Sodium content of processed foods in the United Kingdom: analysis of 44,000 foods purchased by 21,000 households[1–3]

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ABSTRACT

Background: In the United Kingdom, sodium reduction targets have been set for a large number of processed food categories. Assessment and monitoring are essential to evaluate progress.

Objectives: Our aim was to determine whether household consumer panel food-purchasing data could be used to assess the sodium content of processed foods. Our further objectives were to estimate the mean sodium content of UK foods by category and undertake analyses weighted by food-purchasing volumes.

Design: Data were obtained for 21,108 British households between October 2008 and September 2009. Purchasing data (product description, product weight, annual purchases) and sodium values (mg/100 g) were collated for all food categories known to be major contributors to sodium intake. Unweighted and weighted mean sodium values were calculated.

Results: Data were available for 44,372 food products. The largest contributors to sodium purchases were table salt (23%), processed meat (18%), bread and bakery products (13%), dairy products (12%), and sauces and spreads (11%). More than one-third of sodium purchased (37%) was accounted for by 5 food categories: bacon, bread, milk, cheese, and sauces. For some food groups (bread and bakery, cereals and cereal products, processed meat), purchase-weighted means were 18–35% higher than unweighted means, suggesting that market leaders have higher sodium contents than the category mean.

Conclusion: The targeting of sodium reduction in a small number of food categories and focusing on products sold in the highest volumes could lead to large decreases in sodium available for consumption and therefore to gains in public health. *Am J Clin Nutr* 2011;93:594–600.

INTRODUCTION

Excess dietary sodium is associated with high blood pressure (1), which increases risk of cardiovascular disease (2, 3). In 2008, UK population dietary salt intake was estimated to be 8.6 g/d (4), which exceeds the maximum recommended limit of 6 g/d and remains far above the 1–2 g/d required for good health. Efforts to lower dietary sodium intakes can improve blood pressure and reduce risk of cardiovascular disease (5, 6). Reducing intakes to 6 g/d could prevent ≈17,500 premature deaths in the United Kingdom each year (7). However, there is little evidence of temporal decreases over the past several decades (8, 9).

In Europe and North America, most sodium (≈75%) comes from that added to foods due to commercial processing (10). Accordingly, efforts are underway to decrease the sodium content of processed foods (11, 12), and the UK Food Standards Agency (FSA) has set salt reduction targets for 80 categories of food. Review of progress and targets is undertaken on a biennial basis (13), although this nutrition policy work recently became the responsibility of the UK Department of Health.

Monitoring effects of public health initiatives on food reformulation is challenging. Dietary assessment using diary or recall methods substantially underestimates sodium intakes (14, 15), whereas 24-h urinary sodium collections, considered to be the gold standard, are challenging for participants and cannot identify food sources of sodium. Furthermore, the constantly changing composition of national and global food supplies indicates the need for more flexible and up-to-date methods to monitor population exposure.

Market research companies in many countries collect purchasing data from household consumer panels that scan foods at home. Such panels are generally nationally representative, collect data on a continuous basis, and provide estimates of national product sales. One company, Kantar Worldpanel UK, also collects and regularly updates nutrient data to match to purchasing data. The combination of food-purchasing data with nutrient data offers new opportunities to assess sodium content of processed foods and potentially improved precision in estimating population exposure to sodium (16). Although purchasing data are not a surrogate for consumption, their use may offer an alternative strategy to monitor population sodium exposure that reflects both the effect of product reformulation and shifts in purchasing behavior.

The primary aim of these analyses was to determine if household consumer panel food-purchasing data could be used to assess the sodium content of processed foods. Secondary aims

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were to provide up-to-date estimates of the mean sodium concentration of major processed food groups and categories that contribute sodium to the UK food supply and to compare unweighted mean sodium values with means weighted by annual food-purchasing volumes.

METHODS

Analyses were undertaken with the use of 12 mo of continuous household consumer panel data collected by Kantar Worldpanel from 21,108 British households between October 2008 and September 2009. Kantar Worldpanel members scan and record all food and drink purchases brought into their homes. Information recorded on products includes barcode data, purchaser, location of purchase, total cost of shopping trip, product price, and promotional information. Data on nonbarcoded items such as fresh foods are collected by using barcoded show cards (photographs) and questions. Data are not collected on foods consumed out of the home.

