

UNIVERSIDADE FEDERAL DE MINAS GERAIS
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**EFFECT OF CLAIMS PRESENT ON FOOD PRODUCTS WITH FRONT-OF-PACK
NUTRITION LABELING ON BRAZILIAN CONSUMERS' UNDERSTANDING AND
PURCHASE INTENTION**

Belo Horizonte
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Thesis presented to the Postgraduate Program in Food Science at the Faculty of Pharmacy of the Federal University of Minas Gerais as a partial requirement for obtaining the Doctor in Food Science degree.

Advisor: Prof. Dr. Lucilene Rezende Anastácio

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ATA DE DEFESA DE TESE DA ALUNA

SARAH MORAIS SENNA PRATES

Realizou-se, no dia 12 de junho de 2023, às 14:00 horas, Sala 3062 - Faculdade de Farmácia, da Universidade Federal de Minas Gerais, a defesa de tese, intitulada *EFFECT OF CLAIMS ON FOOD PRODUCTS WITH FRONT-OF-PACK NUTRITION LABELING ON BRAZILIAN CONSUMERS' UNDERSTANDING AND PURCHASE INTENTION*, apresentada por SARAH MORAIS SENNA PRATES, número de registro 2018753163, graduada no curso de NUTRIÇÃO, como requisito parcial para a obtenção do grau de Doutora em CIÊNCIA DE ALIMENTOS, à seguinte Comissão Examinadora: Profa. Dra. Lucilene Rezende Anastácio (Orientadora e presidente da comissão), da Faculdade de Farmácia - UFMG, Profa. Dra. Adriana Silvina Pagano, da Faculdade de Letras - UFMG, Profa. Dra. Camila Argenta Fante, da Faculdade de Farmácia - UFMG, Profa. Dra. Larissa Loures Mendes, da Escola de Enfermagem - UFMG, Profa. Dra. Marlene Azevedo Magalhães Monteiro, da Escola de Enfermagem - UFMG.

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Finalizados os trabalhos, lavrou-se a presente ata que, lida e aprovada, vai assinada pelos membros da Comissão. Belo Horizonte, 12 de junho de 2023.

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“Se a gente cresce com os golpes duros da vida, também podemos crescer
com os toques suaves na alma”

