Front-of-package warning labels save lives and resources: results from a modeling study in Barbados

Warning labels have the potential to avert 16% of the deaths caused by noncommunicable diseases and save USD 732.8 million in Barbados

September 2023

Background

The University of the West Indies and the Pan American Health Organization (PAHO) assessed the impact octagonal warning labels could have in improving diets and preventing deaths due to noncommunicable diseases (NCD) in Barbados. The study is the first of its kind in the Caribbean and contributes to the evidence-base from the Region of the Americas.

The study compared the status quo of no label as the baseline scenario against a counterfactual scenario in which the octagonal warning labels (OWL) (see **Figure 1**), included in the Regional Organisation for Standards and Quality (CROSQ) proposal for adoption by the Caribbean Community (CARICOM), would be implemented.

Figure 1. Octagonal warning labels for sugar, saturated fats, sodium, fats, and trans fats

Methods

The Preventable Risk Integrated ModEl (PRIME) was used to link four behavioral risk factors – diet, physical activity, tobacco smoking, and alcohol consumption – with mortality associated with 24 different NCD outcomes that include cardiovascular disease, cancer, kidney disease, liver disease, and chronic obstructive pulmonary disease. The links between these four behavioral risk factors and health outcomes are either direct or mediated through three metabolic risk factors: body mass index (BMI), blood cholesterol, and blood pressure. PRIME estimates the number of deaths from the NCD outcomes that would be delayed or averted as a result of positive changes in the prevalence of one or a combination of the four behavioral risk factors and, in turn, one or more of the three metabolic risk factors within the study population, between the baseline and the counterfactual scenarios. These improvements in the behavioral risk factors may occur as a consequence of a policy change or an intervention *(1)*.

The PRIME model was parametrized using Barbados context-specific and age- and sex-specific distributions of: (i) the number of people living in the population; (ii) diet, physical activity, tobacco smoking, and alcohol consumption in the population; and (iii) the annual number of deaths from each of the 24 NCDs included in the model. This constituted the baseline scenario of the model. The evidence on how the OWL is likely to affect the behavioral risk factors, by reducing the consumption of sodium, saturated fat, and added sugars, then served to parametrize the counterfactual scenario. The data of the baseline and counterfactual distributions and the relative risks linking behavioral risk factors and disease outcomes were then used to calculate a series of population attributable fractions; i.e., the proportional reduction in population disease or mortality that would occur if exposure to the behavioral risk factor were reduced to the counterfactual scenario.

This report used data from the Barbados National Salt Study, a sub-study of the Barbados Health of the Nation Survey, a cross-sectional survey conducted in 2011–2013 *(2–4)*. The survey recruited a nationally representative sample of adults aged ≥25 years (n = 1234) using multistage probability sampling. In the sub-study, a sample of 441 adults (aged 25–64 years) was randomly selected, stratified by sex and age group (25–44 and 45–64 years), with the aim of recruiting at least 100 persons in each group. Each study participant completed two non-consecutive, interviewer-administered, 24-hour dietary recalls. Data were collected during two face-to-face interviews, conducted at home, between June 2012 and November 2013. Dietary data were collected using the United States Department of Agriculture (USDA) multi-pass method *(5–6)*. This method follows five research-based steps, which aim to increase accuracy and reduce participant burden. Systematic probing of all foods and beverages consumed in the previous 24 hours, including supplements, was detailed. Information on serving sizes, portions eaten, and frequency of consumption were documented.

These dietary data were used to parametrize the baseline scenario in PRIME for the following dietary indicators: mean total energy intake (kcal/day), mean fruit intake (g/d), prevalence (%) consuming <1 fruit portion daily, mean vegetable intake (g/d), prevalence (%) consuming <1 vegetable portion daily, mean fiber intake (g/d), mean salt intake (g/d), mean total fat (% total energy), mean saturated fat (% total energy), mean monounsaturated fatty acid (% total energy), mean polyunsaturated fatty acid (% of total energy), and mean dietary cholesterol (mg/d).