UK census data and the Broadcasters' Audience Research Panel Establishment Survey (the industry standard for household demographic characteristics) are used to define and predict demographic targets and to monitor the national representativeness of Kantar Worldpanel. Key variables considered in panel selection are geographic region, life stage, household size, age of "housewife," and social class.

Quality-control procedures are used to ensure correct data capture, panel continuity, and barcode matching and to monitor extreme purchasing. Eligibility criteria are run every 4 wk to ensure the panel is limited to households meeting quality-control criteria. Any household that has not been recording data on the panel for the full 4-wk period is removed as are households that have not recorded shopping data in the last week. Each household must include at least one individual who has recorded $\geq$5 items. Basic purchase volumes and spend criteria are set to exclude the worst-complying households. Spend criteria are based on the size of the household. Households are ranked on the basis of number of items bought compared with their household size average. By using these criteria, the poorest-complying households are excluded to maintain a similar year-to-year average number of items bought (neutrally weighted by household size). Compliance with scanning is encouraged by frequent e-mail, postal, or telephone reminders.

Since 2006 Kantar has also collected nutrient data from package labels for $\approx$100,000 UK products covering all food and drink categories. Information on energy, total fat, saturated fat, total carbohydrate, sugars, fiber, protein, and sodium is linked to food purchase volumes to provide nutritional information on UK household shopping baskets. Nutrient data are obtained for products new to market once 20 purchase occasions are recorded by the panel in a 12-wk period. Package label nutrient data are collected annually by field workers. Generic food composition data derived from national food composition tables (17) are used for fresh produce or in cases in which package label data are not available.

Identification of foods that contribute sodium to the UK diet

Foods selected for inclusion in the UK food purchasing sodium database were chosen on the basis of their known contribution to sodium in the UK diet. Key food category contributors were identified by using the UK INTERMAP study data, which identified the main dietary sources of sodium in the United Kingdom for men and women aged 40–59 y (18), the FSA food classification system established for the purpose of working with industry to achieve salt reduction in target food categories (13), and a recent, similar Australian survey of the sodium content of processed foods (19). A preliminary list of foods integrating all 3 systems was created, and Kantar provided purchasing data and sodium values for all products within the following categories: breads, grains, cereals, processed meats, processed poultry, processed fish, dairy foods, processed vegetables and vegetarian products, spices, flavorings, table salt, edible oils, snack foods, convenience foods, sauces, and spreads.

Definitions of food groups and categories

Food groups and food categories were defined in a pragmatic classification system combining 3 existing systems: the original Kantar food product categories, the FSA salt reduction categories (13), and categories used in a published Australian survey (19). Foods were classified into a hierarchical system consisting of 12 food groups and 43 food categories, which broadly reflected both the UK FSA and Australian categorization systems (19) without necessitating extensive recategorization of the Kantar food-purchasing data for this preliminary study.

Data management and analysis

Kantar provided the following data on all products within the specified food categories: product description, product weight, sodium value per 100 g (2009 fieldwork data), and number of packages purchased by the household sample over 12 mo (unweighted data). Data were collated into the defined food groups and categories, and data checks were undertaken. Package label sodium values collected by field workers from January to June 2009 were available for 99% of products, and generic food composition data were used for a small number of products in the milk and bacon categories.

For some product categories [bread rolls, morning goods (buns, teacakes, scones, crumpets, pikelets, or muffins), cakes, and pastries] sodium content values were reported per serving rather than per 100 g, reflecting the manner in which nutrient data are generally presented for these food items. To maintain consistency with other categories and estimate sodium content per volume purchased for these categories, additional calculations were undertaken using data provided by Kantar on number of servings per package.

In the case of natural cheeses, product weights were missing for a substantial number (1861; 39%) of random or variable weight (delicatessen) purchases. Therefore, to approximate volumes purchased, we estimated the average weight for the cheese category excluding missing values (261 g) and imputed this value to replace missing product weights.

Finally, a random sample of 100 items with zero sodium values was rechecked to ensure zero values were correct. Nutrient data from package labels were located for 67 items, all of which recorded trace, zero or nil, or values $<$0.1 mg/100 g. On this basis, a decision was made to accept zero sodium values as valid.

