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eMethods

Intervention costs

We estimated component-specific resource costs over 10 years across 4 stages of policy development: planning (year 1), development (year 2), partial implementation (years 3-5), and full implementation (years 6-10). Resource needs at each stage were based on the WHO Non-communicable Disease (NCD) Costing Tool,[1] which uses an 'ingredients approach' to estimation, described in the next section. In the planning stage, resource needs were estimated for preparing an evidence base and launching a public consultation. The development stage included resources for drafting a regulatory code, designing enforcement plans and training programs, and developing a media strategy. Implementation, which begins in year 3, included resources for launching a public information campaign and introducing the regulatory code, followed by staged (partial and then full) regular inspections, enforcement, and media advocacy through year 10. To determine resource needs at each stage, the WHO organized multiple consultations with country-specific program experts and validated their estimates against data from earlier studies. For each stage, quantities were estimated for five categories of resource use: human resources, training, meetings, supplies and equipment, and mass media. Within each category of resource, estimates were made for needs at the central and provincial level. An example of the estimated resource needs for a standardized country of 50 million people, split into provinces of 5 million each, is provided in **eTable 2**.

The WHO-CHOICE database contains information on salaries, per diem allowances (for training and meetings), media costs, and consumable item prices for each country. These data were estimated from consultation with regional expert teams, supplemented where possible with other sources, including the International Labour Organization database on occupational salaries. Prices of non-traded goods were derived using linear regression models fitted to a multinational dataset, with GDP per capita, region, and education levels among others used as explanatory variables.[2]

We converted the 2008 WHO NCD Costing Tool estimates to 2012 international dollars by first accounting for local inflation based on World Bank GDP deflator figures,[3] then using 2012 PPP exchange rates from the IMF World Economic Outlook Database.[4] We also updated the underlying data used to predict non-traded good prices, in particular countries' GDP per capita.

Global sodium consumption by country, age, and sex

We used estimates of mean sodium consumption and its uncertainty by age and sex for 187 countries from the 2010 Global Burden of Diseases (GBD) project.[5] These data were based on 205 national and subnational surveys, covering 66 countries and 74.1% of the global adult population. The main metric used was 24-hour urine collection, which might underestimate intake due to non-urinary (e.g., sweat) losses. An age-integrating Bayesian hierarchical imputation model was used to account for differences in missingness, representativeness, and measurement methods between the surveys, and to quantify sampling and modeling uncertainty. The final uncertainty intervals published represent the 2.5–97.5 percentiles of the posterior distribution of estimated mean sodium intakes for each age/sex stratum in each country, and we used these as inputs to our analysis.

Blood pressure levels by country, age, and sex

We used estimates of mean systolic blood pressure (SBP) levels and their uncertainties by age and sex for 187 countries, also from the 2010 GBP project.[6] Data were obtained from published and unpublished health examination surveys and epidemiological studies from around the world, including data from 786 country-years and 5.4 million participants. A Bayesian hierarchical model was developed to obtain estimates for each age-country-year unit. Estimates were made for the years 1980 to 2008; we used the 2008 estimates for our calculations. Similar to the model used for sodium, the model borrowed information across countries, subregions, and regions, according to 'proximity' in geography, time, and country-level covariates, doing so to a greater degree when data were non-existent or non-informative. Various sources of uncertainty were quantified and propagated through the model. The final uncertainty intervals published represent the 2.5–97.5 percentiles of the posterior distribution of estimated mean SBP, and we used these as inputs to our analysis.

Cardiovascular disease burden by country, age, and sex

We used data on disability-adjusted life years (DALYs) for 11 causes, 7 age groups, both sexes, and 187 countries, also from the 2010 Global Burden of Diseases study.[7] These causes were ischemic heart disease (ICD-10 codes I20-I25), ischemic stroke (I63, I65-I67, I69.3), hemorrhagic and other non-ischemic stroke (I60-I62, I69.0-I69.2, I67.4), hypertensive heart disease (I11-I13), aortic aneurysm (I71), rheumatic heart disease (I01, I02.0, I05-I09), endocarditis (I33), atrial fibrillation and flutter (I48), peripheral vascular disease (I73), myocarditis and cardiomyopathy (I40, I42), and other cardiovascular and circulatory diseases. These data were obtained by first estimating cause-specific mortality for 187 countries from 1980 to 2010,[89] based on data on causes of death from vital registration, verbal autopsy, mortality surveillance, censuses, surveys, hospitals, police records, and mortuaries worldwide. Next, the prevalence of disease-sequelae (impairments of health resulting from a disease) was estimated by conducting a systematic analysis of published and available unpublished data sources for prevalence, incidence, remission, and excess mortality, and aggregating this data using a Bayesian meta-regression model, developed from those described above. Finally, disability weights were generated using data collected from more than 31,000 respondents via population-based surveys in the USA, Peru, Tanzania, Bangladesh, and Indonesia, and via an open internet survey. Results were found to be consistent across levels of educational attainment and cultural groups.[10]

Dose-response effects of sodium on BP and of BP on CVD

We used estimates of dose-response effects of sodium on BP and of BP on CVD from recently published meta-analyses. The first used results from 103 randomized trials, with a total of 6,970 subjects, to estimate the blood pressure-lowering effect of sodium reduction. [11] The study tested and confirmed the linearity of the effect, and quantified heterogeneity owing to age, hypertensive status, and race, all of which were found to be significant, and duration of intervention, which was not. We used coefficients estimated in a regression incorporating these first three covariates, together with their standard errors, as inputs to our analysis. The second meta-analysis combined results from the Prospective Studies Collaborative (61 cohorts, 1 million participants, 120,000 deaths) and the Asia Pacific Cohort Studies Collaborative (37 cohorts, 425,000 participants, 6,900 deaths) to estimate the effect of blood pressure on cardiovascular diseases by age.[12] A linear relationship between age and log relative risk was found to have the best fit among a range of models. Monte Carlo simulations were used to estimate relative risks and their standard errors. Age-specific relative risks obtained in this way from the different sources were then pooled using a random effects model. We used these age-specific relative risks, together with their standard errors, as inputs to our analysis.

While some prior observational studies suggest a J-shaped relation between sodium intake and CVD, the potential biases of sodium assessment in observational studies are appreciated. These include incomplete 24-hour urine collections among sicker individuals, which causes a spurious association between low estimated intake and disease risk; reverse causation among at-risk subjects, especially those with high blood pressure, who are both at higher risk and also choose to actively lower their sodium; confounding by physical activity, given the strong positive correlation between sodium intake and total energy intake; and confounding by general health and appetite, due to the same strong correlation between sodium intake and total energy intake.

Intervention impact on disability-adjusted life years (DALYs)

Within each age-sex-country stratum, we calculated the proportion of DALYs attributable to CVD that would be averted if the existing distribution of systolic BP were shifted to lower levels due to reduced sodium consumption. We then multiplied this potential impact fraction by the total number of DALYs that were attributable to CVD in 2010. We performed these analyses separately for each subtype of CVD event (e.g., ischemic heart disease, ischemic stroke, hemorrhagic stroke, etc.). We assumed the intervention would scale up linearly over the implementation period, with 10% of the full effect in the first year, 20% in the second, and so on, reaching full efficacy in the final year. We summed these yearly effects, discounting at 3% per year, to calculate the total effect. We assumed no other changes, other than related to the intervention, on global sodium consumption, BP levels, or CVD rates during this period.

eDiscussion

Strengths of the analysis

Our analysis has several strengths. We used comparable and consistent methods to estimate the cost-effectiveness of a sodium reduction policy intervention for 183 countries. We utilized the most up-to-date available data on age, sex, and country-specific distributions of sodium consumption, BP, and rates of CVD. Effects of sodium reduction on BP were derived from a meta-analysis of randomized controlled trials, accounting for heterogeneity by age, race, and hypertension; and estimates of the age-specific relationship between BP-lowering and CVD was derived from a pooled analysis of established prospective pooling projects. We accounted for a 10-year intervention effect with a realistic scale-up trajectory and reasonable target reductions in sodium. We used a tool developed by the WHO to estimate the different quantities and costs of intervention components by country. These estimates incorporated country-specific demographic, economic, and health data, together with results from cross-country non-traded input price regressions, to produce credible approximations of these prices. We accounted for changes in GDP/capita, price levels, and purchasing power parity between countries. We incorporated uncertainty in all effect input parameters (measures of sodium exposure, distributions of BP, effects of sodium on BP, effects of BP on CVD) by means of Monte Carlo simulations, and evaluated additional uncertainty in intervention effectiveness and intervention costs by means of separate sensitivity analyses.

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Evidence for Optimal Intake Levels and Causal Effects of Sodium

As in all fields from clinical medicine to physics to global warming, we recognize the absence of perfect agreement among all scientists on every topic. In the case of sodium, it is clear that higher sodium intake raises BP, and virtually all epidemiological studies have shown harms for high intakes. The main areas of controversy are whether a J-shape exist, and if it does, at what level. In this case, as for all scientific fields, while perfect agreement between all scientists is not feasible, there is evident broad scientific consensus. Based on all available evidence, the current broad scientific consensus is that higher sodium intake increases CVD events, and that the optimal intake level is around 2000 mg/d or less. This consensus has been reached by different independent groups including the US Dietary Guidelines Advisory Group, the Institute of Medicine, the American Heart Association, the World Health Organization, the UK Food Standards Agency, and the UK National Institute for Health and Clinical Excellence, to name a few (**Table 1**). We have also reviewed the evidence and arrived at the same conclusions. We appreciate that adverse effects of extreme, rapid sodium reduction cannot be excluded, and that true optimal lower limits remain uncertain. Yet, when considering all the evidence together, we conclude – similar to multiple national and international organizations – that the optimal level of sodium intake is ~2000 mg/d, and could be even lower.

Setting Reference Levels of Sodium Consumption

Our methods for identifying the optimal level of sodium consumption have been described.[1, 2] We reviewed the evidence for the observed consumption levels associated with lowest risk across several different types of biologic and clinical endpoints. We also incorporated the evidence and conclusions from major national and international dietary guidelines that had comprehensively reviewed all of the available evidence. Finally, we considered plausibility of identified optimal levels based on the lowest observed national mean consumption levels around the world.

The evidence for the optimal level of sodium consumption based on these various considerations is shown in Table 1. The lowest mean intake level associated with both lower systolic BP and lower age-BP slope in ecologic studies was 614 mg/d.[3] In well-controlled, randomized feeding trials, the lowest tested intake for which BP reductions were clearly documented was 1500 mg/d.[4] In meta-analyses of prospective observational studies, the lowest mean intakes associated with lower risk of CVD events ranged from 1787 to 2391 mg/d.[5] We also considered the observed mean intake levels associated with lowest risk of stomach cancer, which was 1245 mg/d.[6] Thus, intake levels associated with lowest risk ranged from 614 to 2391 mg/d, depending on the type of evidence and the outcome. Based on national consumption data,[7] the lowest observed mean national intakes were ~1500 mg/d. Recommended maximum intakes in major dietary guidelines ranged from 1200 to 2400 mg/d.[8-13]

Several national and international organizations identified optimal levels lower than 2000 mg/d, including the UK National Institute for Health and Clinical Excellence (1200 mg/d) and the American Heart Association (1500 g/d). In addition, the lowest risk of gastric cancer, a leading fatal malignancy worldwide, was observed at levels of ~1250 mg/d. In cross-national ecologic studies, the lowest national mean BP levels and age-BP slopes were seen at even lower intakes, less than 1000 mg/d. Thus, it is evident that the uncertainty range of potential benefits could extend as low as 1000 mg/d.

