Front-of-pack nutrition labels: perceptions and preferences of Brazilian adult consumers

Ana Claudia Mazzonetto, Ana Carolina Fernandes,
Aretusa Dias de Souza, Vanessa Mello Rodrigues, Tailane Scapin,
Paula Lazzarin Uggioni, Marcela Boro Veiros, Greyce Luci Bernardo
and Rossana Pacheco da Costa Proença
*Nutrition Postgraduate Program, Nutrition in Foodservice Research Centre
(NUPPRE), Federal University of Santa Catarina, Florianopolis, Brazil*

Abstract

Purpose – This study aimed to examine the perceptions and preferences of Brazilian adult consumers about four different front-of-pack (FOP) food labeling systems proposed by the Brazilian National Health Regulatory Agency.

Design/methodology/approach – This is a qualitative study conducted with 33 participants allocated in six focus groups. Four different types of FOP labels were displayed on processed and packaged bread: three interpretive warning labels (black triangle, black octagon and red ellipse) and a hybrid model (nutritional traffic light). Thematic analysis was used to identify the key topics addressed by participants.

Findings – Three topics were identified: label design, clarity and precision of information. The results demonstrated an influence of labels on product development and consumers' food choices. Most participants expressed a preference for black warning labels and reported the importance of statements endorsed by the Ministry of Health, which provide credibility and could influence food choices. Furthermore, participants agreed that the traffic light system provides more information but is difficult to interpret when comparing products. Warning labels were reported to have the greatest influence on purchase decisions. However, participants were concerned about how to understand the lack of warning labels on some products.

Practical implications – The results may help and support the Brazilian Health Regulatory Agency to identify and recommend the most effective FOP labeling system to be adopted in Brazil.

Originality/value – Few studies investigating adult consumers' perceptions of different FOP label formats have been conducted in the Brazilian context. Our study contributes to the small pool of evidence on the topic by demonstrating that FOP labels can be helpful for consumers when they are presented in an intuitive, interpretative and trustworthy format.

Keywords Food labeling, Packaged food, Qualitative research, Food legislation, Consumer behavior

Paper type Research paper

Introduction

Food labeling is recognized by the World Health Organization as an important tool for guiding healthy food choices (WHO, 2004, 2017). Food labels should provide clear information to consumers about food (WHO, 2017). Front-of-pack (FOP) nutrition labeling comprises graphic symbols that provide nutritional information in a simplified form on the front or main part of food packaging (WHO, 2017). FOP labels can be categorized into the following groups according to the amount of interpretive information provided: interpretive (e.g. Nutri-Score), semi-interpretive (e.g. Chilean warning labels) and noninterpretive

(e.g. guideline daily amount, GDA) labels (Kanter *et al.*, 2018; Hodgkins *et al.*, 2012; Ikonen *et al.*, 2020).

Systematic reviews have indicated that FOP nutrition labeling can potentially help consumers to understand the nutritional characteristics of foods, to identify healthy foods or nutrients' excess and make more informed choices. Although warning labels seem to be the most effective type of format, there are mixed results about which systems are the best for the proposed outcomes (Ikonen *et al.*, 2020; Feteira-Santos *et al.*, 2020). Feteira-Santos *et al.* (2020) argued that the impact of each FOP label type should be assessed taking into account the characteristics of the population. Ikonen *et al.* (2020) highlighted that "knowledge on consumer reactions to design details, framing, or even the abstractness of the information presented may offer new insights into the best FOP label."

Food labels used in Brazil (Silveira *et al.*, 2013; Rodrigues *et al.*, 2017; Kliemann *et al.*, 2018) and in other countries (Kleef and Dagevos, 2015; Volkova and Ni Mhurchu, 2015; Malloy-Weir and Cooper, 2017) are not understandable and may cause misinterpretation. Since 2003 in Brazil, packaged foods must have a nutrition facts panel (Brazil, 2003). However, complementary nutritional information, such as FOP labeling, is not mandatory, but it has had specific regulations since 2012 (Brazil, 2012). Nevertheless, there is no regulated format for FOP labeling in Brazil.

In 2014, to improve the quality of information available on food labels, the Brazilian Health Regulatory Agency (ANVISA) of the Brazilian Ministry of Health established a working group to review the nutrition labeling regulation. In their final report, the group suggested the adoption of simplified FOP labels. These labels should prioritize graphic formats of information to facilitate consumers' understanding. FOP labels should indicate the amount or excess of critical nutrients and ingredients, such as total, saturated, and industrial trans fats, besides sugar, sodium, artificial sweeteners and additives (Brazil, 2017). Based on literature data and suggestions of the working group on nutrition labeling, ANVISA suggested four different FOP systems for testing (traffic light and three warning label formats) (Brazil, 2018).

There is, however, a gap in qualitative research about consumers' perception of the FOP label designs proposed by ANVISA. It is necessary to understand how Brazilian adult consumers perceive and use the labels proposed by experts. Thus, the research problem is to understand how Brazilian adult consumers perceive each FOP label design and to identify the positive and negative characteristics of each label, consumers' preferred design, and potential use of FOP labels in making food choices. In this context, this study aimed to examine the perceptions and preferences of Brazilian adult consumers about four different FOP food labeling systems proposed by ANVISA.

This paper is structured as follows: literature review about the current state of knowledge of consumers' perception and preferences for FOP labeling; methods; results; discussion; theoretical and practical implications; strengths, limitations, and directions of future research; and conclusion.

Literature review

Food labeling is the main manner by which consumers can be informed about packaged foods during food purchasing. A Norwegian study conducted in the late 90s with 1,050 respondents reported that most consumers read the food labels either often, sometimes, or seldom (Wandel, 1997). Another study with 540 Spanish consumers in 2016 revealed that consumers preferred the Protected Designation of Origin (PDO) indication among seven different food labeling schemes, followed by the EU organic logo and the nutrition facts panel (Gracia and de-Magistris, 2016).

A review of 26 studies indicated that the relationship between diet quality and use of food labels was inconsistent. However, it was found that reading the nutrition facts label was associated with healthier diets. The authors identified a lack of research on associations

between dietary habits and use of ingredients lists, serving size information and FOP labels; they did observe an increasing tendency in the use of FOP labels (Anastasiou *et al.*, 2019).

A systematic review and meta-analysis evaluating 60 studies showed that reading the food label made consumers decrease the intakes of energy and total fat and increase that of vegetables. Nevertheless, the intake of other dietary targets did not significantly change (sodium, carbohydrate, protein, saturated fat, fruits and whole grains) (Shangguan *et al.*, 2018). The authors concluded that the ideal label should have simple, interpretative and standardized pattern, format and location. Shangguan *et al.* (2018) described the emergence of some FOP labels, beginning in 1989 in Sweden, with the creation of the Keyhole logo, which later became a well-known Nordic label. The Netherlands then launched the Choice logo (in 2006), which was also implemented in Belgium, Poland, the Czech Republic, Argentina and Nigeria. In the same year, the United Kingdom recommended the use of the traffic light label for some food categories. Almost 10 years later, in 2017, Chile launched the black warning logo. Other FOP formats include the heart symbol in Finland; the health star ratings and the pick the tick label in Australia and New Zealand; and NuVal, guiding stars, smart choices and heart-check in the United States of America (Shangguan *et al.*, 2018). There are other FOP labeling designs, as compiled in the review of El-Abbadi *et al.* (2020) and depicted in Figure 1. Labels can be classified into nutrient profiling system-based (NPS-based) or non-NPS-based.

