Contribution of Product Reformulation to the EU Salt Campaign: Empirical Evidence from the UK

C. S. Srinivasan & Guiseppe Nocella

School of Agriculture, Policy and Development

University of Reading, UK

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C.S.Srinivasan & Guiseppe Nocella
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University of Reading, UK

Abstract

Voluntary reformulation of food products by the industry is one of the key pillars of the EU Salt Campaign aimed at reducing the daily salt intake in the population. Using the National Diet and Nutrition Surveys in the UK a decade apart, this paper applies regression-based counterfactual decomposition methods to quantify the contribution of product reformulation to reduction in the salt intake observed in the UK. We find that ongoing product reformulation efforts have made a significant contribution to a reduction in the salt intake of the UK population. The significant contribution of reformulation to reduction in salt intakes is in sharp contrast to the results for calories and macronutrients such as fats and sugars where reformulation appears to have a very limited impact on population level intakes. The contribution of different product groups to reduction in salt intake varies substantially across the quantiles of salt intakes. We find that certain product groups which are usually not perceived as being major contributors to excessive salt intakes (e.g., cereals and egg dishes) are important drivers of salt consumption across all segments. However, the differences in the food-product preference across population segments suggests that product-reformulation efforts may have to be targeted at different product groups to influence the salt intakes of different segments.

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Draft discussion paper: Corresponding author: c.s.srinivasan@reading.ac.uk, School of Agriculture, Policy and Development, University of Reading, Reading RG6 6AR, UK

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High consumption levels of sodium, a component of table salt and salt added to processed foods, is a well-established risk factor for hypertension and cardiovascular diseases. Reducing average salt intakes in the population to levels recommended by the WHO (6 gms/day) is becoming a public health priority in many countries. The EU's Salt Reduction Framework (EU, 2012) implemented in the UK through the Food Standards Agency and the Department of Health involves two major pillars – the first is voluntary reformulation of food products by the industry to reduce the salt content of food products and the second is increasing consumer awareness and information to encourage reduced salt consumption. Average salt intakes in the UK have declined since the launch of the Salt Campaign in 2004 by the Food Standards Agency, although average population intakes remain above the recommended norms and worryingly high for some segments of the population. Voluntary product reformulation efforts by the industry are not only seen as an important part of the Government's "nudge agenda" to promote healthier dietary choices, but are also being viewed as viable alternatives to mandatory regulatory and fiscal interventions in food industry markets (Hawkes, 2013). However, empirical assessments of voluntary product reformulation efforts to reduce salt consumption are very limited. Empirical assessments of the impact of product reformulations are challenging because the impacts are mediated by consumer choice and the consumer response to these initiatives. The efficacy of product reformulation in influencing the overall level of salt intake by individuals, therefore, remains an open question. In this paper we develop a methodological framework to quantify the contribution of product reformulation to changes in salt intakes in the UK over a decade.

Previous literature

Evaluating the impact of product reformulation initiatives on population level salt intakes poses a number of challenges, which may explain why empirical studies in this area have been relatively sparse (National Heart Foundation, 2012). Assessing the impact of product formulation initiatives is difficult as they are generally implemented with other public health initiatives such as nutrition awareness or information campaigns. Changes in population level salt intakes depend on changes in the nature, quantum and nutrient composition of food products consumed. Changes in food product demand are influenced by the changes in socio-demographic determinants and food product prices. This makes it difficult to isolate the contribution of product reformulation to changes in energy/nutrient intakes. A limited number of studies have, however, demonstrated the population level impacts of product reformulation initiatives. Studies in Finland (Laatikainen et al., 2006;