In sum, the weight of all available evidence suggests ~2000 mg/d as a primary optimal level, with uncertainty extending down to potential benefits at 1000 mg/d. Based on all the available evidence, we identified a reasonable optimal level of 2000 mg/d, consistent with evidence supporting health benefits of reducing high sodium intakes to moderate levels but perhaps not lower levels,[14] with national mean intakes in several countries, and with several national and international guidelines (Table 1).

Table 1. Evidence used to derive reference intake levels of sodium consumption for adults.

Mean intakes associated with better outcomes	
614 mg/d *	Lower systolic BP and lower age-BP slopes in ecologic studies [3]
1245 mg/d †	Lower incidence of gastric cancer in meta-analysis of prospective cohorts [6]
1500 mg/d	Reduced BP in randomized controlled trials [4]
2391 mg/d †	Lower incidence of total stroke in meta-analysis of prospective cohorts [5]
2245 mg/d †	Lower incidence of stroke mortality in meta-analysis of prospective cohorts [5]
1787 mg/d †	Lower incidence of CHD mortality in meta-analysis of prospective cohorts [5]
Lowest age-standardized national mean intakes [7]	
1480 mg/d	Kenya
1600 mg/d	Rwanda
1660 mg/d	Malawi
Major national and international dietary guidelines	
< 1200 mg/d	UK National Institute for Health and Clinical Excellence, 2025 target [8]
< 1500 mg/d	American Heart Association [9]
< 2300 mg/d	US Dietary Guidelines Advisory Committee 2015
< 2300	US Dietary Guidelines for Americans [10]
< 2400 mg/d	UK Food Standards Agency [12]
< 2000 mg/d	World Health Organization [11]

*Based on the mean of the four populations with the lowest intakes in Intersalt, with results averaged to minimize potential bias or lack of generalizability from using only one population with the lowest intake.

†The mean of the median (or midpoint) intakes in the lowest category of risk across all studies for each outcome. For studies in which only the upper limit of the lowest category was reported, we conservatively estimated the median by assuming the range in that category was the same as the range in the next (second) category.

BP=blood pressure. CHD=coronary heart disease.

Two other issues warrant specific discussion. First, a recent Institute of Medicine report reviewed a focused question, to consider whether recent evidence from studies of clinical events was sufficient to set a target of 1.5 g/d rather than 2.3 g/d for certain population subgroups.[14] This Institute of Medicine committee was not tasked with reviewing all available evidence nor with setting a target level.[15] Rather, they were instructed to limit their focus to studies of clinical endpoints, and only to studies published from 2003 to 2012—that is, the period since the 2005 Dietary Reference Intakes for Water, Sodium, Chloride, and Sulfate (DRI) were developed—and only to the question of comparing a target level of 2.3 to 1.5 g/d. Their task, in other words, was *not* to determine the best evidence base for a dietary target, but to evaluate *one* type of the evidence and over a specified period and only for the question of lowering the target from 2.3 to 1.5 g/d. Based on reviewing this subset of evidence, they concluded that it was uncertain - inconclusive - whether going down to 1.5 g/d would provide additional benefit. They did not conclude that going down to 1.5 would *not* provide benefit, nor that it would confer harm. They further concluded, based on prior reports considering all the evidence, that lowering sodium is beneficial for CVD.

Second, some observational studies and meta-analyses of these studies suggest a J-shape between sodium intake and CVD events. The potential biases in sodium assessment in observational studies, whether utilizing urine collection or diet questionnaires, are established.[17] The most important sources of bias include incomplete 24-hour urine collections (sicker individuals proving less urine, artificially lowering their estimated sodium intake); reverse causation (at-risk subjects, such as those with hypertension, actively lowering sodium); confounding by physical activity (given the very strong correlation between sodium and total energy intake, with r>0.8); and confounding by frailty and other reasons for low total energy intake (given the very strong correlation between sodium and total energy intake). Accordingly, in many studies and especially those in Western populations, participants with very low estimated sodium intakes (e.g., <2300 mg/d) represent a very small and relatively unique subset of the population. These limitations together could entirely explain the apparent "J-shape" seen in certain observational studies.

For example, in one recent large observational study, participants with lowest sodium had numerous more cardiovascular risks at baseline.[16] Appropriately, the authors acknowledged, "reverse causation cannot be completely ruled out and may account in part for the increased risk observed with low estimated sodium excretion."[16] Further, physical activity was self-reported, greatly increasing potential residual confounding, i.e., from those with lowest sodium being most sedentary. Other reasons for very low total calorie intake, which would be very common among those with lowest sodium intakes, were not evaluated in that study.

In contrast, during extended surveillance in a large, randomized, controlled sodium reduction trial, which overcame many of these limitations, subjects with intakes<2.3 g/d experienced 32% lower CVD risk than those consuming 3.6-4.8 g/d, with evidence for linearly decreasing risk.[18]

Our own assessment relied on multiple lines of evidence to establish causality and optimal levels of intake. This included BP reductions in trials, strength of BP as a surrogate outcome, relations with CVD events in meta-analyses of observational studies and extended follow-up of randomized trials, and ecologic and experimental studies.[1] Indeed, the latter types of studies suggest that chronically high sodium induces BP-independent toxicity, including myocardial, vascular, and renal fibrosis[1] – harms which are not incorporated into any of the GBD risk estimates. No major mechanistic harms have been identified which could nullify, let alone reverse, benefits of sodium reduction and explain J-shaped relations at 4.0 g/d; while simple sources of bias could explain such observations.

Consideration of Causal Effects of Sodium Reduction on CVD

Our methods for evaluating causality of diet-disease relationships, including the effects of sodium on CVD, have been reported.[1, 2] Several prior reports have extensively reviewed the evidence for CVD effects of dietary sodium, including strengths and limitations of various studies and implications for causality.[5, 8-14] Here, we highlight several key points. Based on prior analyses and our de novo meta-analysis,[1] sodium reduction significantly lowers BP in a dose-response fashion (**Figure 1**). We also found strong evidence that BP-lowering reduces clinical cardiovascular events including stroke and CHD. A meta-analysis of 154 randomized trials of various anti-hypertensive agents and CVD events demonstrated that the effects of all major classes of anti-hypertensive drugs principally correspond to their BP-lowering.[19] For each class including thiazides, beta blockers, angiotensin converting enzyme inhibitors, angiotensin receptor blockers, and calcium channel blockers, the achieved risk reductions for CHD and stroke in the trials were very similar to the predicted benefits based on their BP-lowering, based on the observed association between BP and CVD risk in prospective cohorts.[20] Beta blockers had a larger effect above and beyond that due to BP reduction only for preventing recurrent CHD events in patients with a history of CHD, and also only limited to the first few years after acute myocardial infarction. These findings indicated that benefits of multiple classes of BP-lowering therapies correspond to the BP reduction itself. Consistent with this, a comprehensive Institute of Medicine report determined that BP reduction is a valid surrogate outcome for assessing clinical risk.[21] In addition, proportional (relative risk) reductions in CHD and stroke events appear similar in people with and without pre-existing CVD and regardless of BP levels prior to treatment (down to 110 mm Hg systolic and 70 mm Hg diastolic).[19] Based on available evidence from around the world, CVD benefits appear to extend down to a systolic BP of at least 115 mm Hg (**Figure 2**). A recent large randomized clinical trial further confirmed that lowering BP toward a target of 120 mm Hg, rather than a higher target of 140 mm Hg, significantly reduces CVD events as well as all-cause mortality.[22]

We considered whether sodium reduction might have any physiologic harms or benefits, beyond the intermediate-term effects on lowering BP, that might reduce or augment its effects. A meta-analysis of 37 trials demonstrated no significant adverse effects of sodium restriction on blood lipids, catecholamine levels, or renal function.[5] In terms of other physiologic effects, a large body of ecologic and experimental evidence suggests that chronically high dietary sodium may increase BP to a greater extent than short- or intermediate-term intake[23] and also induce other, BP-independent effects, for example increasing myocardial, arterial, and renal fibrosis and dysfunction.[24, 25] Thus, we concluded that other physiologic effects of sodium reduction, at least to modest levels (2 g/d), would be predicted to produce larger, not smaller, benefits. We did not incorporate these other potential benefits into our analysis, which could lead to underestimation of the attributable deaths.

The evidence for direct relationships between sodium intake and CVD events included reports of long-term follow-up from modestly sized randomized trials and meta-analyses of large prospective observational cohorts of sodium intakes (assessed by urine collection or diet questionnaire) and CVD events. The largest trials in general populations with long-term follow-up were TOHP I (N=744) and TOHP II (N=2,382), in which subjects were randomized to control or a sodium reduction intervention.[26] Net sodium reductions were 44 and 33 mmol/24 h in TOHP I and TOHP II, respectively; with interventions durations of 18 mo and 36-48 mo. Post-hoc long term follow-up was assessed in 2,415 subjects (77%) 10-15 y after the original trials. Risk of CVD was 30% lower in the intervention group vs. control (RR=0.70, 95%CI: 0.53, 0.94), adjusted for trial, clinic, age, sex, race, and baseline sodium excretion and weight. A meta-analysis of prospective cohorts found that higher sodium intake was associated with higher risk of total stroke (10 cohorts; RR=1.24, 95%CI: 1.08, 1.43), stroke death (3 cohorts; RR=1.63, 95%CI: 1.27, 2.10), and CHD death (3 cohorts; RR=1.32, 95%CI: 1.13, 1.53), but not total CHD (6 cohorts; RR=1.04, 95%CI: 0.86, 1.24). We recognized that urine collections and diet questionnaires provide reasonable estimates of overall mean intakes in populations and population subgroups, but poorly measure intakes in individual people due to intrinsic measurement errors, which could cause bias and/or substantial underestimation of associations with disease risk among individuals.[17, 27] For example, within-individual variation in 24-h urine collections can be similar in magnitude to between-person variation.[28]

A recent meta-analysis reported higher mortality with sodium reduction in trials of heart failure patients.[29] However, these trials, largely reported from a single Italian center, typically also included very high doses of diuretics (e.g., furosemide 500+ mg/d) that were not titrated based on subsequent volume status, with resulting marked azotemia in the patients randomized to sodium reduction. In addition, due to duplication of reported data across at least 2 of the trials, the veracity of the data has been questioned; and the investigators were unable to produce confirmatory records, leading to the retraction of the meta-analysis “on the ground that the reliability of the data on which it is based cannot be substantiated” (heart.bmj.com/content/99/11/820.2.full).