The unweighted mean sodium concentration (mg/100 g) was calculated for each food group and category. Weighted means were also calculated by using data on total annual product

TABLE 1
Sodium content of processed foods in the United Kingdom

Food group category	No. of products	Proportion of annual sodium purchases	Range	Unweighted mean[1]	Weighted mean[1,2]
		%	*mg sodium/100 g*	*mg sodium/100 g*	*mg sodium/100 g*
Bread and bakery products				257	348
Bread	2210	9.6	0–1200	397	426
Morning goods[3]	403	0.0	0–1100	275	350
Biscuits and cookies	2198	2.8	0–1700	374	325
Cakes and pastries	5083	0.8	0–2700	145	119
Cereal and cereal products				245	290
Breakfast cereals	965	3.3	0–1000	274	346
Cereal bars	413	0.1	0–612	186	223
Pasta	922	0.7	0–1200	216	196
Couscous	86	0.0	0–1500	357	205
Rice and savory noodles	559	0.4	0–2400	268	216
Processed meat				590	696
Bacon	814	7.5	0–2800	1298	1346
Sliced ham	794	2.1	0–2600	939	912
Sausages	662	2.2	0–1900	629	623
Meat and pastry products	1302	1.8	70–1500	406	435
Cooked meat	649	1.5	0–3500	908	728
Canned meat	96	0.3	400–1400	951	932
Paste and spreads	318	0.2	100–1100	640	665
Processed poultry	1950	1.3	0–1250	311	3335
Frozen processed meat	1311	1.5	0–1500	319	336
Black and white puddings[4]	17	0.0	370–960	764	664
Dairy				323	111
Cheese	4813	4.9	0–2000	463	568
Yogurt	820	0.8	0–600	76	86
Yogurt drinks	117	0.0	0–350	26	24
Milk	749	5.8	0–600	64	71
Cream	259	0.1	0–500	44	54
Ice cream	684	0.4	0–1000	75	80
Edible oils				501	547
Butter	111	1.1	0–1200	533	487
Margarine	168	2.9	0–1000	564	597
Cooking oils	32	0.0	0–1000	59	69
Fish and fish products				401	365
Processed fish	1764	1.3	0–6200	385	355
Canned fish	548	0.9	0–6000	453	383
Processed vegetables				195	172
Baked beans	180	2.1	90–700	319	311
Canned peas and beans	311	0.3	0–600	185	194
Other canned vegetables	375	0.3	0–700	137	85
Frozen vegetables and vegetarian meals	938	1.7	0–1950	132	118
Sour pickles	242	0.2	0–1600	433	331
Instant mashed potatoes	36	0.0	0–600	279	256
Herbs, spices, and salt	1141	22.6	0–40,000	4635	32,800
Snack foods				739	709
Crisps or chips and snacks	1458	3.2	0–2500	739	709
Convenience foods				379	347
Pizza	1033	1.4	70–1100	429	438
Ready meals	2601	1.7	0–1610	317	325
Soup	1266	1.3	0–8180	463	305
Sauces and spreads				1090	1054
Mayonnaise and salad dressings	510	1.1	0–2000	649	770
Sauces and stocks	2761	9.2	0–29,500	1286	1167
Spreads	436	0.3	0–1390	365	370
Nonalcoholic beverages				601	582
Chocolate beverages and cocoa	175	0.3	0–3000	601	582

[1] Mean values are averages of all recorded values.
[2] Weighted by purchase volumes (product weight × number of units sold over 12 mo).
[3] Buns, teacakes, scones, crumpets, pikelets, or muffins.
[4] Type of sausage consisting of meat, fat, suet, and oatmeal (and blood in black pudding).

volumes purchased (product weight × number of units sold). In addition, purchase volume data were used to estimate the proportional contribution of food groups and categories to total annual sodium purchases.

RESULTS

The 21,108 households providing food purchase data for the analyses were representative of British households in terms of age, household composition, region of residence, and social class. On average, households had been part of the panel for 5.3 ± 4.7 (mean ± SD) y. Twenty-eight percent of main household contacts were current smokers, and there was at least one vegetarian in 27% of households.

Data were available for a total of 44,372 UK food products purchased between October 2008 and September 2009 (**Table 1**). The quantity reflects the variety of food choice in the United Kingdom and diversity in product package sizes. Most of the 44,372 products were bread and bakery goods (22%), processed meat (18%), dairy (17%), and convenience foods (11%). The number of products per food category ranged from 32 (cooking oils) to 5083 (cakes and pastries).

