., 2009). Although there has been recent controversy about the potential health consequences of salt reduction (Alderman and Cohen, 2012; Institute of Medicine, 2013), the majority of research demonstrates that reducing salt intake at the population level will have a significant public health impact (Whelton et al., 2012; Appel et al., 2011). Salt reduction has been shown to be a cost-effective way to reduce cardiovascular disease (Brown et al., 2009; Mason et al., 2014; Cobiac et al., 2010; Barton et al., 2011; Wang and Labarthe, 2011) and is considered a “best buy” for reducing the burden of non-communicable diseases (NCDs) in LMICs (World Economic Forum, 2011; World Bank, 2006).

* Corresponding author at: The George Institute for Global Health, PO Box M201, Missenden Road, NSW 2050, Australia. Tel.: +61 2 9992 4520.

E-mail addresses: shauna.downs@sydney.edu.au (S.M. Downs), achristoforou@georgeinstitute.org.au (A. Christoforou), wendy.snowdon@deakin.edu.au (W. Snowdon), edunford@georgeinstitute.org.au (E. Dunford), Hoejskovp@wpro.who.int (P. Hoejskov), legeticb@paho.org (B. Legetic), ncampbel@ucalgary.ca (N. Campbell), jwebster@georgeinstitute.org.au (J. Webster).

In May 2013 Member States approved the Global Monitoring Framework for NCD prevention and control at the World Health Organization General Assembly (World Health Organization, 2013a). The framework includes nine targets and 25 indicators aimed at achieving a 25% reduction in premature deaths from NCDs by 2025 (World Health Organization, 2013a). Of the nine targets, there was only one diet related target – a 30% relative reduction in mean population salt intakes¹ (World Health Organization, 2013a). In order to accomplish this, the Global Action Plan for NCD prevention and control suggests developing “guidelines, recommendations or policy measures that engage different relevant sectors, such as food producers and processors, and other relevant commercial operators, as well as consumers, to reduce the level of salt/sodium added to food (prepared or processed)” (World Health Organization, 2013b).

In many high-income countries, approximately three quarters of dietary salt intake comes from prepared or processed foods; however, the main contributors to dietary salt consumption differ among countries (He et al., 2012). Although many LMIC populations continue to add significant amounts of salt to food while cooking or at the table, there has been an influx of processed foods in these countries in recent years (Stuckler et al., 2012). Therefore, in addition to ensuring that salt reduction initiatives are aimed at reducing salt added by the consumer, reducing salt levels in processed and prepared foods is imperative.

Prepared and processed foods often contain high amounts of salt (He et al., 2012). The salt found in these foods is often referred to as ‘hidden salt’ given that consumers are often not aware of the high salt content. Where there are large amounts of hidden salt in the food supply, one of the most effective ways to reduce salt consumption may be to encourage the food industry to reduce salt in foods by setting targets or standards for salt levels in different categories of foods that all companies should meet (Vos et al., 2010).

Salt reduction initiatives that aim to reduce salt levels in foods can be either mandatory (salt standards) or voluntary (salt targets). Most salt reduction initiatives to date have taken a voluntary approach to reducing salt levels in foods (Webster et al., 2011); however, there have been a few exceptions where mandatory limits have been put into place. Bulgaria, Belgium, Hungary, The Netherlands and Portugal have mandatory salt standards for a small number of staple food products and Argentina and South Africa have set mandatory salt limits for a more extensive list of processed and, in Argentina’s case, restaurant foods (World Cancer Research Fund International, 2014; Webster et al., 2014).

The UK was the first country to establish comprehensive salt targets and between 2003 and 2011 dietary salt consumption decreased by 1.4 g in the UK (He et al., 2014). Throughout this period there was also a decline in stroke by 40% and ischemic heart disease by 42% – it is likely that salt reduction contributed to these declines (He et al., 2014). This suggests that salt targets could substantially contribute to the global goal to reduce population salt intakes by 30% and help reduce diet-related NCDs, even when they are voluntary.

LMICs may face additional challenges in setting targets for salt levels in foods due to a lack of available data for target development and perhaps, more importantly, a lack of capacity for implementation, enforcement and monitoring. For this reason, they will need to adopt a more practical approach to setting country or region-specific salt targets. The aim of this paper is to propose a step-by-step approach to setting and implementing targets for salt levels in foods for LMICs, which can then be used for voluntary or mandatory policy interventions. It also provides a case study of the

application of this process in the Pacific Islands, where regional targets have now been endorsed.

An approach to setting salt targets in LMICs

We examined existing literature on setting salt targets and consulted with experts in the field to develop an approach to setting salt targets in LMICs. Fig. 1 outlines the proposed steps that should be taken to set salt reduction targets and provides different options to cater for countries and regions with fewer resources. The main steps include: (1) identifying the main sources of salt in the diet, (2) selecting foods for salt targets, (3) setting target levels in foods, (4) identifying strategies for engagement with stakeholders and (5) establishing mechanisms for monitoring. A brief discussion of the following steps is provided below.