In sum, we found convincing evidence that sodium reduction lowered BP and that BP-lowering reduces CHD and stroke, at least to sodium intakes of 2 g/d and systolic BP levels of 115 mm Hg; without compelling evidence for physiologic harms. We also found consistent ecologic and experimental evidence that long-term high intakes induce additional adverse physiologic effects beyond BP; these were not incorporated into our estimates, which might underestimate attributable disease burdens. Post-hoc analyses of trials and meta-analyses of prospective cohorts provided confirmatory evidence that the BP-lowering effects of sodium reduction translated to lower risk of CVD events, as would be expected.

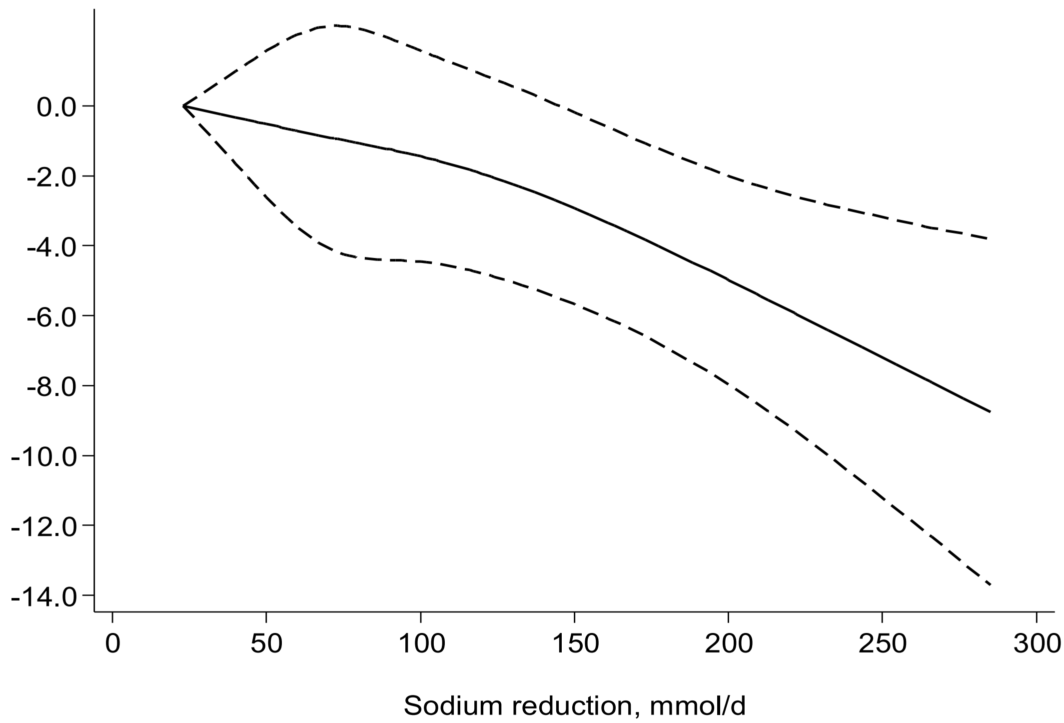

Figure 1. Effects of sodium reduction on systolic blood pressure in randomized controlled trials.[1] Based on 103 trials including 107 comparisons (N=6,970 subjects). Sodium reductions ranged from 23 to 285 (mean±SD: 99±55) mmol/d, intervention durations from 7 to 1100 (mean±SD: 65±160) days, and mean subject age from 13 to 73 (mean±SD: 47.4±14.4) years. The effect of sodium reduction on systolic blood pressure (SBP) was linear (P linearity<0.001), with little evidence for nonlinearity (P nonlinearity=0.58). The solid line represents the central estimate, and the dotted lines the 95% CIs; based on inverse-variance-weighted restricted cubic spline regression adjusted for age, race, and hypertensive status.

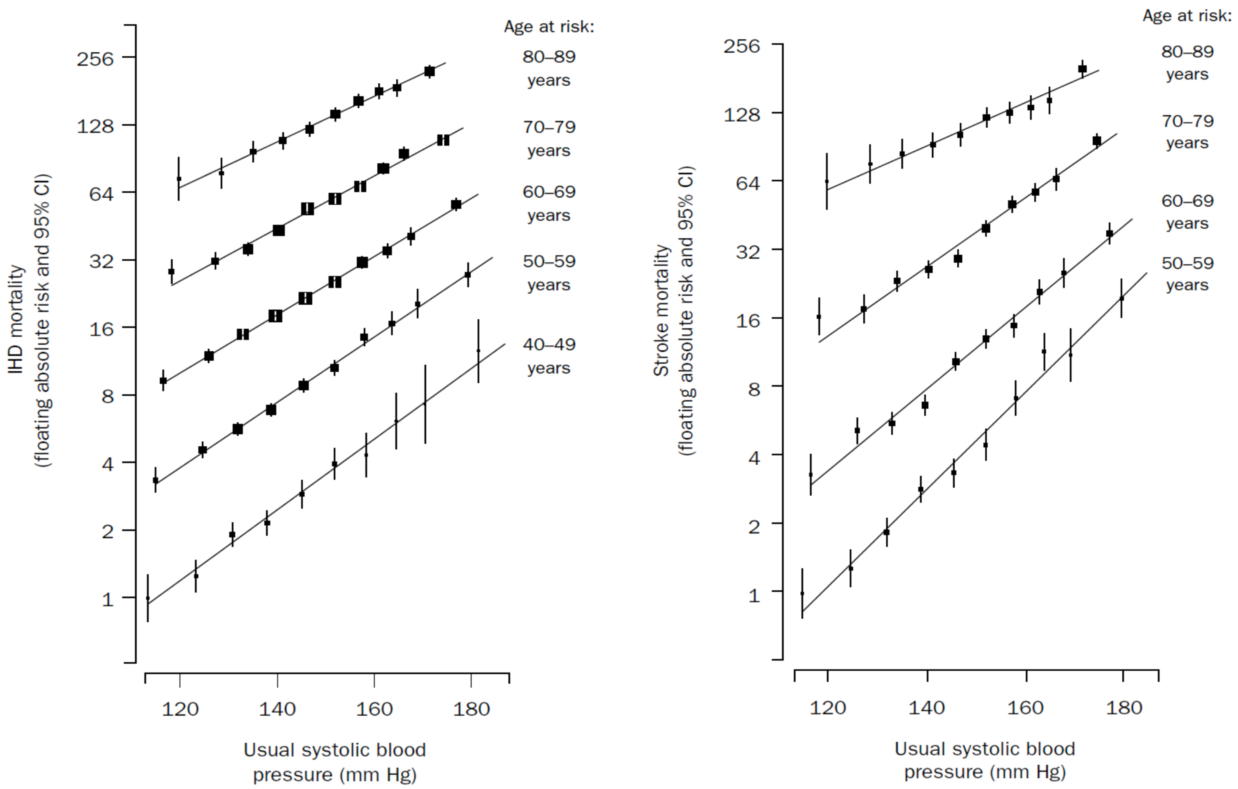

Figure 2. Dose-response relationship between systolic blood pressure and cardiovascular mortality, according to age, in one of the pooling projects utilized in our analysis. We quantified the effects of systolic blood pressure on cardiovascular mortality by combining the results from two large international pooling projects[20, 30] which pooled individual-level data, consistently adjusted for confounding, and accounted for regression dilution bias based on serial measures of blood pressure over time.[31] This Figures shows the main findings from one of these two pooling projects, based on individual-level data across 61 prospective observational studies including 958,074 participants, 12.7 million person-years of follow-up, 34,000 coronary (ischemic) heart disease (IHD) deaths, and 12,000 stroke deaths.[20] Participants were evaluated in deciles of systolic BP in 10-year age groups, with the lowest age-BP strata as the reference category. BP levels were adjusted for regression dilution bias based on serial measures over time. Adjusting for total blood cholesterol and, where available, HDL and non-HDL cholesterol, diabetes, weight, alcohol consumption, and smoking did not materially change these findings. Each square represents one age-BP stratum, with its size inversely proportional to the effective variance of the log mortality rate. The solid lines represent the fitted regression line for the relationship between BP and coronary heart disease and stroke mortality at each age.

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eTable 1. Model components and assumptions for cost-effectiveness analysis of a government strategy to decrease sodium intake in 183 nations.

Model component	Type	Source	Notes and assumptions
Global sodium consumption levels in 2010 by country, age, and sex	Data input to model	Powles et al. [1]	Based on all available global data from systematic searches for national or subnational data on individual-level sodium intake. Data were obtained from published and unpublished surveys from around the world, including 142 surveys of 24-hour urinary excretion and 103 surveys of estimated sodium intake from 66 countries. Dietary estimates were adjusted to be comparable with 24-hour urine collections using 79 data points from 26 surveys for which both measures were collected. Together with additional covariates including national gross domestic product and United Nations Food and Agricultural Organization food balance sheets in all 183 countries, an age-integrating Bayesian hierarchical model (DisMod III) was used to provide estimated intakes by age and sex, with uncertainty intervals, for all 183 countries, incorporating differences in missingness, representativeness, and measurement methods, and quantifying sampling and modeling uncertainty using an MCMC algorithm with 1000 iterations. The uncertainty intervals used as inputs to the present model represent the 2.5-97.5 percentiles of the posterior distribution of estimated mean sodium intakes, by country, age, and sex.
BP levels in 2010 by country, age, and sex	Data input to model	Danaei et al. as part of the 2010 GBD, as previously summarized [2]	Based on all available global data from systematic searches for national or subnational data on individual-level BP levels. Data were obtained from published and unpublished health examination surveys and epidemiological studies from around the world, including data from 786 country-years and 5.4 million participants. They were converted to the comparable metric of mean systolic BP, if necessary imputed from hypertension prevalence. A Bayesian hierarchical model was used to account for differences in data quality and to quantify sampling and modeling uncertainty, with evaluation by both posterior predictive checks and cross-validation. The uncertainty intervals used as inputs to the present model represent the 2.5-97.5 percentiles of the posterior distribution of estimated mean systolic BP, by country, age, and sex.
CVD mortality in 2010 by country, age, and sex	Data input to CVD-related DALY estimates	Lozano et al. as part of the 2010 GBD, as previously summarized [2]	Data on causes of death were obtained from vital registration, verbal autopsy, mortality surveillance, censuses, surveys, hospitals, police records, and mortuaries worldwide. Causes of death, including CVD, were modeled individually and evaluated using out-of-sample predictive validity tests. Of all causes of death modeled in this way, CVD deaths had the lowest out-of-sample root-mean-square error. Causes were proportionately rescaled such that the sum of cause-specific estimates equaled the all-cause mortality estimate for every age-sex-country-year group.
Burden of CVD in 2010 in disability-adjusted life years (DALYs) by country, age, and sex	Data input to model	Murray et al. as part of the 2010 GBD, as previously summarized [2]	For a given population, DALYs are the sum of years of life lost due to premature mortality (YLLs) and years lived with disability (YLDs). YLLs were calculated by multiplying the number of deaths from the study in the row above by a standard life expectancy computed based on the lowest recorded death rates across countries in 2010. YLDs were computed as the prevalence of different disease-sequelae multiplied by the disability weight for each sequela. The prevalence of sequelae was estimated by conducting a systematic analysis of published and unpublished data sources and aggregating this data using a Bayesian meta-regression model (DisMod-MR). The weights were generated using data collected from more than 31,000 respondents via population-based surveys in the USA, Peru, Tanzania, Bangladesh, and Indonesia, and via an open internet survey. DALYs for CVD by country, age, and sex were used an inputs to our analysis.
Effect of sodium on BP	Parameter input to model	Mozaffarian et al. [2]	A meta-analysis of randomized controlled trials of sodium reduction and BP was conducted based on recent systematic searches and meta-analyses. The main analysis included 103 trials and 6,970 subjects. Sodium reductions ranged from 23 to 285 mmol/day (mean±SD: 99±55), intervention durations from 7 to 1100 days (mean±SD: 65±160), and mean subject age from 13 to 73 years (mean±SD: 47.4±14.4). About two-thirds (64.5%) of comparisons were in hypertensive subjects, and 9.3% in black subjects. The linearity of effects of sodium reduction on BP was evaluated using a semi-parametric restricted cubic spline regression with 4 knots. A likelihood ratio test comparing the model with a simple linear fit revealed no significant difference ($p=0.58$), while the first coefficient in the spline was strongly significant ($p<0.001$). This suggested a linear effect. We accounted for differences in effects of sodium on BP by age, hypertensive status, and race, based on meta-regression. In our modeling, we assumed no further BP reduction or cardiovascular benefits for any sodium reduction below a