El-Abbadi *et al.* (2020) explained that most FOP label formats are based on complex NPS algorithms that can vary widely in terms of parameters, designs and approaches. For
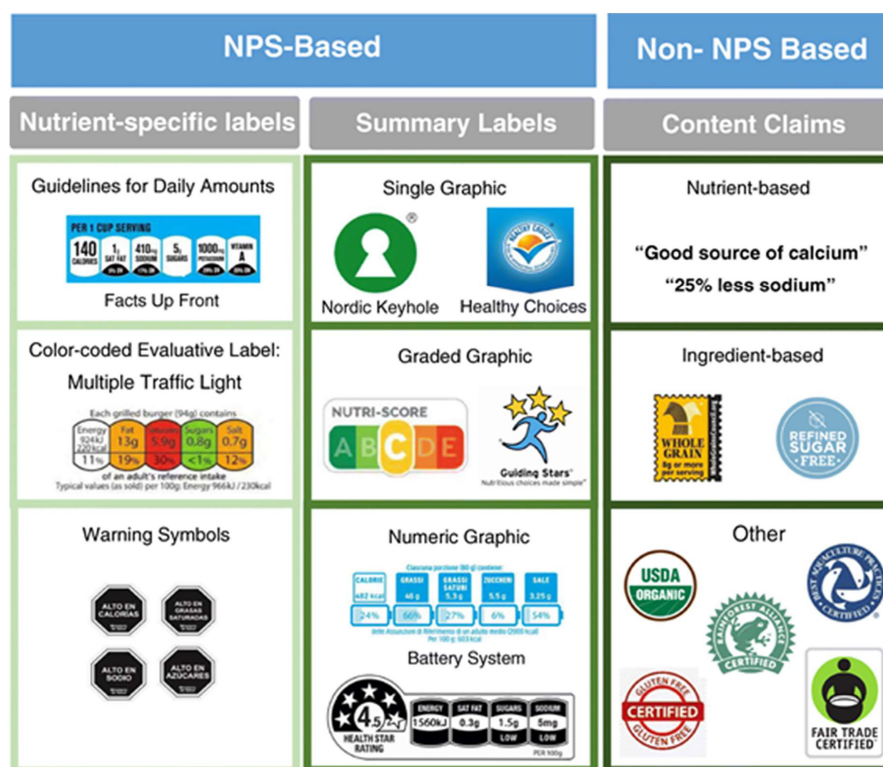
Source(s): El-Abbadi *et al* (2020)

example, some FOP labels reflect the content of both negative and positive attributes (e.g. multiple traffic light), whereas others provide quantitative values (e.g. guidelines for daily amounts), colors and letters (e.g. Nutri-Score) or interpretative symbols (e.g. Nordic keyhole). Other labels are simple warning symbols that highlight the presence of components or nutrients that may be harmful in excess. These labels seem to be quickly understood by consumers, even when used with positive FOP labeling.

Another review explored 14 studies published between 2017 and 2019 providing evidence that FOP labels encourage healthier food purchasing. The studies analyzed the following FOP labels: health star rating or similar, multiple traffic light, NutriScore or similar, Chilean warning system, other "high in" warnings, text-based warnings, Facts Up Front and daily intake guide. Meta-analysis of experimental studies combining the effect of all FOP labels vs no-FOP label revealed that FOP labels were associated with the purchase of food containing lower sugar and sodium contents. The "high in" warnings had the best results, reducing intakes of sugar, calories and sodium, followed by the multiple traffic light, which reduced sodium only. The other FOP label categories showed no improvement compared with no-FOP label (Croker *et al.*, 2020).

Lobstein *et al.* (2020) reviewed 125 studies analyzing costs, equity and acceptability of three policies for obesity prevention: sweetened beverage taxes, restrictions on advertising to children and FOP labeling. The results showed that the three policies are favorable and should be implemented. Regarding FOP labeling, the results of the analysis reinforce the conclusions of review studies by El-Abbadi *et al.* (2020) and Croker *et al.* (2020), showing that FOP warnings contribute more to health equity than other FOP designs, although these formats are more opposed by commercial interests.

El-Abbadi *et al.* (2020) also highlighted that FOP labeling is effective for those who have poor literacy and/or limitations to understanding quantitative information. However, FOP labels are less used in low- and middle-income countries than in high-income countries. According to the authors, there is a need for new studies examining the effectiveness of FOP labeling in different regions and cultures. The FOP label design should be context-specific and consider the country's demographics and food system, as well as health and nutrition literacy (El-Abbadi *et al.*, 2020).

Overall, several studies have been conducted in various countries and regions. These studies examine the effectiveness of FOP labeling and/or consumers' perception about FOP labels, as carried out in Australia and New Zealand (Pettigrew *et al.*, 2017), Canada (Acton *et al.*, 2018), Chile (Dourado *et al.*, 2021), India (Bera *et al.*, 2021), Mexico (Basto-Abreu *et al.*, 2020), Portugal (Feteira-Santos *et al.*, 2021), Uruguay (Gugliucci *et al.*, 2021), the USA (Sonnenberg *et al.*, 2013) and Brazil (Khandpur *et al.*, 2018), where this study was conducted.

We identified only four studies about consumers' perceptions of FOP label formats in Brazil. The first study investigated the influence of three FOP labels (guideline daily amount, traffic light and warning label) on healthy food perception in children ($n = 318$) and parents ($n = 278$). The traffic light and warning label (higher effect) decreased the healthfulness perception of products with unfavorable nutritional profiles in parents and children aged 9–12 years old from private schools (Lima *et al.*, 2018). The second study compared the effects of two warning symbols (triangle and octagon) on consumers' ($n = 2,419$) perception and comprehension of the nutritional profile of foods. The results showed that the triangle and octagon warning symbols performed better than ingredients list and nutrition facts panel. Another study showed that the triangle symbol containing the warning "high in" is more effective than the octagon symbol displaying the warning "a lot of" (Khandpur *et al.*, 2019).

Only two studies evaluated all FOP labeling systems proposed by ANVISA (Deliza *et al.*, 2020; Bandeira *et al.*, 2021). Deliza *et al.* (2020) evaluated (1) how long consumers took to identify FOP labels and decide whether the product had a high nutrient content (visual search study conducted with 62 participants), (2) consumers' ability to accurately use FOP labels and

(3) the influence of FOP labeling on health perception (both 2 and 3 by an online survey with 1,932 participants). Consumers' perceptions of FOP labels were assessed by analyzing the frequency of mentions of labels through an open-ended question. Experiments i and ii showed that warnings have some advantages over traffic light or guideline daily amount labels. However, analysis of consumers' perceptions revealed contradictory results (Deliza et al., 2020).

Bandeira et al. (2021) conducted an online study with 2,400 Brazilian consumers to evaluate (1) consumers' perception of the five FOP models (traffic light, magnifier, and octagon, triangle, and circle warnings) and (2) consumers' comprehension of nutritional content, perception of healthiness and intention of purchase of products regarded as healthy but high in critical nutrients (sugars, fat or sodium). Consumers were randomly allocated into one of six groups (one control and five FOP labels). All FOP groups performed better than the control, and warning formats were better than the others in promoting comprehension, healthiness perception and healthy food choices (aim 2). Consumers were found to approve of FOP labels and reported that labels can increase understanding of the nutritional content of packaged foods, even though perception was analyzed by close-ended questions.

Overall, in reviewing literature data, we found a lack of accurate comprehension of consumers' perceptions about the FOP designs proposed by ANVISA in Brazil. Therefore, the current study deeply analyzed consumers' perceptions of different FOP labels by using a qualitative research approach. This is the first study comparing, discussing and analyzing FOP designs with a diverse group of Brazilian consumers.

Methods
Study design
This exploratory, qualitative, descriptive study was conducted using a focus group approach (Krueger and Casey, 2009) in a main city in southern Brazil. The choice of the city was intentional, given the location of the research group and considering that qualitative studies should explore a variety of points of view, representations and values related to the area studied (domain, field of knowledge, experience) in terms of variability and possibility of consensus.