Barbados-specific and age- and sex-specific distribution of the annual number of deaths from each of the 24 NCDs included in PRIME were obtained from the Global Burden of Disease estimates *(7)*. The 24 NCDs included cerebrovascular diseases, ischemic heart diseases; lip, oral cavity, and pharynx cancer; esophagus cancer, stomach cancer, bronchus and lung cancer, pancreas cancer, colorectum cancer, breast cancer, endometrium cancer, gallbladder cancer, kidney cancer, bladder cancer, liver cancer, cervix cancer, hypertensive disease, diabetes, chronic obstructive pulmonary diseases, liver disease, heart failure, aortic aneurysm, pulmonary embolism, rheumatic heart disease, and chronic renal failure.

No Barbados-specific data sources for physical activity, smoking, and alcohol consumption were used for this impact assessment. Default values already inputted in PRIME were used, assuming no changes to the distribution of physical activity, smoking, or alcohol consumption between baseline and counterfactual scenarios, since food warning labels are not expected to alter those.

For the counterfactual scenarios, it was assumed that the front-of-package (FOP) labeling policy is implemented on a mandatory basis; that the OWL design would be used, such as the one proposed in the CROSQ proposal for adoption by CARICOM; that all packaged products with added sugars, sodium, and saturated fat would be eligible to display the FOP label, if the content of these nutrients was in excess of predetermined nutrient thresholds. Added sugars, sodium, and saturated fat were chosen as the target nutrients in this impact assessment, and the PAHO Nutrient Profile Model *(8)* was used to determine the nutrient thresholds for added sugars, sodium, and saturated fat in packaged processed and ultra-processed products. This impact assessment also assumed no changes in the formulation of products by the food industry. The focus was changes in consumer response to the implementation of the FOP labeling policy only.

This impact assessment modeled potential changes in consumer response that are captured as mean changes in nutrients *(9–11)*. These changes amounted to a decrease in total energy (kcal/100 g) by 10%, decrease in sodium (mg/100 g) by 34.8%, decrease in saturated fat (g/100 g) by 25%, and decrease in added sugars (g/100 g) by 22%, from mean baseline amounts. In this study, only decreases in sodium (34.8%), decreases in saturated fat (25%), and decreases in added sugars (22%) were accounted for, to avoid double counting changes to total energy from both decreases in macronutrient contents and in energy per se.

To implement Counterfactual Scenario 1, the nutrition profile of foods eaten by each individual was decreased by the proportions mentioned, except for salt where the decrease was reflected at the level of the sample and not at the level of the individual. New estimates for each of the dietary indicators were generated, extracted, and inputted into the PRIME model to estimate changes in NCD mortality.

Finally, the economic impact of the estimated changes in NCD mortality was also assessed. The human capital approach was utilized to determine the potential productivity losses the economy could have averted with the implementation of OWL. This accounts for formal employment (i.e., labor force aged 15–64 years). The fixed age threshold for the years of potential life lost was 65 years and was adjusted for the labor force participation rate and the employment rate for males and females, respectively. To obtain a measure of worker productivity, the economic output (gross domestic product – GDP) of each full-time worker in the formal economy for Barbados was utilized.

To address the broader economic impact beyond productivity losses, the Value of a Statistical Life (VSL) was used. VSL supplies a value for mortality and captures the total welfare loss of premature mortality, beyond labor force and productivity losses. The calculation of the VSL has been based on empirical research on revealed preference derived from labor market and product market studies, and stated preference studies *(12)*. In this analysis, as in Viscusi and Masterman (2017), an elasticity of 1 was utilized *(13)*, and this yielded a VSL of USD 2 567 587.03 for Barbados in 2019.