Pietinen et al., 2008) have shown that a reduction in average salt intake of 3 grams/day in the period 1979-2002 has resulted from reformulation of processed foods in conjunction with mandatory labelling of sodium and a public awareness campaign. In the UK, a reduction of 0.9 grams in daily salt intake in the population between 2000 and 2008 has been attributed to the reformulation of products and consumer awareness campaigns (National Centre for Social Research & Human Nutrition Research, 2008; Food Standards Agency, 2009; Wyness, Butriss and Stanner, 2012). Given the challenges in isolating the effects of product reformulation strategies, empirical studies have tended to rely on dietary modelling to (1) assess the potential impact of product reformulation on food supply -e.g., reduction in salt or saturated fat use through the reformulation of products (Fear, Gibbons and Anderson, 2004; L'Abbe et al., 2009; Mozaffarian, Jacobson and Greenstein, 2010; Ratnayake, L'Abbe and Mozaffarian, 2009; Webster, Dunford and Hawkes, 2011; Yach, Lucio and Barroso, 2007; Young and Swinburn, 2002) (2) assess the potential impact of product reformulation on health - e.g., cardiovascular health (Cobiac, Vos and Veerman, 2010; L'Abbe et al., 2009; Webster, Dunford and Hawkes, 2011; Ratnayake, L'Abbe, Farnworth et al., 2009; Mozaffarian and Clarke, 2009) or (3) assess the cost-effectiveness of campaigns to reduce nutrient intakes (or improve dietary choices) in terms of the savings in health costs over the long term (Cobiac, Vos and Veerman, 2010; Appel, 2006, He and MacGregor, 2010; Barton et al., 2011; Bibbins-Domingo et al., 2010, Cappucio et al., 2011; Karppanen and Mervaala, 1996; Karppanen and Mervaala, 2006; Joffres et al., 2007; Selmer et al., 2000; Mohan and Campbell, 2009; Murray et al., 2009; Appel, 2009; He et al., 2010).

Randomised Control Trials (RCTs) to assess dietary impacts of product reformulation (where one group is exposed to reformulated products while the control group is not) may be inappropriate (in terms of feasibility or ethical considerations) in the context of free-living populations. Moreover, RCTs may not provide insight into how free-living populations are likely to respond to product reformulation initiatives.

Approach to Assessing the Impacts of Reformulation

Reformulation of food products varying their salt and other nutrient composition has been an ongoing process in the food industry, even independently of the EU's salt campaign. If we examine the salt composition of food products in a country, say a decade apart, we are likely to find significant changes in the salt composition of several product categories. For example, we are likely to find a decline in the salt content of potato crisps and other savoury snacks reflecting increasing industry and consumer awareness of the need to reduce salt intake. To quantify the impact of the

EU and UK salt campaigns, we analyse population level changes in salt intakes associated with product reformulations taking place over time. For the UK, using data from the two National Diet and Nutrition Surveys a decade apart, we examine the changes in the distribution of salt intakes over this period, which are attributable to changes in the quantity of food products consumed and the salt content of food products. We decompose the change in salt/sodium intakes into "covariate" or quantity effects (i.e., changes on account of the quantity of food products consumed) and "coefficient" or structural effects (i.e., changes on account of the salt content of food products). The covariate or quantity effects will reflect the influence of socio-demographic determinants of food product demand, the prices of food products and public health information campaigns. The coefficient effects isolate the contribution of product reformulation to changes in salt intakes. The decomposition of changes in salt intakes into quantity and product reformulation effects is then used to construct counterfactual distributions of salt intakes – i.e., the distribution of salt intakes that would prevail for a given pattern of product reformulation. The comparison of the actual and counterfactual distributions of salt intakes provides a measure of the potential impact of product reformulation on population salt intakes. As explained below, an important advantage of the method adopted is that it allows the impact of product formulation to vary along the entire distribution of salt intakes. The impact of product reformulation on those consuming high levels of salt (and hence prone to hypertension or cardiovascular disease risk) could be very different from the impact on those whose diets are in compliance with WHO or UK recommended dietary guidelines (Department of Health, 1991).