Participants and focus groups
Participants were recruited from a database of volunteers who had previously participated in studies by our research group and then by snowballing from these contacts. The sample included individuals with different sociodemographic characteristics (sex, age, level of education and occupation). To be eligible, participants had to purchase food on a regular basis and not have received any form of nutrition training. In line with recommendations on the number of focus group participants ($n = 4$ to 12) to optimize discussion quality (Krueger and Casey, 2009), efforts were made to recruit at least five participants for each focus group. Individuals were grouped into six focus groups according to their characteristics: Group 1, technical-administrative staff of a public university ($n = 5$); Group 2, older adults (≥60 years) and retirees ($n = 6$); Group 3, outsourced cleaning workers ($n = 6$); Group 4, women with different occupations ($n = 5$); Group 5, outsourced restaurant workers ($n = 6$); and Group 6, university students ($n = 5$). With the exception of Group 4, which comprised only women, all other groups included participants of both sexes. Each individual participated in only one of the focus groups.

Between February and April 2018, six focus groups were conducted with a total of 33 participants. The majority (73%) were women, the mean age was 43.5 years (range of

18–78 years), 27% had incomplete primary education and 24% had tertiary education. Only one participant reported having food intolerance (lactose intolerance). The number of focus groups was determined based on the principle of data saturation (Krueger and Casey, 2009; Barbour, 2009).

FOP labeling systems

Here we analyzed the four FOP labeling systems selected by the ANVISA working group to be tested in the country: traffic light and three formats of warning labels (octagon, triangle and ellipse) (Figure 2).

The traffic light label indicates the presence of low, medium or high levels of critical nutrients per serving using the colors green, yellow and red, respectively (Kanter *et al.*, 2018). This system was adapted from that used in the United Kingdom (2007; Scarborough *et al.*, 2015) to represent absolute (grams or milligrams) and relative (percent daily value) amounts of total energy, total sugar, saturated fat and sodium per 100 g. The Brazilian proposal differs from the UK system in that it uses ranges of absolute values (in grams or milligrams) and different criteria for food items with serving sizes of up to 100 g/mL and those with serving sizes greater than 100 g/mL (Figure 3).

The three warning labels display symbols and written text to indicate the presence of excessive amounts of critical nutrients. The ellipse warning label contains a statement such as "high content of total sugars," "high content of total fat" or "high content of sodium" printed in red with a black outline for improved contrast against colorful packaging materials. Another format comprises a black octagon with a white border, a message indicating that the product contains high levels of critical nutrients ("contains too many calories," "contains too much sugar," "contains too much sodium," "contains too much fat" or "contains too much saturated fat") or highlighting the presence of industrial trans fat, artificial sweeteners or food additives ("contains trans fat," "contains artificial sweeteners" or "contains chemical additives"). The third warning label presents the same information as the octagon format, except for calories and chemical additives, but within a black triangle against a white background, similar to safety warnings commonly found in product manuals. Criteria for classification of excessive nutrient levels on warning labels were based on the Pan American Health Organization (PAHO) Nutrient Profile Model for identification of processed and ultraprocessed foods (PAHO, 2016) (Figure 4).

Figure 2.
Front-of-pack nutrition labels tested in the study: traffic light system and black octagon, black triangle and red ellipse warning labels

Figure 3.
Brazilian proposal for traffic light labels with color codes indicating the nutritional profile of foods and beverages

Nutrient (per serving)	Food items with serving sizes > 100 g			Food items with serving sizes ≤ 100 g and beverages		
	Green	Yellow	Red	Green	Yellow	Red
Saturated fat	≤1.5 g	1.5–6.6 g	>6.6 g	≤1.5 g	1.5–3.3 g	>3.3 g
Sugar	≤5.0 g	5.0–27 g	>27 g	≤5.0 g	5.0–13.5 g	>13.5 g
Sodium	≤80 mg	80–720 mg	>720 mg	≤80 mg	80–360 mg	>360 mg

Source(s): Preliminary Report on Regulatory Impact Analysis on Nutritional Labeling (Brazil, 2018)

Data collection
Before each focus group, participants completed a sociodemographic questionnaire and signed an informed consent form. The research protocol was approved by the Human Research Ethics Committee of the university where the study was conducted. Focus groups were conducted at the Qualitative Research Laboratory located in the university where this research was developed. The laboratory has a tailored design for conducting focus groups, with an oval table and chairs where participants can be seated and see each other, microphones and cameras to record audio and video, and an observatory room with a one-way mirror. During the focus groups, participants were shown real packages of three types of packaged bread of the same brand (traditional bread, cassava bread and wholemeal bread). The products had different nutritional characteristics. To test four designs of FOP labeling systems, 12 packages were required in each focus group (Figure 5). FOP labels were stickers applied to the upper right-hand corner of each package.

Bread was chosen to test participants' perceptions about FOP labels because it is a staple food in Brazil (Brazil, 2011) and its nutritional characteristics are in line with the recommendations of the PAHO Nutrient Profile Model (PAHO, 2016). Because the tested FOP labels provided different information and used different parameters, we opted to maintain only the nutrients that were common to all formats (sugar, saturated fat and sodium), allowing design-only comparison. For this, we developed a single hybrid parameter for this research (Table 1).

Focus groups were carried out according to conventional procedures (Krueger and Casey, 2009). Discussions were audio-recorded and conducted by an experienced moderator and at

Sodium	Free sugars	Other sweeteners	Total fat	Saturated fat	Trans fat
≥1 mg per 1 kcal	≥10% of total energy	Any amount	≥30% of total energy	≥10% of total energy	≥1% of total energy

Source(s): Pan American Health Organization (PAHO, 2016)

Figure 4.
Criteria defining excessive amounts of sodium, free sugars, sweeteners and fats according to the PAHO Nutrient Profile Model
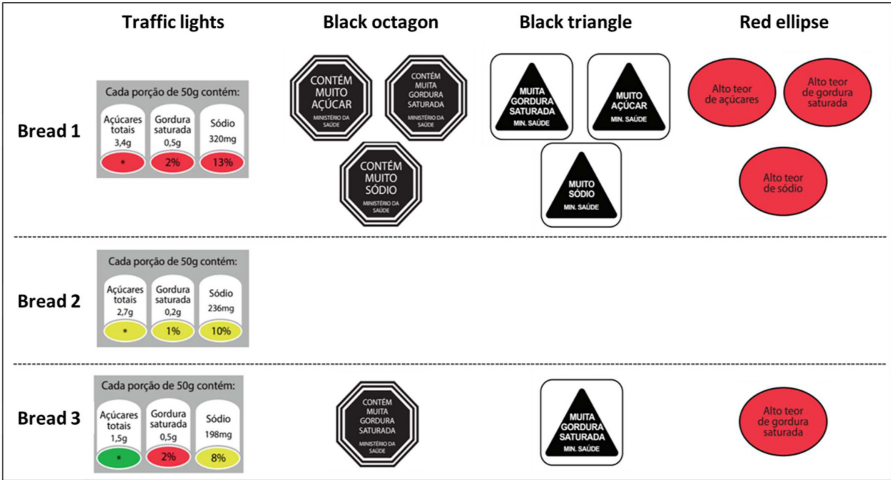

Figure 5.
Labels displayed on bread packages to facilitate focus group discussions on front-of-pack labeling systems

least one observer (researcher) per group. A semi-structured question guide was constructed by the authors, who are specialists in the field of consumer behavior and qualitative research methods. The guide was previously tested with a small sample of consumers (data not used in the analysis) (Figure 6). The observer was responsible for keeping a written record of relevant information. A trained researcher obtained written informed consent from each participant after explaining the study procedures, providing time for them to read the informed consent form and answering any questions they had. After this step, the researcher explained focus group procedures. Demographic information was obtained through a self-administered questionnaire.

