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An Economic Evaluation of Salt Reduction Policies to Reduce Coronary Heart Disease in England: A Policy Modeling Study

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A B S T R A C T

Objectives: Dietary salt intake has been causally linked to high blood pressure and increased risk of cardiovascular events. Cardiovascular disease causes approximately 35% of total UK deaths, at an estimated annual cost of £30 billion. The World Health Organization and the National Institute for Health and Care Excellence have recommended a reduction in the intake of salt in people's diets. This study evaluated the cost-effectiveness of four population health policies to reduce dietary salt intake on an English population to prevent coronary heart disease (CHD). **Methods:** The validated IMPACT CHD model was used to quantify and compare four policies: 1) Change4Life health promotion campaign, 2) front-of-pack traffic light labeling to display salt content, 3) Food Standards Agency working with the food industry to reduce salt (voluntary), and 4) mandatory reformulation to reduce salt in processed foods. The effectiveness of these policies in reducing salt intake, and hence blood pressure, was determined by systematic literature review. The model calculated the reduction in mortality associated with each policy, quantified as life-years gained over 10 years. Policy costs were calculated using evidence from published sources. Health care costs for specific CHD patient groups were estimated. Costs were compared against a "do nothing" baseline. **Results:** All policies resulted in a life-year gain over the baseline. Change4life and labeling each gained approximately 1960 life-years, voluntary reformulation 14,560 life-years, and mandatory reformulation 19,320 life-years. Each policy appeared cost saving, with mandatory reformulation offering the largest cost saving, more than £660 million. **Conclusions:** All policies to reduce dietary salt intake could gain life-years and reduce health care expenditure on coronary heart disease.

Keywords: cardiovascular disease, economic evaluation, population health, salt, UK policy.

Background

Cardiovascular disease (CVD) continues to be a major cause of mortality and morbidity in the United Kingdom. The main forms of CVD are coronary heart disease (CHD) and stroke. Approximately 35% of total UK deaths are attributable to CVD, at an estimated annual cost of £30 billion to the UK economy [1], with £14.4 billion being spent on treatments [2]. High levels of dietary salt intake promote high blood pressure, which is a leading cause of CHD [3]. Attention is therefore turning toward developing CVD prevention policies, including substantially reducing dietary salt intake [4]. In the United Kingdom, the average daily salt intake has subsequently fallen from 9.5 g/d in 2000-2001 to 8.1 g/d in 2011 [5]. This remains, however, well above the 6 g/d maximum recommended by the Scientific Advisory Committee on Nutrition [6]. There is therefore considerable scope to develop policies that focus on further reducing salt intake within the population.

A review of the existing literature on the cost-effectiveness of population health interventions to reduce dietary salt intake found that most of the articles used modeling techniques to analyze the effects of population health interventions. One article, however, has summarized data from two studies that were implemented in two different community settings: North Karelia, Finland, and the Stanford 5 City Project, America. These interventions included health education, screening, and a hypertension control and treatment program in these community settings [7]. The North Karelia study saw a 73% drop in CHD mortality in the region and also a drop in the rest of Finland over the 25-year follow-up period. In the Stanford 5 City Project, there were also useful reductions in cholesterol, blood pressure, and smoking rates compared with sites that did not have the intervention.

The studies that have used modeling techniques have suggested that legislation for reducing salt intake appears more effective than voluntary agreements [8]. In America, government collaboration with the food industry was modeled, assuming a decrease of 9.5% in sodium intake. It was estimated that more than 2 million quality-adjusted life-years (QALYs) and more than $32 billion in medical costs could be saved [9]. Another US study quantified the benefits of a population-wide reduction in salt of up to 3 g/d, and estimated annual savings of $10 billion to $24 billion and 44,000 fewer deaths [10]. A recent UK analysis estimated that reducing daily salt intake by 3 g might result in substantial savings in QALYs and health care

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expenditure [11]. This study did not, however, consider exactly how such salt reductions might actually be achieved. In contrast, a recent study conducted in four Eastern Mediterranean countries explicitly compared three policies to reduce salt intake: a health promotion campaign, labeling of food packaging, and mandatory reduction of salt content in processed foods. Most of these policies appeared cost saving compared with the baseline of doing nothing [12].

To implement more effective policies in future, UK policymakers will need robust and convincing evidence to assess the costs and benefits of specific interventions. The objective of this article was to analyze the potential effect on health outcomes of reducing dietary salt intake in an English population. We used an existing model to quantify and compare four population interventions: a health promotion campaign, labeling of foods, and both voluntary and mandatory reformulation.