Model component	Type	Source	Notes and assumptions
			threshold of 2 g/d, with sensitivity analyses varying this threshold from 1 to 3 g/d.
Effect of BP on CVD	Parameter input to model	Singh et al. [3]	The effect of BP on cardiovascular events was estimated from the combined data of the large Prospective Studies Collaborative and the Asia Pacific Cohort Studies Collaborative, both observational studies. Relative risks were determined, by age, against a theoretical-minimum-risk exposure distribution of 115 mg Hg for the age groups used in this study using a linear relationship between the log relative risk and the midpoint of age in each age category, which was the model with the best fit among a range of models considered. Overall uncertainty was estimated using a simulation approach, with the regression procedure repeated for each of 1000 draws from a normal distribution characterized by the reported log relative risk and its standard error in the original meta-analyses, and the distributions of these draws used to estimate a single log relative risk and standard error for each age group. The age-specific log relative risks obtained in this way from the different sources were pooled using a random effects model. The age-specific log relative risks are presented in eFigure T1. For adults age 25-34 years, we utilized the observed relative risks for adults age 35-44 years. In our modeling, we assumed no further cardiovascular benefits for any BP reduction below a threshold of 115 mm Hg.
Intervention components and costs	Data input to model	WHO NCD Costing Tool [4]	We modeled the effects and costs of a 10-year "soft regulation" government intervention to reduce population sodium consumption. The intervention program was based on recent experience in the UK [14] and included: (a) government-supported industry agreements to reduce sodium in processed foods, (b) government monitoring of industry compliance, and (c) a public health campaign targeting consumer choices. In the UK, for example, this intervention was based upon collaboration between national government offices focused on nutrition (Food Standards Agency) and health (Ministers of Public Health) together with non-governmental advocacy organizations (Consensus Action on Salt & Health). The program applied sustained pressure on food manufacturers to pursue progressive reformulation, reinforced by food-group-specific targets, independent monitoring, and a sustained media campaign against excess salt intake. The program we modeled was thus more robust and costly than simple "voluntary reformulation". Intervention components and costs were based on the WHO NCD Costing Tool. The particular "soft regulation" intervention in the present analysis was explicitly costed by the Costing Tool authors. The Costing Tool uses the standard 'ingredients approach' developed by the WHO CHOICE project: the units of physical inputs required are assessed for each country and multiplied by the unit price for each input in that country. The Costing Tool authors report that quantities required were estimated using data obtained from a review of relevant publications and supplemented by primary data from WHO program staff in several countries. Within each category of resource (human resources, training, meetings, and mass media), estimates were made for needs at the central and provincial level. A standardized country of 50 million people was assumed, split into provinces of 5 million each. These standardized estimates were then adjusted to reflect the actual population size and administrative composition of each country, though national-level quantities were not adjusted. Scaled quantities were then multiplied by country-specific unit costs. These were taken from the WHO-CHOICE database, which contains estimates of salaries, per diem allowances (for training and meetings), media costs, and consumable item prices for each country. These in turn were predicted using linear regression models fitted to a multinational dataset, with GDP per capita, region, and education levels among other used as explanatory variables. Estimates of uncertainty were made neither for prices nor quantities. As such, this study presents the sensitivity of its final results to variations in cost of between 0.25 and 5 times the baseline estimates. Costs in this study are reported in international dollars, in line with the global cost-effectiveness literature, to enable meaningful comparisons between countries. The WHO NCD Costing Tool reports costs in local currency units for 2008. These were converted to 2012 international dollars by first accounting for local inflation using World Bank GDP deflator figures, then using 2012 PPP exchange rates from the IMF World Economic Outlook Database.
Intervention effects on sodium	Model parameter	Recent experiences with similar	Plausible intervention effectiveness was informed by experiences in the UK, which achieved 14.7% (0.6 g/d) reduction in population sodium intake over 10 years, and Turkey, which reported a more rapid 16% (1.2 g/d) reduction over 4 years. To incorporate likely differences in effectiveness across countries, we modeled varying intervention effectiveness – including

Model component	Type	Source	Notes and assumptions
consumption		intervention programs in the UK [5] and Turkey [6]	10% and 30% proportional reductions and 0.5 g/d and 1.5 g/d absolute reductions in sodium intake over 10 years. We assumed similar average effects for each age and sex stratum with a country, in the absence of compelling data otherwise by nation. In all cases, the intervention was assumed to scale up linearly over the implementation period, having 10% of the full effect in the first year, 20% in the second, and so on, reaching full efficacy in the final year. Past experiences with additives (e.g., trans fat) suggest that some companies begin reformulations early, as soon as they see any major government action looming, while other companies start later. Moreover, for some products, immediate small reductions are feasible, with more significant reduction taking more time. Thus, assuming an approximately even effect over time is reasonable and consistent with empirical experiences. The 10-year period was selected based on the approximate period of the UK intervention, and its results, to date. A shorter period could bias choices against programs that take a number of years of activity to start accumulating meaningful benefits. Much longer periods could be unrealistic for many government decisions, as the time horizon of policy decision-makers is often rather short.
Intervention effects on DALYs	Model calculation	Comparative risk assessment framework [2]	The data inputs described above were combined to produce estimates of the intervention effects for each age-sex-country stratum, additionally accounting for differences in effects of sodium on BP by hypertensive status (by estimating the proportional of hypertensive subjects within each stratum, based on the mean and SD of BP levels in that stratum) and for differences in effects of sodium on BP by race (utilizing this stronger effect in African nations, and not accounting for small proportions of people of Black race in other nations, which would underestimate the true impact of sodium reduction in those nations). The estimated DALYs attributable to current sodium intake in each stratum were calculated from the population attributable fraction (PAF) of CVD mortality attributable to current sodium intake, multiplying the PAF by the number of DALYs attributable to CVD in that stratum. The same procedure was used to calculate the estimated DALYs attributable to counterfactual sodium intake under the selected intervention (proportional or absolute sodium reductions, described above). The difference between these two estimates, summed across countries and regions, represents the estimated effect of the intervention, which was then evenly scaled over 10 years. Uncertainty was quantified using Monte Carlo simulation. For each of 1000 simulations, a draw was made from the (uncertainty) distributions of sodium intake for each country-age-sex stratum, of the sodium-BP effect for each country-age-sex stratum (accounting for hypertensive status and race, as above), and the effects of BP on each disease outcome of interest. Each draw was used to calculate for each stratum both the DALYs attributable to current sodium intake and the DALYs attributable to the counterfactual sodium intake, with the difference between these two numbers taken to be one simulated intervention effect for that stratum. The uncertainty intervals for each stratum then represent the 2.5-97.5 percentiles of the distribution of the intervention effects estimated across all 1000 simulations for that stratum.
Intervention cost-effectiveness	Model calculation	N/A	The cost-effectiveness of the intervention is calculated by dividing the total cost of the intervention by its total effect over the intervention period, with both cost and effect discounted at 3% per year, and effects scaled linearly over 10 years as described above.

BP = blood pressure. CVD = cardiovascular disease. GBD = Global Burden of Diseases study.

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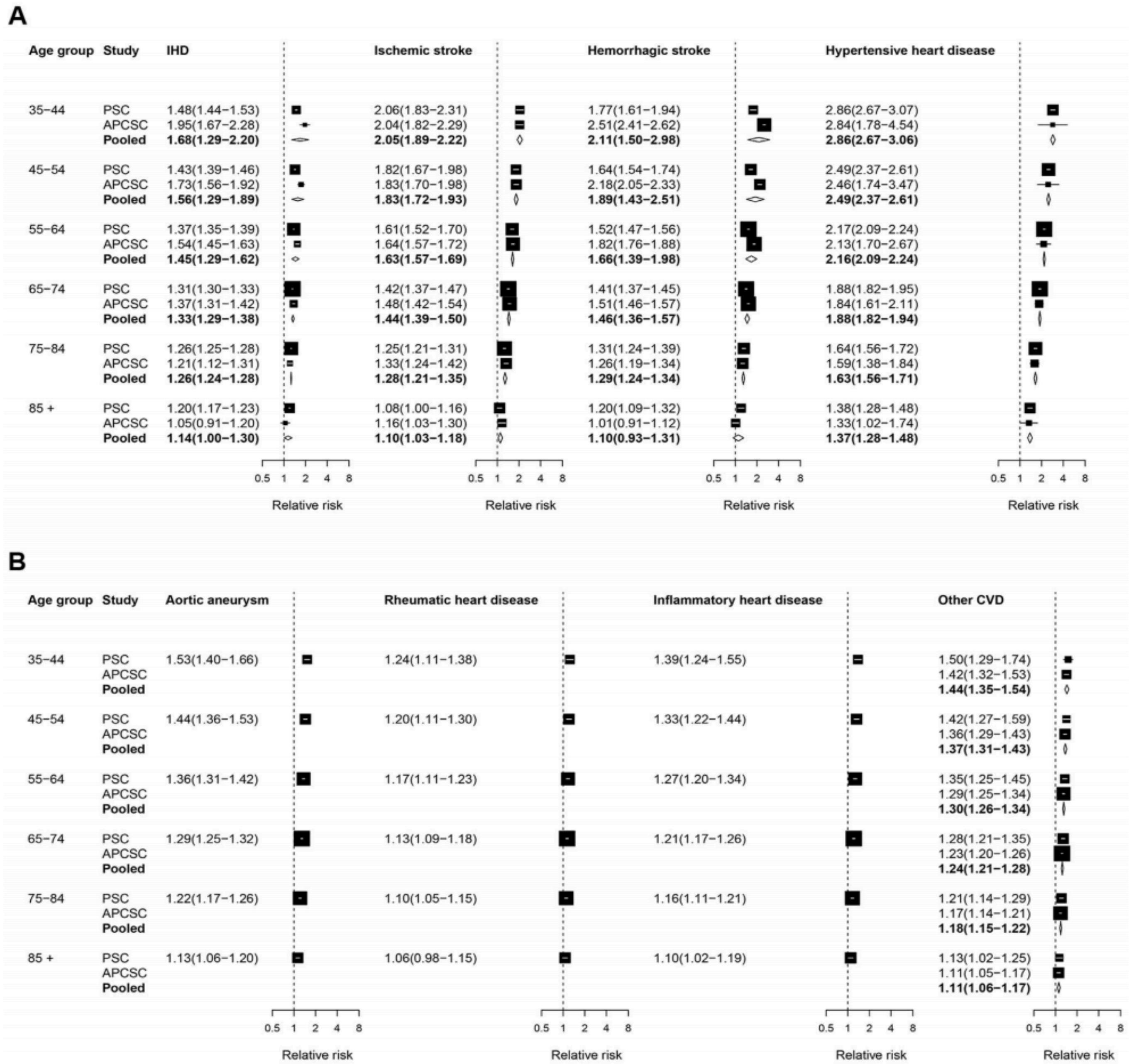


eFigure T1. Relative risks (RRs) by age for cardiovascular diseases according to systolic blood pressure (SBP). Reproduced with permission from Singh et al., PLoS One 2013;8(7):e65174.[3]

eTable 2. Resource needs for sodium reduction intervention for an example[a] country.

