

Nutrient Warnings:

Summary of the Scientific Literature and Policy Recommendations

Nutrient warnings, including warnings on packaged foods and restaurant menus, can be used to show when a food or drink has high levels of calories or unhealthful nutrients like sodium, saturated fat, and added sugars. The overconsumption of these nutrients can lead to hypertension,¹ high LDL cholesterol,² or excess weight,³ which are major risk factors for cardiovascular disease,⁴ type 2 diabetes,⁵ or cancer.⁶ As of December 2021, calorie and nutrient warnings (including for sodium, saturated fat, and sugar) are required on packaged food and beverage labels in five countries (Chile, Peru, Uruguay, Mexico, and Israel) and similar laws have passed but are not yet implemented in three additional countries (Brazil, Colombia, and Argentina).^{7,8,9} In addition, sodium warnings are required on restaurant menus in two U.S. cities (New York and Philadelphia).^{10,11}

In this factsheet, we review relevant, scientific literature on nutrient warnings for a science and policy audience. Overall, evidence from randomized controlled trials and real-world studies suggests that nutrient warnings can increase consumers' understanding of the healthfulness of foods and have the potential to play a role in reducing purchases of foods and drinks high in calories, sodium, and added sugars. To maximize public health impact, policymakers should design nutrient warnings to be simple, highly visible, and convey information with shapes, icons, and other imagery in addition to text.



Figure 1: Warnings are required on products high in calories, sugars, sodium, and saturated fat in Chile

What does the experimental evidence tell us about the impact of nutrient warnings?

Nutrient warning labels improve consumers' understanding of the (un)healthfulness of foods.

Experiments have found that viewing products with nutrient warning labels improves understanding of the healthfulness or unhealthfulness of foods compared to viewing products with no label or with more complex and/or less interpretive front-of-package labels.

In one study, nutrient warning labels increased participants' odds of correctly identifying a product as high in saturated fat (OR=1.41-2.95 across 5 different nutrient warning formats that were tested) or high in sugar (OR=1.21-1.60), with statistically significant increases in the odds of a correct response for most warning formats compared to the no-label control (p<0.01).¹²

Four other studies found that nutrient warnings had a statistically significantly greater impact on participants' ability to correctly assess whether products contained excess amounts of certain nutrients compared to traffic light labels^a (p<0.001),¹³ Guideline Daily Amount (GDA) labels^b (p<0.001),¹⁴ and no label (p<0.05).^{15,16}

Three of these studies, plus one additional study, also found that participants who viewed products with nutrient warning labels were more often able to accurately identify the most healthful product in a pair or set than those who viewed products with no label,^{17,18} or with GDA labels^{19,20} (p<0.001 in all four studies).

^a Traffic light labels display calorie and nutrient amounts per serving, and their equivalent percentage contribution to an adult's daily needs, with colors (red, yellow, green) indicating high, medium, or low amounts.

^b Guideline Daily Amount labels display calorie and nutrient amounts per serving but provide no color interpretation.

Other experiments have assessed whether consumers can use warning labels to accurately rank the nutritional quality of three products (Highest, Medium, and Lowest) across three product categories (cakes, pizzas, and breakfast cereals). In the largest study, participants had statistically significantly higher odds of correctly ranking products after viewing warnings compared to Reference Intake labels (OR=1.28 [95% CI 1.15-1.43]).²¹ In the smaller studies, warning labels only helped accurately rank the nutritional quality of cakes and not pizzas or breakfast cereals.^{22,23}

Overall, studies consistently show positive effects of nutrient warning labels on outcomes related to participants' understanding of product healthfulness.

Nutrient warnings show potential to affect the nutritional quality of purchases, warranting further investigation.

Findings from experimental studies assessing the impact of nutrient warnings on purchasing or selection of foods and beverages are promising. Larger studies have found statistically significant effects of nutrient warnings on decreasing purchases of unhealthful nutrients, but findings from smaller studies have been inconsistent.