Cora Coralina

ABSTRACT

Food labeling is often reported as little used and difficult to understand by consumers. To facilitate the understanding of the nutritional composition of food products and promote healthier food choices, front-of-pack nutritional labeling (FoPNL) was proposed. FoPNL consists of nutritional labeling systems that quickly inform the nutritional composition of food products. Warning FoPNL models, which use symbols that refer to the idea of alert to highlight food products with an excess of harmful nutrients, such as sugars, saturated fat, and sodium, have been emerging as a strategy to reduce the consumption of ultra-processed foods to face the current pandemic of obesity and chronic non-communicable diseases. Many American countries, such as Chile, Uruguay, Mexico, and Argentina, have already implemented FoPNL systems, especially with the black octagon design. In Brazil, the FoPNL was implemented in October 2022, with the black magnifying glass model, with the descriptor “high in” highlighting products with excess added sugars, saturated fat, and sodium. In addition to the FoPNL, other label information communicates about the nutritional composition of food products, such as nutritional claims. Unlike FoPNL, nutritional claims only highlight positive attributes of the product's composition, such as “rich in fiber,” “low in sodium,” and “zero sugar.” The combined presence of nutrient claims and warnings can confuse consumers about the overall healthfulness of products. For this reason, unlike Brazil, some countries, such as Mexico and Argentina, prohibit the publication of claims on food products that contain FoPNL. In this sense, this study evaluated the influence of nutritional claims and different FoPNL models on the understanding of nutritional information, associations and perceptions of healthiness, and the purchase intention of Brazilian consumers. This was an experimental study conducted through an online questionnaire. Brazilian adults ($n = 720$) were randomized into four FoPNL conditions: control, octagon, triangle, and magnifying glass. Each participant viewed 12 food labels, which were developed following a factorial design ($3 \times 2 \times 2$): (i) food category (cereal bars, whole-grain cookies, and snacks); (ii) product type (one critical nutrient in excess $\times$ two critical nutrients in excess) and (iii) nutrition claims (present $\times$ absent). The understanding of nutritional information was assessed through the correct identification of excessive nutrients, perceived healthiness, and purchase intention were assessed using a 7-point scale, and consumer associations/perceptions of products were explored using a word association task. The results indicated that the FoPNL increased the understanding of information and reduced the perception of healthiness and purchase intention. The presence of claims acted by decreasing the probability of understanding nutritional information by 32% (odds ratio = 0.68, 95% confidence interval 0.58 to 0.78, $p < 0.01$) and significantly increasing it ($p < 0.05$) the perception of healthiness (odds ratio (95% confidence interval)) from 1.95 (1.91-2.00) to 2.02 (1.98-2.06) and purchase intention (odds ratio (95% confidence interval)) in the categories of biscuits, from 2.03 (1.98-2.07) to 2.08 (2.03-2.12) and snacks, from 1.88 (1.83-1.93) to 1.97 (1.92-2.02). In the word association task, FoPNL increased associations with harmful nutrients and negative associations with health. It increased the likelihood that participants would give answers about unhealthy products by 12%, 26%, and 27% for the magnifying glass, octagon, and triangle, respectively, about the control. The claims had the opposite effect, increasing associations with beneficial nutrients and positive associations with health. But they had no significant effect on the likelihood that participants gave answers about the healthiness or unhealthiness of the products. The results prove the effectiveness of the FoPNL in the understanding and judgment of consumers since, in general, the inclusion of the FoPNL favored the evaluated outcomes. The FoPNL models varied in performance depending on the outcome, food category, and amount of excess nutrients. Nutritional claims had the opposite and less

significant effect than FoPNL. However, the FoPNL was not enough to nullify the positivity bias generated by the claims.

Keywords: food labelling; nutrition policy; FOP; warning labels; consumer research; consumers' perceptions; health halo; positivity bias.