Data and Variables

We use data from UK's National Diet and Nutrition Surveys (NDNS) for 2000-01 and 2010-11. The NDNS-2000-01 (ONS, 2005) was part of a programme of periodic diet and nutrition surveys and collected diet and nutrition information from a nationally representative sample of 2251 adults aged 19-64 years. The NDNS-2010-11 is part of a rolling annual programme of national diet and nutrition surveys started in 2008-09 (Bates, Lennox and Swan, 2010) with a nationally representative sample of nearly 1000 respondents each year. (NDNS-2010-11 has 950 respondents, however, in our analysis we only used the data for adults aged 19-64 years for comparison with NDNS 2000-01). The surveys collected detailed information on foods consumed (at home and outside the home) based on 4/7-day food diaries maintained by the respondents. The surveys also collected social and demographic information at the household and individual level and information on anthropometry, health parameters and physical activities of the respondents. The foods consumed by the respondents are grouped into 16 aggregated food group categories, 60 main food categories and over 7000 food products. In addition to the quantity consumed (weight or volume) of each food product, the data set provides nutrient conversion factors for each food item covering a total of 51 macro and micronutrients. A number of "derived variables" are also provided such as the total energy and nutrient intakes, share of different macro nutrients in energy intake, consumption of fruits and vegetables, salt, fibre and cholesterol – which are relevant to the recommended dietary guidelines for the UK. Our analysis was carried out at the level of aggregated food groups which are listed in Table-1 below.

Table-1: Aggregate categories of food products in National Diet and Nutrition Surveys

Product Group	Description
P1	Cereals and Cereal Products
P2	Milk and Milk Products
P3	Eggs and Egg Dishes
P4	Fat Spreads
P5	Meat and Meat Products
P6	Fish and Fish Dishes
P7	Vegetables inc Potatoes
P8	Savoury Snacks
P9	Fruit
P10	Sugar Preserves and Confectionery
P11	Non-Alcoholic Beverages
P12	Alcoholic Beverages
P13	Miscellaneous
P14	Dietary Supplements
P15	Artificial Sweeteners

Methods

We examined the effects of product reformulation on population level salt/sodium intakes using a quantile regression (QR) (Koenker, 2005) approach to model salt intake as a function of the consumption of different food products (aggregated food groups). The QR equation estimated was:

$Y_{\tau} = \alpha_{\tau} + \beta_{1\tau}X1 + \beta_{2\tau}X2 + \beta_{3\tau}X3 + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_{15\tau}X15 + \varepsilon_{\tau}$

where Y = percapita daily intake of salt/sodium

X1 … X15 = quantities of product groups P1 to P15 consumed in grams

τ denotes the quantiles and ε denotes the error term.