Contribution of food groups and categories to total sodium purchases

The total annual quantity of sodium purchased was 41,454 kg, or ≈2.0 kg sodium per household/y (equivalent to ≈5.4 g sodium per household/d or 14 g salt). The largest single contributor to annual sodium purchases was herbs, spices, and salt (23%), predominantly attributable to table salt purchases. The largest food group contributors to total sodium purchases were processed meats (18%), bread and bakery products (13%), dairy products (12%), and sauces and spreads (11%) (**Figure 1**). Within these food groups, the majority of sodium purchased was accounted for by 5 food categories: bacon [8% total (46% of processed meat) sodium], bread [10% total (73% of bread and bakery) sodium], milk [6% total (49% of dairy) sodium], cheese [5% total (41% of dairy) sodium], and dried package sauces [9% total (86% of sauces and spreads) sodium] (**Figure 2**).

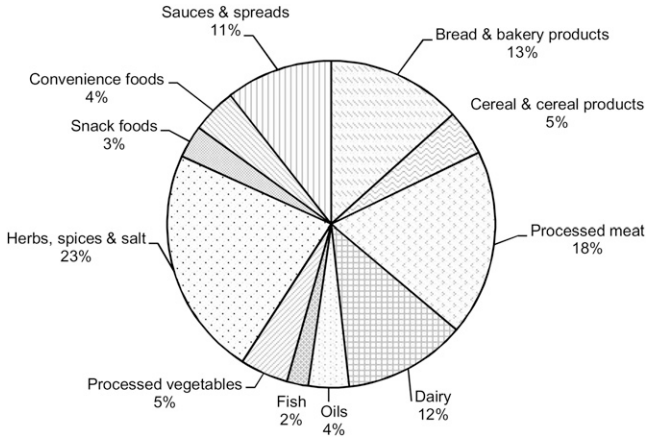

FIGURE 1. Proportional contribution of major processed-food groups to annual UK sodium purchases. "Bread & bakery products" includes bread, morning goods (buns, teacakes, scones, crumpets, pikelets, and muffins), biscuits or cookies, cakes, and pastries; "Cereal & cereal products" includes breakfast cereals, cereal bars, pasta, couscous, rice, and savory noodles; "Processed meat" includes bacon, sliced ham, sausages, meat and pastry products, cooked meat, canned meat, paste and spreads, and processed poultry; "Dairy" includes cheese, yogurt, yogurt drinks, milk, cream, and ice cream; "Oils" includes butter, margarine, and cooking oils; "Fish & fish products" includes processed fish and canned fish; "Processed vegetables" includes baked beans, canned peas and beans, other canned vegetables, frozen vegetables and vegetarian meals, and sour pickles; "Snack foods" includes crisps or chips and snacks; "Convenience foods" includes pizza, ready meals, and soup; and "Sauces & spreads" includes mayonnaise, salad dressings, sauces, stocks, and spreads.

Mean sodium content

Food groups with the highest (unweighted) mean sodium contents were sauces and spreads (1090 mg/100 g), snack foods (739 mg/100 g), and processed meats (590 mg/100 g) (Table 1). Processed vegetables had the lowest mean sodium content (195 mg/100 g). Within food groups, the categories with the highest unweighted mean sodium content were bacon (1298 mg/100 g),