RESUMO

A rotulagem de alimentos é, frequentemente, reportada como pouco utilizada e de difícil entendimento pelos consumidores. Com o objetivo de facilitar o entendimento da composição nutricional dos produtos alimentícios e favorecer escolhas alimentares mais saudáveis, a rotulagem nutricional frontal (RNF) foi proposta. A RNF consiste de sistemas de rotulagem nutricional que informam a composição nutricional de produtos alimentícios de forma simples e rápida. Os modelos de RNF de advertência, que utilizam símbolos que remetem a ideia de alerta para destacar produtos alimentícios com excesso de nutrientes prejudiciais, como açúcares, gordura saturada e sódio, vêm despontando como estratégia para reduzir o consumo de alimentos ultraprocessados enfrentar a atual pandemia de obesidade e doenças crônicas não transmissíveis. Muitos países das Américas, como Chile; Uruguai, México e Argentina, já implementaram ou estão implementando sistemas de RNF, especialmente com o design de octógono preto. No Brasil, a RNF foi implementada a partir de outubro de 2022, com o modelo de lupa preta, com o descritor “alto em”, destacando produtos com excesso de açúcares adicionados, gordura saturada e sódio. Além da RNF, outras informações nos rótulos comunicam sobre a composição nutricional dos produtos alimentícios, como as alegações nutricionais. Ao contrário da RNF, as alegações nutricionais destacam apenas atributos positivos da composição dos produtos, como “rico em fibras”, “baixo em sódio” e “zero açúcar”. A presença conjunta de alegações e advertências sobre nutrientes pode confundir os consumidores sobre a saudabilidade geral dos produtos. Por este motivo, diferente do Brasil, alguns países, como México e Argentina, proíbem a veiculação de alegações em produtos alimentícios que recebem RNF. Nesse sentido, este estudo avaliou a influência de alegações nutricionais e de diferentes modelos de RNF na compreensão das informações nutricionais, nas associações e percepções de saudabilidade e na intenção de compra de consumidores brasileiros. Tratou-se de estudo experimental, conduzido por meio de questionário on-line. Adultos brasileiros ($n = 720$) foram randomizados em quatro condições de RNF: controle, octógono, triângulo e lupa. Cada participante visualizou 12 rótulos de alimentos, que foram desenvolvidos seguindo o desenho fatorial ($3 \times 2 \times 2$): (i) categoria de alimento (barras de cereal, biscoitos integrais e snacks); (ii) tipo de produto (um nutriente crítico excessivo $\times$ dois nutrientes críticos excessivos) e (iii) alegações nutricionais (presente $\times$ ausente). A compreensão das informações nutricionais foi avaliada por meio da identificação correta dos nutrientes excessivos, a saudabilidade percebida e a intenção de compra foram avaliadas por escala de 7 pontos e as associações/percepções dos consumidores foram exploradas por meio de tarefa de associação de palavras. Os resultados indicaram que a RNF aumentou a compreensão das informações, reduziu a percepção de saudabilidade e a intenção de compra. Já as alegações nutricionais atuaram diminuindo a probabilidade de compreensão das informações nutricionais em 32% (*odds ratio* = 0,68, intervalo de confiança de 95% 0,58 a 0,78, $p < 0,01$) e aumentando significativamente ($p < 0,05$) a percepção de saudabilidade (*odds ratio* (intervalo de confiança de 95%)) de 1,95 (1,91-2,00) para 2,02 (1,98-2,06) e a intenção de compra (*odds ratio* (intervalo de confiança de 95%)) nas categorias de biscoitos, de 2,03 (1,98-2,07) para 2,08 (2,03-2,12) e de snacks, de 1,88 (1,83-1,93) para 1,97 (1,92 – 2,02). Na tarefa de associação de palavras, a RNF aumentou as associações com nutrientes nocivos e associações negativas com a saúde e aumentou a probabilidade de os participantes darem respostas sobre a insalubridade dos produtos em 12%, 26% e 27% para a lupa, octógono e triângulo, respectivamente, em relação ao controle. As alegações tiveram efeito oposto, aumentando as associações com nutrientes benéficos e associações positivas com a saúde. Mas, elas não tiveram efeito significativo sobre a probabilidade de os participantes darem respostas sobre a salubridade ou insalubridade dos produtos. Os resultados comprovam a eficácia da RNF

na compreensão e julgamento dos consumidores, uma vez que, no geral, a inclusão da RNF favoreceu os desfechos avaliados. Os modelos de RNF variaram em seu desempenho, a depender do desfecho, assim como da categoria de alimento e da quantidade de nutrientes em excesso. As alegações nutricionais tiveram efeito contrário e menos significativo do que a RNF. No entanto, a RNF não foi suficiente para anular o viés de positividade gerado pelas alegações.

Palavras-chave: rotulagem de alimentos; política nutricional; FOP; rótulos de advertência; pesquisa de consumo; percepções dos consumidores; halo de saúde; viés de positividade.

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LIST OF ABBREVIATIONS AND ACRONYMS

ABRASCO	- <i>Associação Brasileira de Saúde Coletiva</i>
AI	- Area of interest
ANOVA	- Analysis of Variance
ANVISA	- <i>Agência Nacional de Vigilância Sanitária</i>
BH	- <i>Belo Horizonte</i>
CAISAN	- <i>Câmara Interministerial de Segurança Alimentar e Nutricional</i>
CFN	- <i>Conselho Federal de Nutricionistas</i>
COVID-19	- Coronavirus Disease of 2019
CP	- <i>Consulta Pública</i>
FoPNL	- Front-of-pack nutrition labeling
FUNED	- <i>Fundação Ezequiel Dias</i>
GDA	- Guideline Daily Amount
GGALI	- <i>Gerência-Geral de Alimentos</i>
GLM	- Generalized linear model
HSR	- Health Star Rating
IDEC	- <i>Instituto Brasileiro de Defesa do Consumidor</i>
IN	- <i>Instrução Normativa</i>
INFORMAS	- International Network for Food and Obesity/Non-communicable Diseases Research, Monitoring and Action Support
LCD	- Liquid Crystal Display
Mercosur	- <i>Mercado Común del Sur</i>
NCDs	- Non-communicable diseases
PAHO	- Pan American Health Organization
PROTESTE	- <i>Associação Brasileira de Defesa do Consumidor</i>
RDC	- <i>Resolução de Diretoria Colegiada</i>
RNF	- <i>Rotulagem Nutricional Frontal</i>
SPSS	- Statistical Package for the Social Sciences
TCLE	- <i>Termo de Consentimento Livre e Esclarecido</i>
TPS	- <i>Tomada Pública de Subsídios</i>
UFMG	- <i>Universidade Federal de Minas Gerais</i>
UFPR	- <i>Universidade Federal do Paraná</i>