Identifying the main sources of salt in the diet

Targets for salt levels in foods should be established for the food categories that contribute most to dietary salt consumption. Understanding the contribution of different foods to dietary salt intake is best done using national food consumption data. These data will identify the foods and consumption patterns that are associated with high salt intake. The main ways in which information about food intakes can be obtained are by using: food records, 24-h dietary recalls, food frequency questionnaires (FFQ), household budget surveys, food sales or import data (WHO/PAHO, 2013). The type of information used depends on the availability of existing data and country resources. The existing range of products and their current salt levels need to be obtained through surveys according to the protocol outlined by the Food Monitoring Group (Dunford et al., 2012). Where survey information is not available, and resources do not permit collecting data, information can be obtained through consultation with key stakeholders. A summary of the strengths and limitations of these different means of identifying the main sources of salt in the diet can be found elsewhere (WHO/PAHO, 2013).

Selecting foods for salt targets

There are two main approaches to selecting which foods should have salt targets: (1) setting targets for all processed food categories (which could also include restaurants) that contribute to salt in the diet and (2) prioritizing specific foods or categories based on salt contribution. Given the limited resources available in most LMICs, it will not always be feasible to set targets for all food categories that contribute to salt in the diet. The preferred approach may be to identify and establish targets for priority product categories based on a number of factors including contribution of salt to the diet and feasibility of making reductions.

Setting targets for salt levels in foods

As a general rule, if we are trying to reduce population salt intake by 30% and a significant amount of salt in the diet is coming from processed foods, then we need to reduce salt in processed foods by at least 30%, and even more where possible. However, simply setting a generic target to reduce salt levels in all foods by 30% would not be appropriate given that different product categories have specific requirements.

The main considerations to make when setting the target level for salt in foods include: the existing range of products and their current salt levels; how these compare to existing targets from other countries; technical, food safety and consumer acceptability

¹ Sodium and salt are often used interchangeably when referring to dietary salt intake. When referring to dietary salt consumed and the quantity of salt in food we are primarily referring about sodium chloride (NaCl).

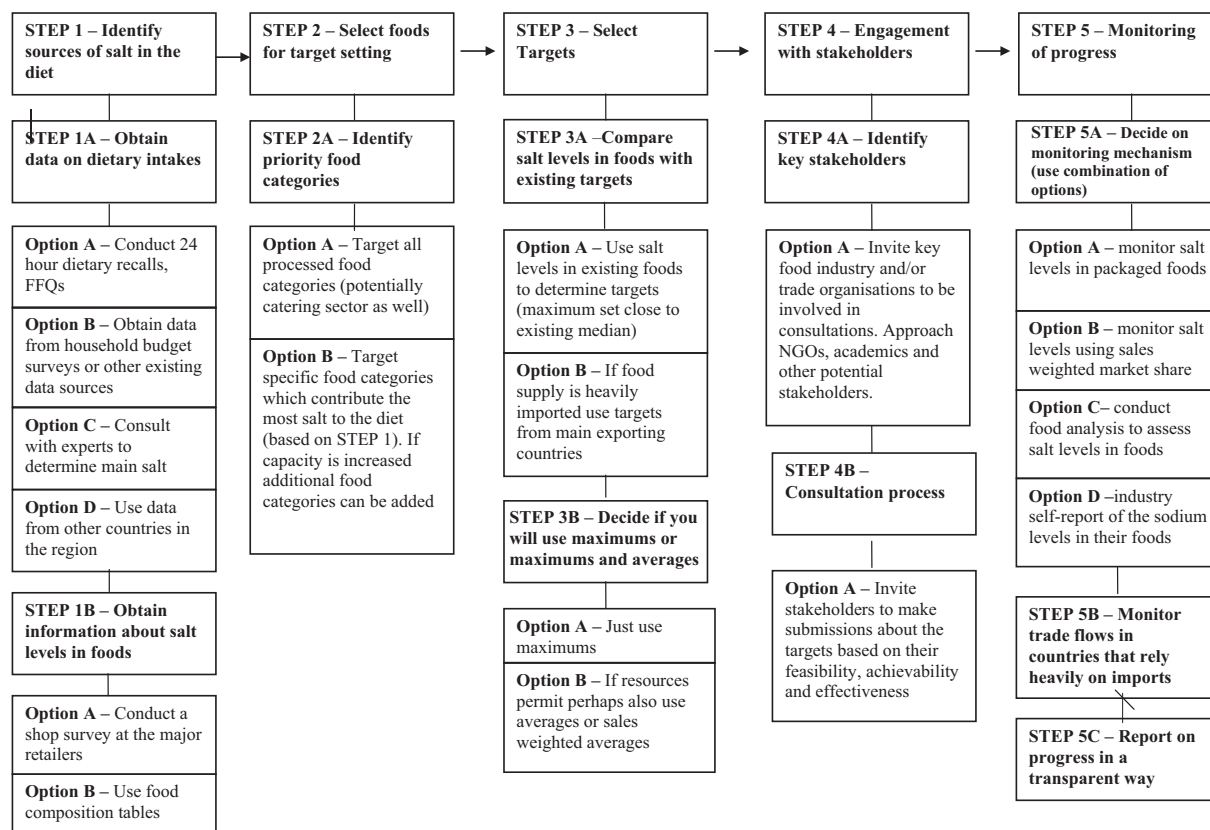


Fig. 1. Step-wise approach to setting national or regional salt targets*. Options for step 1 are listed progressively from the most to least desirable based on validity and methodological strength. A combination of options (if resources permit) is advised for steps 3B and 5A.

of changes in salt levels; and the extent to which products are locally produced or imported (Charlton et al., 2014).

