PAN AMERICAN JOURNAL
OF PUBLIC HEALTH

Efficacy of different front-of-package labeling systems in changing purchase intention and product healthfulness perception for food products in Argentina

Luciana Castronuovo[1], Maria Victoria Tiscornia[1], Leila Guarnieri[1], Enrique Martins[1], Fabio S Gomes[2], Lorena Allemandi[1]

ABSTRACT

Objectives. To identify the front-of-package scheme—Multiple Traffic Light (MTL), Nutri-Score (NS), and black octagon Warning System (WS)—most effective in reducing purchase intention and perceived product healthfulness of drinking yogurts, cookies and cheese spreads, and to assess the joint influence of nutrient claims on the effects.

Methods. Randomized-controlled experiment. A within-subjects factorial design was used to evaluate the influence of three independent factors on perceived product healthfulness and purchase intention. A total of 704 adults in Argentina were shown three mock-up products and asked to indicate which product they would buy choosing between pairs of products from different categories and to rate product healthfulness on a 7-point Likert scale.

Results. The WS was the most effective in reducing purchase intention in drinking yogurts (OR:0.16, 95%CI: 0.09;0.28), cookies (OR:0.10, 95%CI: 0.05;0.18) and cheese spreads (OR:0.10, 95%CI: 0.05;0.18), and the perception of healthfulness (WS Mean score 3,63 vs No label 4,24, $p<0.001$), regardless of the participants' gender, age, and level of education. NS was inefficacious in reducing product healthfulness perception, while MTL had significantly increased how healthful the product was perceived ($p<0.001$). Nutrient claims increased purchase intention and perception of healthfulness, thus reducing the effectiveness of front-of-package labels ($p<0.001$).

Conclusions. In line with growing evidence, our findings support that WS perform better than NS and MTL in reducing purchase intention and healthfulness perception of products with excessive amounts of critical nutrients associated with the greatest burden of diseases. Front-of-package WS are expected to facilitate the population in Argentina to make healthier decisions.

Keywords   Nutrition policy; food labeling; health policy; diet, healthy; Argentina.

Overweight and obesity have increased dramatically over the past few years, posing one of the greatest global challenges in public health. In Argentina, the most recent data indicate overweight and obesity affect 41.1% of children and teenagers between 5 to 17 years of age and almost 70% of adults, with significant disparities in the prevalence of overweight across genders and educational levels (1).

Front-of-package (FOP) labeling has been identified as an effective policy tool to promote changes in consumer behavior and facilitate healthier food choices (2). There are different

[1]   Fundación Interamericana del Corazón Argentina, Buenos Aires, Argentina. ✉ Luciana Castronuovo, luciana.castronuovo@ficargentina.org

[2]   Pan American Health Organization, Washington DC, United States of America

types of FOP labels available, based on the type of nutritional information they provide. Non-directive labels, such as the Guideline Daily Amount (GDA) system, provide nutrient content data, as absolute values or percentage of recommended daily intake. In contrast, directive systems are designed to assist consumers in identifying a healthier or a more harmful product (e.g., Nutri-Score) or the harmful presence of a critical nutrient (e.g., nutritional warning labels), while semi-directive systems provide information on multiple levels (low, medium and high) of critical nutrients (e.g., Multiple Traffic Light), following pre-established cut-offs or algorithms (3).

Research shows that semi-directive and directive FOP labels exert a different effect in improving the consumers' ability to understand nutritional information and discouraging consumption of less healthful food products depending on the type of FOP (4–7). The scientific literature is consistent in concluding that FOP nutritional warnings labels perform better than other systems in meeting the purpose of informing consumers about the excessive amounts of critical nutrients associated with the greatest burden of diseases (2,8). In addition, there is growing evidence that health and nutrient claims on food products influence purchase intention by increasing perceived nutritional quality of less healthful products (9,10). However, more research is still needed to assess how FOP label schemes may affect consumer choices among different socioeconomic groups and genders and contribute to health disparities, particularly in low and middle-income countries. Additionally, the efficacy and effectiveness of different FOP labels may vary in different socioeconomic and cultural contexts, so country-specific data also helps to inform policy-making processes.

Over the past few years, several Latin American countries approved mandatory FOP labeling systems in food products: Brazil, Chile, Ecuador, Mexico, Peru, Uruguay and, most recently, Argentina (11–16). The Bill on the Promotion of Healthy Eating, also known as the "Front-of-Package Labeling Law", which includes black octagon warnings for products exceeding the thresholds found in the Pan American Health Organization (PAHO)'s nutrient profile model, was passed by the Argentine Congress in October 2021, and regulated by the National Executive Branch in March 2022 (15).

The research presented in this paper is part of a more comprehensive, multi-component study to generate local evidence to support effective FOP nutrient label policies in Brazil and Argentina. The general objective of this specific study was to determine which of the FOP label schemes was better at facilitating healthier food choices among consumers in Argentina: a black octagonal warning system featuring nutrients in excess (WS), as included in the bill, Nutri-Score (NS), or Multiple Traffic Lights (MTL). The MTL includes numeric data on critical nutrients accompanied by a traffic-light color scheme (green, amber, red) to indicate "low", "medium" and "high", respectively, contents of each nutrient as established by the UK's Food Standards Agency (17). Nutri-Score is partially based on the nutrient content thresholds set by the UK's Food Standards Agency but adapted to the French context by the French High Council for Public Health (18). These thresholds are added to non-nutrient parameters in an algorithm used to compute an overall healthfulness score for each food product, allocating negative points for less healthful content (energy, total sugar, total fat, etc.) and positive points for more healthful nutrients (proteins, fruit, etc.). Products are classified on a 5-point scale

(from A to E) accompanied by a color gradient scheme ranging from green to red to indicate higher nutritional quality products on the green/A end of the scale, and more unhealthful products on the red/E end. Finally, the WS displays black "stop" warning signs on products that contain excessive amounts of sugars, sodium, total and saturated fats, according to the nutrient content cut-offs set by PAHO's Nutrient Profile Model (19).