Data analysis

The audio file was transcribed *verbatim* by the moderator, supplemented with notes taken by observers and subjected to a manual thematic analysis process (Braun and Clarke, 2006) using Microsoft Office® Excel spreadsheets. The first step in the analysis (familiarization) was achieved through multiple readings of the data corpus to search for meanings and patterns. Coding and grouping of preliminary themes were carried out by two researchers, and results were discussed and refined with the other researchers involved in the study on two different occasions. The following step was to code the material into categories, which consists in the systematic transformation of raw data through the aggregation of words or phrases into meaningful content. In a discussion meeting between the researchers involved, a preliminary set of categories was generated, respecting the principles of mutual exclusion, homogeneity, pertinence, objectivity, fidelity and productivity (Braun and Clarke, 2006).

Nutrient	Green traffic light[a]	Yellow traffic light[a]	Red traffic light plus warning label[b]
Sugar	≤1.5 g per serving	1.5–3.3 g per serving	≥10% of total energy
Saturated fat	≤5.0 g per serving	5.0–3.5 g per serving	≥10% of total energy
Sodium	≤80 mg per serving	80–360 mg per serving	≥1 mg per 1 kcal

Source(s): Adapted from the Preliminary Report on Regulatory Impact Analysis on Nutritional Labeling (Brazil, 2018)
[a]Parameters proposed by the Brazilian food industry for foods with serving sizes ≤100 g and beverages
[b]Parameters proposed by the Pan-American Health Organization for saturated fat and sodium. Labeling of free sugars was replaced by labeling of total sugars for easier calculation

Table 1.
Proposed parameters for front-of-pack labeling of sugar, saturated fat and sodium

1. [Ice-breaker question]: Please introduce yourselves and tell us whether you commonly pay attention to food labels when you buy packaged foods (and what type of information you pay attention to).

2. The Ministry of Health has proposed a new format for front-of-pack food labels. [Show the bread packages containing nutritional food labels, share one with each participant, and instruct them to exchange the products.] What do you think of these proposals?

3. Imagine that you are grocery shopping. Which bread would you choose? Which food label would facilitate your food choices? Why do you choose this label? [If needed, ask about the pros and cons of each labeling format.]

4. [Thank participants and close the meeting.]

Figure 6.
Semi-structured protocol used to guide focus groups examining different front-of-pack labeling systems

Results

When participants were asked about their general opinion and use of food labels, they reported mainly paying attention to expiration dates. Participants also reported finding it difficult to use the nutrition facts panel and other nutrition information because of their low readability, small print size and low color contrast. They generally did not pay attention to nutritional information displayed on food labels, except to identify items related to dietary restrictions or when they were not familiar with the product.

Some participants mentioned the lack of sugar information on the nutrition facts panel and reported observing the order of ingredients in the ingredients list. Others mentioned knowing that ingredients are listed in descending order of weight. Many participants distrusted the information provided on food labels. For example, they mentioned the contradiction of "homemade" foods having a long shelf life. Participants also reported distrusting information about lactose and zero lactose claims. According to the interviewees, supplementary nutritional information (e.g. zero sugar) and claims (e.g. whole food) influence their food choices.

The FOP labels evaluated here were well accepted by the interviewees. They mentioned liking the FOP labeling initiative and reported that such labels draw attention because of their central position on food packages. Analysis of the participants' statements about FOP labels revealed three themes: (1) label design, (2) comprehensibility and clarity of information and (3) influence on product development and consumers' food choices (Table 2).

Label design

Participants discussed the colors and shapes of warning labels, as well as the size of the information presented. Although some participants reported that the ellipse warning stood out for its red color, the two black-colored warning labels were considered more appealing and eye-catching and were found to be easily read. The white square surrounding the black triangle was considered to give additional emphasis to the warning symbol. Both black symbols were highly associated with warnings because of their shape. The octagon was associated with the stop sign and the triangle with symbols for "attention" and "caution." The ellipse's color was also related to "warning" and "stop" messages but the shape reduced its impact. Most participants could not say whether they preferred the triangle or the octagon, but specific comments about the triangle revealed its potential and possible greater attractiveness: "Compared with the others, the triangle is a symbol that represents attention and caution" (Male participant, Group 1).

Participants noticed that the colors used in the ellipse and traffic light labels might mix or blend with the color of food packages. The red traffic light was perceived to indicate something bad or that should be consumed less often. This information was considered positive, as it could help the consumer to identify excesses. "This label [traffic light] helped because of its color. We know that red is a dangerous color, green is not so bad, and yellow or orange represents attention, right?" (Female participant, Group 3). Furthermore, warning labels were deemed easier to read because of the greater print size and type of information compared with the traffic light label. Participants reported that the quantitative information shown on the traffic light symbol was difficult to visualize because of the small font size, lacking practicality.

Comprehensibility and clarity of information

The participants believed that warning labels are more practical and intuitive than the traffic light label, being easier to understand and interpret. "It's large and that's it! It's very clear" (Male participant, Group 2). "I liked it because the label is very clear, so, for lay people like me, it is very practical" (Female participant, Group 2). Warning labels could make it easier to

Theme	Labeling system			
	CONTÉM MUITO AÇÚCAR	MUITO AÇÚCAR MIN. SAÚDE	Alto teor de açúcares	Cada porção de 50g contém: Açúcares totais 1,5g / Gordura saturada 0,5g / Sódio 198mg
Label design	Evoke attention, warning, and caution. Warning labels stand out from the package and facilitate visualization. Font size facilitates reading			Red refers to something bad or dangerous. Font size makes it difficult to read
	Lack of a white background places less emphasis on the label	White background places added emphasis on the label	Label colors may be confounded or masked by package colors	
Comprehensibility and clarity of information	More practical and intuitive. Facilitate comprehension and analysis of food composition. Facilitate comparison between foods. The meaning of "high" or "much" is not well defined. If a food item does not have a warning symbol, is it because it does not contain any nutrients in excessive amounts or because the manufacturer did not include the label?			Not practical to read. May be useful when comparing different brands of foods. Color codes facilitate comprehension. Colors can aid those who do not understand numbers. Numerical information is difficult to understand and requires greater knowledge. Interpretation is necessary. Provides more information but repeats what is displayed on the nutrition facts panel
	The term "much" is easier to understand. More direct, easier to understand		The terms "high" and "content" are difficult to understand	
	It does not judge the product but rather provides information	-	Increased clarity compared with the traffic light system	
Influence on product development and consumers' food choices	Information will not be used by those who want to buy foods that are known to contain excessive amounts of sugars, sodium, and/or fats			
	Labels assist consumers in their food choices. Stimulate consumers to buy foods with fewer warning labels. Stimulate the food industry to improve product composition. The food industry will not like the labeling proposals			Color combinations cause confusion and are less practical at the point of purchase. Seems to serve for marketing purposes rather than for informing consumers
	Accreditation by the Ministry of Health confers greater credibility		-	

Table 2.
Themes and categories identified through thematic analysis of statements provided by consumers in focus groups assessing front-of-pack labeling systems proposed by the Brazilian Health Regulatory Agency

analyze and compare different foods, but the traffic light label could be useful when comparing different brands of the same food. According to the participants, the octagon symbol provides information without judging the product. Compared with the traffic light, the ellipse was deemed easier to understand, but, in general, participants preferred the black warnings because they were more direct and easier to comprehend.

All labels seemed to lack information about what is considered an excess. For instance, participants wanted to know what determines if the levels of a given nutrient are high. The term "high content" was not well accepted by interviewees. They mentioned that the term "content" can be difficult to understand and that they prefer terms such as "much" or "high." "It is not everyone who understands what 'content' means. What does it mean? On the other hand, 'contains too much saturated fat' is more descriptive" (Female participant, Group 3).