	Administrative level (Standardized population, in millions)	Planning (year 1) National (50m)	Planning (year 1) Province (5m)	Development (year 2) National (50m)	Development (year 2) Province (5m)	Partial implementation (years 3-5) National (50m)	Partial implementation (years 3-5) Province (5m)	Full implementation (years 6-10) National (50m)	Full implementation (years 6-10) Province (5m)
HUMAN RESOURCES (incl. consultants)	***Roles / responsibilities***	FTE[b]	FTE	FTE	FTE	FTE	FTE	FTE	FTE
Program management									
Director	*Oversight; Monitoring; Reporting*	0.125	0.0625	0.125	0.0625	0.125	0.0625	0.125	0.0625
Manager	*Oversight; Monitoring; Reporting*	0.25	0.125	0.25	0.125	0.25	0.125	0.25	0.125
Administrative officer	*Data collection; Monitoring*	0.5	0.25	0.5	0.25	0.5	0.25	0.5	0.25
Clerical officer	*Data collection; Monitoring*	1	0.5	1	0.5	1	0.5	1	0.5
Secretary	*Office support*	0.9	0.4	0.9	0.4	0.9	0.4	0.9	0.4
Accountant	*Financial data entry/analysis*	0.25	0.125	0.25	0.125	0.25	0.125	0.25	0.125
I.T. computing manager	*I.T. support*	0.125	0.0625	0.125	0.0625	0.125	0.0625	0.125	0.0625
I.T. computing officer	*I.T. support*	0.25	0.125	0.25	0.125	0.25	0.125	0.25	0.125
Cleaner	*General office maintenance*	0.25	0	0.25	0	0.25	0	0.25	0
Subtotal		3.6	1.7	3.6	1.7	3.6	1.7	3.6	1.7
Promotion / media / advocacy									
Public health specialist	*Advocacy; Dissemination*	0.25	0.125	0.25	0.25	0.25	0.125	0.25	0.125
Public health officer	*Admin / research support*	0.5	0.25	0.5	0.5	0.5	0.25	0.5	0.25
Health educator/trainer	*Advocacy; Dissemination*	0.5	0.25	0.5	0.5	0.5	0.25	0.5	0.25
Public Relations Manager		0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Public Relations Officer		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Subtotal		2.0	1.4	2.0	2.0	2.0	1.4	2.0	1.4
Law enforcement / inspection									
Superintendent	*Supervision of new (voluntary) code*			0.25	0.25	0.5	0.5	0.5	0.5
Enforcement / health safety officer	*Inspection*			1	1	2	2	2	2
Lawyer	*Development of new code*	1	0.5	1	0.25	0.25	0.125	0.25	0.125
Legal Officer	*Development of new code*	2	1	2	0.5	0.5	0.25	0.5	0.25
Transport manager	*Transport support*	0.2	0.1	0.3	0.1	0.2	0.1	0.2	0.1
Transport driver	*Transport support*	0.9	0.5	1.1	0.6	0.8	0.6	0.8	0.6
Subtotal		4.2	2.2	5.6	2.7	4.3	3.6	4.3	3.6
National-level technical assistance	*(local planning / implementation)*								
International consultant (No. of 5-day trips p.a.)		2		2		1		1	
TOTAL HUMAN RESOURCES		9.8	5.2	11.2	6.4	9.9	6.7	9.9	6.7

a. Example country is assumed to have a population of 50 million, split into provinces of 5 million each.
b. Full-time equivalent.

eTable 2. Resource needs for sodium reduction intervention for an example country (continued).

		Planning (year 1)		Development (year 2)		Partial implementation (years 3-5)		Full implementation (years 6-10)	
	Administrative level (Standardised population, in millions)	**National** (50m)	**Province** (5m)	**National** (50m)	**Province** (5m)	**National** (50m)	**Province** (5m)	**National** (50m)	**Province** (5m)
TRAINING (for programme staff)	***Purpose***								
Training course / workshop (1)	*(sodium and public health)*								
Frequency of meetings (expressed per year)		1	1	1	1	1	1	1	1
Number of meetings needed (within the year)		2	1	2	2	1	2	1	2
Length of meetings (days)		2	2	2	2	2	2	2	2
National experts in attendance (No., per diem, travel cost)		2	1	2	1	2	1	4	1
Local experts in attendance (No., per diem, travel cost)		20	15	20	15	20	15	20	15
Training course / workshop (2)	*(food inspection)*								
Frequency of meetings (expressed per year)					1		1		1
Number of meetings needed (within the year)					2		1		1
Length of meetings (days)					3		2		2
National experts in attendance (No., per diem, travel cost)					2		1		1
Local experts in attendance (No., per diem, travel cost)					15		15		15
MEETINGS (involving external agencies)	***Purpose***								
Meetings / workshops (1)	*(planning, + M&E)*								
Frequency of meetings (expressed per year)		1	1	1	1	1	1	1	0.5
Number of meetings needed (within the year)		3	1	2	1	2	1	2	1
Length of meetings (days)		3	3	3	3	2	2	2	2
National experts in attendance (No., per diem, travel cost)		4	3	4	2	4	1	4	1
Local experts in attendance (No., per diem, travel cost)		15	10	15	10	15	10	15	10
MASS MEDIA									
Television time (minutes)				150		150		150	
Radio time (minutes)				200	150	150	100	150	100
Newspapers (100 word insert)				60	30	60	30	60	30
Flyers / leaflets					20,000		15,000		15,000

eTable 3. Cost-effectiveness by country of a policy intervention to reduce sodium consumption by 10%.

Country[a]	DALYs averted (95% UI)	Cost/capita	CER (95% UI)[b]	CE/GDP	DALYs /1000 adults
Afghanistan	158,653 (96,533, 215,189)	$0.55	$36.39 ($59.81, $26.83)	0.04	15.1
Albania	16,319 (10,461, 22,097)	$2.89	$332.72 ($519.06, $245.73)	0.04	8.7
Algeria	107,283 (67,357, 146,916)	$0.54	$94.14 ($149.95, $68.75)	0.01	5.8
Andorra	272 (171, 370)	$121.42	$27,027.80 ($43,026.24, $19,847.69)	0.73	4.5
Angola	38,426 (23,120, 54,392)	$1.25	$208.86 ($347.13, $147.55)	0.03	6
Antigua and Barbuda	171 (106, 241)	$60.14	$16,618.77 ($26,802.34, $11,813.69)	0.95	3.6
Argentina	111,450 (71,479, 153,335)	$0.55	$116.32 ($181.36, $84.54)	0.01	4.7
Armenia	24,967 (16,468, 33,555)	$2.04	$155.06 ($235.08, $115.38)	0.03	13.2
Australia	42,067 (26,751, 57,251)	$2.48	$858.76 ($1,350.46, $631.01)	0.02	2.9
Austria	28,902 (18,470, 39,581)	$2.83	$600.41 ($939.52, $438.42)	0.01	4.7
Azerbaijan	68,292 (44,129, 89,484)	$5.65	$442.07 ($684.12, $337.37)	0.04	12.8
Bahamas	672 (414, 937)	$24.34	$7,428.39 ($12,043.73, $5,327.12)	0.24	3.3
Bahrain	2,313 (1,491, 3,105)	$12.71	$4,511.28 ($7,000.09, $3,360.83)	0.16	2.8
Bangladesh	254,523 (157,903, 355,833)	$0.64	$181.39 ($292.38, $129.75)	0.09	3.5
Barbados	827 (529, 1,123)	$21.96	$4,938.55 ($7,714.75, $3,635.51)	0.19	4.4
Belarus	134,779 (87,212, 182,545)	$2.52	$127.11 ($196.44, $93.85)	0.01	19.8
Belgium	33,266 (21,593, 45,300)	$3.27	$755.44 ($1,163.84, $554.76)	0.02	4.3
Belize	384 (235, 525)	$21.32	$7,559.40 ($12,366.03, $5,523.37)	0.9	2.8
Benin	19,727 (12,046, 27,679)	$0.87	$142.99 ($234.17, $101.92)	0.08	6.1
Bhutan	1,417 (889, 1,941)	$2.67	$671.44 ($1,069.95, $490.05)	0.1	4
Bolivia	19,224 (12,032, 26,395)	$1.11	$250.66 ($400.50, $182.56)	0.05	4.4
Bosnia and Herzegovina	22,506 (14,529, 30,856)	$5.29	$628.89 ($974.20, $458.70)	0.08	8.4
Botswana	4,154 (2,408, 5,955)	$3.99	$872.78 ($1,505.99, $608.89)	0.05	4.6
Brazil	755,263 (494,700, 1,011,356)	$0.81	$119.97 ($183.16, $89.59)	0.01	6.8
Brunei Darussalam	923 (595, 1,243)	$44.20	$10,917.91 ($16,944.36, $8,106.95)	0.22	4
Bulgaria	87,451 (56,737, 117,077)	$2.77	$177.66 ($273.84, $132.71)	0.01	15.6
Burkina Faso	32,320 (19,592, 45,061)	$0.56	$97.60 ($161.00, $70.00)	0.07	5.7
Burundi	9,065 (4,273, 14,723)	$0.53	$194.56 ($412.75, $119.79)	0.32	2.7
Cambodia	64,460 (42,030, 85,353)	$0.51	$51.31 ($78.70, $38.75)	0.02	10
Cameroon	26,993 (15,380, 39,560)	$0.81	$227.47 ($399.22, $155.21)	0.1	3.6
Canada	86,609 (55,244, 116,240)	$1.86	$503.88 ($789.96, $375.43)	0.01	3.7
Cape Verde	1,508 (932, 2,057)	$10.47	$1,557.11 ($2,518.26, $1,141.63)	0.38	6.7
Central African Republic	16,694 (10,514, 23,099)	$0.89	$91.71 ($145.62, $66.28)	0.11	9.7