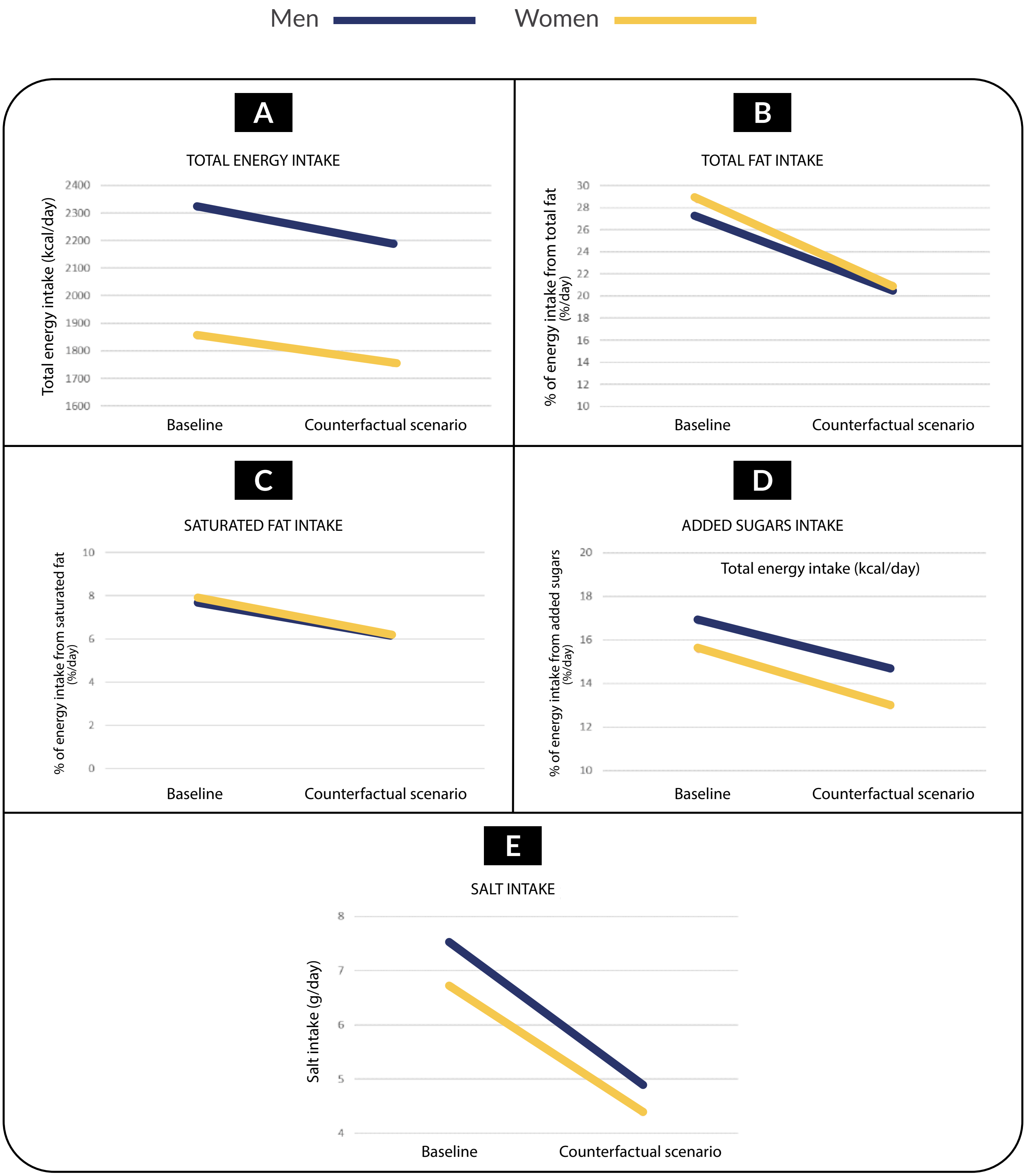
Results

Impact on diet

With the implementation of octagonal warning labels in Barbados, men would reduce mean energy intake by 5.6%, mean salt intake by one-third (34.7%), mean fat intake by 24.3%, mean saturated fat intake by 19.5%, and mean added sugars intake by 13%.

Among women, the mean energy intake would be reduced by 5.3%, mean salt intake by one-third (34.4%), mean fat intake by 27.4%, mean saturated fat intake by 20.5%, and mean added sugars intake by 16.7% (see **Figure 2)**.