Interviewees highlighted the need for information campaigns on FOP labels for the population to understand what excess warnings mean and, especially, what the absence of a warning label means. They suggested including some type of indication when a food item

does not have an excess of critical nutrients so that consumers will know that the product complies with FOP labeling legislation. As reported by one of the participants, "If someone buys a food product that does not have a warning label, they might be buying a pig in a poke; someone just forgot to put the label, right? . . . The product should have a stamp saying 'the product was analyzed,' so that you can buy it safely" (Female participant, Group 4).

The traffic light label was considered impractical to read. The label's color system was believed to facilitate comprehension, especially for those who did not understand the numbers. However, the interviewees reported difficulty in comprehending numerical information and the need for more knowledge about food composition, dietary recommendations and nutrition information. Unlike warning labels, the traffic light label requires interpretation. If, on the one hand, the traffic light system provides a greater amount of information than warning labels, on the other hand, such information repeats that already shown in the nutrition facts panel.

Groups differed in their perception of factors that affect the influence of FOP labels on consumers' food choices. In groups 3 (outsourced cleaning workers) and 6 (university students), some participants mentioned that FOP labels may influence their choices depending on product price and expiration date.

Influence of FOP labels on product development and consumers' food choices
Regardless of the label used, participants stated that nutritional information would probably be disregarded when they wanted to buy foods known to contain excessive amounts of sugars, sodium and/or fats. However, they considered it important for everyone to have access to information on excess nutrients. For instance, one participant stated, "I would not stop eating chocolate because of a warning label, although it could stop many people, especially those who do not have much information" (Female participant, Group 6).

Participants reported that warning labels may help consumers make informed food choices easily and intuitively. The presence of a warning symbol might make consumers think twice about buying certain foods, which was considered a positive outcome by participants, as warning labels highlight information about excess critical nutrients. This is crucial for making healthy food choices, as pointed out by one of the interviewees, "Because of the label, I do not know if I would buy this; it says that it has a lot of saturated fat. So, I'd be a little wary" (Male participant, Group 3). Warning labels could help consumers compare foods and lead them to buy the product with fewer warnings, as highlighted by a participant, "I would choose one that has nothing written, like this one, which has no sign of danger" (Female participant, Group 4). "It would provide more assurance. I can automatically discard . . . I do not even need to look at the products that have a warning symbol" (Female participant, Group 1).

Regarding the traffic light system, even participants who knew how to correctly interpret the colors reported difficulty in making food choices in real or imagined situations. This was attributed to the diversity of combinations of colors used in the traffic light symbol. "Two [nutrients] have a yellow color and the other has a green color. The person does not know what to choose. I think it would make [the choice] a little difficult, actually" (Male participant, Group 6). The various possibilities of color combinations and high amount of information were mentioned as barriers to the correct use and applicability of the traffic light system by participants. For instance, one participant questioned, "Who will read it? If you have to read the label of every product you want to buy, you'll have to spend a whole day at the supermarket. You have to spend a lot of time to understand what it says" (Female participant, Group 4). "I'm usually in a rush; I do not have much time to do grocery shopping and analyze each product" (Female participant, Group 4). Interviewees also mentioned that quantitative information would serve a specific audience, not the general public: "Would someone stop

and read this information at the supermarket? For a dietitian, it is useful; for those who will recommend a food item, sure. But for those who are buying . . ." (Female participant, Group 4).

Participants also perceived the traffic light system as a marketing strategy, as it seems to promote food items without actually warning about the presence of excess nutrients. They also believed that warning labels could displease the food industry, which, in turn, could hinder FOP labeling regulation and implementation. On the other hand, they believed that warning systems could stimulate the development of products with improved nutritional quality. Interviewees highlighted that warning labels could draw attention and potentially stimulate the industry to reformulate foods, "With this new regulation, the industry will try to improve food products so that they have the lowest number of warnings, making the food better for consumers" (Female participant, Group 1).

Special attention was given to the Ministry of Health's endorsement statement, shown in the octagon and triangle labels. Participants believed that the statement would provide assurance to consumers. "I think it influences the purchase. I would assume that I'm buying a healthy product, but, at the same time, I can see that the Ministry of Health considers the product to contain high amounts of sugar" (Male participant, Group 6).

Discussion

Participants reported that they used little of the information available on food packages at the time of purchase, mostly expiration date and product weight; the latter information is generally used to compare the prices of different brands. Research shows that an important part of consumers understand some of the terms and information used on food labels and are able to make simple calculations; however, consumers' understanding seems to decrease with increasing data complexity (Cowburn and Stockley, 2005; Grunert and Wills, 2007). Studies have also indicated that consumers often do not use nutritional information for making purchase decisions because of the low readability of nutrition labels, stemming from a lack of color contrast or small letter size (Cowburn and Stockley, 2005; Campos *et al.*, 2011). The findings of the current study are consistent with previous publications on the topic.

Study participants had a good acceptance of FOP labeling strategies, as also observed in other studies conducted in Brazil and abroad. FOP labels attract attention and seem to contribute to more conscious food choices by consumers without disrespecting their freedom of choice (Ni Mhurchu *et al.*, 2017; Talati *et al.*, 2017; Lima *et al.*, 2018; Machín *et al.*, 2019; Ikonen *et al.*, 2020).

Regarding label color and shape, the octagon and triangle symbols were preferred by participants, who mentioned the importance of a white background to highlight the message, regardless of the format used. In Brazil, an online experiment conducted by Khandpur *et al.* (2019) compared the impact of different FOP warning labels and identified that participants shown the triangle symbol were better able to identify the healthiest food between two options than participants in the control group; this result was not observed for participants shown the octagon warning symbol. The authors argued that consumers' preference for the triangle symbol may be due to the contrast generated by the white square background and to the fact that the triangle is a simple geometric shape compared with the octagon (Khandpur *et al.*, 2019). These findings are in line with those of a review article that emphasized the importance of visual highlighting of information on food labels, which can be achieved by using contrasting colors, among other methods (Graham *et al.*, 2012).

Deliza *et al.* (2020), on the other hand, observed a higher preference for the red ellipse label. It is noteworthy, however, that Deliza *et al.* (2020) used optional open-ended questions, whereas the present study worked with focus groups. In focus groups, all individuals are encouraged to participate and engage with other interviewees and moderators, contributing to the deepening of discussions and reflections on the topic. Qualitative studies are the most

appropriate to investigate the perception of individuals about a given topic, especially in the case of exploratory contexts (Barbour, 2009; Krueger and Casey, 2009).

The interviewees found that warning labels were practical and easy to understand, as also observed in other studies in Brazil and other countries (Hodgkins *et al.*, 2012; Ni Mhurchu *et al.*, 2017; Talati *et al.*, 2017; Lima *et al.*, 2018; Machín *et al.*, 2019). Malloy-Weir and Cooper (2017) identified that people with poor health knowledge may benefit more from graphic presentation of nutritional information on food labels than people with high levels of health knowledge (Malloy-Weir and Cooper, 2017). Additionally, a broad range of Australian consumers preferred FOP labels that are easy to use, have interpretive content and are salient (Pettigrew *et al.*, 2017).

The participants of this study also expressed the need for information and clarification campaigns on FOP labeling for a better understanding of the importance of the initiative and the criteria used for food classification. This result corroborates those of Machín *et al.* (2019), who demonstrated the importance of consumer comprehension and familiarity with FOP labels. Another important point highlighted by our study participants was the preference for the term "much" instead of "high content of," because the former was considered easier to understand.