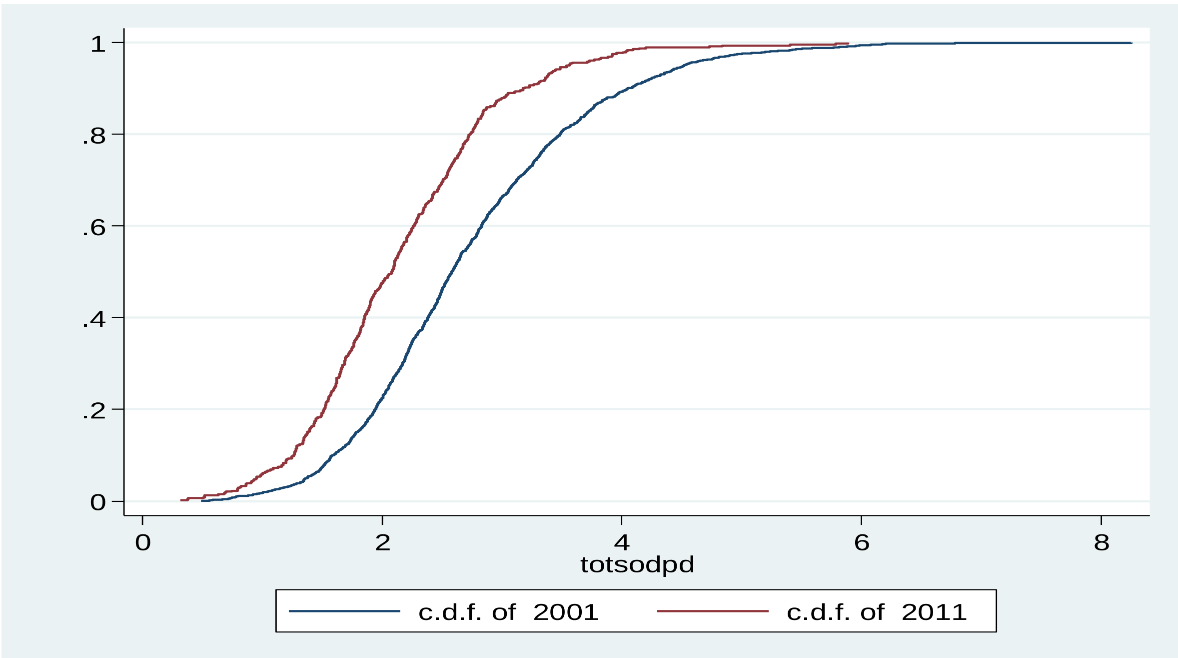
In the above equation, the coefficients $\beta_{1\tau}$ ….. $\beta_{15\tau}$ represent the salt content of the product group per gram in the given quantile of the outcome variable. It should be noted that for any given food product, the salt content is fixed. The variation across individuals arises on account of the differences in product choices within each product group. For instance, the salt content of the aggregate product group "Savoury Snacks" for an individual depends on the choice of products within that group. The coefficient for any product group therefore, reflects the choice of products within that product group. The QR method allows the effect of explanatory variables to vary along the range of the outcome variable – daily salt intake in this case. For any product group, the differences in the coefficients across quantile will reflect differences in product choices within that group – individuals in the upper quantiles of salt consumption may be making very different product choices within product group than individuals in the lower quantiles.

The QR results give us the conditional quantile effects of changes in aggregate food group consumption patterns on salt intakes. The coefficient of any variable (e.g., "Savoury Snacks" consumed in grams) at different quantiles gives us the effect of a unit change in the variable on the outcome variable (daily salt intake) at the relevant quantile of the outcome variable, holding all the other covariates constant at their median level. The QR coefficients do not convey the unconditional quantile effects, i.e., the effect of a unit change in the variable when the covariates (other aggregated food group products consumed) are distributed as in the sample, or when their distribution changes in a particular way (e.g., when products in a particular category are reformulated). From an evaluation perspective, it is this unconditional quantile effect that we are interested in when assessing the impacts of product reformulation. We use a counterfactual decomposition exercise using the method suggested by Machado and Mata (2005) to examine changes in the distribution of daily salt intake if (1) individual product groups are reformulated and (2) if different combinations of product groups are reformulated. The counterfactual decomposition exercise does not convey the effect of every individual in the population switching to reformulated products (which is the kind of insight gained from intervention studies or RCTs). Instead, it tells us what the population distribution of salt intake is likely to be if the consumption pattern of the entire population were to be similar to that of a sub-population that uses reformulated products. The dietary adjustment process does not proceed by replacing all products in the consumers' baskets with healthier (reformulated lower salt) alternatives, but rather through the adoption of the consumption pattern of a sub-population that uses reformulated products. Such a dietary adjustment process may be more appropriate for assessing the impact of reformulation on free-living populations in response to public health initiatives like the Salt Campaign, rather than the (controlled) dietary changes imposed in intervention studies. The counterfactual decomposition is carried out in two stages. In the first stage we generate an aggregate decomposition of changes in energy/fat/sugar intakes between 2000-01 and 2010-11 into covariate (quantity) and coefficient (nutrient composition or reformulation) effects. In the second stage we carry out a detailed decomposition exercise that identifies the contribution of individual product groups to changes in energy/fat/sugar intakes over the two time periods.

