ORIGINAL ARTICLE

Reducing salt in food; setting product-specific criteria aiming at a salt intake of 5 g per day

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INTRODUCTION

There is increasing public health concern regarding high salt intake, which is generally between 9 and 12 g per day, and much higher than the 5 g recommended by World Health Organization. Several relevant sectors of the food industry are engaged in salt reduction, but it is a challenge to reduce salt in products without compromising on taste, shelf-life or expense for consumers. The objective was to develop globally applicable salt reduction criteria as guidance for product reformulation.

SUBJECTS/METHODS: Two sets of product group-specific sodium criteria were developed to reduce salt levels in foods to help consumers reduce their intake towards an interim intake goal of 6 g/day, and — on the longer term — 5 g/day. Data modelling using survey data from the United States, United Kingdom and Netherlands was performed to assess the potential impact on population salt intake of cross-industry food product reformulation towards these criteria.

RESULTS: Modelling with 6 and 5 g/day criteria resulted in estimated reductions in population salt intake of 25 and 30% for the three countries, respectively, the latter representing an absolute decrease in the median salt intake of 1.8–2.2 g/day.

CONCLUSIONS: The sodium criteria described in this paper can serve as guidance for salt reduction in foods. However, to enable achieving an intake of 5 g/day, salt reduction should not be limited to product reformulation. A multi-stakeholder approach is needed to make consumers aware of the need to reduce their salt intake. Nevertheless, dietary impact modelling shows that product reformulation by food industry has the potential to contribute substantially to salt-intake reduction.

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MATERIALS AND METHODS
Development of the salt targets

Various sets of criteria for salt or sodium reduction have been developed by health authorities or governments, but these criteria do have their limitations. Criteria are often set to differentiate between products currently on the market in order to determine eligibility for claims; marketing to children or health logos, which is different from steering long-term product reformulation. Some criteria are pragmatically set and embedded in the local nutrient profiling systems, which are not globally applicable. Some sets of criteria are not covering the entire diet, making it difficult to get overall salt-intake levels towards a certain intake target. Some systems do include many different criteria for sub-categories of food, making application very complex. Moreover, most of these criteria have been set pragmatically without a clear science-based rationale or impact evaluation through dietary intake modelling. The lack of a gold standard and/or globally applicable product targets stimulated Unilever to develop its own set of product group-specific sodium criteria aiming to reduce salt levels in foods over time to ultimately help consumers reducing their intake towards population intake targets.

Defining the intake goals

International, generally accepted, dietary recommendations formed the basis for the development of the salt reduction criteria. Criteria were set to target a dietary intake of 6 g of salt (2400 mg of sodium), and a further reduction towards 5 g of salt (2000 mg of sodium). The first target is in line with current recommendation used in many countries; the second target is the recommendation of the WHO.

Conversion of intake goals into product group-specific targets

When developing the criteria, a total diet approach was taken. Thus, product group-specific sodium criteria were set for all product groups contributing to sodium intake and not only product groups relevant for Unilever. Absolute sodium criteria were defined, rather than relative reduction targets. Product group-specific absolute criteria allow taking into account the composition and the contribution of product groups to overall daily salt intake.

Different sets of sodium test criteria were developed, taking the criteria used in Unilever’s Nutrition Enhancement Programme, the sodium criteria applied in various countries (for example, UK or international nutrient profiling systems (for example, International Choices Programme) as a starting point. The potential impact of these test criteria on total salt intake was evaluated through daily menu modelling, as described below.

Impact evaluation of test criteria using typical daily menus (step 1)

Product group-specific sodium criteria were tested using typical daily menus. For several countries, average salt intakes from national surveys were converted into three typical daily menus per country. To provide a global representation, daily menus were created for the Netherlands, Spain, Greece, US, South Africa and China. Details about these daily menus are described in Roodenburg et al. In these menus, the contribution of food products to daily salt intake in the context of their role within a typical menu is taken into account—focusing on how often and how much salt-containing products consumers typically eat. Salt-intake levels used for the modelling did not include intake from discretionary salt, except for Spain where salt intake could be based solely on 24-h urine excretion, and the US, where salt used during cooking was included in the recipes of prepared foods. With these menus, the impact of product group-specific sodium criteria on total daily salt intake was crudely estimated by adjusting the sodium levels of all non-complying products in these menus to the levels of the test criteria. Finally, the average total daily salt intake after adjusting the sodium product values was compared with salt recommendations to evaluate the effectiveness of the sodium test criteria. This iterative process finally led to the 6 and 5 g/day product group criteria, as shown in Table 1. More detailed information on the criteria is available as Supplementary information.