A previous study with Brazilian consumers suggested that individuals may be more familiar with the term "much/too much" to signal excess nutrients; however, this term can also be thought to indicate product quality. The claim "high in [nutrient]" may be an interesting alternative, as evidenced by the results of a previous study in which individuals shown a triangle warning with the claim "high in [nutrient]" made healthier choices (Khandpur *et al.*, 2019). These data suggest that the preference of study participants for labels containing the term "much" over the label displaying "high content of" may be attributed to the use of the term "content."

The traffic light label was deemed more difficult to understand by study participants, although it provided more information. Studies have shown that excess quantitative information (numbers and percentages) combined with qualitative information hinders the understanding of consumers with low levels of education, requiring more time for analysis (Van't Riet *et al.*, 2011; Cowburn and Stockley, 2005). De la Cruz-Góngora *et al.* (2017) reported that Mexican consumers found it easy to relate the green color with good characteristics and the red color with bad characteristics. However, consumers found it difficult to interpret the meaning of the yellow traffic light. Spanish consumers also found it difficult to understand the traffic light system (León-Flández *et al.*, 2015).

Participants reported that FOP warning labels could influence their purchase decision. When imagining a shopping situation, interviewees stated that they would look for food items with the fewest number of warning labels. Uruguayan researchers observed similar results in an online survey; participants revealed that they would modify their choices according to FOP warning symbols, opting for products with the fewest number of warnings (Ares *et al.*, 2018). Machín *et al.* (2019) used mock supermarket shelves to assess the visual attention given to warning labels. The authors used mobile eye tracking to understand what influences Uruguayan consumers' food choices. The intervention group made healthier choices (products with fewer warning labels), whereas the control group chose food items with two or three warnings (Machín *et al.*, 2019). In a real shopping environment, consumers might be confused by the variety of color combinations used in traffic light systems, increasing the difficulty of understanding this type of label and requiring more analysis time, which might not be possible for consumers (Cowburn and Stockley, 2005; Van't Riet *et al.*, 2011). The greater time needed to analyze products and compare different options could make the use of traffic light labels unfeasible. According to the dual-system theory, everyday decision-making is made predominantly by the fast, automatic, associative, nonconscious system, which requires little cognitive effort, especially in situations with distractions, time pressure, standard options or recurrent

tasks. Thus, it is suggested that warning labels could influence food purchase decisions, serving as an effective "nudge" toward healthier food choices (Thaler and Sunstein, 2008). A review article analyzing studies with consumers in the Southern Hemisphere concluded that individuals prefer labels that use symbols or images, provide clear and simple information, use large letters and have the support of government agencies, giving credibility to the information (Mandle *et al.*, 2015). Our results agree with those of previous international studies on FOP labels by showing that labels with symbols are more effective, especially when endorsed by the Brazilian Ministry of Health.

Our results suggest that FOP labels could more strongly influence consumers' perceptions of "nutritionally ambiguous" foods than that of foods known to be "unhealthy," in agreement with the findings of Acton *et al.* (2018).

According to study participants, FOP labeling regulations may stimulate food manufacturers to improve the nutritional quality of foods. This can be achieved by either formulating novel products that do not contain excessive amounts of critical nutrients or reformulating current food products. Such a trend has been observed in countries that have implemented FOP labeling, although further studies are needed to assess whether this outcome is a consequence of labeling regulations (Young and Swinburn, 2002; Vyth *et al.*, 2010; Machín *et al.*, 2019; Khandpur *et al.*, 2019). Machín *et al.* (2019) observed that, one year after implementation, FOP warning labels continued to be used by Uruguayan consumers for making purchase decisions. The authors highlighted that educational campaigns could facilitate the use of warning labels for decision making.

The current study provides results that are specific to the Brazilian context and also reinforce the conclusions of literature reviews by El-Abbadi *et al.* (2020), Croker *et al.* (2020), and Lobstein *et al.* (2020), indicating that FOP warnings may be more influential on consumers' decisions than other FOP designs.

Theoretical and practical implications

Few studies investigating consumers' perceptions about different FOP label formats have been conducted in the Brazilian context. Our study contributes to the small pool of evidence on this topic by demonstrating that FOP labels can be helpful to consumers when labels are presented in an intuitive, interpretative, trustworthy format. Government regulations on FOP labels should be developed considering aspects that can maximize implementation and ensure that labels are fit for their purpose. Furthermore, priority should be given to investments in public campaigns through media channels to instruct individuals on how to use FOP information to make healthier food choices.

Implementation of easy-to-understand FOP labels can also help dietitians and nutrition professionals in their daily practice. FOP labels can be integrated as part of primary care dietetic practice to advise patients on how to avoid unhealthy foods that are high in added sugars, saturated fats and sodium. Because of their straightforward message, FOP labels can also be part of primary and secondary school curricula to educate children and adolescents on healthy eating practices, given that these groups often consume ultra-processed foods high in critical nutrients.

The findings of our study can also be relevant to the food industry. The FOP warning format was preferred by participants because it helped them avoid unhealthy foods. Implementation of FOP warnings may stimulate manufacturers to reformulate their products and produce healthier options as well as to develop alternative products with better nutritional quality, thereby gaining consumers' attention in the ever-competitive food market. However, food reformulations must take into account the latest evidence on nutrition science to protect population health. Regulatory food agencies, such as ANVISA in Brazil, should partner with researchers to monitor changes in the nutrition quality of packaged

foods over time, evaluate the effectiveness of FOP implementation and verify whether information declared on labels complies with current food labeling regulations.

Strengths, limitations and directions of future research

A strength of this study was the focus groups approach, which provides the ability to elicit spontaneous and wide-ranging responses from participants. This approach is suitable for exploratory studies, as it allows active participation and generates detailed qualitative information. Although data were collected from a single Brazilian city, the current sample included a broad range of participant characteristics, including sex, occupation and age. Each focus group comprised participants with similar characteristics to avoid hierarchy and embarrassment. This setup, although it may dilute different views, captures meaningful findings and creates good rapport and understanding between participants.

Nevertheless, there is a need for additional qualitative studies in different Brazilian regions to provide a broader view of consumers' perceptions of FOP labels in different contexts. The methods used for data collection in this study can be easily adapted for such a purpose. Ultimately, we suggest that future large-scale quantitative studies be conducted in real-world environments to assess whether understanding FOP food labels can assist consumers in making healthier food choices.

Conclusion

Of the four FOP labels analyzed, participants showed a preference for black warning labels, regardless of their shape. Black symbols with a white background were found to provide good color contrast against food packages. We emphasize that participants preferred the term "much" over "high content of" and reported that labels were more reliable when endorsed by the Ministry of Health; this characteristic was reported as critical for making a purchase decision.

Participants stated that, if FOP warning labels were used, they would avoid foods with one or more warnings, depending on the type of food. They also found that a lack of warning labels could lead consumers to doubt whether the food was evaluated or whether the manufacturer was not complying with legislation. Some participants preferred the traffic light label because it contains more information than warning labels. However, individuals found it difficult to choose between three breads with different nutritional profiles when the traffic light system was used. Compared with the other labels, the traffic light system had more negative than positive aspects, both in relation to clarity of information and contribution to food choices.

References

Acton, R.B., Vanderlee, L. and Hammond, D. (2018), "Influence of nutritional labels on the front of the package on the perceptions of wholesomeness of beverages: results of a randomized experiment", *Preventive Medicine*, Vol. 115, pp. 83-89.

Anastasiou, K., Miller, M. and Dickinson, K. (2019), "The relationship between food label use and dietary intake in adults: a systematic review", *Appetite*, Vol. 138, pp. 280-291.

Ares, G., Aschemann-Witzel, J., Curutchet, M.R., Antúnez, L., Moratorio, X. and Bove, I. (2018), "A citizen perspective on nutritional warnings as front-of-pack labels: insights for the design of accompanying policy measures", *Public Health Nutrition*, Vol. 21, pp. 3450-3461.