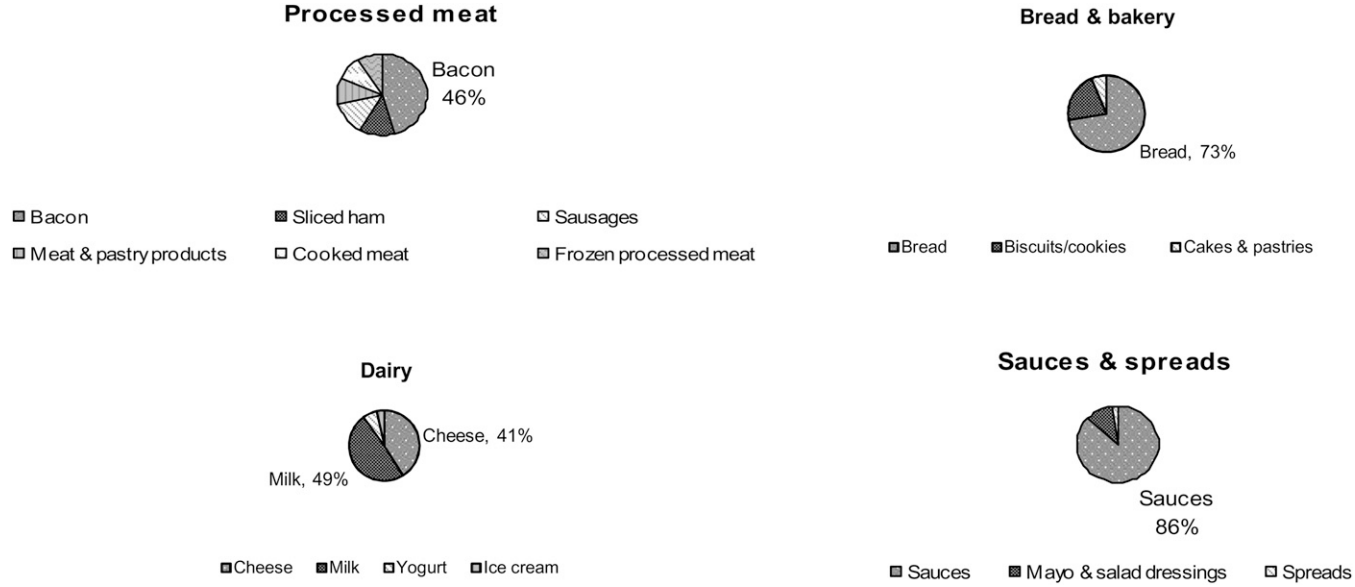

FIGURE 2. Selected processed-food category contributions to annual UK sodium purchases.

sauces (1286 mg/100 g), and sliced ham (939 mg/100 g). Those with the lowest were yogurt drinks (26 mg/100 g), cream (44 mg/100 g), and milk (64 mg/100 g).

Examination of weighted mean sodium values (sodium weighted by purchase volumes) showed that for many categories the weighted mean was similar or somewhat lower than the unweighted mean (Table 1). In some cases, however, weighted means were higher than the unweighted mean, suggesting that market leaders in these food groups contain higher sodium concentrations than do lesser-selling products. These latter groups were bread and bakery products (unweighted compared with weighted mean: 257 compared with 348 mg/100 g), cereals and cereal products (245 compared with 290 mg/100 g), and processed meat (590 compared with 696 mg/100 g). Food categories principally accounting for these differences include bread (unweighted compared with weighted mean: 397 compared with 426 mg/100 g), morning goods (275 compared with 350 mg/100 g), breakfast cereals (274 compared with 346 mg/100 g), and bacon (1298 compared with 1346 mg/100 g) (**Figure 3**). In contrast, in the dairy food group, the unweighted mean was substantially higher than the weighted mean (323 compared with 111 mg/100 g), possibly reflecting the predominance of milk purchases (with associated large volumes) within this category.

DISCUSSION

These analyses show that household consumer panel data can be used to assess the sodium content of processed foods. Table salt is a major contributor to sodium in the United Kingdom (23% of total), but this value may not reflect actual consumption due to wastage and other uses (eg, melting ice in winter). Apart from table salt, more than one-third of sodium purchased (37%) comes from only 5 processed-food categories: bacon, bread, milk, cheese, and sauces. Accordingly, the targeting of sodium content reductions in these categories (except for milk, where its sodium contribution is due to volume rather than concentration) could lead to large potential gains in public health.

The United Kingdom has had an active nationwide salt reduction program since 2003. Nevertheless, intakes remain well above the maximum recommended limit of 6 g/d. Direct comparisons against FSA 2012 targets were possible for 14 food categories, and in only one instance (cakes and pastries) was the mean category sodium content below the target. Although the unweighted mean sodium content for the morning goods category (275 mg/100 g) came within target (300 mg/100 g), the weighted mean (350 mg/100 g) exceeded the target by 17%. Similarly, the unweighted mean sodium content of the breakfast cereal category (274 mg/100 g) was close to the target (270 mg/100 g), but the weighted mean exceeded it by 28% (346 mg/100 g). Therefore, for many categories, greater efforts are needed to reduce sodium content in line with national targets for 2012.