Examining targets from other countries in relation to the range of products on the national market identified through the shop surveys is a good starting point for LMICs in terms of developing country or region-specific targets for salt levels in food. The UK, the United States, Canada, Australia and other countries worldwide have already established targets (Food Standards Agency, 2014; Health Canada, 2012; The New York City Department Of Health and Mental Hygiene, 2014; Australian Division of World Action on Salt and Health, 2011; Australian Government Department of Health, 2013), which have undergone an extensive consultation process and could be adopted as they stand or modified to reflect country or region-specific requirements. Moreover, mandatory salt standards adopted in Argentina and South Africa could also be a good starting point, particularly for countries in South America and Africa, respectively.

If a proportion of the products on the shelves already meet the international targets then reductions should be technically feasible for that product category. Salt targets can be set as maximum, average or sales weighted average (SWA) levels of salt in foods (WHO/PAHO, 2013). Average targets refer to the average salt levels of all the products in a given category, meaning that some products in the category can be higher as long as others are lower. SWAs refer to the average salt levels in a range of products within a given category, weighted by the sales of those products. The main strengths and limitations of the different approaches to setting targets are reported elsewhere (WHO/PAHO, 2013). Averages, whether SWA or not, allow flexibility in terms of the levels of salt in different products within the same food category (WHO/PAHO, 2013). This flexibility can be helpful in terms of accounting for the natural variation in the salt levels of some foods

(WHO/PAHO, 2013); however, using averages makes it very difficult to hold individual companies to account and it can be extremely difficult (and often expensive) to gain access to sales data for both the setting and monitoring of sales weighted average targets. For this reason, setting targets as maximum salt levels in foods is likely the most feasible approach for LMICs where resources are limited. However, these could be combined with targets based on simple, non-weighted, averages as well, where there is appropriate data and expertise.

Targets should be set in a standardized way (e.g., salt per 100 g of the product) rather than per serving to enable comparisons across products. Moreover, products that require reconstitution before consumption should specify whether the target applies to the 'as sold' or 'as prepared' product (WHO/PAHO, 2013).

It is important that appropriate timelines for meeting the proposed targets are established. There is no set formula for setting timelines, as it will depend on the product category and extent of salt reduction. In the UK, where work with the food industry to reduce salt in foods has been very successful, reductions were in the range of 30% over three years so around 10% a year (Wyness et al., 2012). Over time, targets can be adjusted to ensure that the stealth reduction (incremental reductions to allow consumers to adapt to the change in taste) of salt levels in food continues once the initial targets have been met.

Engagement with stakeholders

In order to obtain relevant insight and create buy-in for proposed targets, it is important to consult with academics, health professionals, non-governmental organizations, government and the food industry. This will help increase engagement and ensure that targets are feasible within the context of the country or

region's existing food environment. Stakeholder consultation can be undertaken through meetings, including bi-lateral and cross-sectoral meetings with the food industry, academics and public health groups. In addition, written consultations on draft policy outlining the rationale, approach and proposed targets can be useful.

Engagement with stakeholders will also be important in terms of engaging with small and medium enterprises in the informal food sector. Salt targets will likely not reach these manufacturers – it will therefore be important to engage with them directly to increase their awareness and capacity to produce and sell lower salt products.

Establishing mechanisms for monitoring

Prior to implementing the targets, it is also important to establish robust and transparent mechanisms for monitoring industry's progress towards meeting the salt targets. There are three main ways to monitor progress: (1), monitor salt levels in packaged foods through regular surveys or use of food market data that includes both market share and information about the salt content of foods (e.g., nutrition labels), (2) by conducting food analysis, particularly for foods that do not carry nutrition labels or (3) industry self-report of the salt levels in their foods. Countries may want to use a combination of these options, depending on resources and capacity. Retail food marketing data can be used to examine salt levels in foods, although the cost of these data may make this option prohibitive for most LMICs. For countries that rely heavily on imports (e.g., small island countries), trade flows should also be monitored particularly as trade becomes more liberalized and new trade and investment agreements are signed.