Two of three studies that looked at the impact of nutrient warnings on nutrients in selected restaurant meals found that warnings have an effect. One large study (>1,400 participants in each group) found statistically significant reductions in average sodium ordered after viewing menus with the red stop sign and traffic light sodium warnings pictured in Figure 2 (-46 mg and -68 mg per meal, respectively, compared to the no-label control; $p < 0.05$).²⁴ Another study (~225 participants per study arm) found a statistically significant difference in the percentage of participants who selected a meal or beverage with excessive content of at least one nutrient (total fat, saturated fat, sodium, or sugar) between the warning label and control group (76% vs. 62%, $p = 0.002$).²⁵ However, a third study (<140 participants per study arm) found no differences in average sodium after viewing a menu labeled with calorie counts and sodium warnings compared to either calories-only and no-label groups.²⁶



Figure 2: Sodium stop sign (left) and traffic light (right) warnings

Other studies looked at purchasing or selection of drinks, snacks, or groceries. One large study (>700 participants in each treatment group) that looked at the impact of nutrient warning labels on beverage and snack purchases found small but statistically significant ($p < 0.05$) decreases in sugar (-2.5 g), saturated fat (-0.1 g), and calories (-13) in purchased beverages, and in calories (-9) and sodium (-13 mg) in purchased snacks, compared to the no-label control group (no significant differences were observed for sodium for beverages or sugar and saturated fat in snacks).²⁷ Another study (350-425 participants per study arm) found a statistically significant ($p < 0.05$) effect of nutrient warnings on calories (-11 kcal/100g), sugar (-0.9 g/100g), saturated fat (-0.3 g/100g), and sodium (-76 mg/100g) in groceries selected to cook one meal, compared to the control group.²⁸

Findings from smaller studies were more mixed. One study (~100 participants per study arm) found 12% less calories, 43% less added sugars, 43% less saturated fat, and 50% less sodium in snacks selected by participants who viewed snacks with warning labels versus those who viewed snacks without ($p < 0.05$).²⁹ Two smaller studies (each with fewer than 200 participants per study arm) found that nutrient warnings for sugar led to modest reductions in the selection of drinks and/or foods that were high in sugar, but these findings were not statistically significant.^{30,31} Another small study (<150 participants per study arm) found no statistically significant differences in the energy density, sugar, saturated fat, or salt content of selected products among participants in a warning label versus a no-label control condition.³²

These mixed findings suggest that nutrient warning labels have the potential to affect the nutritional quality of foods purchases in controlled settings, but further investigation is warranted.

What does the real-world evidence tell us about nutrient warning labels?

Nutrient warnings show promise for improving diets.

Studies evaluating the effects of Chile’s nutrient warning label policy have compared purchasing data from before and after the policy’s implementation in June 2016 and reveal important reductions in purchases of calories and overconsumed nutrients.

One study of purchasing data from 2,381 Chilean households found statistically significant declines in overall calories (-3.5%), calories from sugar (-10.2%), calories from saturated fat (-3.9%), and mg of sodium (-4.7%) purchased from packaged foods (*see* Figure 3).³³

Another study looking specifically at beverage purchases in the same study population found a statistically significant 7.5% decrease in calories from beverage purchases, driven by a 27.5% decline in calories from beverages with ‘high in’ labels (primarily ‘high in’ sugar), but partially offset by an increase in purchases of calories from healthier beverages.³⁴

A third study analyzed scanner-level data from Walmart-Chile, the country’s largest supermarket retailer. This study found that sugar content of Walmart purchases decreased from 27.3 g to 24.9 g per dollar spent, and calorie content decreased from 488 to 457 kcal per dollar.³⁵

Overall, while studies have not yet evaluated the impact of Chile’s (or any other country’s) nutrient warning label policy on overall diet quality, purchasing data give reason for optimism.