UK – United Kingdom

WHO - World Health Organization

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1 INTRODUCTION

Chronic non-communicable diseases (NCDs) are the leading cause of loss of quality of life, disability, and death in countries with more significant economic development (STRAZZULLO *et al.*, 2021). They are strongly associated with unhealthy lifestyle habits, such as inadequate nutrition, a risk factor that most contributes to the global burden of these diseases (ANVISA, 2018). In 2019, 8 million deaths were attributed to dietary risk factors such as excessive sugar consumption, saturated fat, and sodium (SONG *et al.*, 2021). In Brazil in 2018, chronic NCDs accounted for 74% of all deaths, with cardiovascular diseases having the most significant impact (26%) (WHO, 2018).

The pandemic of NCDs is increasing in parallel with the consumption of ultra-processed foods (CURIONI *et al.*, 2022). Excess harmful nutrients and food additives characterize these products, and their consumption is directly associated with NCDs (LANE *et al.*, 2021). The increasing availability, accessibility, and promotion of these products (MONTEIRO *et al.*, 2010; OPAS, 2019; SWINBURN *et al.*, 2019) favors food environments that do not facilitate healthy and sustainable food choices. Food environments are characterized by “food entry points”, accessibility to physical spaces, personal determinants, and political, social, and cultural norms (BORGES; JAIME, 2022).

In this context, several strategies, such as encouraging the practice of physical exercises, taxing unhealthy foods, and food labeling, have been considered to promote healthier eating environments and try to reduce the negative impact of the chronic NCDs (ANVISA, 2018; BEAGLEHOLE *et al.*, 2011; PAHO, 2020). Among these strategies, nutritional labeling, through information on food composition, aims to guide consumers toward healthier food choices (GRESSIER; SASSI; FROST, 2020).

Labeling makes up the list of food regulation strategies of the National Food and Nutrition Policy (PNAN) to promote adequate and healthy eating (BRASIL, 2013). Despite this potential, classic labeling information, such as the nutrition facts table, is generally reported by consumers as challenging to interpret (BONSMANN *et al.*, 2020).

Thus, to facilitate the visibility and understanding of nutritional information on foods and, consequently, promote healthier choices and prevent chronic NCDs, front-of-pack nutrition labeling (FoPNL) has been identified as a promising strategy (BONSMANN *et al.*, 2020; JONES *et al.*, 2019). This type of labeling consists of labels placed on the front panel of the packages, which simply and quickly inform about the nutritional quality of the food,

complementing the other nutritional information, such as the nutritional table (JONES et al., 2019; PAHO, 2020).

In Latin America, for example, several countries, such as Chile (MINISTERIO DE SALUD CHILE, 2015), Uruguay (MINISTÉRIO DE SALUD PÚBLICA, 2021) Peru (MINISTERIO DE SALUD DE PERÚ, 2018), Mexico (SECRETARIA DE ECONOMIA, 2020), Argentina (MINISTERIO DE SALUD, 2022), Colombia (EL CONGRESO DE COLOMBIA, 2021) e Venezuela (MINISTERIO DEL PODER POPULAR PARA LA SALUD, 2021) have already adopted or are in the process of implementing required octagonal front warning labels (FAO, PAHO, UNICEF, 2022). So-called warning labels identify foods that contain excessive amounts of harmful nutrients, through warning labels such as the octagon and text messages such as “high/excess”, referring to critical nutrients (PAHO, 2020). Warning labels have gained popularity mainly in Latin America, and much evidence shows that this type of front label is effective in capturing consumers' attention, facilitating information processing and understanding (ARRÚA *et al.*, 2017b; DELIZA *et al.*, 2020; GOODMAN *et al.*, 2018; KHANDPUR *et al.*, 2018), in addition to promoting healthier choices (ACTON et al., 2019; ARES et al., 2018; KHANDPUR et al., 2018; TAILLIE et al., 2020a; TAILLIE, 2020b; VARGAS-MEZA et al., 2019).