The most straightforward way of assessing the impact of targets is likely by monitoring salt levels in packaged foods over time. One way to do this is by conducting regular shop surveys, as outlined by the Global Food Monitoring Group (Dunford et al., 2012). However, whenever possible this should be combined with food analysis of a sample of products in each food category, given that there is evidence to suggest that there may be inaccuracies in nutrition labels in some countries (Lobanco et al., 2009; Reshma et al., 2012) and top contributors to dietary salt consumption may come from unpackaged foods (including those from the informal sector) that do not contain nutrition labels. Regardless of how progress towards meeting the targets is monitored it is important that the process is transparent. Enforcement and monitoring capacity may be limited in many LMICs – linking up with universities in the region to conduct shop surveys (The George Institute for Global Health, 2013) to help facilitate monitoring could alleviate some constraints in this respect. Health inspectors responsible for implementation and enforcement of existing food legislation could also play a key role in monitoring the salt content of food available on the market if time, capacity and resources permit. Box 1 provides a case study of the step-by-step approach taken to develop regional targets in the Pacific Island region.

Box 1 A case study of setting regional salt targets in the Pacific Island Countries.

Fig. 2 provides the step-wise process conducted to set regional salt targets in the Pacific Island Countries (PICs). Regional targets were developed that would be applicable to all of the countries in the region.

Step 1 – Identifying the main sources of salt in the diets

of PICs: The main sources of salt in the diet were established based on a dietary survey in Fiji (Institute for Health Metrics and Evaluation, 2004) followed by consultations in ten Pacific Island countries to identify other potential key contributors to dietary salt intakes in the region (Christoforou et al., 2015). The assessment of sodium levels in processed food was done through a five country survey of the nutrition content of foods co-ordinated by the Pacific Research Centre for the Prevention of Obesity and Non-communicable Diseases (C-POND) in 2011 (Snowdon et al., 2013). Information on sodium levels in locally produced bread within the region was not available but it was agreed that, as this was such an important product category, analysis of the sodium content of bread would be undertaken in the future and used to inform the implementation and monitoring of the targets.

Step 2 – Selecting foods for target setting in the PICs:

It was agreed that targets should be set for the products that constituted the majority of salt in the diet. Regional targets were therefore proposed for bread, Asian sauces (soy and other Asian sauces), canned fish, canned meat, sausages, snack foods (crisps, extruded snacks, corn chips), biscuits (plain/breakfast, savoury and sweet) and flavoured noodles.

Step 3 – Selecting target levels for salt in PICs:

Assess sodium medians and ranges for existing products:

The median and ranges of sodium levels of existing products on the market were assessed. Median sodium levels (per 100 g) in different countries were compared for each product category to ensure that there were no major differences in the salt levels (Table 1). As no large discrepancies were apparent, regional targets were deemed appropriate.

Compare to existing targets:

The median and ranges of different product categories were then compared with the UK and Australian targets (Table 2). Because it was posited that many products in the PICs would be imported from Australia these targets were deemed initially appropriate. Comparison of median salt levels in the PICs product categories to those in Australian products was also made to ensure that salt levels in foods were not disproportionately higher in the PICs.

Deciding the type of targets for PICs: Given the lack of comprehensive information on the salt levels of foods and their respective sales figures in the PICs, combined with limited resources for monitoring progress, maximum targets were deemed most practical for the Pacific.

Steps 4 – Stakeholder Consultations:

The proposals for the regional targets were presented and agreed by representatives at the Pacific Islands NCD Forum in Auckland in September 2013 and further endorsed in principle at the Pacific Directors of Health meeting in Fiji in April 2014. It is expected that the targets will be formally endorsed at the Pacific Island Health and Finance Ministers meeting in 2015. In the meantime, Fiji has already adopted the targets and other PICs are being encouraged to start integrating the standards into the revision of food regulations.

Step 5 – Establishing Mechanisms for Monitoring:

Comprehensive baseline assessments of salt levels in foods will be repeated in Fiji and Samoa in 2015 (Webster et al., 2014) and a broader country survey is being planned for 2020.

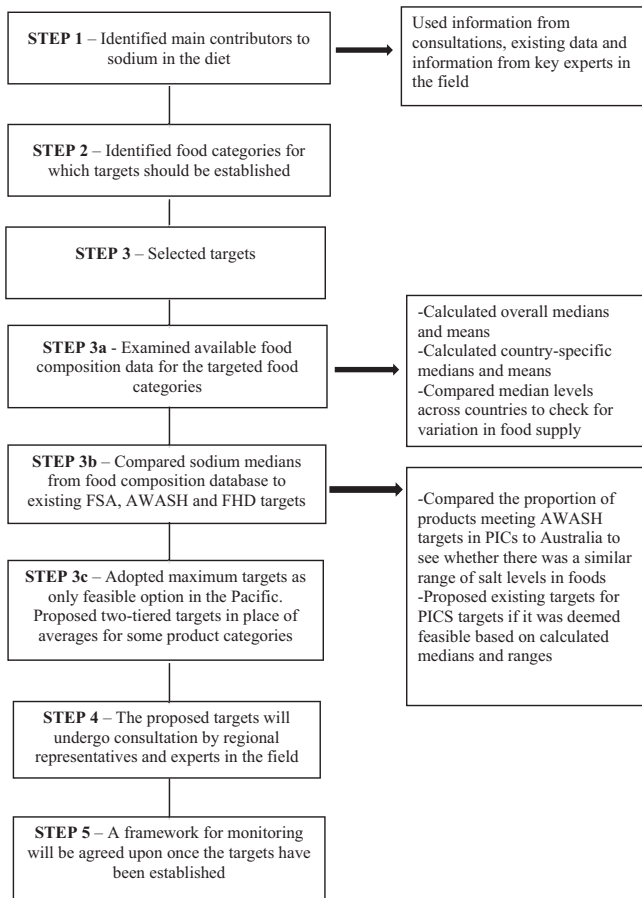


Fig. 2. The step-wise approach used to set Pacific Island regional targets.