Impact evaluation of final criteria on population salt intake (step 2)

To have a more robust insight in the potential impact of the product group-specific sodium criteria on population salt intake, additional modelling was conducted by using the complete food consumption survey data from the US, UK and NL. The sodium content in food products, listed in the composition tables attached to the surveys, was modified to simulate sodium-specific product reformulation. An overview of the food consumption surveys and food composition tables used in the assessments is presented in Table 2. Discretionary salt intake was not included in the surveys, except for the US survey where salt used during cooking was included in the recipes of prepared foods. Analyses were performed with Crème Food between December 2011 and March 2012.

For each of the countries, three scenarios were analysed:

- Population salt intake based on the original survey data (as measured).
- Hypothetical population salt intake following the reformulation to meet the product group-specific sodium criteria aiming at 6 g salt/day.
- Hypothetical population salt intake following the reformulation to meet the product group-specific sodium criteria aiming at 5 g salt/day.

Table 1. Product group-specific sodium criteria

| Sodium criteria aiming at | 6 g salt/day | 5 g salt/day |
|--------------------------|-------------|-------------|
|                          | (2400 mg sodium/day) | (2000 mg sodium/day) |
| Generic criteria         | 1.6 mg/kcal | 1.3 mg/kcal |
| Bread and breakfast cereals | 1.0 mg/100 g | 1.0 mg/100 g |
| Sandwiches/rolls         | 375 mg/100 g | 375 mg/100 g |
| (Un)processed meat, meat products, meat substitutes | 1.6 mg/kcal | 1.4 mg/kcal |
| (Un)processed fish, fish products | 675 mg/100 g | 675 mg/100 g |
| Cheese (products)        | 340 mg/100 g | 340 mg/100 g |
| Main dish                | 900 mg/100 g | 675 mg/100 g |
| Side dishes              | 250 mg/100 g | 250 mg/100 g |
| Meal sauces              | 540 mg/100 g | 340 mg/100 g |
| Dressings, emulsified (e.g., mayonnaise) | 1080 mg/100 g | 750 mg/100 g |
| Dressings, water-based (e.g., ketchup) | 1080 mg/100 g | 750 mg/100 g |
| Seasonings (e.g., herbs and spices, marinades) | 360 mg/100 g | 265 mg/100 g |
| Soups and bouillons      | 360 mg/100 g | 265 mg/100 g |
| Spreads and cooking products (margarine, butter and oil/fat products for roasting and frying) | 1.6 mg/kcal or 100 mg/100 g | 1.3 mg/kcal or 470 mg/100 g |

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To calculate the ‘as measured’ overall population salt intake in the surveys, a standard assessment was performed in which no nutrient levels were altered in the original food composition data. To model the impact of the 6 and 5 g salt/day criteria, sodium levels in the food composition data were modified to simulate reformulation, assuming that all food products included in the survey would be compliant with the relevant criteria. Sodium values in the food composition tables for the products that were not compliant to the criteria (Table 1) were modified to meet these criteria. For example, sodium levels of all soups consumed in the survey that were not complying with the 6 g/day criterion of 360 mg/100 g and/or 5 g/day criterion of 265 mg/100 g were adjusted to these levels. Products with sodium levels that were already compliant to the sodium criterion for the relevant sodium product group were not modified.

For all scenarios, median daily salt intake was calculated for the total population and for a subgroup of high-salt users. This population subgroup was identified because of their relatively higher risk of high blood pressure and subsequent cardiovascular disease risk, and therefore they are expected to benefit more from salt-intake reduction. The high-salt user subgroup was defined as the quartile of the population with the highest salt consumption. In addition to median intakes, the percentage of the population compliant with overall intake targets was calculated.

To analyse the different scenarios, it was necessary to align food groups in the food composition tables with the food groups for which the different product-specific criteria were defined (see Table 1). All foods that could not be categorised into the specific product groups (USA, 30%; UK, 22%; and NL, 41% of products listed in the country-specific composition table) were modelled to comply with the ‘generic’ sodium criteria (for example, beverages, milk products, bread toppings, fruits and vegetables, potatoes and grains). For product groups with two criteria, either the criterion in x mg/100 g or x mg/kcal had to be met.