The specific objectives of this study were to determine which system had the highest impact on purchase intention and perceived product healthfulness, and to evaluate how these outcomes are affected by the influence of nutrient claims and different FOP labels.

METHODS

Study design

A randomized-controlled experiment was carried out. This in-person survey used a within-subjects (partial factorial) design to evaluate the influence of three independent factors on perceived product healthfulness and purchase intention. These factors were:

a) Product category—three most sold product categories (20) that contain at least one critical nutrient in excess according to the PAHO Nutrient Profile Model (19): cookies, drinking yogurts and cheese spreads.
b) FOP labeling system—three systems and a *status quo* condition (absence of FOP label) were included in the study: MTL, NS, WS, and no FOP label.
c) Nutrient claims—the study analyzed the effect of one nutrient claim for all conditions ("0% trans-fat") to reduce bias arising from different types of nutrition claims.

For the profiling of products, the MTL and NS labels were applied following the criteria established by the UK's Food Standards Agency and the French High Council for Public Health, respectively. For the WS, the PAHO Nutrient Profile Model thresholds were used to define when a product was excessive in one or more critical nutrients and should have one or more warning labels applied. The drinking yogurt featuring the NS displayed a "C" score, the one featuring the MTL yogurt displayed a red light for sugars, a green light for saturated fats and for sodium, and one warning label for sugars when the WS was present. The cheese spread with the NS had a "D" score applied, when featuring the MTL it displayed a red light for total fat and saturated fat, green light for sugars and amber light for sodium, and had warning labels for total and saturated fats when the WS was applied. The cookie featured an "E" score when NS was applied, had an amber light for sodium, a red light for sugars, total fats and saturated fats when the MTL was applied, and had sugars, total and saturated fats warning labels (Figure 1).

To avoid uncontrolled influences over participant choices (e.g., package features, brand preferences) mock-up products with fictitious brands and versions were designed. These were visually similar to products commonly found in the Argentinean market. One mock-up product was designed for each category. A total of 24 3D mock-up products were designed to represent all possible combinations of product category (three), presence of one of the FOP labeling systems and the absence of

FIGURE 1. Examples of three pairs of 30 mock-up products (one pair per product category) featuring the warning system used to assess purchase intent

a.

b.

c.

label (four) and presence/absence of nutrient claim (two) (3 × 4 × 2 = 24)

To assess purchase intention, a discrete choice experiment (DCE) was conducted. Participants were asked to choose between two options of the same product category, and these options had a distinct nutritional composition. For example, between two options of cookies, one had "excess in sugars" and the other did not. Some products also had nutrient claims and some others did not (Figure 1).

The second task was designed to assess perception of product healthfulness. Participants were presented with one product from each category at a time and asked to rate each product according to how healthful they perceived the product to be. The order of the categories and the order of the products within each category were random and balanced across participants (partial factorial design).

Population and sample design

The target population consisted of adults aged 18 to 64 that live in the City of Buenos Aires and who had visited a supermarket to purchase groceries for their household. Participants were recruited outside supermarkets. They were selected to meet sample quotas by attained education level to match the distribution of this variable in the City of Buenos Aires (21). Surveys were conducted in two retail stores located in different neighborhoods of the city.

Nutrition professionals and food industry employees were excluded from the sample to reduce bias arising from previous knowledge on the subject and to avoid conflicts of interest, since the food industry has declared to be in favor of certain FOP labeling schemes (22). People who did not consume the selected product categories on a regular basis were also excluded from the study to emulate real life shopping conditions as much as possible. The final sample consisted of 704 adult men and women.

For the partial factorial design, there were 24 possible trials (3 categories of products × 4 possible FOP, including the absence × 2 possibilities for claims absence or presence) demanding a minimum of 480 participants to obtain 20 replicates for each trial (23). We increased the minimum sample size by 40% to make up for missing data (n=672) and rounded up to 700.

Data collection

The in-person survey was conducted during May 2019 using the QuickTap Survey software. A pilot test (n=70) provided information about clarity of the questions and instructions for answering the questions. Minor changes were made to the original version.

Respondents first provided information regarding their age, gender, highest attained level of education and their perceived degree of knowledge about nutrition (high, medium, low). Interviewees were also asked whether or not they had consumed any of these products during the past three months and whether or not they were nutrition professionals or food engineers/technicians. They could proceed with the rest of the questions if they answered "yes" to the first question and "no" to the second one.

To assess purchase intention, participants were first shown three pairs of 3D mock-up products, one pair per product

category (see examples of pairs of choices in Figure 1). The pair of mock-up products were presented in a table with the front of the package facing the interviewee. For the first task, for each pair of mock-up products, participants were asked which of the two products they were more likely to buy. Participants could pick-up the mock-up products if they wanted to have a closer look at them before answering. Only one option could be selected.