Implementing salt targets

Salt targets can be voluntary or mandatory and can be used to provide an impetus for product reformulation by the food industry. Governments can ask food companies to commit to voluntary targets and then monitor progress. In the absence of punishment for non-compliance they can publish the results and use these to raise consumer awareness as well as putting pressure on the food industry.

In addition to trying to reduce salt levels at the manufacturing level (through salt targets or standards), targets can be used as the basis for labelling and taxation policies. Different approaches to labeling include salt warnings (which was done in Finland), front-of-pack labelling such as traffic light labels which indicate whether foods are high (red), medium (amber) or low (green) in salt which is being used in the UK, or healthy choice symbols such as the Australian and New Zealand Heart Foundation Tick schemes (World Cancer Research Fund International, 2014; British Heart Foundation, 2013; Heart Foundation, 2014).

In relation to taxation, sales taxes have been introduced in Hungary and Portugal as part of salt reduction strategies. Although it is too early to assess the impact of these taxes, a modeling study conducted in the US found that a sodium tax that increased the price of salty foods by 40% would reduce sodium consumption by 6% (Smith-Spangler et al., 2010). However, further research is needed to ensure that there are no unintended consequences of taxes with regards to substitution and further consideration should be given to subsidies on healthier products. For example, salt substitutes (e.g., low sodium table salt, low sodium soy and fish sauce, etc.) could be subsidised in countries where

Table 1
Median sodium levels in targeted food categories in Pacific Island Countries.

Food Category	Sub Category	Overall median (mean) mg/100 g	Fiji Median (n products) mg/100 g	Guam Median (n products) mg/100 g	Nauru Median (n products) mg/100 g	New Caledonia Median (n products) mg/100 g	Samoa Median (n products) mg/100 g
Asian Sauces	Soy Sauce	5476 (5461.7)	5209 (16)	4176.5 (3)	5400 (2)	6458 (3)	7529 (8)
	Other Asian sauces	3300 (3374)	2020 (9)	3050 (43)			3940 (15)
Canned Fish		420 (416)	474 (32)		398 (14)	470 (15)	385 (26)
Canned Meat		715 (727.3)	770 (4)		690 (4)	750 (7)	660 (11)
Sausages		808 (826)	777 (15)	835 (19)	640 (2)		835 (1)
Snack foods	Crisps	570 (630)	603 (36)	428 (3)	786 (1)	540 (15)	600 (8)
	Extruded snacks	786 (820)	821 (20)	758 (2)	164 (1)	1210 (4)	630 (23)
	Corn Chips	607 (611)	607 (11)	214 (1)			726 (1)
Biscuits	Plain (breakfast)	546.1 (601.6)	528 (11)	616.7 (24)		210 (5)	616.7 (4)
	Savoury	713 (715.5)	677.5 (6)	733.3 (10)		717 (5)	729.5 (26)
	Sweet	270.8 (275.3)	275 (57)	294.6 (14)	146 (4)	200 (77)	280 (44)
Flavoured noodles		1860.5 (1898.9)	1428.5 (12)	2069.8 (17)		1638 (13)	1516 (7)

Table 2
Proposals for PIC targets for salt levels in foods.