Country[a]	DALYs averted (95% UI)	Cost/capita	CER (95% UI)[b]	CE/GDP	DALYs /1000 adults
Chad	22,085 (13,373, 30,675)	$0.94	$166.73 ($275.35, $120.04)	0.08	5.6
Chile	26,986 (16,976, 37,911)	$1.03	$386.38 ($614.21, $275.04)	0.02	2.7
China	6,598,540 (4,460,556, 8,624,043)	$0.87	$112.76 ($166.80, $86.27)	0.01	7.7
Colombia	105,836 (70,158, 140,949)	$0.65	$151.59 ($228.69, $113.83)	0.01	4.3
Comoros	542 (270, 896)	$5.15	$2,740.90 ($5,501.36, $1,657.86)	2.11	1.9
Congo	11,034 (6,148, 16,306)	$1.87	$273.78 ($491.40, $185.27)	0.06	6.8
Costa Rica	6,567 (4,112, 9,075)	$1.89	$754.64 ($1,205.20, $546.10)	0.06	2.5
Côte d'Ivoire	65,684 (39,219, 91,670)	$0.73	$85.34 ($142.92, $61.15)	0.05	8.6
Croatia	27,603 (17,355, 37,275)	$2.26	$262.60 ($417.68, $194.47)	0.01	8.6
Cuba	30,666 (19,183, 43,265)	$0.90	$225.83 ($361.01, $160.06)	0.02	4
Cyprus	2,499 (1,630, 3,396)	$15.07	$3,004.96 ($4,606.02, $2,211.14)	0.11	5
Czech Republic	59,174 (38,802, 79,566)	$1.80	$234.06 ($356.95, $174.08)	0.01	7.7
Democratic People's Republic of Korea	131,411 (83,091, 179,293)	$0.31	$35.58 ($56.28, $26.08)	0.02	8.8
Democratic Republic of the Congo	142,703 (84,788, 207,796)	$0.51	$79.55 ($133.89, $54.63)	0.2	6.5
Denmark	15,502 (10,022, 21,436)	$3.50	$868.67 ($1,343.72, $628.20)	0.02	4
Djibouti	1,840 (1,077, 2,660)	$4.92	$1,011.93 ($1,729.21, $699.98)	0.37	4.9
Dominica	140 (85, 196)	$50.03	$14,194.71 ($23,422.99, $10,111.66)	0.97	3.5
Dominican Republic	21,721 (13,216, 30,916)	$0.90	$206.79 ($339.86, $145.29)	0.02	4.4
Ecuador	19,709 (12,102, 28,019)	$0.84	$313.01 ($509.77, $220.18)	0.04	2.7
Egypt	455,019 (287,380, 624,452)	$0.63	$54.78 ($86.73, $39.91)	0.01	11.5
El Salvador	9,381 (5,739, 13,236)	$1.39	$424.80 ($694.37, $301.06)	0.06	3.3
Equatorial Guinea	1,259 (710, 1,876)	$21.54	$4,956.41 ($8,786.29, $3,324.73)	0.25	4.3
Eritrea	9,945 (5,754, 14,519)	$1.04	$209.13 ($361.42, $143.24)	0.26	4.9
Estonia	10,405 (6,738, 13,983)	$17.00	$1,555.00 ($2,401.25, $1,157.14)	0.07	10.9
Ethiopia	127,441 (76,004, 187,775)	$0.49	$120.00 ($201.22, $81.44)	0.1	4.1
Fiji	4,037 (2,396, 5,833)	$3.82	$427.99 ($720.97, $296.21)	0.09	8.9
Finland	22,091 (14,431, 29,758)	$3.82	$659.14 ($1,009.06, $489.32)	0.02	5.8
France	147,200 (95,540, 198,883)	$1.72	$506.75 ($780.75, $375.06)	0.01	3.4
Gabon	2,855 (1,447, 4,370)	$5.42	$1,239.27 ($2,445.36, $809.84)	0.07	4.4
Gambia	3,849 (2,343, 5,315)	$2.42	$385.74 ($633.61, $279.32)	0.2	6.3
Georgia	63,063 (41,707, 82,849)	$1.33	$61.47 ($92.95, $46.79)	0.01	21.6
Germany	299,996 (190,382, 407,770)	$1.51	$311.28 ($490.49, $229.01)	0.01	4.8
Ghana	58,679 (34,476, 85,086)	$0.64	$110.67 ($188.35, $76.32)	0.03	5.8
Greece	49,044 (30,988, 67,584)	$2.10	$364.13 ($576.30, $264.24)	0.01	5.8
Grenada	266 (164, 380)	$51.37	$10,071.49 ($16,394.71, $7,054.24)	0.71	5.1

Country[a]	DALYs averted (95% UI)	Cost/capita	CER (95% UI)[b]	CE/GDP	DALYs /1000 adults
Guatemala	14,381 (8,813, 20,302)	$0.96	$366.91 ($598.74, $259.90)	0.07	2.6
Guinea	24,046 (14,384, 34,081)	$0.79	$121.85 ($203.69, $85.97)	0.11	6.5
Guinea-Bissau	4,989 (2,968, 6,970)	$1.67	$196.81 ($330.84, $140.87)	0.18	8.5
Guyana	2,606 (1,525, 3,706)	$4.12	$574.57 ($981.56, $404.02)	0.07	7.2
Haiti	34,727 (21,208, 48,736)	$0.69	$85.74 ($140.39, $61.09)	0.07	8.1
Honduras	14,638 (8,993, 20,374)	$1.11	$241.07 ($392.41, $173.20)	0.05	4.6
Hungary	89,765 (59,278, 119,425)	$5.28	$428.94 ($649.55, $322.41)	0.02	12.3
Iceland	592 (370, 808)	$29.40	$10,405.03 ($16,616.50, $7,622.12)	0.26	2.8
India	4,284,301 (2,768,629, 5,789,032)	$0.75	$107.80 ($166.81, $79.78)	0.03	7
Indonesia	987,857 (622,578, 1,348,436)	$0.54	$71.48 ($113.42, $52.37)	0.01	7.5
Iran (Islamic Republic of)	277,532 (174,670, 376,502)	$0.56	$82.54 ($131.14, $60.84)	0.01	6.8
Iraq	86,044 (55,224, 118,300)	$0.96	$131.62 ($205.07, $95.73)	0.03	7.3
Ireland	11,239 (7,195, 15,135)	$3.79	$1,004.23 ($1,568.61, $745.69)	0.02	3.8
Israel	13,428 (8,563, 18,370)	$3.47	$1,111.17 ($1,742.60, $812.25)	0.03	3.1
Italy	228,308 (146,844, 310,253)	$1.36	$271.20 ($421.65, $199.57)	0.01	5
Jamaica	2,720 (1,625, 3,950)	$1.85	$985.31 ($1,648.64, $678.45)	0.11	1.9
Japan	443,744 (301,526, 586,860)	$1.31	$283.75 ($417.59, $214.55)	0.01	4.6
Jordan	15,076 (9,730, 20,531)	$1.67	$280.68 ($434.88, $206.10)	0.05	5.9
Kazakhstan	209,394 (142,270, 271,379)	$3.08	$133.96 ($197.17, $103.36)	0.01	23
Kenya	5,995 (2,871, 10,199)	$0.76	$1,873.89 ($3,913.69, $1,101.54)	1.04	0.4
Kiribati	209 (118, 320)	$53.01	$10,280.08 ($18,146.73, $6,718.15)	1.74	5.2
Kuwait	6,856 (4,135, 9,658)	$12.92	$2,982.06 ($4,943.76, $2,116.92)	0.07	4.3
Kyrgyzstan	41,594 (27,525, 55,013)	$0.76	$45.91 ($69.37, $34.71)	0.02	16.5
Lao People's Democratic Republic	26,932 (17,070, 36,030)	$0.75	$73.24 ($115.55, $54.75)	0.02	10.2
Latvia	23,136 (15,017, 31,341)	$8.45	$591.35 ($911.07, $436.54)	0.03	14.3
Lebanon	11,997 (7,675, 16,472)	$2.59	$523.46 ($818.27, $381.25)	0.03	5
Lesotho	8,345 (4,926, 11,739)	$1.83	$187.30 ($317.26, $133.14)	0.09	9.8
Liberia	7,396 (4,267, 10,538)	$0.80	$160.34 ($277.94, $112.54)	0.23	5
Libyan Arab Jamahiriya	24,662 (15,318, 34,145)	$2.10	$281.05 ($452.50, $202.99)	0.02	7.5
Lithuania	27,583 (17,467, 37,565)	$11.44	$969.30 ($1,530.68, $711.74)	0.05	11.8
Luxembourg	1,522 (1,007, 2,062)	$31.48	$7,287.41 ($11,010.99, $5,379.54)	0.09	4.3
Macedonia (Former Yugoslav Republic of)	16,515 (10,920, 22,183)	$2.10	$175.82 ($265.90, $130.90)	0.02	11.9
Madagascar	58,713 (33,021, 86,318)	$0.69	$90.63 ($161.15, $61.65)	0.09	7.6
Malawi	11,411 (5,913, 18,455)	$0.82	$359.92 ($694.55, $222.54)	0.4	2.3
Malaysia	91,442 (59,142, 125,363)	$0.97	$155.54 ($240.49, $113.46)	0.01	6.2