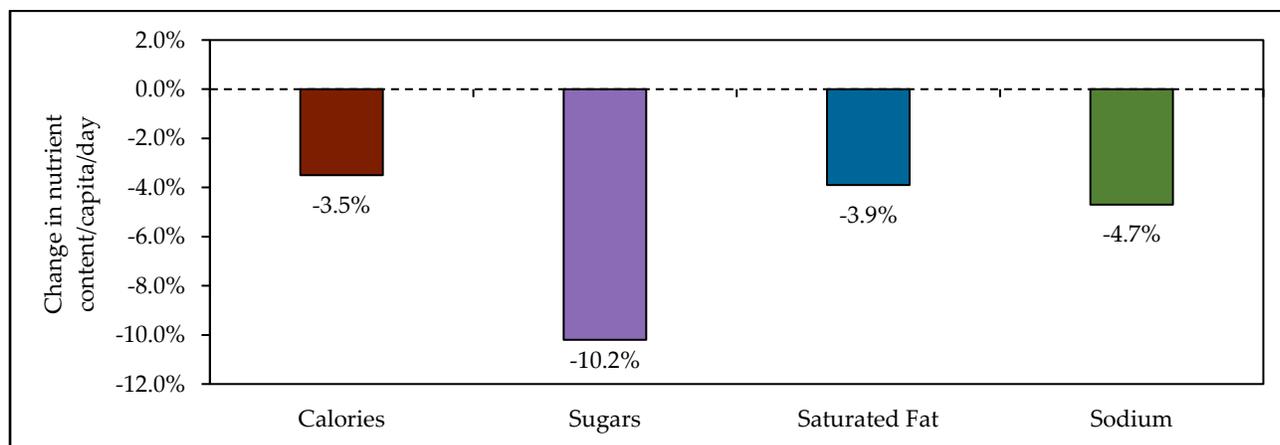


Figure 3: Mean percent differences in nutrient content of foods purchased in Chile between estimated post-policy purchases and counterfactual scenario, adapted from Taillie et al., 2021.

The food industry is reformulating products to avoid nutrient warning labels.

Policies requiring nutrient warnings may push the food industry to make their products healthier. A serial cross-sectional study that looked at thousands of packaged foods and beverages sold in Chile found a statistically significant decrease in the proportion of food and beverages requiring at least one “high in” label, from 51% to 44%, several months after the country’s warning label law took effect.³⁶ The most frequent reductions were found in the proportion of ‘high in’ sugar and ‘high in’ sodium products, but there were also decreases in ‘high in’ saturated fat and calories products in certain food categories.

A longitudinal evaluation study looked at a smaller sample of 476 packaged foods commonly consumed in Chile and found a statistically significant 15% decrease in the proportion of foods meeting the criteria for ‘high in’ sugar labels from 2013 to 2019 ($p=0.001$), as well as smaller (non-significant) declines in the proportions of foods meeting criteria for ‘high in’ calories (-3.9%), saturated fat (-1.5%), and sodium (-9.2%) labels.³⁷

These studies indicate that food companies may be making changes in food formulation to avoid warning labels on their products.

Policymakers should design nutrient warnings to maximize their impact.



Figure 4: Examples of text-only, icon-and-text, and graphic-and-text warnings for added sugar

A recent review paper made several recommendations for front-of-package nutrition labels to have maximum public health impact,³⁸ specifying that labels should:

- be highly visible and salient
- convey a simple and easy-to-understand message(s)
- limit or avoid numeric information
- use symbols and colors that leverage automatic associations to help consumers interpret nutrition information quickly and accurately (e.g., stop signs, letter grades, traffic lights)
- integrate informational and emotional messaging
- warn or caution consumers (e.g., use words/phrases like excess, high in, avoid, or warning)

In addition to these recommendations, a large body of tobacco research suggests that including symbols and imagery in warning labels can increase the impact of warnings on behavior.^{39,40,41} Experimental studies confirm that these findings translate to sugar warnings. For example, one study tested three different label formats on sugary drinks (see Figure 4) and found that icon and graphic warnings led to lower intentions to purchase sugary drinks compared to text-only warnings ($p<0.001$).⁴² While several studies have shown that text-only warnings still out-perform controls without warnings, including a combination of text and pictorial elements can help boost the impact of warnings.

Policymakers should design nutrient warnings with attention to health equity.