Category	PIC Sodium Median (Range) ^a Mg/100 g	FSA 2012 target Mg/100 g ^b	AWASH 2012 and Food and Health Dialogue (FHD) Targets ^c Mg/100 g	Number of products in PICs food composition database currently meeting targets	Proposed PIC target	Notes
Bread and Roti	No information available	400	400	No information available	400	AWASH Target One of the key contributors to salt in the diet so we need to have a target and then develop a strategy for how to enforce it FSA/AWASH/FHD targets the same AWASH target
Asian sauces – Soy Sauce, fish sauce, etc.	5688 (680-9999)	NA	AWASH: 4840 FHD: 15% reduction in Asian sauces exceeded 680 mg/100 g	8/32 products meet AWASH target	4840	
Canned Fish (including tuna, salmon, sardines, mackerel and other canned fish)	420 (147-840)	370	AWASH: 430	47/87 products meet AWASH target 29/87 products meet FSA maximum target	430	AWASH target Even if you break down into smaller product categories there are some that meet the target
Canned Meat	715 (280-1100)	NA	AWASH: 540	2/26 products meet AWASH target	540	AWASH Target
Sausages	808 (260-1400)	450 (uncooked) 600 (cooked)	AWASH: 600	5/38 products meet AWASH target	600	AWASH Target
Snack foods – Crisps	570 (45-1594.0)	650 (550)	AWASH: 600 FHD Avg: 550 FHD Max: 800	37/63 products meet AWASH target 30/63 products meet FSA and FHD average target	600	AWASH target
Snack foods – Extruded Snacks	786 (164-1603.0)	1000 (750)	AWASH: 1000 FHD Avg: 950 FHD Max: 1250	39/50 products meet AWASH target 36/50 products meet FHD average target 58/50 products meet FHD maximum target 45/50 products meet FSA average target	950	FHD target
Snack foods- Corn Chips	607 (214-961)	900	AWASH: 560	5/13 products meet AWASH target 12/13 products meet FSA target	560	AWASH target
Biscuits-Plain Biscuits/crackers	546 (130-1267)	NA	AWASH: 610	28/44 products meet AWASH target	610	AWASH target
Biscuits-Savoury Biscuits	713 (310-1545)	800 (550) unfilled	AWASH: 800	34/47 products meet AWASH target 13/47 products meet FSA average target	800	AWASH target
Biscuits- Sweet Biscuits Filled and unfilled	271 (17-1486)	450 (270)	AWASH: 270	95/196 products meet-AWASH target 180/196 products meet FSA maximum target	450	AWASH target
Flavoured Noodles	1861 (278-4440)	NA	AWASH: 370	1/49 products meet AWASH target	1600	AWASH Target (as prepared). Fiji target 1600 (as sold).

^a All sodium data were obtained from the C-POND database which includes information from shop surveys conducted in: Fiji, Guam, Nauru, New Caledonia and Samoa. Future work will also look at existing sodium information obtained from shop surveys in additional Pacific Island Countries.

^b When both maximum and average targets were available, reported as: maximum target (average target).

^c When Australian Food and Health Dialogue target was available it is also reported.

table salt or high salt sauces are the main contributor to the dietary salt consumption in order to ensure that they are comparably priced to the higher salt alternatives, as salt substitutes have been found to be an effective means of lowering blood pressure ([China Salt Substitute Study Collaborative Group, 2007](#)).

Although there are several uses for salt targets, it is important to acknowledge their shortfalls in LMIC contexts. In many LMICs, many processed foods are produced and sold in the informal sector

([Food and Agriculture Organization, 2007](#)). These foods escape regulation, including those related to standards, labeling and taxation. In order to address salt levels in these foods, a broader approach to salt reduction will be required. Targeting the small and medium scale enterprises that make up the informal manufacturing sector will be necessary in combination with the aforementioned policy approaches to reduce salt levels in foods. In order to accomplish this, it will be necessary to engage with these manufacturers to

increase their awareness related to salt levels in foods and their capacity to reformulate their products using technological approaches that concomitantly retain food safety and organoleptic properties.

Conclusions

In order to achieve the global recommendation to reduce population salt intakes by 30%, LMICs will need to take action to reduce salt levels in foods. Setting targets for the main contributors to dietary salt intake is an important first step. LMICs with limited resources should select maximum targets for the main contributors of salt in the diet and use existing targets as the starting point for country or region-specific target development. In addition to setting targets that can be used for setting voluntary or mandatory levels of salt in processed packaged foods, labelling or taxation, interventions at the consumer level are also required. In some LMICs, a large proportion of dietary salt comes from salt added at the table or by high sodium sauces such as soy or fish sauce. In these cases, targets need to be complemented with both initiatives aimed at increasing consumer awareness and investment in research and development to find ways of manufacturing affordable substitutes for table salt, soy and fish sauce that have the organoleptic properties that consumers demand. Governments should consider subsidising these low salt alternatives to encourage their uptake by both consumers and manufacturers.

Acknowledgments

JW is supported through a National Health and Medical Research Council and National Heart Foundation of Australia Career Development Fellowship and an NHMRC Project Grant. SMD is supported by a Canadian Institutes of Health Research Postdoctoral Fellowship. Other sources of funding for this work include the World Health Organization and a University of Sydney Travelling Fellowship.