Country[a]	DALYs averted (95% UI)	Cost/capita	CER (95% UI)[b]	CE/GDP	DALYs /1000 adults
Maldives	367 (230, 510)	$13.24	$5,569.16 ($8,878.50, $4,009.70)	0.64	2.4
Mali	36,483 (21,814, 51,466)	$0.79	$110.77 ($185.25, $78.52)	0.1	7.2
Malta	1,459 (947, 1,940)	$17.91	$3,620.52 ($5,579.75, $2,722.73)	0.14	4.9
Marshall Islands	151 (87, 211)	$84.54	$15,069.42 ($26,189.19, $10,757.07)	4.71	5.6
Mauritania	8,787 (5,429, 12,366)	$1.20	$189.91 ($307.40, $134.95)	0.09	6.3
Mauritius	11,493 (8,006, 14,108)	$3.60	$249.91 ($358.75, $203.57)	0.02	14.4
Mexico	156,362 (97,089, 215,496)	$0.81	$307.75 ($495.63, $223.30)	0.02	2.6
Micronesia (Federated States of)	303 (186, 433)	$42.06	$6,310.99 ($10,250.47, $4,415.14)	2.1	6.7
Moldova	36,855 (23,764, 49,691)	$1.40	$88.66 ($137.50, $65.76)	0.03	15.8
Mongolia	26,478 (16,925, 35,035)	$1.15	$60.54 ($94.72, $45.76)	0.01	18.9
Montenegro	4,411 (2,848, 5,970)	$26.22	$2,487.13 ($3,852.71, $1,837.64)	0.21	10.5
Morocco	107,021 (69,911, 143,478)	$0.65	$102.10 ($156.30, $76.16)	0.02	6.4
Mozambique	29,216 (16,920, 43,243)	$0.60	$173.61 ($299.78, $117.30)	0.14	3.4
Myanmar	246,217 (162,515, 326,712)	$0.31	$33.30 ($50.46, $25.10)	0.02	9.2
Namibia	8,595 (5,241, 11,944)	$2.86	$321.97 ($528.04, $231.70)	0.04	8.9
Nepal	61,800 (38,769, 84,742)	$0.40	$83.83 ($133.63, $61.13)	0.06	4.8
Netherlands	37,631 (24,256, 51,252)	$2.24	$693.93 ($1,076.58, $509.51)	0.02	3.2
New Zealand	9,639 (6,170, 13,177)	$3.36	$989.45 ($1,545.86, $723.77)	0.03	3.4
Nicaragua	9,364 (5,915, 12,724)	$1.00	$272.20 ($430.90, $200.32)	0.08	3.7
Niger	30,201 (17,764, 42,016)	$0.71	$120.24 ($204.43, $86.43)	0.13	5.9
Nigeria	253,603 (154,353, 357,516)	$0.65	$153.80 ($252.69, $109.10)	0.06	4.2
Norway	12,433 (7,891, 17,399)	$4.30	$1,145.40 ($1,804.68, $818.48)	0.02	3.8
Oman	5,114 (3,106, 7,235)	$7.26	$2,010.51 ($3,309.73, $1,421.03)	0.07	3.6
Pakistan	461,242 (289,095, 629,447)	$0.84	$136.62 ($217.98, $100.11)	0.05	6.2
Panama	6,698 (4,264, 9,086)	$1.65	$465.37 ($731.07, $343.08)	0.03	3.5
Papua New Guinea	8,894 (4,932, 12,906)	$0.69	$223.50 ($403.03, $154.03)	0.08	3.1
Paraguay	20,559 (13,571, 27,307)	$1.12	$161.99 ($245.40, $121.96)	0.03	6.9
Peru	32,151 (20,070, 45,102)	$0.74	$339.43 ($543.75, $241.97)	0.03	2.2
Philippines	406,809 (262,442, 542,698)	$0.62	$63.56 ($98.52, $47.64)	0.01	9.8
Poland	236,199 (154,876, 315,240)	$3.74	$427.97 ($652.69, $320.66)	0.02	8.7
Portugal	40,519 (26,798, 55,034)	$1.64	$317.07 ($479.43, $233.45)	0.01	5.2
Qatar	1,719 (1,038, 2,433)	$19.10	$14,056.69 ($23,275.52, $9,932.23)	0.14	1.4
Republic of Korea	139,348 (93,766, 181,597)	$0.89	$215.82 ($320.73, $165.61)	0.01	4.1
Romania	215,036 (139,641, 284,900)	$2.06	$146.93 ($226.25, $110.90)	0.01	14
Russian Federation	1,874,746 (1,218,294, 2,520,416)	$2.27	$120.65 ($185.66, $89.74)	0.01	18.8

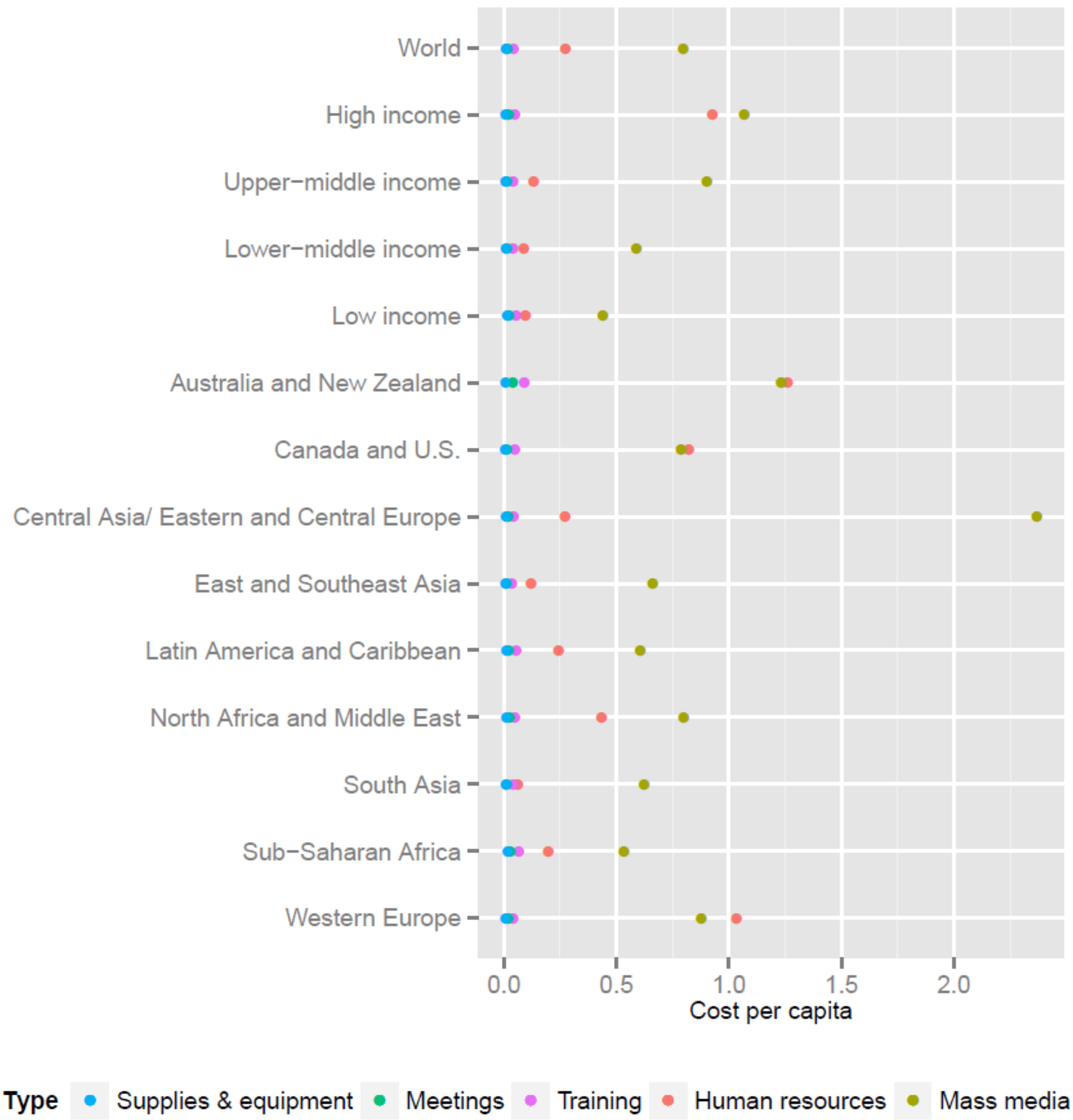
Country[a]	DALYs averted (95% UI)	Cost/capita	CER (95% UI)[b]	CE/GDP	DALYs /1000 adults
Rwanda	5,008 (2,186, 8,894)	$0.79	$614.80 ($1,408.22, $346.18)	0.44	1.3
Saint Lucia	375 (235, 517)	$26.71	$6,755.78 ($10,774.11, $4,900.44)	0.51	4
Saint Vincent and the Grenadines	265 (163, 371)	$35.70	$8,068.08 ($13,144.57, $5,770.83)	0.68	4.4
Samoa	169 (97, 246)	$25.42	$11,967.23 ($20,801.04, $8,227.85)	1.93	2.1
Saudi Arabia	52,431 (31,697, 72,979)	$2.13	$576.75 ($954.03, $414.36)	0.02	3.7
Senegal	18,090 (10,986, 25,242)	$0.93	$228.05 ($375.52, $163.43)	0.12	4.1
Serbia	61,318 (39,809, 82,924)	$3.86	$425.77 ($655.82, $314.84)	0.04	9.1
Seychelles	563 (376, 710)	$110.94	$6,109.59 ($9,134.70, $4,844.14)	0.23	18.2
Sierra Leone	12,667 (7,530, 18,338)	$0.98	$171.61 ($288.70, $118.54)	0.12	5.7
Singapore	12,276 (8,210, 16,018)	$5.42	$1,098.18 ($1,641.91, $841.63)	0.02	4.9
Slovakia	38,364 (24,589, 51,641)	$11.67	$1,163.21 ($1,814.85, $864.13)	0.05	10
Slovenia	8,623 (5,582, 11,495)	$5.04	$889.30 ($1,373.82, $667.13)	0.03	5.7
Solomon Islands	1,267 (719, 1,834)	$8.21	$1,416.99 ($2,497.92, $979.24)	0.42	5.8
South Africa	161,479 (96,722, 229,780)	$1.14	$176.06 ($293.93, $123.72)	0.02	6.5
Spain	123,145 (79,960, 166,031)	$1.35	$365.54 ($562.96, $271.12)	0.01	3.7
Sri Lanka	82,979 (54,184, 112,156)	$0.61	$91.72 ($140.47, $67.86)	0.02	6.7
Sudan	45,411 (26,201, 65,790)	$0.50	$193.29 ($335.00, $133.41)	0.08	2.6
Suriname	1,353 (845, 1,906)	$7.01	$1,476.22 ($2,363.86, $1,048.27)	0.12	4.7
Swaziland	4,472 (2,547, 6,372)	$5.59	$543.39 ($954.00, $381.40)	0.1	10.3
Sweden	27,292 (17,394, 37,540)	$2.32	$554.59 ($870.18, $403.21)	0.01	4.2
Switzerland	17,614 (11,068, 23,929)	$2.51	$792.78 ($1,261.71, $583.56)	0.01	3.2
Syrian Arab Republic	74,985 (46,183, 103,790)	$0.75	$86.77 ($140.89, $62.69)	0.02	8.6
Tajikistan	37,292 (24,575, 48,976)	$0.68	$49.95 ($75.79, $38.03)	0.02	13.7
Thailand	270,884 (182,507, 354,029)	$0.33	$54.46 ($80.84, $41.67)	0.01	6.1
Timor-Leste	3,320 (2,183, 4,376)	$6.59	$747.26 ($1,136.38, $566.84)	0.08	8.8
Togo	14,596 (8,554, 20,707)	$0.90	$147.90 ($252.38, $104.26)	0.13	6.1
Tonga	156 (94, 225)	$38.01	$11,176.54 ($18,594.04, $7,738.31)	1.49	3.4
Trinidad and Tobago	5,395 (3,394, 7,481)	$7.17	$1,098.89 ($1,747.11, $792.49)	0.05	6.5
Tunisia	43,888 (28,283, 58,936)	$0.79	$108.90 ($168.99, $81.09)	0.01	7.3
Turkey	339,898 (220,727, 456,923)	$1.62	$194.41 ($299.37, $144.62)	0.01	8.4
Turkmenistan	42,826 (27,919, 56,546)	$3.60	$207.21 ($317.85, $156.93)	0.02	17.4
Uganda	32,885 (17,883, 50,460)	$0.47	$151.08 ($277.83, $98.46)	0.11	3.1
Ukraine	624,510 (402,129, 850,152)	$0.95	$49.72 ($77.21, $36.52)	0.01	19
United Arab Emirates	13,516 (7,447, 20,320)	$3.34	$1,242.39 ($2,254.82, $826.38)	0.03	2.7
United Kingdom	184,120 (116,045, 250,906)	$1.99	$465.59 ($738.71, $341.66)	0.01	4.3