RESULTS
Impact evaluation of test criteria using typical daily menus (step 1)
Iterative modelling by using the typical daily menus showed that if the finally proposed product group-specific sodium criteria would be achieved, it should be possible to move salt intakes towards the interim target of 6 g and the long-term target of 5 g per day. However, the expected impact of salt reduction in food products is different between countries, as shown in Figure 1. In countries such as Spain and the US, reformulation towards the product group-specific sodium criteria may not be sufficient, and increasing consumer awareness on the need to reduce intake of food products that contribute most to their salt intake is required. In China and South Africa, the contribution of food products to overall salt intake is smaller than the other countries (4.0 and 3.9 g/day salt, respectively), and excessive intake is still mainly driven by the discretionary salt that consumers add during food preparation or at the table (3.6 and 10.9 g/day salt, respectively). Therefore, in these countries, it will also be very important to convince the population to use less discretionary salt.

Impact evaluation of final criteria on population salt intake (step 2)
Median daily salt-intake values from food products as measured in the three surveys were 7.8, 6.7 and 6.9 g for populations in the US, UK and NL, respectively (Figure 2). In all three populations, less than 25% of the population had median salt-intake levels compliant to the recommended intake of 5 g salt/day (Table 3).

Table 2. Overview of food consumption survey and composition tables used in assessments

| Food consumption survey | Composition table | Sample size (n) | Population age | Data collection method |
|-------------------------|-------------------|----------------|----------------|------------------------|
| NHANES 2007-2008        | FNDDS 4.1 2008    | 7227           | Total population | 2-Day 24-h recall + specific questionnaire to enable recipe calculation |
| NDNS 2000-2001          | McCance and Widdowson’s 5th edition | 1724 | 2–80 yrs, Adult population | 7-Day food diary + blood and 24-h urine samples |
| DNFC 2003               | NEVO 2001 in combination with 2006 | 750 | Young adults 18–30 yrs | 2-Day 24-h recall by dieticians+general questionnaire |

Figure 1. Estimated impact of reformulation on salt intake using daily menu modelling. The vertical bars indicate current salt intake from foods* in the typical daily diet, and the modelled intake after replacing actual sodium levels in food products by 6 and 5 g/day criteria. The horizontal dashed lines indicate total daily salt-intake targets of 6 and 5 g salt/day. *Discretionary salt use was not taken into account.
In high-salt users, median daily salt intake was 12.8, 10.1 and 9.9 g per day for the US, UK and NL, respectively (Table 3).

In Figure 2a, the potential impact on salt intake of product reformulation to meet the sodium criteria is shown. Modelling with the 6 g/day criteria yielded a daily salt-intake reduction of 1.4–1.8 g, equalling a 20–27% reduction compared with baseline. The 5 g/day product criteria would result in reductions in salt intake of 1.8–2.2 g per day (26–32%). As expected, results for high-salt users show greater absolute sodium intake reductions (Figure 2b). In this subgroup, salt intake would be reduced with 2.2–3.2 g per day (equalling a 22–29% reduction) using the 6 g/day product criteria and with 2.7–3.9 g (equalling a 28–33% reduction) using the 5 g/day product criteria.

Applying the 6 g/day product criteria would increase compliance with the 6 g/day recommendation in all three populations by at least 25%. Applying the 5 g/day product criteria, the number of people complying with the 5 g/day intake recommendation would more than double in all three countries analysed (Table 3).

**DISCUSSION**

In the absence of globally applicable and accepted sodium reduction criteria, the criteria described in this article could serve as a direction for salt reduction in food products. Salt reduction must be seen as a journey—significant changes are required and it will take time to successfully implement. Although it will be very challenging, for technological and/or taste reasons, to get all products fully compliant, the product group-specific sodium criteria could certainly help guide reformulation and reduce population salt intake.