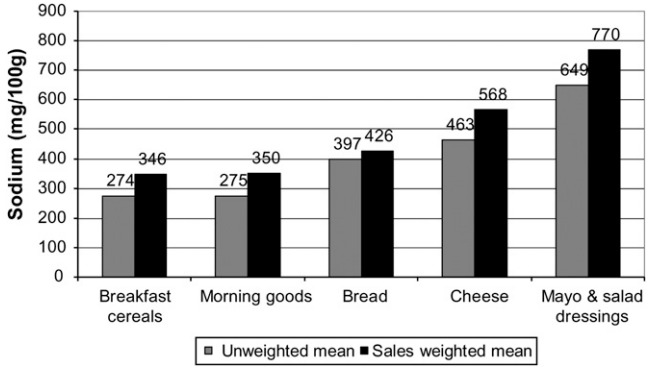

FIGURE 3. Unweighted compared with purchase-weighted mean sodium content of key processed-food categories. Means are averages of all recorded values. No formal statistical comparisons were undertaken. Weighted means are weighted by purchase volumes (product weight × number of units sold over 12 mo). Breakfast cereals, 965 products; morning goods, 403 products; breads, 2210 products; cheeses, 4813 products; mayonnaise (Mayo) and salad dressings, 510 products. Morning goods include buns, teacakes, scones, crumpets, pikelets, and muffins.

These are the first analyses to integrate the sodium content of UK processed foods with purchasing data to provide estimates of purchase-weighted sodium contents. For a number of categories (bread and bakery, cereals and cereal products, and processed meat), purchase-weighted means were 18–35% higher than unweighted means, which showed that market leaders have higher sodium contents. Use of purchasing or sales data should therefore guide reformulation efforts to target top-selling products within food categories to produce the greatest effect on population sodium exposure. The use of purchasing data for monitoring also better reflects the combined effect of product reformulation and shifts in purchasing behavior. Although not a substitute for food consumption data or urinary sodium analyses, these data provide a complementary approach to monitoring population level trends.

The 2008–2009 UK National Diet and Nutrition Survey (NDNS) reported that 30% of UK adults' daily sodium intake came from cereals and cereal products, 28% from meat and meat products, and 8% from milk and milk products (20). The INTERMAP study reported that 35% of UK sodium intake came from breads, grains, and cereals; 20% from meats, poultry and eggs; and 8% from dairy products (18). Similar findings were reported in the 2008 Family Food Study (21). These estimates of the proportional contribution of dietary sources to sodium intakes are quantitatively different from those derived from our analyses, where cereals and cereal products (bread and bakery plus cereals and cereal products combined) accounted for 18%, processed meat for 18%, and dairy for 12% of sodium purchased in the United Kingdom.

Differences in estimates between previous studies and our analyses are most likely due to the exclusion of table salt from other studies (23% of estimated total sodium in these analyses). The exclusion of table salt from our analyses would bring our numbers more in line with the previous studies: for example, cereals would then account for 23% of sodium purchases, processed meat for 24%, and dairy 15.5%. Differential wastage of foods from various categories will also introduce differences relative to measures of food consumption. In addition, different food categorization systems and disaggregation of composite foods (eg, convenience foods, ready meals, and sauces) into component food categories in NDNS and INTERMAP studies are also likely to account for some differences. Nevertheless, whereas quantitatively different, all studies are consistent in identifying the same food groups as major contributors to UK sodium purchases and intakes.

Comparisons with similar data from Australia shows that for most food groups the unweighted mean sodium content of UK foods is substantially less than that of similar Australian foods (19). The mean sodium content of Australian bread and bakery products is 82% higher than that of UK products (467 compared

with 257 mg/100 g), processed vegetables are 86% higher (362 compared with 195 mg/100 g), processed meat is 55% higher (912 compared with 590 mg/100 g), and sauces and spreads are 18% higher (1283 compared with 1090 mg/100 g) (**Figure 4**). A small number of Australian foods have lower mean sodium contents than UK foods—eg, convenience foods are 20% lower and both cereal products and edible oils are 16% lower. However, in general, our comparisons imply that the UK salt reduction program has led to substantial reductions in the sodium content of many processed foods, particularly those known to be major contributors to sodium intake.