For the second task, participants were asked to rate how they perceived products' healthfulness using a 7-point Likert scale ranging from 1-"not healthy at all" to 7-"very healthy". This task was completed for three products, one product per category.

Data analysis

An alternative-specific conditional logit model was adjusted to estimate the likelihood of having the intention to purchase the least healthful option for all products and for each product category. The least healthful option was defined according to the nutritional composition of products. Products with the greatest number of critical nutrients in excess were defined as the least healthful. The impact of each design variable on the participants' choices was assessed by estimating attribute effect sizes. These were estimated by running reduced choice models, i.e. models without one of the variables. The difference between these partial log-likelihoods and those obtained from the full models were considered an estimate of the relative importance of each variable. Perceived healthfulness was analyzed using a mixed ANOVA model with FOP label system, claim, and product category as fixed effects factors. Separate models were constructed for men and women and for age and educational level groups. Bivariate analysis was performed by Student's *t* or Mann-Whitney's U tests for continuous variables and chi-square or Fisher's Exact Test for categorical variables. Tukey's post-hoc test was used to analyze the significance of pairwise differences. Statistical analyses were conducted using Microsoft Excel from the Microsoft Office Professional Plus 2016 suite, STATA 13.0 and IBM SPSS Statistics 25.

The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the CEMIC (Centro de Educación Médica e Investigación Clínica)'s Ethics Committee (approval number 1168). Oral informed consent was obtained from all subjects; verbal consent was witnessed and formally recorded.

RESULTS

Survey participants (n=704) included women (63.6%) and men (36.4%) between 18 and 64 years of age. Approximately 20% of respondents had not completed high school, while 27.7% had a university degree (Table 1).

Purchase intention

Purchase intent was influenced negatively by the presence of any FOP labeling system and positively by nutrient claims, as shown by the model coefficients of the independent variables considered. The coefficient for the interaction between presence of claim and type of FOP label was not significant (Table 2).

WS was able to reduce consumers intention to purchase products with an excessive amount of one or more critical nutrients by 84% for drinking yogurt (OR: 0.16, 95% CI: 0.09; 0.28) and by 90% for cookies (OR: 0.10, 95% CI: 0.05; 0.18) and by 90% for cheese spreads (OR: 0.10, 95% CI: 0.05; 0.18), while NS was only able to significantly reduce the purchase intention of the least healthful option within the cheese spread category by 57% (OR: 0.43, 95% CI: 0.22; 0.84) and MTL had no significant effect. The presence of a nutrient claim ("0% trans-fat") was found to increase purchase intention for all three products and FOP label types, except for cookies showing a MTL label, where no

significant interaction was found with the presence of the nutrient claim (Table 2).

Perceived healthfulness

The result of ANOVA showed a significant difference in healthfulness ratings among FOP types (F = 36.5 p <0.001). Tukey's post-hoc test showed that all pairwise differences were significant (p<0.001), except for Nutri-Score vs. no FOP label (p=0.989) meaning Nutri-Score was ineffective to change participants' perception about product's healthfulness. MTL had significantly increased how healthful the product was perceived (p<0.001) (Table 3).

Student's *t*-test (t=5.47; p<0.001) confirmed that the nutrient claim increased perceived healthfulness for all three products and FOP label types (Table 3).

Two-way ANOVAs suggest that perceived healthfulness was not found to be significantly influenced by gender or age (as age groups); it was only affected by education level. The influence of educational level on perceived healthfulness was found to be statistically significant by one-way ANOVA (F: 6.88, 18.98, and 18.6770.05, p<0.001). However, no significant interactions were found between educational level and FOP label types or presence of a nutrient claim. This means that the magnitude of effects of each FOP type label and the presence of nutrient was affected by the education level, but they did not affect them differently, so that the differences of the effects between FOP type labels and between presence/absence of nutrient claims were not altered neither on their own nor in interaction with FOP label types and nutrient claims (Tables 4 and 5).

DISCUSSION

The study results suggest that the black octagonal warning system could be the most effective option among the evaluated schemes to assist consumers in Argentina in making healthier decisions. This model had the greatest impact in reducing purchase intention and perceived healthfulness in the three product categories included in this study and across all educational level

TABLE 1. Demographic variables and reported level of nutritional knowledge of survey participants, Buenos Aires, Argentina, 2019

	n (%)
Total	**704 (100)**
Age (median 43 years old)	
18 - 34	232 (33)
35 - 54	285 (40.5)
55+	187 (26.5)
Gender	
Female	448 (63.6)
Male	256 (36.4)
Educational level	
Low	**142 (20.2)**
Elementary (incomplete)	12 (1.7)
Elementary (complete)	40 (5.7)
High School (incomplete)	90 (12.8)
Medium	**187 (26.6)**
High School (complete)	135 (19.2)
Tertiary/ Graduate School (incomplete)	52 (7.4)
High	**375 (53.3)**
Tertiary/ Graduate School (complete)	69 (9.8)
University (incomplete)	110 (15.6)
University (complete)	195 (27.7)
Other	1 (0.1)

Source: Prepared by authors from study results

TABLE 2. Odds ratios and 95%CI for the contribution of front-of-pack label and the influence of nutrient claim (presence), on the purchase intention compared to the control condition, according to label type, by product categories and all categories, Buenos Aires, Argentina, 2019