The daily menu modelling was a first step to get insight into the potential impact of the sodium reduction criteria on total salt intake in various countries. However, there were differences in the measurement of salt intake between the countries. For most countries, salt intake was based on the dietary records,17,19,20,23 which generally do not properly include the use of discretionary salt. However, for Spain, salt intake was based solely on 24-h urine
impact of food reformulation on total salt intake would be much
from the United States, United Kingdom and the Netherlands.
performed by using the dietary food consumption survey data
three typical menus. Therefore, additional robust modelling was
available at the time that the analyses were performed. To get the
surveys for the three countries analysed, as the data were not yet
beyond these countries, the modelling could be expanded
regarding non-communicable diseases. The signi
industry.11 Only when all parties and their actions are joined,
workshops served as
of over-compensating.35
In achieving a population salt intake of maximally 5 g/day,
there is an important role for health authorities and salt-interest
groups to help increase the consumer awareness on the need to
reduce salt. Together, Unilever and the International Union of
Nutrition Societies initiated consumer studies and stakeholder
workshops in Germany/Austria, Hungary, South Africa, China,
India and Brazil. The studies revealed that, although salt
workshops in Germany/Austria, Hungary, South Africa, China,
reduction towards the described product group-specific
reformulation can contribute substantially to salt-intake reduction,
the modelling represents a
all countries. This also means that the absolute compliance to the recommen-
dations after simulated reformulation shown in this study is
overestimated. Nevertheless, the relative increase in compliance
gives a valid reflection of the potential impact of the food
reformulation. An additional reduction of discretionary salt use
may be achieved by increasing consumer awareness around salt,
which should eventually lead to a change in the behaviour.
A recent study showed that the number of people in England
adding salt to food at the table fell by more than a quarter in the
5 years following a national campaign.31
Finally, we acknowledge that the modelling represents a
theoretical approach based on dietary survey data with its
limitations, and it reflects the results of a best case scenario,
assuming that the entire food industry would apply the criteria
and all food products would be reformulated to these targets.
Although this may not be completely realistic in practice, we feel
that the modelling results give a reasonable indication of the
impact on population salt intake that could be achieved by food
reformulation towards the described product group-specific
criteria.
Within Unilever, the criteria are genuinely used to guide salt
reduction within the product portfolio. Reductions of up to 25%
were made across the entire product portfolio, while maintaining
great tasting products. By the end of 2012, more than 50% of the
foods portfolio met the 5 g salt/day criteria.32 However, salt
reduction cannot be limited to product reformulation. With
proposed criteria we are already challenging the boundaries of
what is technologically possible, but also with regard to consumer
acceptance.2 Some older studies have shown33,34 that participants
did not fully compensate via the salt shaker for the reduced salt
content of their diet or meal. However, a more recent study
showed that when a single product (soup) was 30% reduced in
salt, the majority of the participants did add salt back, even to the
point of over-compensating.35
excretion,16 which does include discretionary salt use. For US, salt
used during cooking was included in the recipes of prepared
foods.18 Therefore, results between countries may not be
completely comparable. Another limitation is that the menus
reflected a manual translation of nutrient intakes in a country in three
typical menus. Therefore, additional robust modelling was
performed by using the dietary food consumption survey data
from the United States, United Kingdom and the Netherlands.
Baseline salt-intake levels significantly exceeded the interna-
tional guidelines for salt intake for all three populations,
indicating the relevance of salt reduction in these countries. In
all three populations, modelling with 6 g/day criteria resulted in
an average reduction in population salt intake of ~ 25%;
modelling with 5 g/day criteria led to an average reduction in
population intake of 30%. As a result of cross-industry product
reformulations to these criteria, the number of people complying
with the recommendation of 5 g salt/day could be more than
doubled.
We realise that the modelling is subject to a few limitations that
need to be addressed. First, we could not use the most recent
surveys for the three countries analysed, as the data were not yet
available at the time that the analyses were performed. To get the
most up-to-date insight on the potential impact on actual intakes,
it would be preferable to repeat the modelling with more recent
data that have become available in the meantime. Nevertheless,
also publications regarding the more recent survey data indicate
that there is still a need for further salt reduction in all three
countries examined.28–30
Second, owing to the limited availability of food consumption
survey data, the modelling was applied to only three Western
countries. To get more insight into the potential impact
beyond these countries, the modelling could be expanded
to other countries. However, in non-Western countries such as
China and South Africa, the contribution of food products to
overall salt intake is smaller than in Western countries (27% and
53%, respectively), and excessive intake is mainly
driven by a high discretionary salt use.19,20 Therefore, the
impact of food reformulation on total salt intake would be much
smaller than the 25–30% we estimated for the three Western
countries.
Third, a limitation of dietary surveys in general is that these do
not properly measure discretionary salt intake. Reductions in total
Table 3. Compliance to 6 and 5 g salt/day intake goals at baseline and
after simulated product reformulations

| Scenario description | Overall population compliance with intake goal (%) |
|----------------------|-----------------------------------------------|
|                      | 6 g/day | 5 g/day |
| USA                  |         |         |
| ‘As measured’ salt intake | 27      | 15      |
| Applying 6 g salt/day criteria | 50 | 33 |
| Applying 5 g salt/day criteria | 57 | 39 |
| UK                   |         |         |
| ‘As measured’ salt intake | 39      | 20      |
| Applying 6 g salt/day criteria | 74 | 55 |
| Applying 5 g salt/day criteria | 80 | 62 |
| NL                   |         |         |
| ‘As measured’ salt intake | 35      | 22      |
| Applying 6 g salt/day criteria | 60 | 40 |
| Applying 5 g salt/day criteria | 69 | 49 |