Bandeira, L.M., Pedroso, J., Toral, N. and Gubert, M.B. (2021), "Performance and perception on front-of-package nutritional labeling models in Brazil", *Revista de Saúde Pública*, Vol. 55, pp. 1-12.

Barbour, R. (2009), *Grupos Focais*, Porto Alegre, Artmed. Translate for Barbour, R. 2007. Doing Focus Groups, Sage Publications, London, p. 174, ISBN 978-0- 7619-4978-7.

Basto-Abreu, A., Torres-Alvarez, R., Reyes-Sánchez, F., González-Morales, R., Canto-Osorio, F., Colchero, M.A., Barquera, S., Rivera, J.A. and Barrientos-Gutierrez, T. (2020), "Predicting obesity reduction after implementing warning labels in Mexico: a modeling study", *PLoS Medicine*, Vol. 17 No. 7, e1003221, doi: 10.1371/journal.pmed.1003221.

Bera, O.P., Saleem, S.M. and Bhattacharya, S. (2021), "Promoting healthier diets in India through 'front of package food labeling'", *Indian Journal of Community Health*, Vol. 33, pp. 25-29.

Braun, V. and Clarke, V. (2006), "Using thematic analysis in psychology", *Qualitative Research in Psychology*, Vol. 3, pp. 77-101.

Brazil. Ministry of Economy of Brazil. Brazilian Institute of Geography and Statistics (2011), *Pesquisa de Orçamentos Familiares, POF 2008-2009: análise do consumo alimentar pessoal no Brasil (Brazilian Budgets Survey, 2008–2009: Analysis of Individual Food Intake in Brazil)*, Instituto Brasileiro de Geografia e Estatística, Brasília, DF, available at: https://biblioteca.ibge.gov.br/visualizacao/livros/liv50063.pdf (accessed 14 October 2021).

Brazil. Ministry of Health of Brazil. National Health Surveillance Agency (2003), *Resolução da Diretoria Colegiada RDC nº 359, 2003: aprova regulamento técnico de porções de alimentos embalados para fins de rotulagem nutricional (Resolution no. 359, 2003: Approves the Technical Rules for Packaged Food Serving Sizes for Food Labeling Purposes)*, Agência Nacional de Vigilância Sanitária, Brasília, DF, available at: http://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2003/rdc0359_23_12_2003.html (accessed 14 October 2021).

Brazil. Ministry of Health of Brazil. National Health Surveillance Agency (2012), *Resolução da Diretoria Colegiada RDC nº 54, 2012: dispõe sobre o regulamento técnico sobre informação nutricional complementar (Resolution nº 54, 2012: Technical Regulation on Supplementary Nutritional Information)*, Agência Nacional de Vigilância Sanitária, Brasília, available at: https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2012/rdc0054_12_11_2012.html (accessed 14 October 2021).

Brazil. Ministry of Health of Brazil. National Health Surveillance Agency (2018), *Relatório preliminar de análise de impacto regulatório sobre rotulagem nutricional (Preliminary Report of Regulatory Impact Analysis on Nutritional Labeling)*, Agência Nacional de Vigilância Sanitária, Brasília, DF, available at: https://pesquisa.anvisa.gov.br/upload/surveys/981335/files/An%C3%A1lise%20de%20Impacto%20Regulat%C3%B3rio%20sobre%20Rotulagem%20Nutricional.pdf (accessed 14 October 2021).

Campos, S., Doxey, J. and Hammond, D. (2011), "Nutrition labels on pre-packaged foods: a systematic review", *Public Health Nutrition*, Vol. 14, pp. 1496-1506.

Cowburn, G. and Stockley, L. (2005), "Consumer understanding and use of nutrition labelling: a systematic review", *Public Health Nutrition*, Vol. 8, pp. 21-28.

Croker, H., Packer, J., Russell, S.J., Stansfield, C. and Viner, R.M. (2020), "Front of pack nutritional labelling schemes: a systematic review and meta-analysis of recent evidence relating to objectively measured consumption and purchasing", *Journal of Human Nutrition and Dietetics*, Vol. 33, pp. 518-537.

De la Cruz-Góngora, V., Torres, P., Contreras-Manzano, A., de la Mota, A.J., Mundo-Rosas, V., Villalpando, S. and Rodriguez-Oliveros, G. (2017), "Understanding and acceptability by Hispanic consumers of four front-of-pack food labels", *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 14, p. 28, doi: 10.1186/s12966-017-0482-2.

Deliza, R., DE Alcantara, M., Pereira, R. and Ares, G. (2020), "How do different warning signs compare with the guideline daily amount and traffic-light system?", *Food Quality and Preference*, Vol. 80, 103821.

Dourado, D.Q.S., Ramires, T.G., Flores, J.A. and Fernandes, A.C.P. (2021), "Impact of front-of-pack labeling on food purchase pattern in Chile", *Nutricion Hospitalaria*, Vol. 38, pp. 358-365.

El-Abbadi, N.H., Taylor, S.F., Micha, R. and Blumberg, J.B. (2020), "Nutrient profiling systems, front of pack labeling, and consumer behavior", *Current Atherosclerosis Reports*, Vol. 22 No. 8, p. 36, doi: 10.1007/s11883-020-00857-5.

Feteira-Santos, R., Fernandes, J., Virgolino, A., Alarcão, V., Sena, C., Vieira, C.P., Gregório, M.J., Nogueira, P., Costa, A., Graça, P. and Santos, O. (2020), "Effectiveness of interpretive front-of-pack nutritional labelling schemes on the promotion of healthier food choices: a systematic review", *JBI Evidence Implementation*, Vol. 18, pp. 24-37.

Feteira-Santos, R., Alarcão, V., Santos, O., Virgolino, A., Fernandes, J., Vieira, C.P., Gregório, M.J., Nogueira, P., Costa, A. and Graça, P. (2021), "Looking ahead: health impact assessment of front-of-pack nutrition labelling schema as a public health measure", *International Journal of Environmental Research and Public Health*, Vol. 18, pp. 1-18.

Gracia, A. and De-Magistris, T. (2016), "Consumer preferences for food labeling: what ranks first?", *Food Control*, Vol. 61, pp. 39-46.

Graham, D.J., Orquin, J.L. and Visschers, V.H.M. (2012), "Eye tracking and nutrition label use: a review of the literature and recommendations for label enhancement", *Food Policy*, Vol. 37, pp. 378-382.

Grunert, K.G. and Wills, J.M. (2007), "A review of European research on consumer response to nutrition information on food labels", *Journal of Public Health*, Vol. 15, pp. 385-399.

Gugliucci, V., Machín, L., Curutchet, M.R. and Ares, G. (2021), "Do nutritional warnings encourage healthier choices on food ordering websites? An exploratory experimental study in Uruguay", *Public Health Nutrition*, Vol. 24, pp. 3547-3551.

Hodgkins, C., Barnett, J., Wasowicz-Kirylo, G., Stysko-Kunkowska, M., Gulcan, Y., Kustepeli, Y., Akgungor, S., Chryssochoidis, G., Fernández-Celemin, L., Storcksdieck Genannt Bonsmann, S., Gibbs, M. and Raats, M. (2012), "Understanding how consumers categorise nutritional labels: a consumer derived typology for front-of-pack nutrition labelling", *Appetite*, Vol. 59, pp. 806-817.

Ikonen, I., Sotgiu, F., Aydinli, A. and Verlegh, P.W.J. (2020), "Consumer effects of front-of-package nutrition labeling: an interdisciplinary meta-analysis", *Journal of the Academy of Marketing Science*, Vol. 48, pp. 360-383.