Methods

Salt Reduction Policies for Evaluation

There are currently policies being implemented in the United Kingdom that raise awareness of the benefits of reducing salt intake and also encourage people to change their dietary habits. These policies include a health promotion campaign called Change4Life, which was launched in 2009 as the social marketing part of the Healthy Weight, Healthy Lives strategy for England [13]. This campaign used a range of media, including TV and radio advertisements and print media, to encourage people to get active and to promote healthier food choices, with a focus on increasing fruit and vegetable consumption and reducing the consumption of foods high in fat, sugar, and salt. In addition, food labeling is now a requirement in the United Kingdom to inform consumers about the nutritional content of the food they buy [14]. UK Food manufacturers and retailers are increasingly using the Traffic Light System on food packaging, on which red, amber, and green color codes are used to indicate the levels of fats, sugars, and salt [15]. A potentially confusing variety of schemes currently exist, however, and a standardized approach across all food manufacturers has not yet been implemented. This is highlighted by the recent Department of Health recommendations on the use of a single "traffic light" nutritional labeling system [16].

In the United Kingdom, 75% of the salt eaten comes from processed foods [17]. This led to the Food Standards Agency (FSA) launching a health promotion campaign in 2003 alongside working with the food industry to encourage reformulation of processed foods on a voluntary basis. The first salt targets were set in 2006, and subsequently replaced with new targets to be met by 2012. These policies outlined above are currently being implemented in the United Kingdom. There is little evidence, however, on the relative cost-effectiveness of specific policies. Such evidence is crucial to direct future policy on salt reduction to reach the recommended daily maximum of 6 g/d [6].

We have chosen to evaluate these policies, three of which have already been shown to be feasible in the United Kingdom. These are 1) the Change4Life health promotion campaign that encourages people to eat less and get active, 2) front-of- pack labeling to display the salt content of food using a standardized traffic light system to help consumers to make more informed purchasing decisions, 3) the FSA continuing to work with the food industry to reformulate products on a voluntary basis, and 4) mandatory reformulation of processed foods with legislation in place.

Effectiveness of Salt Reduction Policies

The effectiveness of these policies can be expressed as the percentage decrease in dietary salt intake achievable from each policy. Limited information on the effectiveness of voluntary reformulation was already available from successive National Diet and Nutrition Surveys [5]. These surveys are used as a way of monitoring the ongoing effect of the FSA's work in reducing salt in processed food. Therefore, an assumption has been made that these surveys were capturing the reduction of salt intake from the FSA's work with industry on a voluntary basis. A further assumption was made that voluntary measures alone would not achieve 100% compliance across industry, whereas a mandatory approach might be expected to be more effective, reducing consumption by at least 20%. For the other policies, information on the effectiveness was obtained from published studies. The literature review focused on the cost-effectiveness of population health interventions and articles that reported estimates of the effectiveness of each policy. Databases searched include MEDLINE, Jstor, Cochrane, and the National Health Service Economic Evaluation Database (see Appendix 1 for the search strategies in Appendix 1 for the search strategies in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.1722).

For each policy, a "best" estimate was selected from the systematic review. The final effectiveness estimates used in the analysis are presented in Table 1. The best estimates for options 1, 2, 3, and 4 were assumed to be 2%, 2%, 15%, and 20%, respectively. To account for uncertainty around each best estimate, a minimum and maximum value was also included to provide a range of potential effect sizes for each policy (Table 1).

Health Outcomes

We extended the current IMPACT CHD model calibrated for the English population to estimate the effect of different salt reduction policies on mortality and on life-years [18].

Data Sources for the IMPACT CHD Model

Mortality and demographic data were obtained from the Office for National Statistics. Patient numbers were estimated for seven mutually exclusive patients groups: acute myocardial infarction admissions, unstable angina admissions, secondary prevention after acute myocardial infarction, secondary prevention after revascularization, angina in the community, heart failure admissions (hospital), and heart failure (community), with data from Hospital Episode Statistics, the Myocardial Ischemia National Audit Project [19], and the General Practice Research Database. Systolic blood pressure levels were obtained from the Health Survey for England [20]. Further details on data sources can be obtained from Bajekal et al. [21] and Appendix 2 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.03.1722.

IMPACT CHD Model Methods

The expected change in salt intake (as presented in Table 1) was translated into a change in blood pressure on the basis of a large meta-analysis, taking into account the differential effect on systolic blood pressure (SBP) of salt intake reduction among hypertensive and nonhypertensive persons [3]. The nonhypertensive persons were split into the seven mutually exclusive patient groups outlined above.

The expected number of deaths in 2020 was calculated by estimating 2020 rates using an exponential decay regression model fitted to past mortality rates observed from 1993 to 2010. This model captures how CHD mortality rates decrease over time while avoiding unrealistic negative values. In the regression approach used for SBP, the expected number of deaths from CHD occurring in 2020 was multiplied by the absolute change in risk factor prevalence, and by a regression coefficient quantifying the change in CHD mortality that would result from the change in SBP levels. Natural logarithms were used, as is conventional, to