References

- Alderman, M.H., Cohen, H.W., 2012. Dietary sodium intake and cardiovascular mortality: controversy resolved? *Am. J. Hypertens.* 25 (7), 727–734.
- Appel, L.J., Frohlich, E.D., Hall, J.E., Pearson, T.A., Sacco, R.L., Seals, D.R., et al., 2011. The importance of population-wide sodium reduction as a means to prevent cardiovascular disease and stroke: a call to action from the American heart association. *Circulation* 123 (10), 1138–1143.
- Australian Division of World Action on Salt and Health, 2011. Interim Australian targets for sodium levels in 85 food categories [Internet]. <<http://www.awash.org.au/wp-content/uploads/2012/10/Interim-Salt-Targets-for-Australia-March-2011.pdf>> (cited 23.05.14).
- Australian Government Department of Health, 2013. Summary of Food Categories Engaged under the Food and Health Dialogue to date [Internet]. Australian Government Department of Health. <http://www.foodhealthdialogue.gov.au/internet/foodandhealth/publishing.nsf/Content/summary_food_categories> (cited 23.05.14).
- Barton, P., Andronis, L., Briggs, A., McPherson, K., Capewell, S., 2011. Effectiveness and cost effectiveness of cardiovascular disease prevention in whole populations: modelling study. *BMJ* 343, d4044.
- British Heart Foundation, 2013. Food labelling [Internet]. <<https://www.bhf.org.uk/get-involved/campaigning/food-labelling.aspx>> (cited 26.10.14).
- Brown, I.J., Tzoulaki, I., Candeias, V., Elliott, P., 2009. Salt intakes around the world: implications for public health. *Int. J. Epidemiol.* 38 (3), 791–813.
- Charlton, K., Webster, J., Kowal, P., 2014. To legislate or not to legislate? A comparison of the UK and South African approaches to the development and implementation of salt reduction programs. *Nutrients* 6 (9), 3672–3695.
- China Salt Substitute Study Collaborative Group, 2007. Salt substitution: a low-cost strategy for blood pressure control among rural Chinese. A randomized, controlled trial. *J. Hypertens.* 25 (10), 2011–2018.
- Christoforou, A., Snowdon, W., Laesango, N., Vatucawaqa, S., Lamar, D., Alam, L., et al., 2015. Progress on salt reduction in the Pacific Islands: From strategies to action. *Heart Lung Circ.* 24 (5), 503–509.
- Cobiac, L.J., Vos, T., Veerman, J.L., 2010. Cost-effectiveness of interventions to reduce dietary salt intake. *Heart* 96 (23), 1920–1925.
- Dunford, E., Webster, J., Metzler, A.B., Czernichow, S., Ni Mhurchu, C., Wolmarans, P., et al., 2012. International collaborative project to compare and monitor the nutritional composition of processed foods. *Eur. J. Prev. Cardiol.* 19 (6), 1326–1332.
- Elliott, P., Stamler, J., Nichols, R., Dyer, A., 1996. Intersalt revisited: further analyses of 24 hour sodium excretion and blood pressure within and across populations. *BMJ* 312 (7041), 1249–1253.
- Food and Agriculture Organization, 2007. Promises and Challenges of the Informal Food Sector in Developing Countries. <<http://www.fao.org/3/a-a1124e.pdf>>.
- Food Standards Agency, 2014. 2017 UK Salt Reduction Targets [Internet]. <<http://www.food.gov.uk/scotland/scotnut/salt/saltreduction#.U3-zmy9qMfE>> (cited 23.05.14).
- He, F., Campbell, N., MacGregor, G., 2012. Reducing salt intake to prevent hypertension and cardiovascular disease. *Rev. Panam. Salud Publica* 32 (4), 293–300.
- He, F.J., Pombo-Rodrigues, S., MacGregor, G.A., 2014. Salt reduction in England from 2003 to 2011: its relationship to blood pressure, stroke and ischaemic heart disease mortality. *BMJ Open.* 4 (4), e004549.
- Health Canada, 2012. Guidance for the Food Industry on Reducing Sodium in Processed Foods [Internet]. <<http://www.hc-sc.gc.ca/fn-an/legislation/guide-ld/2012-sodium-reduction-indust-eng.php>> (cited 23.05.14).
- Heart Foundation, 2014. Heart Foundation Tick [Internet]. <<http://www.heartfoundation.org.au/healthy-eating/heart-foundation-tick/Pages/default.aspx>> (cited 26.10.14).
- Institute for Health Metrics and Evaluation, 2004. Fiji National Nutrition Survey 2004 [Internet]. Institute for Health Metrics and Evaluation. <<http://ghdx.healthdata.org/record/fiji-national-nutrition-survey-2004>> (cited 26.05.14).
- Institute of Medicine, 2013. Sodium Intake in Populations: Assessment of Evidence [Internet]. Committee on the Consequences of Sodium; Food and Nutrition Board; Board on Population Health and Public Health Practice. The National Academies Press, Washington, DC. <<http://books.google.com/books?hl=en&lr=&id=4Q11AgAAQBAJ&oi=fnd&pg=PA1&dq=Sodium+Intake+in+Populations+Assessment+of+Evidence&ots=j0OCw141qp&sig=xCrGh33BMOuqoVjzELioIELLY>> (cited 11.12.14).
- Lim, S.S., Vos, T., Flaxman, A.D., Danaei, G., Shibuya, K., Adair-Rohani, H., et al., 2012. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 380 (9859), 2224–2260.
- Lobanco, C.M., Vedovato, G.M., Cano, C.B., Bastos, D.H.M., 2009. Reliability of food labels from products marketed in the city of São Paulo, Southeastern Brazil. *Rev. Saude Publica* 43 (3), 499–505.
- Lozano, R., Naghavi, M., Foreman, K., Lim, S., Aboyans, V., Abraham, J., et al., 2012. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 380, 2095–2128.
- Mason, H., Shoaibi, A., Ghandour, R., O'Flaherty, M., Capewell, S., Khatib, R., et al., 2014. A cost effectiveness analysis of salt reduction policies to reduce coronary heart disease in four Eastern Mediterranean countries. *PLoS One* 9 (1), e84445.
- Reshma, M., Ravi Kiran, C., Nisha, P., Soban Kumar, D., Sundaresan, A., Jayamurthy, P., 2012. Trans fat content in labeled and unlabeled Indian bakery products including fried snacks. *Int. Food Res. J.* 19 (4), 1609–1614.
- Smith-Spangler, C.M., Jusuola, J.L., Enns, E.A., Owens, D.K., Garber, A.M., 2010. Population Strategies to Decrease Sodium Intake and the Burden of Cardiovascular Disease: A Cost-Effectiveness Analysis. *Ann. Intern. Med.* 152 (8), 481–487.
- Snowdon, W., Raj, A., Reeve, E., Guerrero, R.L., Fesaitu, J., Cateine, K., et al., 2013. Processed foods available in the Pacific Islands. *Glob. Health* 9 (1), 53.
- Stuckler, D., McKee, M., Ebrahim, S., Basu, S., 2012. Manufacturing epidemics: the role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco. *PLoS Med.* 9 (6), e1001235.
- The George Institute for Global Health, 2013. Global Food Monitoring Group [Internet]. The George Institute for Global Health. <<http://www.georgeinstitute.org/projects/global-food-monitoring-group>> (cited 23.05.13).
- The New York City Department of Health and Mental Hygiene, 2014. National Salt Reduction Initiative [Internet]. <<http://www.nyc.gov/html/doh/html/diseases/salt.shtml>> (cited 23.05.14).
- Vos, T., Carter, R., Barendreg, J., Mihalopoulos, C., Veerman, J.L., Magnus, A., et al., 2010. Assessing Cost-Effectiveness in Prevention (ACE-prevention) [Internet]. University of Queensland, Brisbane and Deakin University, Melbourne. <http://www.sph.uq.edu.au/docs/BODCE/ACE-P/ACE-Prevention_final_report.pdf> (cited 23.06.13).
- Wang, G., Labarthe, D., 2011. The cost-effectiveness of interventions designed to reduce sodium intake. *J. Hypertens.* 29 (9), 1693–1699.
- Webster, J.L., Dunford, E.K., Hawkes, C., Neal, B.C., 2011. Salt reduction initiatives around the world. *J. Hypertens.* 29 (6), 1043–1050.
- Webster, J., Trieu, K., Dunford, E., Hawkes, C., 2014. Target salt 2025: a global overview of national programs to encourage the food industry to reduce salt in foods. *Nutrients* 6 (8), 3274–3287.
- Webster, J., Snowdon, W., Moodie, M., Viali, S., Schultz, J., Bell, C., et al., 2014. Cost-effectiveness of reducing salt intake in the Pacific Islands: protocol for a before and after intervention study. *BMC Public Health* 14 (1), 107.
- Whelton, P.K., Appel, L.J., Sacco, R.L., Anderson, C.A.M., Antman, E.M., Campbell, N., et al., 2012. Sodium, blood pressure, and cardiovascular disease: further evidence supporting the American Heart Association sodium reduction recommendations. *Circulation* 126 (24), 2880–2889.
- WHO/PAHO, 2013. Regional Expert Group for Cardiovascular Disease Prevention through Population-wide Dietary Salt Reduction. A Guide for Setting Targets