Figure 2. Expected reductions in energy intake, total fat intake, saturated fat intake, added sugars intake, and salt intake with the adoption of octagonal warning labels in Barbados



Impact on NCDs

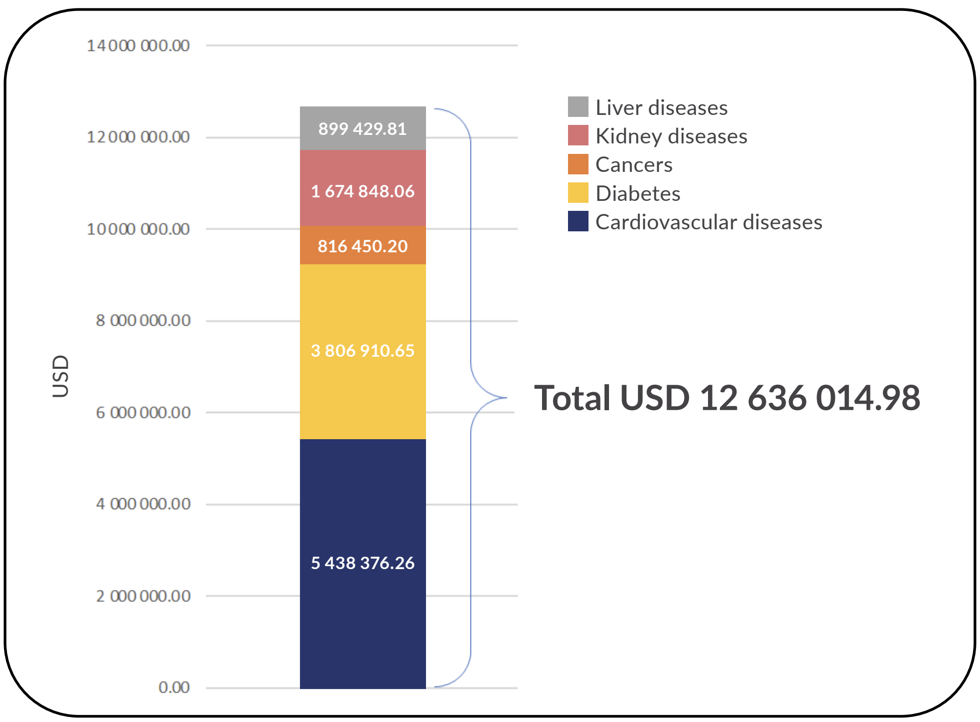
These changes in dietary risk factors attributed to the introduction of FOP OWL in Barbados would avert or delay approximately 16% of the deaths due to NCDs.

Out of the total number of deaths averted or delayed by warning labels, 57% would be from cardiovascular diseases, 29% from diabetes, 7% from kidney diseases, 2% from liver diseases, and 5% would be from cancers.

Impact on economy

The total productivity loss due to the absence of OWL was USD 12 636 014.98 for 2019 in Barbados (see **Figure 3**).

Figure 3. Value of employed workers' contribution to GDP lost due to the absence of OWL in Barbados, by categories of diseases, 2019



Note: GDP: gross domestic product.

When accounting for the broader economic impact beyond productivity losses, the monetized mortality loss due to the absence of OWL was **USD 732.8 million** (95% uncertainty interval [525.6 million, 910.7 million]).

Conclusions

Decreases in sodium, added sugars, and saturated fat intakes expected with the implementation of the octagonal warning labels in Barbados also resulted in a decreased energy intake. These modifications of dietary patterns translated into an increase in the total number of NCD-specific deaths that were avoided or delayed.

Given the conservative assumptions underpinning the counterfactual scenario, including the modeling of consumer-level behavior changes only as opposed to both consumer- and industry-level changes, the conservative decreases in nutrient profile modeled, and the costing estimates based on deaths only not including those associated with disabilities, the estimated effects in mortality and economic savings are very likely to be even higher than the ones shown here.

Nevertheless, the results already indicate that the implementation of a mandatory FOP warning labeling policy in Barbados could prevent at least 16% of deaths from diet-related NCDs and save USD 732.8 million in mortality costs, further supporting effective FOP labels as an important tool to protect public health.

The study supports the conclusion that the current CROSQ proposal for a subregional standard on FOP labeling, which includes OWL, provides the best option available to protect the population's healthy diet and health.