Warning label policies aim to equip consumers with nutrition information to encourage healthier choices and push companies to improve the healthfulness of their products. Neither of these aims dismantles the structural barriers that produce current health and nutrition disparities. Mitigating these disparities will require coordinated and sustained social and economic change to reduce inequitable distribution of constraints on food choice such as physical and financial access to resources to support a healthy life.

That said, warning label policies should be designed with attention to equity in order to maximize the equitable distribution of their benefits. Ensuring that warning labels are understood and utilized across diverse populations can help prevent these policies from exacerbating health disparities.

Existing tools for consumers to gain access to nutrition information on foods (e.g., the Nutrition Facts label) tend to require nutrition literacy and numeracy skills⁴³ and are utilized less by people with less education and income.^{44,45} In contrast, some studies suggest warning labels are at least as accessible for people with lower versus higher levels of education and income.^{46,47}

Warning label policies can also consider equity by being designed to ensure they include the communities most unjustly burdened by health disparities. For example, policies that apply to fast food restaurants, which are disproportionately located in under-resourced communities,^{48,49} would be more likely to benefit these communities than policies targeting chain grocery stores, which disproportionately fail to serve under-resourced communities.^{50,51}

Policy Recommendations

The Food and Drug Administration (FDA) should require nutrient warnings on packaged foods.

The Nutrition Labeling and Education Act of 1990 authorizes the FDA to require that foods bear nutrition information in a “readily observ[able]” location, such as on the front-of-package.⁵² FDA should follow the evidence and utilize its authority to require nutrient warning labels on packaged foods.



States and localities should require warnings on restaurant menus and grocery store shelves.

Federal law also permits states and localities to require statements on food labels and restaurant menus “concerning the safety of the food or component of the food.”^{53,54} New York City and Philadelphia have both enacted policies requiring sodium warning icons on restaurant menu items that contain more than a day’s worth of sodium. More cities and states should consider requiring warnings for sodium and other nutrients on restaurant menus and explore new policy interventions such as nutrient warnings on shelves at grocery stores, convenience stores, and other retailers.



Research Recommendations

Future research should explore whether nutrient warning labels are associated with changes in diet and health outcomes. Longitudinal studies of nutrient warning labels should collect data on outcomes such as consumption of foods high in unhealthy nutrients. More real-world research is needed on the supply-side effects of warning label policies, such as reformulation. Furthermore, real-world studies should examine subgroup effects of nutrient warnings to understand whether warning label policies have any greater or lesser impact on sociodemographic groups facing nutrition and health disparities.

Funding

This fact sheet was supported by grant #76290 from the Robert Wood Johnson Foundation through its Healthy Eating Research Program.