After a lengthy discussion in Brazil, the FoPNL will be adopted using a black magnifying glass model, which has not yet been studied regarding its effectiveness, which will inform about the high content of added sugars, saturated fat, and sodium. The law regulating the FoPNL in Brazil (BRASIL, 2020a) entered into force in October 2022, with an adaptation period until October 2023 or more, depending on the product. It establishes next to the magnifying glass symbol of the National Health Surveillance Agency of Brazil (*Agência Nacional de Vigilância Sanitária - ANVISA*), the text "high in" refers to the content of nutrients of interest to public health. In addition, the area for the application of FoPNL is also defined in the legislation, which will vary according to the area of the front panel of the packages and the limits of the nutrients targeted by the information (BRASIL, 2020b). In Brazil, unlike other countries such as Mexico (SECRETARIA DE ECONOMIA, 2020) and Argentina (MINISTERIO DE SALUD, 2022), the placement of nutrition claims will not be prohibited on foods with FoPNL as long as the claims do not refer to the nutrients warned on the front label.

Although ANVISA's magnifying glass model provides the exact nutritional information as other "high/excessive" labels, it is essential to note that this symbol does not refer to the idea of an alert, such as the octagon, for example, but to the idea of enlarging

information (ANVISA, 2019a). In addition, another relevant difference is that, while with the warning symbols, for each nutrient in excess, a seal is applied to the label, with the ANVISA magnifying glass model, regardless of the number of excessive nutrients, only one seal is applied (THE INTERCEPT BRASIL, 2021).

Although FoPNL has already proven effective in discouraging unhealthy food choices by consumers (ARRÚA *et al.*, 2017a; ARRÚA, 2017b; CORREA *et al.*, 2019; KHANDPUR *et al.*, 2018; KHANDPUR, 2019), other information available on labels, such as nutritional claims, can act oppositely, creating positivity bias towards products (FRANCO-ARELLANO *et al.*, 2020a; MCCANN *et al.*, 2022; MEDIANO STOLTZE *et al.*, 2021; NOBREGA; ARES; DELIZA, 2020), influencing the effectiveness of front-of-pack nutrition labeling (ACTON; HAMMOND, 2018b; FRANCO-ARELLANO *et al.*, 2020a; MEDIANO STOLTZE *et al.*, 2021). Some studies have focused on evaluating this association – the effect of the concomitant presence of FoPNL and nutritional claims on food labels on consumer perceptions and behavior. However, this type of study is still scarce in the Brazilian population (NOBREGA; ARES; DELIZA, 2020), above all, evaluating the magnifying glass model that is already implemented in the country, which justifies the execution of this project.

2 OBJECTIVES

2.1 General objective

To evaluate the effect of claims presence on food labels with different front-of-pack nutrition labeling models on the understanding of nutritional information, healthfulness perception, and purchase intention of Brazilian consumers.

2.2 Specific objectives

- Evaluate and compare the performance of different front-of-pack nutrition labeling models (black octagon, black magnifying glass, and black triangle) on the understanding of nutritional information, healthfulness perception, and purchase intention of Brazilian consumers;
- Investigate the effect of nutritional claims on the understanding of the exact parameters mentioned in the previous item;
- Qualitatively explore the effect of nutritional claims and front-of-pack nutrition labelling on Brazilian consumers' perceptions/associations;
- Assess the relative impact and interactions of FoPNL, nutritional claims, category (cereal bars, whole grain cookies, and snacks), and product type (containing 1 or 2 harmful nutrients in excess) on nutritional information understanding, perceptions, and consumers' purchase intention.