Kanter, R., Vanderlee, L. and Vandevijvere, S. (2018), "Front-of-package nutrition labelling policy: global progress and future directions", *Public Health Nutrition*, Vol. 21, pp. 1399-1408.

Khandpur, N., De Morais Sato, P., Mais, L.A., Bortoletto Martins, A.P., Spinillo, C.G., Garcia, M.T., Urquizar Rojas, C.F. and Jaime, P.C. (2018), "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*, Vol. 10, p. 688.

Khandpur, N., Mais, L.A., De Morais Sato, P., Martins, A.P.B., Spinillo, C.G., Rojas, C.F.U., Garcia, M.T. and Jaime, P.C. (2019), "Choosing a front-of-package warning label for Brazil: a randomized, controlled comparison of three different label designs", *Food Research International*, Vol. 121, pp. 854-861.

Kleef, E.V. and Dagevos, H. (2015), "The growing role of front-of-pack nutrition profile labeling: a consumer perspective on key issues and controversies", *Critical Reviews in Food Science and Nutrition*, Vol. 55, pp. 291-303.

Kliemann, N., Kraemer, M.V.S., Scapin, T., Rodrigues, V.M., Fernandes, A.C., Bernardo, G.L., Uggioni, P.L. and Proença, R.P.C. (2018), "Serving size and nutrition labelling: implications for nutrition information and nutrition claims on packaged foods", *Nutrients*, Vol. 10 No. 7, pp. 891-904.

Krueger, R.A. and Casey, M.A. (2009), *Focus Groups: A Practical Guide for Applied Research*, Sage Publications, Thousand Oaks, CA.

León-Flández, K.A., Prieto-Castillo, L. and Royo-Bordonada, M.A. (2015), "Semáforo nutricional: conocimiento, percepción y utilización entre los consumidores de Madrid, España", *Revista Española de Nutrición Humana y Dietética*, Vol. 19 No. 2, pp. 97-104, doi: 10.14306/renhyd.19.2.150, available at: http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S2174-51452015000200006&lng=es.

Lima, M., Ares, G. and Deliza, R. (2018), "How do front of pack nutrition labels affect healthfulness perception of foods targeted at children? Insights from Brazilian children and parents", *Food Quality and Preference*, Vol. 64, pp. 111-119.

Lobstein, T., Neveux, M. and Landon, J. (2020), "Costs, equity and acceptability of three policies to prevent obesity: a narrative review to support policy development", *Obesity Science and Practice*, Vol. 6, pp. 562-583.

Machín, L., Curutchet, M.R., Giménez, A., Aschemann-Witzel, J. and Ares, G. (2019), "Do nutritional warnings do their work? Results from a choice experiment involving snack products", *Food Quality and Preference*, Vol. 77, pp. 159-165.

Malloy-Weir, L. and Cooper, M. (2017), "Health literacy, literacy, numeracy and nutrition label understanding and use: a scoping review of the literature", *Journal of Human Nutrition and Dietetics*, Vol. 30, pp. 309-325.

Mandle, J., Tugendhaft, A., Michalow, J. and Hofman, K. (2015), "Nutrition labelling: a review of research on consumer and industry response in the global South", *Glob Health Action*, Vol. 8, pp. 259-312.

Ni Mhurchu, C., Volkova, E., Jiang, Y., Eyles, H., Michie, J., Neal, B., Blakely, T., Swinburn, B. and Rayner, M. (2017), "Effects of interpretive nutrition labels on consumer food purchases: the starlight randomized controlled trial", *The American Journal of Clinical Nutrition*, Vol. 105, pp. 695-704.

Paho. Pan American Health Organization (2016), *Nutrient Profile Model*, Washington, District of Columbia, available at: https://iris.paho.org/handle/10665.2/18621 (accessed 13 October 2021).

Pettigrew, S., Talati, Z., Miller, C., Dixon, H., Kelly, B. and Ball, K. (2017), "The types and aspects of front-of-pack food labeling systems preferred by adults and children", *Appetite*, Vol. 109, pp. 115-123.

Rodrigues, V.M., Rayner, M., Fernandes, A.C., De Oliveira, R.C., Proença, R.P. and Fiates, G.M. (2017), "Nutritional quality of packaged foods targeted at children in Brazil: which ones should be eligible to bear nutrient claims?", *International Journal of Obesity (London)*, Vol. 41, pp. 71-75.

Scarborough, P., Matthews, A., Eyles, H., Kaur, A., Hodgkins, C., Raats, M.M. and Rayner, M. (2015), "Reds are more important than greens: how UK supermarket shoppers use the different information on a traffic light nutrition label in a choice experiment", *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 12, p. 151.

Shangguan, S., Afshin, A., Shulkin, M., Ma, W., Marsden, D., Smith, J., Saheb-Kashaf, M., Shi, P., Micha, R., Imamura, F. and Mozaffarian, D. (2018), "Food price (policy review and intervention cost-effectiveness) project. A meta-analysis of food labeling effects on consumer diet behaviors and industry practices", *American Journal of Prevention Medicine*, Vol. 56, pp. 300-314.

Silveira, B.M., Kliemann, N., Silva, D.P., Colussi, C.F. and Proença, R.P.D.C. (2013), "Availability and price of food products with and without trans fatty acids in food stores around elementary schools in low- and medium-income neighborhoods", *Ecology of Food and Nutrition*, Vol. 52, pp. 63-75.

Sonnenberg, L., Gelsomin, E., Levy, D.E., Riis, J., Barraclough, S. and Thorndike, A.N. (2013), "A traffic light food labeling intervention increases consumer awareness of health and healthy choices at the point-of-purchase", *Preventive Medicine*, Vol. 57, pp. 253-257.

Talati, Z., Norman, R., Pettigrew, S., Neal, B., Kelly, B., Dixon, H., Ball, K., Miller, C. and Shilton, T. (2017), "The impact of interpretive and reductive front-of-pack labels on food choice and willingness to pay", *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 14, p. 171.

Thaler, R.H. and Sunstein, C.R. (2008), *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Yale University Press, New Haven, New Jersey.

Van't Riet, J., Sijtsema, S.J., Dagevos, H. and De Bruijn, G.J. (2011), "The importance of habits in eating behaviour. An overview and recommendations for future research", *Appetite*, Vol. 57, pp. 585-596.

Volkova, E. and Ni Mhurchu, C. (2015), "The influence of nutrition labeling and point-of-purchase information on food behaviours", *Current Obesity Reports*, Vol. 4, pp. 19-29.

United Kingdom (2007), *Using Traffic Lights to Make Healthier Food Choices*, Food Standards Agency, London.

Vyth, E.L., Steenhuis, I.H., Roodenburg, A.J., Brug, J. and Seidell, J.C. (2010), "Front-of-pack nutrition label stimulates healthier product development: a quantitative analysis", *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 7, p. 65, doi: 10.1186/1479-5868-7-65.

Wandel, M. (1997), "Food labelling from a consumer perspective", *British Food Journal*, Vol. 99, pp. 212-219.

WHO (2004), Word Health Organization, *Global Strategy on Diet, Physical Activity and Health: List of All Documents and Publications*, 57th World Health Assembly, World Health Organization, Geneva.

WHO (2017), FAO. World Health Organization, Food and Agriculture Organization of the United Nations, *Discussion Paper on Consideration of Issues Regarding Front-of-Pack Nutrition Labelling*, World Health Organization, Rome.

Young, L. and Swinburn, B. (2002), "Impact of the Pick the Tick food information programme on the salt content of food in New Zealand", *Health Promotion International*, Vol. 17 No. 1, pp. 13-19, doi: 10.1093/heapro/17.1.13.

Corresponding author
Ana Claudia Mazzonetto can be contacted at: ac.mazzonetto@gmail.com