Citations

- ¹ National Academies of Sciences, Engineering, and Medicine. 2019. *Dietary Reference Intakes for Sodium and Potassium*. Washington, DC: The National Academies Press. Available at: <https://www.nap.edu/catalog/25353/dietary-reference-intakes-for-sodium-and-potassium>. Accessed August 27, 2021.
- ² Sacks FM, et al. Dietary fats and cardiovascular disease: a presidential advisory from the American Heart Association. *Circulation*. 2017;136:e1-e23.
- ³ de Ruyter JC, et al. A trial of sugar-free or sugar-sweetened beverages and body weight in children. *N Engl J Med*. 2012;367(15):1397-406.
- ⁴ Sacks (2017).
- ⁵ de Ruyter (2012).
- ⁶ National Cancer Institute. *Obesity and Cancer*. 2017. Available at: <https://www.cancer.gov/about-cancer/causes-prevention/risk/obesity/obesity-fact-sheet>. Accessed August 30, 2021.
- ⁷ Global Food Research Program at University of North Carolina at Chapel Hill. Countries with mandatory or voluntary interpretive labels on packaged foods and drinks. Available at: https://www.globalfoodresearchprogram.org/wp-content/uploads/2018/11/FOP_Label_Regulations_maps.pdf. Accessed August 25, 2021.
- ⁸ Michail N. *Colombian government and food industry reveal mandatory warning label design*. Food Navigator. March 2, 2020. <https://www.foodnavigator-latam.com/Article/2020/03/02/Colombian-government-and-food-industry-reveal-mandatory-warning-label-design>. Accessed December 2, 2021.
- ⁹ Organización Panamericana de la Salud. *OPS/OMS celebra la aprobación de la nueva ley de promoción de la alimentación saludable de Argentina*. October 27, 2021. <https://www.paho.org/es/noticias/27-10-2021-opsoms-celebra-aprobacion-nueva-ley-promocion-alimentacion-saludable-argentina>. Accessed December 2, 2021.
- ¹⁰ NYC Health. *Sodium Initiatives*. n.d. Available at: <https://www1.nyc.gov/site/doh/health/health-topics/national-salt-reduction-initiative.page>. Accessed August 30, 2021.
- ¹¹ Food Fit Philly. *Sodium Warning Label*. n.d. Available at: <http://foodfitphilly.org/sodium-warning-label/>. Accessed August 30, 2021.
- ¹² Goodman S, et al. The impact of front-of-package label design on consumer understanding of nutrient amounts. *Nutrients*. 2018;10:1624.
- ¹³ Khandpur N, et al. Are front-of-package warning labels more effective at communicating nutrition information than traffic-light labels? A randomized controlled experiment in a Brazilian sample. *Nutrients*. 2018;10:688.
- ¹⁴ Deliza R, et al. How do different warning signs compare with the guideline daily amount and traffic-light system? *Food Quality and Preference*. 2019.
- ¹⁵ Khandpur N, et al. Choosing a front-of-package warning label for Brazil: A randomized, controlled comparison of three different label designs. *Food Research International*. 2019;121:854-861.
- ¹⁶ Bandeira LM, et al. Performance and perception on front-of-package nutritional labeling models in Brazil. *Revista de Saude Publica*. 2021;55(19):1-12.
- ¹⁷ Khandpur (2018).
- ¹⁸ Khandpur (2019).
- ¹⁹ Arrúa A, et al. Warnings as a directive front-of-pack nutrition labelling scheme: comparison with the Guideline Daily Amount and traffic-light systems. *Public Health Nutr*. 2017;20(13):2308-2317.
- ²⁰ Deliza (2019).
- ²¹ Egnell M, et al. Objective understanding of front-of-package nutrition labels: an international comparative experimental study across 12 countries. *Nutrients*. 2018;10:1542.
- ²² Egnell M, et al. Consumers' responses to front-of-pack nutrition labelling: results from a sample from the Netherlands. *Nutrients*. 2019;11:1817.
- ²³ Egnell M, et al. Comparison of front-of-pack labels to help German consumers understand the nutritional quality of food products. *Ernaehrungs Umschau International*. 2019;5:76-84.
- ²⁴ Musicus AA, et al. Online randomized controlled trials of restaurant sodium warning labels. *Am J Prev Med*. 2019;57(6):e181-e193.
- ²⁵ Gugliucci V, et al. Do nutritional warnings work on food ordering websites? An exploratory experimental study in Uruguay. *Public Health Nutr*. 2021;24(11):3547-3551.