Abbreviations: UK, United Kingdom; US, United States; NL, Netherlands.

salt intake thus mainly reflect the impact of reformulation of food
products. If discretionary salt could have been taken into account,
the intake goals of 6 and 5 g would not have been met entirely.
Within the review by Moodie
et al
reduction
sodium criteria
impacting the
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impact. According to meta-analyses, a conservative estimate indicates that a reduction of 1 g/day would result in reduction in blood pressure of 0.8/0.5 mmHg, which would reduce stroke risk by 5% and ischaemic heart disease risk by 3%. Altogether, many small actions can make a big difference.

CONFLICT OF INTEREST
All authors are employed (MD-K, WPMMG and KHvhH) or were employed at time of the study (GWM) by Unilever Research and Development Vlaardingen, The Netherlands.

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AUTHOR CONTRIBUTIONS
MD-K, GWM, and KHvhH contributed to the development of salt targets. WPMMG performed the impact modelling. MD-K drafted the paper and WPMMG, GWM and KHvhH commented upon and revised drafts. MD-K had full access to the data in the study and final responsibility for the decision to submit for publication. All authors approved the final version.

REFERENCES
1 WHO. Guideline: Sodium Intake for Adults and Children. WHO Document Production Services: Geneva, Switzerland, 2012.
2 World Health Organization. Reducing Salt Intake in Populations Report of a WHO Forum and Technical Meeting. WHO Document Production Services: Geneva, Switzerland, 2007.
3 Mattes RD, Donnelly D. Relative contributions of dietary sodium sources. J Am Coll Nutr 1991; 10: 383–393.
4 James WP, Ralph A, Sanchez-Castillo CP. The dominance of salt in manufactured food in the sodium intake of affluent societies. Lancet 1987; 1: 426–429.
5 Brown U, Tzoulaki I, Candeias V, Elliott P. Salt intakes around the world: implications for public health. Int J Epidemiol 2009; 38: 791–813.
6 Nijman CA, Zijp IM, Sierksma A, Roedenburg AJ, Leenen R, van den KC et al. A method to improve the nutritional quality of foods and beverages based on dietary recommendations. Eur J Clin Nutr 2007; 61: 461–471.
7 World Health Organisation. Global strategy on diet, physical activity, and health. World Health Assembly (WHASH5.17) held on May 22 2004, WHO Document Production Services: Geneva, Switzerland, 2004.
8 Unilever Sustainable Living Plan http://www.unilever.com/sustainable-living/
9 EU Pledge Nutrition White Paper. EU: Brussels, Belgium, 2012. http://www.eu pledge.eu/sites/eu pledge.eu/files/releases/EU_Pledge_Nutrition_White_Paper_Nov 2012.pdf (accessed 19 August 2014).
10 Roedenburg AJ, Popkin BM, Seddell JC. Development of international criteria for a front of package food labelling system: the International Choices Programme. Eur J Clin Nutr 2011; 65: 1190–1200.
11 Reuterswärd AL, The keyhole Symbol. Livsmedelverket http://www.slv.se/templates/SLV_Page.aspx?id=12220&selanguage=EN-GB (accessed 19 August 2014).
12 Food Standards Agency. Salt: is your food full of it? http://fna.europarcc.org/ 20090810121540/salt.gov.uk/ (accessed 19 August 2014).
13 Webster JL, Dunford EK, Hawkes C, Neal BC. Salt reduction initiatives around the world. J Hypertens 2011; 29: 1043–1050.
14 Roedenburg AJ, Schlatmann A, Dotsch-Klerk M, Daamen R, Dong J, Guerra M et al. Potential effects of nutrient profiles on nutrient intakes in the Netherlands, Greece, Spain, USA, Israel, China and South-Africa. ProSe One 2011; 6: e14721.
15 Voedingscentrum. Zo eet Nederland: Resultaten van de Voedselconsumptiepeiling 1997-1998. Voedingscentrum: Den Haag, the Netherlands, 1998.
16 Otero ML. Contenido en sodio de la dieta y enfermedades cardiovasculares. Cardiovasc Risk Factors 2000; 9: 319–326.