Acknowledgments

PAHO gratefully acknowledges the contributions from the following: Neha Khandpur (Division of Human Nutrition and Health, Wageningen University, Wageningen, the Netherlands; Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, MA, United States of America; Department of Nutrition, School of Public Health, University of São Paulo, São Paulo, Brazil); Rachel Harris (The University of the West Indies, Bridgetown, Barbados); Angela M.C. Rose (Epiconcept, France); Nigel Unwin (The George Alleyne Chronic Disease Research Centre, Caribbean Institute for Health Research, The University of the West Indies, Bridgetown, Barbados; MRC Epidemiology Unit, University of Cambridge, Cambridge, United Kingdom; European Centre for Environment and Human Health, University of Exeter Medical School, Truro, United Kingdom); Eduardo Nilson (Center for Epidemiological Studies in Health and Nutrition, Faculty of Public Health, University of São Paulo, São Paulo, Brazil; Oswaldo Cruz Foundation, FIOCRUZ, Brazil); Felicia Carter and Taraleen Nichola Malcolm (Office of the Eastern Caribbean Countries, PAHO); and Fabio S. Gomes and Kimberly-Ann Gittens-Baynes (Department of Noncommunicable Diseases and Mental Health, PAHO). PAHO also acknowledges the support from Resolve to Save Lives.

References

1. Scarborough P, Harrington RA, Mizdrak A, Zhou LM, Doherty A. The preventable risk integrated ModEl and its use to estimate the health impact of public health policy scenarios. Scientifica (Cairo). 2014;2014:748750.
2. Harris RM, Rose AMC, Forouhi NG, Unwin N. Nutritional adequacy and dietary disparities in an adult Caribbean population of African descent with a high burden of diabetes and cardiovascular disease. Food Sci Nutr. 2020;8(3):1335–1344.
3. Harris RM, Rose AMC, Hambleton IR, Howitt C, Forouhi NG, Hennis AJM, et al. Sodium and potassium excretion in an adult Caribbean population of African descent with a high burden of cardiovascular disease. BMC Public Health. 2018;18(1):998.
4. Howitt C, Hambleton IR, Rose AM, Hennis A, Samuels TA, George KS, et al. Social distribution of diabetes, hypertension and related risk factors in Barbados: a cross-sectional study. BMJ Open. 2015;5(12):e008869.
5. Raper N, Perloff B, Ingwersen L, Steinfeldt L, Anand J. An overview of USDA's dietary intake data system. J Food Comp Anal. 2004;17(3–4):545–555.
6. Rhodes DG, Murayi T, Clemens JC, Baer DJ, Sebastian RS, Moshfegh AJ. The USDA Automated Multiple-Pass Method accurately assesses population sodium intakes. Am J Clin Nutr. 2013;97(5):958–964.
7. Institute for Health Metrics and Evaluation. Global Burden of Disease 2019. Seattle: University of Washington; 2020. Available from: https://vizhub.healthdata.org/gbd-results.
8. Pan American Health Organization. Pan American Health Organization Nutrient Profile Model. Washington, D.C.: PAHO; 2016. Available from: https://iris.paho.org/handle/10665.2/18621.
9. Acton RB, Jones AC, Kirkpatrick SI, Roberto CA, Hammond D. Taxes and front-of-package labels improve the healthiness of beverage and snack purchases: a randomized experimental marketplace. Int J Behav Nutr Phys Act. 2019;16(1):46.
10. Machín L, Curutchet MR, Giménez A, Aschemann-Witzel J, Ares G. Do nutritional warnings do their work? Results from a choice experiment involving snack products. Food Qual Prefer. 2019;77:159–165.
11. Machín L, Aschemann-Witzel J, Curutchet MR, Giménez A, Ares G. Does front-of-pack nutrition information improve consumer ability to make healthful choices? Performance of warnings and the traffic light system in a simulated shopping experiment. Appetite. 2018;121:55–62.
12. Kniesner TJ, Viscusi WK. The Value of a Statistical Life. Oxford Research Encyclopedia of Economics and Finance, Vanderbilt Law Research Paper No. 19-15. Oxford: Oxford University Press; 2019. Available from: https://doi.org/10.1093/acrefore/9780190625979.013.138.
13. Viscusi WK, Masterman CJ. Income elasticities and global values of a statistical life. J. Benefit Cost Anal. 2017;8(2):226–250.

PAHO/NMH/RF/23-0040