Results

Figure 1 shows the changes in the distribution of the daily per capita sodium consumption in the UK population between 2000-01 and 2010-11. It may be noted that the WHO norm for maximum consumption of salt at 6gms per day is equivalent to sodium consumption of 2.4 gms per day. Figure 1 shows a substantial decline in salt consumption across the distribution, but the decline is more pronounced in the upper tail of the distribution (characterised by high levels of salt/sodium consumption). Average salt consumption in the UK is estimated to have declined from 9.5gms per day in 2000-01 to 8.1 gms per day in 2010-11, a decline of 14.7% over a decade[1]. However, nearly 50% of the population continues to consume excess levels of salt in relation to the recommended norms.

Figure-1: Changes in distribution of sodium consumption in UK adults -2001-2011



[1] The estimates of salt consumption derived from the food diaries of the NDNS are known to understate the total salt consumption because they include only the salt content of the foods consumed and do not reflect salt added at the table. The figures for dietary salt/sodium intake reported here are taken from the Urinary Sodium Survey based on 24 hour urine samples taken from 600 respondents.

The changes in quantity consumed and the salt content of major product groups between 2000-01 and 2010-11 is summarised in Table-2.

Table-2: Changes in salt composition and quantity consumed of major food product groups consumed in the UK between 2000-01 and 2010-11

Food product group	Salt composition (mg of sodium/gm)			Quantity consumed (gms per capita per day)		
	2001	2011	Change	2001	2011	Change
Cereals and Cereal Products	3.997	2.831	-29.2%	243.09	220.38	-9.34%
Milk and Milk Products	0.837	0.974	16.4%	261.63	212.67	-18.71%
Eggs and Egg Dishes	2.832	2.000	-29.4%	18.46	20.99	13.72%
Fat Spreads	7.238	5.103	-29.5%	12.20	12.48	2.27%
Meat and Meat Products	4.462	3.866	-13.4%	155.58	137.99	-11.31%
Fish and Fish Dishes	3.523	3.243	-7.9%	31.11	28.54	-8.27%
Vegetables inc Potatoes	0.903	0.584	-35.3%	238.09	248.57	4.40%
Savoury Snacks	7.588	5.491	-27.6%	9.07	10.94	20.65%
Fruit	0.084	0.174	106.4%	97.99	93.91	-4.16%
Sugar Preserves and Confectionery	0.560	0.522	-6.7%	26.77	21.49	-19.74%
Non-Alcoholic Beverages	0.021	0.023	9.4%	1259.80	1403.57	11.41%
Alcoholic Beverages	0.077	0.071	-7.2%	300.94	249.34	-17.15%
Miscellaneous	4.435	5.201	17.3%	53.90	57.86	7.34%

Source: Computed from NDNS 2000-01 and NDNS- 2010-11

It may be seen from the above table that cereals and cereal products are the major sources of salt in the diet. The other major contributors meats, egg dishes and fish dishes. It is interesting that savoury snacks (which include crisps) are not a major contributor to the overall salt intake. However, savoury snacks and fat spreads have the highest salt density of all product groups. With the exception of fruit products, all other food product groups consumed have shown a significant decrease in salt density per unit weight of the product over the period 2000-01 to 2010-11. However, it may also be seen that between 2000-01 and 2010-11, there has been a sharp increase in the consumption of savoury snacks (20.6%) and egg-based dishes (13.7%). There has also been a significant increase in the consumption of vegetable and potato dishes (4.4%) and fat spreads (2.3%). These changes may offset some reduction in salt intake that may otherwise result from the reformulation (reduced salt content) of food product groups.

The results of the aggregate decomposition exercise using the Machado and Mata (2005) procedure are presented in Table-3. Changes in average daily sodium intake between NDNS-2000-01 and NDNS-2010-11 are decomposed into quantity effects and production reformulation effects.