	All categories of products (n = 2112) OR (95%CI)	Drinking yogurt (n = 704) OR (95%CI)	Sweet biscuits (n = 704) OR (95%CI)	Cheese spread (n = 704) OR (95%CI)
MTL	1.75[a] (0.93; 3.27)	0.77[a] (0.37; 1.62)	0.97[a] (0.50; 1.92)	0.82[a] (0.41; 1.63)
NS	1.47[a] (0.82; 2.64)	0.82[a] (0.44; 1.57)	0.52[b] (0.25; 1.07)	0.43[b] (0.22; 0.84)*
WS	0.15[b] (0.09; 0.24)**	0.16[b] (0.09; 0.28)**	0.10[c] (0.05; 0.18)**	0.10[c] (0.05; 0.18)**
Nutrient claim effect under the presence of MTL	1.89 (1.25; 2.85)*	1.66 (1.07; 2.58)**	1.16 (0.76; 1.77)	2.09 (1.38; 3.17)**
Influence of nutrient claim under the presence of NS	2.32 (1.59; 3.37)**	2.46 (1.66; 3.63)**	1.84 (1.23; 2.76)**	2.07 (1.42; 3.01)**
Influence of nutrient claim under the presence of WS	1.33 (0.95; 1.85)	2.12 (1.48; 3.03)**	3.43 (2.28; 5.14)**	3.33 (2.24; 4.94)**
Overall effect of nutrient claims	1.49 (1.23; 1.81)*	1.87 (1.50; 2.31)*	1.65 (1.34; 2.04)*	2.09 (1.69; 2.60)*
Claim and type of FOP label interaction factor	1.13 (0.88; 1.45)	0.97 (0.85; 1.11)	0.91 (0.80; 1.04)	1.03 (0.90; 1.18)

MTL, Multiple Traffic-Lights; NS, Nutri-Score; WS, Warning system; 95%CI, 95% confidence interval; FOP, front-of-pack.
**p<0.001; * p<0.05
a,b,c: Different superscript letters within a column indicate significant differences (p<0.05) when comparing FOP label types (e.g. MTL 1.75[a] and NS 1.47[a] are not significantly different from each other, but both are significantly different from WS 0.15[b]).
Source: Prepared by authors from study results

TABLE 3. Mean scores‡ and 95%CI for perception of healthfulness scores according to front-of-pack label type and presence of a nutrient claim, and the interaction factors between label type and nutrient claims with gender, age and education level, Buenos Aires, Argentina, 2019

	Healthfulness perception			
	Mean score (95%CI)	Interaction with gender F statistic (p-value)	Interaction with age group F statistic (p-value)	Interaction with education level F statistic (p-value)
FOP label type		1.185 (0.314)	1.342 (0.235)	3.777 (0.023)
No label	4.24ᵃ (4.08; 4.40)			
MTL	4.85ᵇ (4.71; 4.98)			
NS	4.20ᵃ (4.04; 4.36)			
WS	3.63ᶜ (3.45; 3.82)			
Nutrient claim		2.836 (0.092)	0.024 (0.976)	0.854 (0.528)
No	4.04ᵃ (3.92; 4.16)			
Yes	4.50ᵇ (4.39; 4.61)			

MTL, Multiple Traffic-Lights; NS, Nutri-Score; WS, Warning system; 95%CI, 95% confidence interval; FOP, front-of-pack.
‡Scores range from 0 to 7, the higher the score the healthier the participant perceived the product as healthy. Different superscript letters within a column indicate significant differences (p<0.001) when comparing FOP label types and when comparing presence versus absence of nutrient claim.
ᵃ,ᵇ,ᶜ: Different superscript letters within the FOP label type column and within the nutrient claim column indicate significant differences (p<0.05) when comparing FOP label types and when comparing presence and absence of nutrient claim (e.g. No label 4.24ᵃ and NS 4.20ᵃ do not differ significantly from each other, but they are significantly different from MTL 4.85ᵇ and from WS 3.63ᶜ, which are also significantly different from each other).
Source: Prepared by authors from study results

TABLE 4. Two-way ANOVAs: influence of gender, age groups, and education level on the effects of front-of-pack label type or presence of nutrient claim on perceived healthfulness of products, Buenos Aires, Argentina, 2019

FOP label type and sociodemographic factors			Claims and sociodemographic factors		
	F	p-value		F	p-value
Gender					
FOP label type	26.941	0.011	Claim	23.257	<0.001
Gender	1.000	0.390	Gender	0.859	0.354
FOP label type × Gender	1.185	0.314	Claim × Gender	2.836	0.092
Age					
FOP label type	27.285	0.001	Claim	781.291	<0.001
Age	1.788	0.244	Age	123.551	0.008
FOP label type × Age	1.342	0.235	Claim × Age	0.024	0.976
Education level					
FOP label type	36.965	<0.001	Claim	28.581	<0.001
Educational level	70.051	<0.001	Educational level	66.728	<0.001
FOP label type × Educational level	0.854	0.528	Claim × Educational level	3.777	0.023

FOP, front-of-pack.
Note: Multiplicative interaction factor between the variables (e.g., FOP label type × Gender refers to the interaction factor between the variables FOP label type and Gender).
Source: Prepared by authors from study results

groups. NS was ineffective to reduce purchase intention except for one of the categories of products, and it was less effective than WS. The MTL format had no impact over purchase intention, and conversely, it significantly increased the perceived healthfulness of products that should not be perceived as healthier, because they contain at least one critical nutrient in excess. This was shown among all educational level groups. This could be due to the presence of green and amber colors on products indicating low and medium levels of critical nutrients, thus neutralizing the effect of red lights which indicate the high content of critical nutrients, or also to the effect of the red color in triggering positive emotions towards sweet ultra-processed products, as previously reported in other studies (5,24,25).