A key strength of these analyses is that they comprise a complete year of food-purchasing data from a large, nationally representative sample of households across Britain. The sample size (21,150 households) is many orders of magnitude larger than that of NDNS and INTERMAP, and the number of foods included (>44,000) is substantially greater than in many food composition databases. Furthermore, 99% of sodium values were collected from food package labels by field workers in 2009, thus increasing the precision of estimates of mean sodium values and providing a good baseline from which to monitor changes over time. Quality checks identified only a few minor data errors and suggested that the data were robust. Importantly, integration of purchasing volumes with sodium values allowed estimation of purchase-weighted means and a better assessment of the contribution of food categories to sodium exposure.

Limitations include the fact that our analysis was based on food purchased for consumption within the home. Food and drink purchased for consumption outside the home (takeaway, restaurants, etc) comprise ≈45% of household food and drink expenditure but comprise a far smaller proportion in terms of servings (≈12% of servings on the basis of data from the 2010 Kantar food consumption panel). Nevertheless, there may be important differences in the sodium composition of food consumed outside the home. Furthermore, our analysis included only a selection of all UK foods (≈44%), although it comprised all categories known to be major contributors to sodium in the United Kingdom. Missing data for random weight items such as cheese were problematic, although this occurred for <5% of all products purchased. Finally, underreporting or selective scanning of food purchases by panel members is a possibility. However, Kantar implements strict quality-control procedures to minimize this and to ensure high-quality data attractive to commercial clients. Furthermore, whereas underreporting and selective scanning may affect estimates at a single point in time, such errors are less relevant if tracking purchasing over time.

Household consumer panel data potentially offer a comprehensive and contemporaneous method to monitor sodium in population food supplies. However, the consumer panel methodology limits the ability to compare findings with other sodium surveys, which means that its greatest value may be in tracking changes over time. Market research companies are global entities present in a growing number of low-, middle-, and high-income countries. Although integration of nutrient values with food-purchasing data is currently unique to Kantar UK, expansion of this system to other countries could permit important between-country comparisons of processed-food formulation and cost-efficient tracking of changes over time. Linkage of quantitative food and nutrient data with other information collected on consumer demographic characteristics, psychosocial factors, food pricing, and product promotions also suggests the possibility of further useful analyses to guide public health nutrition interventions and strategies. Finally, the academic-commercial collaboration used for these analyses is a tangible example of how public-private partnerships can play a role in protection and promotion of public health (22).

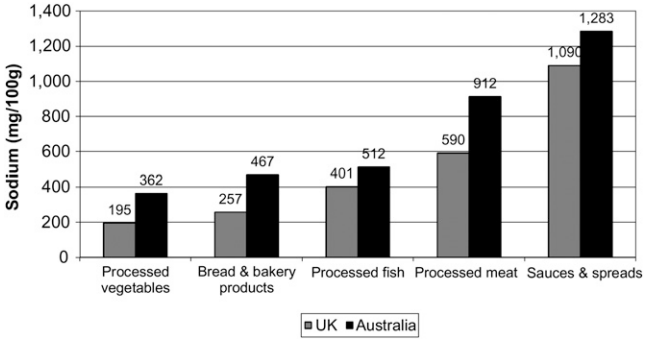

FIGURE 4. Comparison of sodium content of selected processed-food groups between the United Kingdom and Australia (19). Means are averages of all recorded values. No formal statistical comparisons were undertaken. Processed vegetables (2082 products, United Kingdom; 698 products, Australia); bread & bakery products (9894 products, United Kingdom; 1107 products, Australia); processed fish (1764 products, United Kingdom; 370 products, Australia); processed meat (7913 products, United Kingdom; 458 products, Australia); sauces & spreads (3707 products, United Kingdom; 1078 products, Australia).

The authors' responsibilities were as follows—CNM: oversight of project, research design, data analysis, interpretation of results, and drafting of the manuscript; CC: oversight of data collation and extraction, interpretation of results, and review of the manuscript; EKD: provision of Australia comparative data, input into food categorization, and review of the manuscript; JLW and BCN: input into the interpretation of results and review of the manuscript; and SAJ: input into study design, interpretation of results, and review of the manuscript. CC and the staff at Kantar provided advice on data structure and interpretation of results. Kantar Worldpanel had no role in study design or data analysis. CC is an employee of Kantar Worldpanel and provided consumer panel data for these analyses. JLW was previously responsible for implementation of the UK FSA salt-reduction strategy. BCN is chairman of the Australian Division of World Action on Salt and Health. SAJ is the independent Chair for the Food Network, part of the Responsibility Deal for England, established by the UK Department of Health. The authors declared no other conflicts of interest.