-
- ²⁶ Byrd K, et al. Adding sodium information to casual dining restaurant menus: beneficial or detrimental for consumers? *Appetite*. 2018;125:474-485.
- ²⁷ Acton RB, et al. 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.
- ²⁸ Machín L, et al. 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.
- ²⁹ Machín L, et al. Do nutritional warnings do their work? Results from a choice experiment involving snack products. *Food Quality and Preference*. 2019;77:159-165.
- ³⁰ Acton RB, Hammond D. The impact of price and nutrition labelling on sugary drink purchases: results from an experimental marketplace study. *Appetite*. 2018;121:129-137.
- ³¹ Ang FJL, Agrawal S, Finkelstein EA. Pilot randomized controlled trial testing the influence of front-of-pack sugar warning labels on food demand. *BMC Public Health*. 2019;19(1):164.
- ³² Machín L, et al. Can nutritional information modify purchase of ultra-processed products? Results from a simulated online shopping experiment. *Public Health Nutr*. 2017;21(1):49-57.
- ³³ Taillie LS, et al. Changes in food purchases after Chile's policies on food labeling, marketing, and sales in schools: a before and after study. *Lancet Planet Health*. 2021;5(8):e526-e533.
- ³⁴ Taillie LS, et al. An evaluation of Chile's Law of Food Labeling and Advertising on sugar-sweetened beverage purchases from 2015 to 2017: A before-and-after study. *PLoS Med*. 2020;17(2):e1003015.
- ³⁵ Barahona N, et al. Equilibrium effects of food labeling policies. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3698473. Accessed August 25, 2021.
- ³⁶ Reyes M, et al. Changes in the amount of nutrient of packaged foods and beverages after the initial implementation of the Chilean Law of Food Labelling and Advertising: a nonexperimental prospective study. *PLoS Med*. 2020;17(7):e1003220.
- ³⁷ Scarpelli DQ, et al. Changes in nutrient declaration after the Food Labeling and Advertising Law in Chile: a longitudinal approach. *Nutrients*. 2020;12:2371.
- ³⁸ Roberto CA, et al. The influence of front-of-package nutrition labeling on consumer behavior and product reformulation. *Annu. Rev. Nutr*. 2021;11(43):22.1-22.22.
- ³⁹ Noar SM, et al. Pictorial cigarette pack warnings: a meta-analysis of experimental studies. *Tob Control*. 2016;25(3):341-354.
- ⁴⁰ Noar SM, et al. The impact of strengthening cigarette pack warnings: systematic review of longitudinal observational studies. *Social Science & Medicine*. 2016;164:118-129.
- ⁴¹ Brewer NT, et al. Effect of pictorial cigarette pack warnings on changes in smoking behavior: a randomized clinical trial. *JAMA Intern Med*. 2016;176(7):905-912.
- ⁴² Hall MG, et al. Designing warnings for sugary drinks: a randomized experiment with Latino parents and non-Latino parents. *Prev Med*. 2021;148:106562.
- ⁴³ Persoskie A, Hennessy E, Nelson WL. US consumers' understanding of nutrition labels in 2013: the importance of health literacy. *Prev Chronic Dis*. 2017;14:170066.
- ⁴⁴ Blitstein JL, Evans WD. Use of Nutrition Facts Panels among adults who make household food purchasing decisions. *J Nutr Educ Behav*. 2006;38:360-364.
- ⁴⁵ Christoph MJ, et al. Nutrition Facts: who is using them, what are they using, and how does it relate to dietary intake? *J Acad Nutr Diet*. 2018;118(2):217-228.
- ⁴⁶ Grummon AH, et al. How should sugar-sweetened beverage health warnings be designed? A randomized experiment. *Prev Med*. 2019;121:158-166.
- ⁴⁷ Machin L, et al. Consumer perception of the healthfulness of ultra-processed products featuring different front-of-pack nutrition labeling schemes. *Journal of Nutrition Education and Behavior*. 2017;49(4):330-338.
- ⁴⁸ Hilmers A, Hilmers DC, Dave J. Neighborhood disparities in access to healthy foods and their effects on environmental justice. *Am J Public Health*. 2012;102(9):1644-1654.
- ⁴⁹ James P, et al. Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States?. *Health & Place*. 2014;29:10-17.
- ⁵⁰ Richardson AS, et al. Are neighbourhood food resources distributed Inequitably by income and race in the USA? Epidemiological findings across the urban spectrum. *BMJ Open*. 2012;2(2):e000698.
- ⁵¹ Odoms-Young AM, et al. Obesity and the food environment among minority groups. *Current Obesity Reports*. 2012;1:141-151.
- ⁵² Pub. L. 101-535, §2(a), Nov. 8, 1990, 104 Stat. 2364.
- ⁵³ Pub. L. 101-535, §6(c), Nov. 8, 1990, 104 Stat. 2364.
- ⁵⁴ Pub. L. 111-148, title IV, §4205(d), Mar. 23, 2010, 124 Stat. 576.