Our findings show that NS was inefficacious in reducing purchase intention and healthful perception of products containing at least one critical nutrient in excess in comparison with the WS, in line with other studies (26), whilst some studies have reported that for the purpose of correctly ranking products according to their healthiness NS performs better than other FOP labeling systems (27). This could be attributed to the intended purpose of each system. The WS is intended to allow consumers to correctly, quickly, and easily identify products that contain excessive amounts of critical nutrients; NS provides an overall summary score about the healthfulness of the product and is intended to rank products according to this score (2).

Our findings were not altered after controlling for educational levels and gender, which shows that an octagonal warning system could be an effective tool to assist people from all socioeconomic backgrounds and genders in making healthier choices.

These results are consistent with evidence indicating that FOP labels with straightforward warnings for excessive content of critical nutrients (sodium, fats and sugars) have the highest potential to influence consumer decisions, while MTL may be less effective (5–8,25,28,29).

TABLE 5. Perceived healthfulness to understand nutritional quality of products: mean scores and 95%CI by front-of-pack label type/presence of claim, gender, age groups and education level, Buenos Aires, Argentina, 2019

	Sociodemographic factors	Perception healthfulness	
		Mean score	(95%CI)
FOP label type			
	Gender		
No label	Women	4.13	(3.90; 4.35)
	Men	4.39	(4.17; 4.62)
MTL	Women	4.89	(4.71; 5.06)
	Men	4.77	(4.56; 4.99)
NS	Women	4.13	(3.92; 4.33)
	Men	4.34	(4.09; 4.59)
WS	Women	3.63	(3.39; 3.87)
	Men	3.64	(3.35; 3.92)
	Age groups		
No label	18 – 34	4.05	(3.81; 4.29)
	35 – 54	4.23	(3.98; 4.49)
	55 +	4.59	(4.21; 4.98)
MTL	18 - 34	4.81	(4.57; 5.05)
	35 - 54	4.76	(4.53; 4.99)
	55 +	5.01	(4.78; 5.24)
NS	18 - 34	4.06	(3.77; 4.34)
	35 - 54	4.16	(3.89; 4.43)
	55 +	4.43	(4.14; 4.72)
WS	18 - 34	3.81	(3.50; 4.11)
	35 - 54	3.55	(3.21; 3.88)
	55 +	3.5	(3.15; 3.85)
	Educational level		
No FOP	Low	4.99	(4.60; 5.38)
	Medium	4.36	(4.15; 4.58)
	High	3.63	(3.34; 3.91)
MTL	Low	5.65	(5.38; 5.91)
	Medium	4.84	(4.62; 5.06)
	High	4.51	(4.30; 4.71)
NS	Low	5.09	(4.80; 5.38)
	Medium	4.20	(3.95; 4.46)
	High	3.66	(3.41; 3.91)
WS	Low	4.52	(4.11; 4.92)
	Medium	3.50	(3.22; 3.79)
	High	3.25	(2.96; 3.54)
Claim			
	Gender		
No	Women	3.96	(3.80; 4.12)
	Men	4.18	(4.00; 4.37)
Yes	Women	4.52	(4.38; 4.66)
	Men	4.46	(4.29; 4.62)
	Age groups		
No	18 - 34	3.96	(3.76; 4.16)
	35 - 54	4.02	(3.81; 4.22)
	55 +	4.21	(3.98; 4.44)
Yes	18 - 34	4.42	(4.24; 4.60)
	35 - 54	4.45	(4.27; 4.63)
	55 +	4.68	(4.47; 4.89)

TABLE 5. (Cont.)

	Sociodemographic factors	Perception healthfulness	
		Mean score	(95%CI)
	Educational level		
No	Low	5.00	(4.75; 5.24)
	Medium	4.07	(3.89; 4.25)
	High	3.43	(3.24; 3.63)
Yes	Low	5.19	(4.96; 5.42)
	Medium	4.46	(4.29; 4.63)
	High	4.20	(4.03; 4.37)
Total	Low	5.09	(4.92; 5.26)
	Medium	4.27	(4.15; 4.40)
	High	3.86	(3.73; 3.99)

MTL, Multiple Traffic-Lights; NS, Nutri-Score; WS, Warning system; 95%CI, 95% confidence interval; FOP, front-of-pack.
Note: Low educational level: High School incomplete, Elementary complete, and Elementary incomplete; Medium educational level: High School complete, Tertiary/graduate School incomplete; High educational level: College/ University complete, College/ University incomplete, Tertiary/Graduate complete and Other.
Source: Prepared by authors from study results

The presence of a nutrient claim was found to increase purchase intention and to lead consumers to believe products were healthier for all product categories and FOP label types. This fact has particularly serious public health implications since evidence shows that many food products with low nutritional quality display nutrient and health claims in Argentina. For example, a recent study found that 40% of breakfast cereals, dairy-based desserts and cookies with low nutritional value had health or nutrient claims on their labels (30). The Argentinean Food Regulatory Code states that supplementary nutritional information, such as nutrient claims, must be consistent with mandatory label elements (e.g., ingredients and daily reference intake data). However, while a nutrient claim might be truthful in terms of a specific nutrient ("0% trans-fat"), this study suggests that the presence of the claim boosts purchase intention and perceived healthfulness, for products that may have excess content of other critical nutrients such as sugars, saturated fats or sodium. This "halo effect" of nutrient claims has been demonstrated to lead consumers to overestimate the nutritional quality of food products (9,10,31), reduce the efficacy of FOP labels when claims refer to the same nutrient that is warned on the FOP label (32), ultimately inducing consumers to purchase products that are excessive in critical nutrients. This result underscores the importance of promoting strict regulations that prohibit the use of health or nutrition claims on products with excessive content of one or more critical nutrients, as has been regulated recently in Argentina (15) and implemented in other countries such as Australia, New Zealand (33) and Mexico (13), as well as the need for labeling policies and regulations to be more coherent with other policies aimed at promoting healthy diets.