REFERENCES

1. Intersalt Cooperative Research Group. Intersalt: an international study of electrolyte excretion and blood pressure: results for 24 hour urinary sodium and potassium excretion. BMJ 1998;297:319–28.
2. Prospective Studies Collaboration. Cholesterol, diastolic blood pressure, and stroke. 13,000 strokes in 45,000 people in 45 prospective cohorts. Lancet 1995;346:1647–53.
3. Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJL; The Comparative Risk Assessment Collaborating Group. Selected major risk factors and global and regional burden of disease. Lancet 2002; 360:1347–60.
4. Joint Health Surveys Unit. An assessment of dietary sodium levels among adults (aged 19-64) in the general population, based on analysis of dietary sodium in 24 hour urine samples. London, United Kingdom: National Centre for Social Research, 2008.
5. Appel LJ, Moore TJ, Obarzanek E, et al. A clinical trial of the effects of dietary patterns on blood pressure. N Engl J Med 1997;336: 1117–24.
6. Appel LJ, Champagne CM, Harsha DW, et al. Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA 2003;289:2083–93.

7. Science Advisory Committee on Nutrition. Salt and health. Norwich, United Kingdom: The Stationary Office, 2003.
8. Bernstein AM, Willett WC. Trends in 24-h urinary sodium excretion in the United States, 1957–2003: a systematic review. Am J Clin Nutr 2010;92:1172–80.
9. McCarron DA, Geerling JC, Kazaks AG, Stern JS. Can dietary sodium intake be modified by public policy? Clin J Am Soc Nephrol 2009;4: 878–82.
10. Brown IJ, Tzoulaki I, Candeias V, Elliott P. Salt intakes around the world: implications for public health. Int J Epidemiol 2009;38:791–813.
11. Committee on Strategies to Reduce Sodium Intake Food and Nutrition Board. Strategies to reduce sodium intake in the United States. Washington, DC: Institute of Medicine, 2010.
12. World Action on Salt and Health. WASH. World Action on Salt & Health. Available from: http://www.worldactiononsalt.com/index.htm (cited 12 July 2010).
13. Salt reduction targets. Available from: http://www.food.gov.uk/scotland/scotnut/salt/saltreduction (cited 12 July 2010).
14. Espeland MA, Kumanyika S, Wilson AC, et al. Statistical issues in analysing 24-hour dietary recall and 24-hour urine collection data for sodium and potassium intakes. Am J Epidemiol 2001;153: 996–1006.
15. Rennie KL, Coward WA, Jebb SA. Estimating under-reporting of energy intake in dietary surveys using an individualised method. Br J Nutr 2007;97:1169–76.
16. Angell SY. Emerging opportunities for monitoring the nutritional content of processed foods. Am J Clin Nutr 2010;91:298–9.
17. Food Standards Agency. McCance and Widdowson's the composition of foods, sixth summary edition. Cambridge, United Kingdom: Royal Society of Chemistry, 2002.
18. Anderson CAM, Appel LJ, Okudo N, et al. Dietary sources of sodium in China, Japan, the United Kingdom, and the United States, women and men aged 40 to 59 years: the INTERMAP study. J Am Diet Assoc 2010;110:736–45.
19. Webster JL, Dunford EK, Neal BC. A systematic survey of the sodium contents of processed foods. Am J Clin Nutr 2010;91:413–20.
20. Food Standards Agency and Department of Health. National Diet and Nutrition Survey: headline results from year 1 of the rolling programme (2008/2009). London, United Kingdom: Food Standards Agency, 2010.
21. Department for Environment Food and Rural Affairs. Family food 2008: a report on the 2008 Family Food Module of the Living Costs and Food Survey. London, United Kingdom: The Stationery Office, 2008.
22. Buse K, Waxman A. Public-private health partnerships: a strategy for WHO. Bull World Health Organ 2001;79:748–54.