17 Mmanas I, Bertssias G, Linardakis M, Moschandreas I, Kafatos A. Nutrient intake and food consumption among medical students in Greece assessed during a Clinical Nutrition course. Int J Food Sci Nutr 2004; 55: 17–26.
18 Centers for Disease Control and Prevention (CDC).National Center for Health Statistics (NCHS) National Health and Nutrition Examination Survey Data 1999-2000 http://www.cdc.gov/nchs/nhanes/search/nhanes99_00.aspx (accessed 19 August 2014).
19 Charlton KE, Steyn K, Levitt NS, Zulu JV, Jonathan D, Veldman FJ et al. Diet and blood pressure in South Africa: Intake of foods containing sodium, potassium, calcium, and magnesium in three ethnic groups. Nutrition 2005; 21: 39–50.
20 Ministry of Health, Ministry of Science and Technology, National Bureau of Statistics The Nutrition and health status of the Chinese people. 2004 http://www.goldenrice.org/PDFs/China_nutr_rep_2004_en.pdf. accessed 19 August 2014.
21 Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS) National Health and Nutrition Examination Survey Data 2007-2008 http://www.cdc.gov/nchs/nhanes/search/nhanes07_08.aspx (accessed 19 August 2014).
22 The National Diet & Nutrition Survey (NDNS): Adults Aged 19–64 Year. TSO: London, UK, 2001.
23 DCNS-Young Adults (2003); part of the Dutch National Food Consumption Survey. RIVM: Bilthoven, the Netherlands, 2003.
24 USDA Food and Nutrient Database for Dietary Studies. 41. Agricultural Research Group: Beltsville, US, 2008.
25 Holland B, Welch AA, Unwin ID, Buss DH, Paul AA, Southgate DAT. McCance and Widdowson’s The Composition of Foods, 5th edn, The Royal Society of Chemistry and Ministry of Agriculture, Fisheries, and Food: Cambridge, UK, 1991.
26 Stichting Nederlands Voedingstoestandenbestand. NEVO-table: Nederlands Voedingstoestandenbestand 2006. Voedingscentrum: Den Haag, The Netherlands, 2006.
27 van Rossum CTM, Buurma-Rethans EJM, Fransen HP, Verkaik-Kloosterman J, Hendriksen MAH. Salt consumption of children and adults in the Netherlands: Results from the Dutch National Food Consumption Survey 2007-2010. RIVM: Bilthoven the Netherlands, 2012. Report no. RIVM Report 350050007.
28 Centers for Disease Control and Prevention. Trends in the prevalence of excess dietary sodium intake - United States, 2003-2010. Morb Mortal Wty Rep 2013; 62: 1021–1025.
29 He FJ, Brinsden HC, MacGregor GA. Salt reduction in the United Kingdom: a successful experiment in public health. J Hum Hypertens 2013; 28: 345–352.
30 Sutherland J, Edwards P, Shankar B, Dangour AD. Fewer adults add salt at the table after initiation of a national salt campaign in the UK: a repeated cross-sectional analysis. Br J Nutr 2013; 110: 552–558.
31 Unilever Sustainability Plan. Progress Report 2012 http://www.unilever.com/images/ USLP-Progress-Report-2012-FI tcm13-352007.pdf (accessed 19 August 2014).
32 Beauchamp GK, Bertino M, Engelmann K. Failure to compensate decreased dietary sodium with increased table salt usage. JAMA 1987; 258: 3275–3278.
33 Shepherd R, Farleigh CA, Wharf SG. Limited compensation by table salt for reduced salt within a meal. Appetite 1989; 13: 193–200.
34 Liem DG, Miremadi F, Zandstra EH, Keast RS. Health labelling can influence taste perception and use of table salt for reduced-sodium products. Public Health Nutr 2012; 15: 2340–2347.
35 Newson RS, Lion R, Crawford RJ, Curtis V, Elmadfa I, Feunekes GI et al. Behaviour change for better health: nutrition, hygiene and sustainability. BMC Public Health 2013; 13: 51.
36 Moodie R, Stuckler D, Monteiro C, Sheron N, Neal B, Thamarangsi T et al. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. Lancet 2013; 381: 670–679.
37 He FJ, MacGregor GA. Effect of modest salt reduction on blood pressure: a meta-analysis of randomized trials. Implications for public health. J Hum Hypertens 2002; 16: 761–770.

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