WS proved to be the most efficacious in reducing perceived healthfulness and purchase intention of products with excessive content of fats, saturated fats, sugars, and sodium. Moreover, the implementation of WS has also been observed to induce product reformulation (34), which could have an additional impact on nutrient intake and health, when the criteria to define which products are excessive in these nutrients are aligned with the World Health Organization population intake goals (2,19).

This study provides valuable input for the progress made in Argentina with the passing of the FOP label policy. However,

it also presents some limitations. First, the experimental design adopted in the study and the sample selected are subject to some limitations regarding external validity. Second, the DCE did not include an opt-out option; participants were indicated to choose one of two products and "none" was not a possible answer. Third, the study is limited to consumers in the city of Buenos Aires, so the population characteristics are different from the rest of the country. However, the design adopted is considered the most accurate in a context where there is no FOP label policy implemented in the country. Likewise, even if the inclusion of an opt-out option would increase external validity this may result in censoring of the data and could compromise the estimation of the participants structure of preferences (35). Evidence of theoretical validity was found, considering that the results behaved in line with prior evidence from experimental and real-life scenario studies (6,7).

Conclusion

This study adds to the body of existing evidence on the efficacy and effectiveness of octagonal FOP warning labels and shows that this system performed best in helping consumers take healthier decisions by reducing their healthfulness perception and intention to purchase products with excessive amounts of sugars, sodium and fats in Argentina. These findings support the recent adoption of this FOP system as the best option to facilitate the population in Argentina to make healthier decisions, and contribute to the reduction of unhealthy diet-related diseases and of health disparities.

Disclaimer. Authors hold sole responsibility for the views expressed in the manuscript, which may not necessarily reflect the opinion or policy of the RPSP/PAJPH or the Pan American Health Organization (PAHO).

REFERENCES

1. 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 May 21;16(1):46.

2. Pan American Health Organization. Launching of Front-of-Package Labeling as a Policy Tool for the Prevention of Noncommunicable Diseases in the Americas | [Internet]. [cited 2021 Dec 20]. Available from: https://www.paho.org/en/events/launching-front-package-labeling-policy-tool-prevention-noncommunicable-diseases-americas

3. Hodgkins C, Barnett J, Wasowicz-Kirylo G, Stysko-Kunkowska M, Gulcan Y, Kustepeli Y, et al. Understanding how consumers categorise nutritional labels: A consumer derived typology for front-of-pack nutrition labelling. Appetite. 2012 Dec 1;59(3):806–17.

4. Julia C, Hercberg S. Nutri-Score: Evidence of the effectiveness of the French front-of-pack nutrition label. Ernähr Umsch. 2017 Dec 15;64(12):158–65.

5. Arrúa A, Machín L, Curutchet MR, Martínez J, Antúnez L, Alcaire F, 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 Sep;20(13):2308–17.

6. Ares G, Varela F, Machin L, Antúnez L, Giménez A, Curutchet MR, et al. Comparative performance of three interpretative front-of-pack nutrition labelling schemes: Insights for policy making. Food Qual Prefer. 2018 Sep 1;68:215–25.

7. Arrúa A, Curutchet MR, Rey N, Barreto P, Golovchenko N, Sellanes A, et al. Impact of front-of-pack nutrition information and label design on children's choice of two snack foods: Comparison of warnings and the traffic-light system. Appetite. 2017 Sep 1;116:139–46.

8. Temple NJ. Front-of-package food labels: A narrative review. Appetite. 2020 Jan 1;144:104485.

9. Arrúa A, Vidal L, Antúnez L, Machín L, Martínez J, Curutchet MR, et al. Influence of Label Design on Children's Perception of 2 Snack Foods. J Nutr Educ Behav. 2017 Mar;49(3):211-217.e1.

10. Hall MG, Lazard AJ, Grummon AH, Mendel JR, Taillie LS. The impact of front-of-package claims, fruit images, and health warnings on consumers' perceptions of sugar-sweetened fruit drinks: Three randomized experiments. Prev Med. 2020 Mar;132:105998.

11. Díaz AA, Veliz PM, Rivas-Mariño G, Mafla CV, Altamirano LMM, Jones CV. Etiquetado de alimentos en Ecuador: implementación, resultados y acciones pendientes. Rev Panam Salud Pública. 2017 Jun 8;41:e54.