3 CHAPTER I - LITERATURE REVIEW

3.1 Food nutritional labeling – brief context

In Brazil, labeling is defined as any inscription, caption, image, or descriptive or graphic material, written, printed, stamped, engraved, embossed, lithographed, or pasted on food packaging (BRASIL, 2002). Nutrition labeling is a description intended to inform the consumer about the nutritional properties of food (CODEX ALIMENTARIUS COMMISSION, 2017). Although of great importance, nutritional labeling was voluntary for a long time. Initially, the declaration of nutrition labeling was only mandatory for foods with nutritional claims (ANVISA, 2018). In these cases, only the energy content and values of macronutrients (carbohydrates, proteins, and fats) and the nutrients object of the claim were declared (ANVISA, 2018). The purpose of the information was to avoid information asymmetry and deceiving consumers (ANVISA, 2018).

With the evolution of science and the evidence on the impact of food/nutrients on health, nutrition labeling began to be used as a public health instrument for the promotion of adequate and healthy food and the fight against overweight and chronic NCDs; in addition, to be considered consumer law information (ANVISA, 2018). In this context, such a declaration became mandatory for most packaged foods, and the list of declared nutrients was expanded to include substances whose consumption is associated with the development of chronic NCDs. (ANVISA, 2018).

This whole scenario resulted in a series of revisions to the provisions on nutrition labeling by the Codex Alimentarius to help countries, through nutritional labeling, to reduce the negative impacts of chronic NCDs (CODEX ALIMENTARIUS COMMISSION, 2006; CODEX ALIMENTARIUS COMMISSION 2007; CODEX ALIMENTARIUS COMMISSION 2008; CODEX ALIMENTARIUS COMMISSION 2009; CODEX ALIMENTARIUS COMMISSION, 2010). In this sense, the main guidelines for nutrition labeling were the recommendation to declare this information on a mandatory basis, the expansion of the nutrients to be declared, the definition of the reference values of some nutrients based on the nutritional recommendations, and the risk of chronic NCDs and the improvement of the readability of the nutritional table (CODEX ALIMENTARIUS COMMISSION, 2017). All these changes have contributed to the substantial increase in countries with the mandatory declaration of nutrition labeling (ANVISA, 2018).

3.2 Nutritional labeling of food in Brazil

In Brazil, the evolution of the nutrition labeling statement followed the international scenario. The country was one of the first to adopt nutrition labeling on a compulsory basis, making it mandatory on foods with nutritional claims in 1998 (ANVISA, 2018; BRASIL, 1998a). In the same year, the mandatory declaration of nutritional information was extended to foods specially formulated or processed for particular purposes by modifying the nutrient content to meet the needs of people with specific metabolic and physiological conditions (ANVISA, 2018; BRASIL, 1998b).

In 1999, in the first version of the National Food and Nutrition Police, the National Health Surveillance Agency (ANVISA), the body responsible for food surveillance in the country, highlighted the need to review food health legislation and, in 2000, it was published the resolution that established the obligatory declaration of nutritional labeling on packaged foods, considerably expanding the scope of application of mandatory nutritional labeling (ANVISA, 2018; BRASIL, 2000). This resolution was repealed in 2001 by two pieces of legislation that included amendments to improve the rules for mandatory nutrition labeling in the country (ANVISA, 2018; BRASIL, 2001a; BRASIL, 2001b). However, these publications triggered a series of discussions in Mercosur (*Mercado Común del Sur*), as they contradicted the harmonized legislation in the bloc (ANVISA, 2018).