- and Timelines to Reduce the Salt Content of Food [Internet]. <http://www.paho.org/hq/index.php?option=com_docman&task=doc_view&gid=21493+&Itemid=999999&lang=en> (cited 23.05.14).
- World Bank, 2006. Disease Control Priorities Project. Investing in Global Health. "Best buys" and Priorities for Action in Developing Countries [Internet]. <<http://www.dcp2.org/file/57/DCPP-InvestGlobalHealth.pdf>> (cited 23.05.14).
- World Cancer Research Fund International, 2014. NOURISHING Framework [Internet]. <<http://www.wcrf.org/int/policy/nourishing-framework>> (cited 11.12.14).
- World Economic Forum, 2011. World Health Organization. From Burden to "Best Buys": Reducing the Economic Impact of Non-Communicable Disease in Low-and Middle-Income Countries [Internet]. <http://www3.weforum.org/docs/WEF_WHO_HE_ReducingNonCommunicableDiseases_2011.pdf> (cited 11.12.14).
- World Health Organization, 2010. Global Status Report on Noncommunicable Diseases [Internet]. WHO, p. 176. <http://www.who.int/nmh/publications/ncd_report2010/en/> (cited 23.05.13).
- World Health Organization, 2013a. NCD Global Monitoring Framework [Internet]. WHO: Geneva. <http://www.who.int/nmh/global_monitoring_framework/en/> (cited 23.05.14).
- World Health Organization, 2013b. Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020 [Internet]. WHO. <http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf> (cited 22.05.14).
- Wyness, L.A., Buttriss, J.L., Stanner, S.A., 2012. Reducing the population's sodium intake: the UK Food Standards Agency's salt reduction programme. *Public Health Nutr.* 15 (2), 254–261.