12. Gobierno de Uruguay. Decreto N° 272/018 [Internet]. [cited 2021 Dec 20]. Available from: https://www.gub.uy/ministerio-salud-publica/comunicacion/noticias/octogonos-para-etiquetado-de-alimentos

13. Gobierno de México. Diario Oficial de la Federación [Internet]. [cited 2021 Dec 21]. Available from: https://www.dof.gob.mx/nota_detalle.php?codigo=5575205&fecha=11/10/2019

14. Gobierno del Perú. Decreto Supremo N° 012-2018-SA [Internet]. [cited 2021 Dec 20]. Available from: https://www.gob.pe/institucion/produce/normas-legales/185544-012-2018-sa

15. Gobierno de Argentina. Boletín Oficial de la República Argentina - Promoción de la alimentación saludable - Ley 27642 [Internet]. [cited 2021 Dec 20]. Available from: https://www.boletinoficial.gob.ar/detalleAviso/primera/252728

16. Gobierno de Brasil. Nacional I. Instrução normativa-in n° 75, de 8 de outubro de 2020. Imprensa Nacional [Internet]. [cited 2021 Dec 20]. Available from: https://www.in.gov.br/web/dou

17. UK Government. Policy Guide to creating a front of pack (FoP) nutrition label for pre-packed products sold through retail outlets [Internet]. 2013 [cited 2022 May 12]. Available from: https://extranet.who.int/nutrition/gina/en/node/22935

18. Haut Conseil de la Santé Publique, France. Opinion on information regarding the nutritional quality of foodstuffs, 2015. [Internet] [cited 2022 May 12]. Available from: http://www.hcsp.fr/explore.cgi/avisrapportsdomaine?clefr=519

19. Pan American Health Organization. Pan American Health Organization Nutrient Profile Model [Internet]. 2016 [cited 2022 May 12]. Available from: https://iris.paho.org/bitstream/handle/10665.2/18621/9789275118733_eng.pdf?sequence=9&isAllowed=y

20. Euromonitor. Sweet Biscuits, Snack Bars and Fruit Snacks in Argentina [Internet]. 2017 [cited 2021 Dec 21]. Available from: https://www.euromonitor.com/sweet-biscuits-snack-bars-and-fruit-snacks-in-argentina/report

21. Dirección General de Estadísticas y Censos de Argentina. Encuesta Anual de Hogares de la Ciudad de Buenos Aires 2018. Síntesis de resultados. [Internet]. [cited 2021 Dec 21]. Available from: https://www.estadisticaciudad.gob.ar/eyc/wp-content/uploads/2019/07/2018_sintesis_resultados.pdf

22. World Research Cancer Foundation International. Building Momentum: lessons on implementing robust restrictions of food and non-alcoholic beverage marketing to children. [Internet]. 2020 [cited 2022 May 12]. Available from: wcrf.org/buildingmomentum

23. Lancsar E, Louviere J. Conducting discrete choice experiments to inform healthcare decision making: a user's guide. Pharmacoeconomics. 2008;26(8):661–77.

24. Lemos TC, Almo A, Campagnoli RR, Pereira MG, Oliveira L, Volchan E, et al. A red code triggers an unintended approach motivation toward sweet ultra-processed foods: Possible implications for front-of-pack labels. Food Qual Prefer. 2020 Jan 1;79:103784.

25. Khandpur N, de Morais Sato P, Mais LA, Bortoletto Martins AP, Spinillo CG, Garcia MT, 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 May 28;10(6):688.

26. Croker H, Packer J, Russell SJ, Stansfield C, Viner RM. Front of pack nutritional labelling schemes: a systematic review and meta-analysis of recent evidence relating to objectively measured consumption and purchasing. J Hum Nutr Diet Off J Br Diet Assoc. 2020 Aug;33(4):518–37.

27. Egnell M, Talati Z, Hercberg S, Pettigrew S, Julia C. Objective Understanding of Front-of-Package Nutrition Labels: An International Comparative Experimental Study across 12 Countries. Nutrients. 2018 Oct 18;10(10):1542.

28. Taillie LS, Hall MG, Popkin BM, Ng SW, Murukutla N. Experimental Studies of Front-of-Package Nutrient Warning Labels on Sugar-Sweetened Beverages and Ultra-Processed Foods: A Scoping Review. Nutrients. 2020 Feb 22;12(2).

29. Lima M, Ares G, Deliza R. How do front of pack nutrition labels affect healthfulness perception of foods targeted at children? Insights from Brazilian children and parents. Food Qual Prefer. 2018 Mar 1;64:111–9.

30. Allemandi L, Castronuovo L, Tiscornia MV, Gutkowski P, Gijena J, Nessier C. Nutritional quality, child-oriented marketing and health/nutrition claims on sweet biscuit, breakfast cereal and dairy-based dessert packs in Argentina. Cad Saude Publica. 2020;36(9):e00196619.

31. Hall MG, Lazard AJ, Higgins ICA, Blitstein JL, Duffy EW, Greenthal E, et al. Nutrition-related claims lead parents to choose less healthy drinks for young children: a randomized trial in a virtual convenience store. Am J Clin Nutr. 2022 Apr 1;115(4):1144–54.

32. Acton RB, Hammond D. Do manufacturer 'nutrient claims' influence the efficacy of mandated front-of-package labels? Public Health Nutr. 2018 Dec;21(18):3354–9.

33. Food Standards Australia. Calculation method for determining foods eligible to make health claims. [Internet]. [cited 2022 May 12]. Available from: https://www.foodstandards.gov.au/code/proposals/Pages/proposalp293nutritionhealthandrelatedclaims/Default.aspx

34. Kanter R, Reyes M, Vandevijvere S, Swinburn B, Corvalán C. Anticipatory effects of the implementation of the Chilean Law of Food Labeling and Advertising on food and beverage product reformulation. Obes Rev. 2019 Nov;20 Suppl 2:129–40.