In this scenario, ANVISA established an educational period for the implementation of nutritional labeling, which ended in 2003, with the harmonization of the theme in Mercosur and with the publication of Collegiate Board Resolutions (*Resolução de Diretoria Colegiada - RDC*) 359 and 360 (ANVISA, 2018; BRASIL, 2003a; BRASIL, 2003b), legislation that regulated the nutritional labeling of foods packaged in the country until October 2022. In practice, the legislation above on nutrition labeling was only implemented in 2006, with the end of the period for compliance with Mercosur resolutions (ANVISA, 2018). Table 1 presents the scope and mandatory nutrients for the declaration of legislation on nutrition labeling in Brazil, from the first standard published in 1998 to the current one in force, published in 2003.

Once the rules above on food labeling were implemented in the country (BRASIL, 2003a; BRASIL, 2003b), some inconsistencies and practical limitations of their application were identified over time, some of which were remedied promptly, such as updating the requirements for declaration of nutritional claims, harmonized in Mercosur (ANVISA, 2019b; BRASIL, 2012).

Table 1 - Scope and mandatory nutrients in the declaration of legislation on nutrition labeling in Brazil from 1998 to 2003

Technical elements	Ordinance n° 41/1998	Resolution RDC n° 94/2000	Resolutions RDC n° 39 e 40/2001	Resolutions RDC n° 359 e 360/2003
Scope of application of nutrition labeling	Food packaged in the absence of the consumer, except water.	Food packaged in the absence of the consumer, except water and alcoholic beverages.	Food packaged in the absence of the consumer, except water, alcoholic beverages, and small packages (80 cm ²) without nutritional claims	Food packaged in the absence of the consumer, except water, alcoholic beverages, salt, vinegar, fresh vegetables and meat, spices, coffee, tea, herbs, food additives, additives technology, restaurant foods, and small packages (100 cm ²) without nutritional claims.
List of nutrients from declaration obligatory	Energy value, carbohydrates, lipids, proteins, dietary fiber, and nutrients are targeted by nutritional claims.	Energy value, carbohydrates, dietary fiber, protein, total fat, saturated fat, cholesterol, calcium, iron, sodium, and nutrients targeted by nutritional claims.	Energy value, carbohydrates, dietary fiber, protein, total fat, saturated fat, cholesterol, calcium, iron, sodium, and nutrients targeted by nutritional claims.	Energy value, carbohydrates, dietary fiber, protein, total fat, saturated fat, trans fat, sodium, and nutrients targeted by nutritional claims.

Source: Adapted from ANVISA (2018, p. 25; 2019a, p.24).

3.3 Limitations of nutrition labeling and the global food and epidemiological scenario

Research on food labeling shows an underutilization of nutritional information by consumers due to the difficulty in accessing, processing, and understanding this information (BONSMANN ET AL., 2020; COWBURN; STOCKLEY, 2005; GRUNERT *et al.*, 2010). In Brazil, for example, the difficulty of visualizing and reading the information, the low level of knowledge/education of consumers in food and nutrition, and the confusion generated about the nutritional quality of foods due to the different types of information transmitted on labels, are examples of practical limitations that make this use difficult (ANVISA, 2019a). It is also known that typical shopping situations involve several choices in a short period, with minimal cognitive effort (COWBURN; STOCKLEY, 2005; HOYER, 1984), which can also compromise healthy food choices.

Associated with these limitations involving nutritional labeling, there is the increasing availability, accessibility, and promotion of ultra-processed foods (MONTEIRO *et al.*, 2010; PAHO, 2019; SWINBURN *et al.*, 2019). The high consumption of these foods and

the consequent excessive intake of nutrients that are harmful to health are the leading causes of the increase in overweight, obesity, and chronic NCDs (ASTRUP *et al.*, 2008; RAUBER *et al.*, 2018), which represent seven of the ten leading causes of death in the world (WHO, 2020). Evidence also shows that the relationship between the consumption of ultra-processed foods and chronic NCDs, especially cardiovascular diseases, goes beyond nutrients of interest to public health, involving other factors such as changing the food matrix, and food additives, among others (JUUL; VAIDEAN; PAREKH, 2021).