Table-3: Decomposition of changes in sodium intake between 2000-01 and 2010-11

Sodium intake (mgms per capita per day)					
Quantile	**10th**	**25th**	**50th**	**75th**	**90th**
2000-01	1.588	2.057	2.583	3.304	4.053
2010-11	1.260	1.608	2.080	2.629	3.189
Difference	-0.327	-0.449	-0.503	-0.675	-0.864
Quantity effect	3.53%	3.08%	0.18%	0.15%	-1.98%
Reformulation effect	96.47%	96.92%	99.82%	99.85%	101.98%

Table-3 shows that the decline in the sodium intake for the UK population ranged from 0.327mgs in the 10th quantile to 0.864 gms in the 90th quantile of sodium consumption a decline of around 20% in each of the quantiles[2]. The most striking feature of the decomposition exercise is the dominance of the product reformulation effect. The contribution of the product reformulation effect to the decline in the salt intake ranges from 96.47% in the 10th quantile to 101.98% in the 90th quantile (where the product reformulation effect is also offsetting the negative (increased salt consumption) quantity effects. These results suggest that voluntary product reformulation by the industry under the EU salt campaign has been very effective in reducing the salt/sodium intake of the population, even without large changes in consumer dietary patterns. The results of the detailed decomposition exercise (not reported here) provide further insights into the contribution of changes in salt composition of specific product groups to changes in overall salt intakes intakes. The reformulation of cereals and cereal products and meat/egg/fish dishes make the dominant contribution to changes in salt intakes rather than processed snack foods.

These results relating to the contribution of product reformulation to salt intakes are in sharp contrast to our earlier results on the impact of product reformulation on population level intakes of calories and macronutrients such as fats and sugars (Srinivasan, 2015). The application of the same

[2] The decline of around 20% in salt intake for different quantiles reported here is derived from the food diary data of NDNS. This differs from the 14.7% decline in salt intake reported earlier in the paper which is based on the results of the adjunct Urinary Sodium Survey (which is a more reliable indicator of sodium intake).

methods to population level intakes of calories, fats and sugars showed that the impact of product formulation was very limited. In the case of calories, it was seen that product reformulation had actually contributed to an increase in energy intakes – i.e., the reduced intake of food products by consumers had been offset by the increasing energy density of several major product groups. A similar pattern was observed in the case of fat and sugar intakes, where reduction in intakes via the quantity effects were offset by product reformulation effects (increasing fat/sugar density of products consumed). The dominant contribution of product reformulation to reduction in sodium/salt intakes is, therefore, a striking result. This raises an interesting question as to why product reformulation appears to be so effective in influencing salt consumption while it has very modest impacts on energy, fat and sugar intakes. This needs to be explored further – plausible reasons may be related to the very small contribution that salt makes to the weight of food products (which may allow manufacturers to reduce salt content of products without replacing it with any other nutrient, which may be much less feasible in the case of fats of sugars) and to the feasibility of getting consumers to accept lower levels of salt in food products (which in turn may be related to their willingness to adapt to changes in taste associated with lower salt content in food products).

Conclusions

Our results demonstrate that voluntary reformulation of food products by the industry to lower salt content of food products (in response to the EU's Salt Campaign and otherwise) has made a major contribution to the reduction in salt intake in the UK over a decade. However, in order to influence population levels of salt intakes, product reformulation may need to be targeted at specific food product groups rather than being applied across the board as in the UK's "Responsibility Deals". Rather than product categories like processed savoury snacks (which are often implicated as driving high levels of salt intakes), it is be product categories like cereals and cereal products, meat/egg dishes and fruit products that may need to be targeted for product reformulation. A key insight from this discussion paper is that the effects of product reformulation on population level intakes of nutrients can vary sharply by nutrient. The reasons for the contrasting impact of product reformulation on different nutrients is an important question that needs to be explored in future research.

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