Country[a]	DALYs averted (95% UI)	Cost/capita	CER (95% UI)[b]	CE/GDP	DALYs /1000 adults
United Republic of Tanzania	58,224 (35,353, 81,234)	$0.53	$146.07 ($240.56, $104.69)	0.09	3.7
United States of America	1,008,472 (660,402, 1,376,241)	$1.65	$332.39 ($507.57, $243.56)	0.01	5
Uruguay	9,291 (5,744, 12,867)	$1.56	$352.45 ($570.06, $254.49)	0.02	4.4
Uzbekistan	208,075 (139,049, 270,194)	$0.41	$26.08 ($39.02, $20.08)	0.01	15.7
Vanuatu	537 (308, 800)	$17.13	$3,187.20 ($5,553.15, $2,140.83)	0.65	5.4
Venezuela (Bolivarian Republic of)	75,782 (48,651, 103,578)	$0.87	$173.33 ($270.00, $126.82)	0.01	5
Viet Nam	246,143 (164,423, 326,144)	$0.31	$62.00 ($92.81, $46.79)	0.02	5
Yemen	54,336 (33,675, 76,059)	$0.72	$107.75 ($173.86, $76.97)	0.05	6.7
Zambia	22,388 (12,953, 32,574)	$0.98	$193.50 ($334.44, $132.99)	0.11	5.1
Zimbabwe	53,126 (32,709, 73,739)	$3.03	$260.33 ($422.83, $187.56)	0.52	11.6

a. Palestine, Somalia, Taiwan, and Sao Tome and Principe could not be included in this analysis due to lack of data.

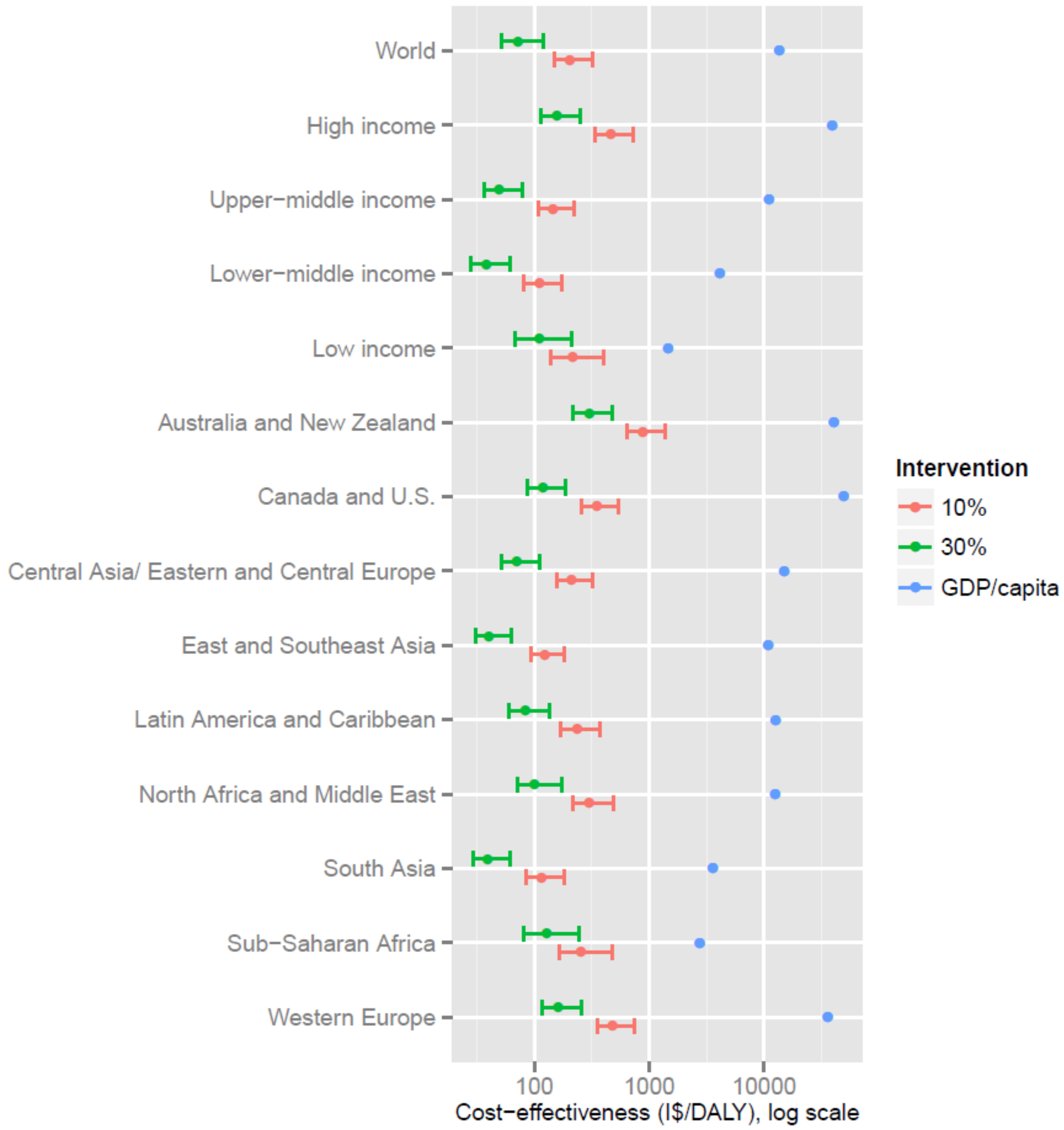
b. The eleven nations with estimated CERs between I$10,000 and I$30,000/DALY were Grenada, Kiribati, Iceland, Brunei, Tonga, Samoa, Qatar, Dominica, the Marshall Islands, Antigua and Barbuda, and Andorra.

eFigure 1. The relative contributions of intervention components to total cost by income and geographic region.



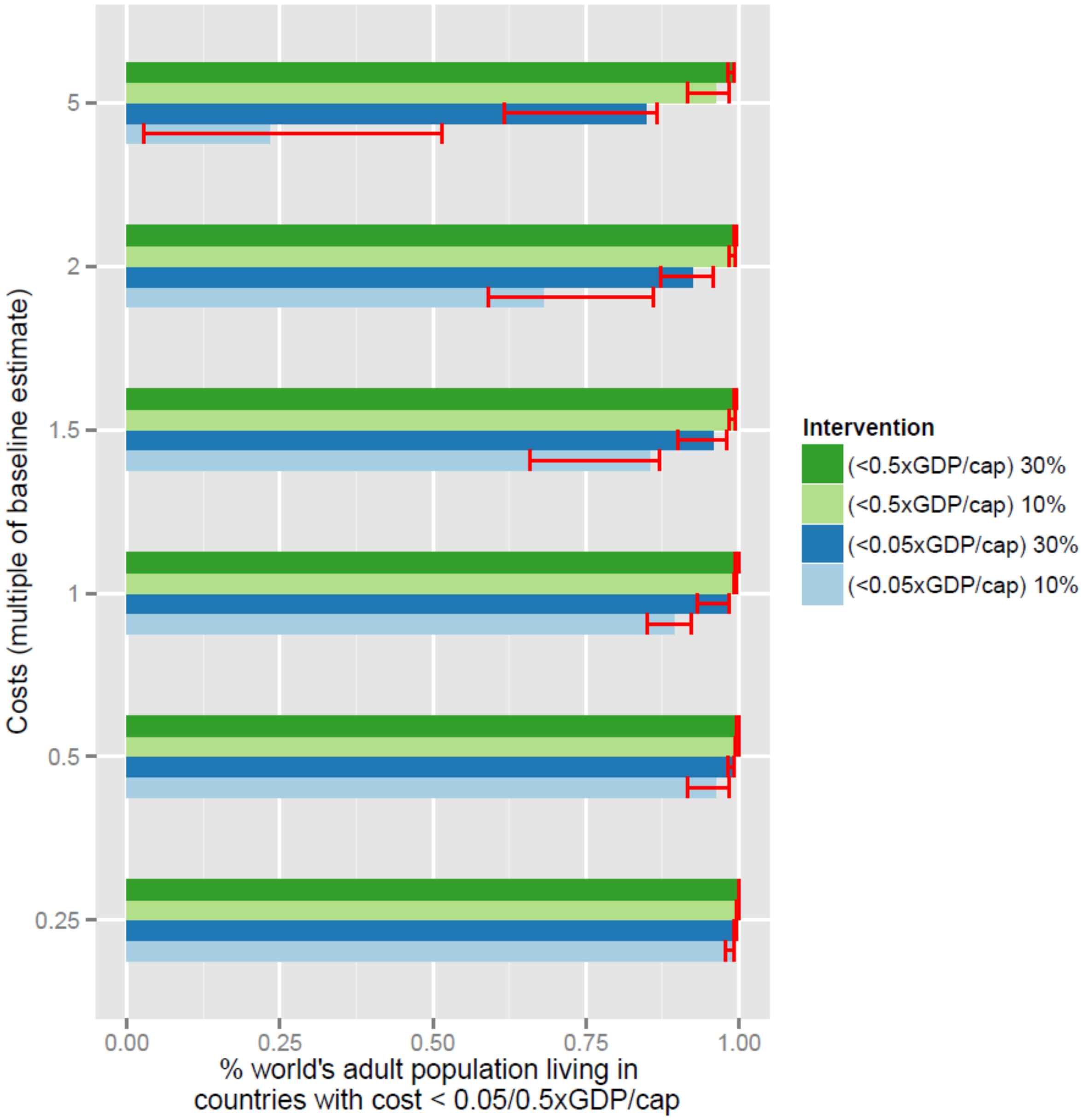
For each income and geographic region, the blue dot shows the cost per capita of supplies and equipment for the intervention, the light green dot the cost per capita of meetings, the pink dot the cost per capita of training, the orange dot the cost per capita of human resources, and the dark green dot the cost per capita of mass media.

eFigure 2. Cost-effectiveness (I$/DALY) by income and geographic region of interventions to reduce sodium consumption by 10% and 30%.



For each income and geographic region, the red point shows the intervention's cost-effectiveness (I$/DALY) and its 95% uncertainty interval assuming an achieved sodium intake reduction of 10%; the green point shows the same assuming a reduction of 30%; and the blue point shows the regional GDP per capita. All figures are population-weighted averages.

eFigure 3. Sensitivity analysis of intervention cost assuming 10% and 30% reductions with optimal intake 2g/day.



For each cost multiple (along the y-axis: 0.25, 0.5, 1, 1.5, 2, and 5 times the baseline cost), the dark and light green lines show the percentage of the world's adult population living in countries with intervention cost <0.5xGDP per capita assuming achieved sodium intake reductions of 30% and 10% respectively; the dark and light blue lines show the percentage of the world's adult population living in countries with intervention cost <0.05xGDP per capita again assuming achieved sodium intake reductions of 30% and 10% respectively.