35. Bridges JFP, Hauber AB, Marshall D, Lloyd A, Prosser LA, Regier DA, et al. Conjoint analysis applications in health--a checklist: a report of the ISPOR Good Research Practices for Conjoint Analysis Task Force. Value Health. 2011 Jun;14(4):403–13.

Eficacia de los diferentes sistemas de etiquetado frontal en Argentina para modificar la intención de compra y la percepción saludable de productos alimentarios

RESUMEN

Objetivos. Determinar el sistema de etiquetado frontal -semáforo múltiple, Nutri-Score (NS) y sistema de advertencia con forma de octágono negro- más efectivo para reducir la intención de compra y la percepción saludable de yogures bebibles, galletitas y quesos para untar, y evaluar la influencia conjunta de las declaraciones nutricionales sobre los efectos del etiquetado frontal.

Métodos. En el estudio, un ensayo controlado aleatorizado, se empleó un diseño factorial entre los sujetos para evaluar la influencia de tres factores independientes en la percepción saludable y la intención de compra. A un total de 704 adultos en Argentina se les mostraron tres prototipos de productos; se les pidió que indicaran qué producto comprarían eligiendo entre pares de diferentes categorías y que calificaran qué tan saludable era cada producto en una escala Likert de 7 puntos.

Resultados. El sistema de advertencias con octágonos negros fue el más efectivo para reducir la intención de compra en yogures bebibles (OR: 0,16, IC 95%: 0,09; 0,28), galletitas (OR: 0,10, IC 95%: 0,05; 0,18) y quesos para untar (OR: 0,10, IC 95%: 0,05; 0,18) y para reducir la percepción saludable (puntuación promedio del sistema de advertencias: 3,63; ninguna etiqueta: 4,24, p<0,001), independientemente del sexo, la edad y el nivel de educación de los participantes. El Nutri-Score fue ineficaz para reducir la percepción saludable, mientras que el sistema de semáforo múltiple aumentó significativamente cuán saludable se percibió el producto (p<0,001). Las declaraciones nutricionales aumentaron la intención de compra y la percepción saludable, lo que redujo la eficacia de las etiquetas frontales en el envase (p<0,001).

Conclusiones. En consonancia con la evidencia disponible, nuestros resultados respaldan que el sistema de advertencia con forma de octágono negro funciona mejor que el Nutri-Score y el semáforo múltiple en la reducción de la intención de compra y la percepción de saludable de productos con cantidades excesivas de nutrientes críticos asociados con la mayor carga de enfermedades. Se espera que el uso de los símbolos octagonales de advertencia en la parte frontal de los envases facilite la toma de decisiones más saludables para la población en Argentina.

Palabras clave Política nutricional; etiquetado de alimentos; política de salud; dieta saludable; Argentina.

Eficácia de diferentes sistemas de rotulagem nutricional frontal para mudar a intenção de compra e a percepção de saudabilidade de produtos alimentícios na Argentina

RESUMO

Objetivos. Identificar o modelo de rotulagem nutricional frontal – tipo semáforo (Multiple Traffic Light, MTL), Nutri-Score (NS) e octógonos pretos (Warning System, WS) – mais eficaz para reduzir a intenção de compra e a percepção de saudabilidade de iogurtes líquidos, biscoitos doces e pastas de queijo, bem como avaliar a influência conjunta das alegações nutricionais sobre tais efeitos.

Métodos. Estudo experimental randomizado e controlado. Foi utilizado um delineamento fatorial de sujeito único para avaliar a influência de três fatores independentes sobre a percepção de saudabilidade e a intenção de compra dos produtos. A uma amostra de 704 adultos na Argentina foram mostrados três *mock-ups* de produtos, e foi solicitado aos participantes que indicassem qual produto eles comprariam (escolhendo entre pares de produtos de diferentes categorias) e que classificassem a saudabilidade do produto em uma escala tipo Likert de 7 pontos.

Resultados. O sistema WS foi o mais eficaz em reduzir a intenção de compra dos iogurtes líquidos (*odds ratio* [OR]: 0,16, intervalo de confiança [IC] 95%): 0,09; 0,28), biscoitos doces (OR: 0,10, IC95%: 0,05; 0,18) e pastas de queijo (OR: 0,10, IC95%: 0,05; 0,18), bem como a percepção de saudabilidade (pontuação média: 3,63 com rotulagem WS x 4,24 sem rotulagem, p<0,001), independentemente do sexo, idade e escolaridade dos participantes. O sistema NS foi ineficaz em reduzir a percepção de saudabilidade dos produtos, e o MTL aumentou significativamente essa percepção (p<0,001). As alegações nutricionais aumentaram a intenção de compra e a percepção de saudabilidade, reduzindo assim a eficácia da rotulagem frontal (p<0,001).

Conclusões. Corroborando um corpo crescente de evidências, nossas constatações indicam que o sistema WS de rotulagem frontal tem melhor desempenho do que os modelos NS e MTL na redução da intenção de compra e da percepção de saudabilidade de produtos com teor excessivo de nutrientes críticos associados a uma maior carga de morbidade. Espera-se que a rotulagem nutricional frontal do tipo WS favoreça a tomada de decisões mais saudáveis pela população da Argentina.

Palavras-chave   Política nutricional; rotulagem de alimentos; política de saúde; dieta saudável; Argentina.