In this sense, restricting the supply of and access to ultra-processed foods and improving access, understanding, evaluation, and application of nutritional information by consumers are strategies for preventing chronic NCDs and promoting health (ACT; IDEC, 2022; MANSFIELD; WAHBA; DE GRANDPRÉ, 2020). With this objective, several political tools have been implemented in the world, such as the taxation of sugary drinks, the prohibition of advertising to children in ultra-processed foods, and frontal nutritional labeling to indicate to consumers which foods contain excessive amounts of nutrients that are harmful to health (PEREIRA *et al.*, 2022).

3.4 Front-of-pack nutrition labeling

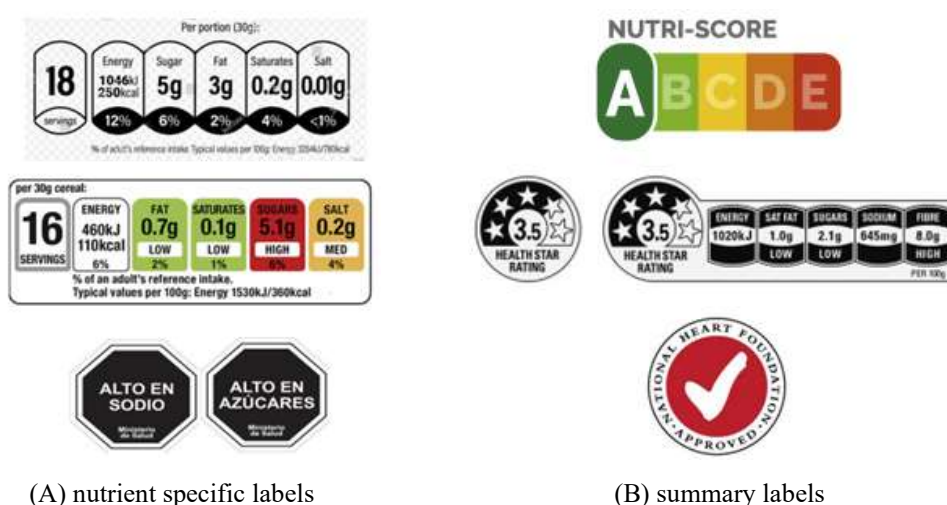
3.4.1 Definition, objectives, and classification of front-of-pack models

In a simplified way, the FoPNL consists of nutritional labeling systems presented on the front panel of packages to transmit nutritional information simply and fast and to influence consumers to make healthier choices (WHO, 2020). In addition to the main objective of favoring healthy eating, the FoPNL can encompass other secondary objectives, such as promoting the reformulation of products by the industry towards healthier foods and, within the scope of broader nutritional policies, the FoPNL can even shape rules for advertising and selling food (WHO, 2020).

Around the world, hundreds of different FoPNL systems are applied to food products with different purposes (PAHO, 2020). The different models of FoPNL labels can be categorized in different ways. Temple (2020), for example, proposes a categorization of models into two groups: (i) nutrient-specific labels, which inform about the content of specific nutrients, most commonly saturated fat, sugar, and sodium (or salt), and (ii) summary labels, which use algorithms to translate food components into a single value that denotes how healthy

the food is or is not (TEMPLE, 2020). Considering this classification, the nutritional traffic light and the warning labels are classified in the first group. In contrast, the Nutri-Score and the Health Star Rating (HSR) are classified in the second group (Figure 1).

Figure 1 - Categorization of front-of-pack nutrition labeling models based on the classification proposed by Temple (2020)



Source: Adapted from Temple (2020, p. 2-3).

Another way of classifying these labels is based on the degree of interpretation of nutritional information by the FoPNL systems, in which the models are classified into interpretive, semi-interpretive, non-interpretive, and hybrid models (Figure 2). In interpretive models, the information is already interpreted for the consumer, requiring less nutritional knowledge; these models combine criteria to indicate food healthiness, providing judgment, opinion, or guidance (ANVISA, 2019a). Semi-interpretative uses symbols, qualitative descriptors, or colors to help understand the nutrient content of foods (ANVISA, 2019a). Non-interpretive ones present information about nutrients without judgment or guidance (ANVISA, 2019a). Hybrid models combine attributes of the other three models (ANVISA, 2019a). This classification can confuse the FoPNL's purpose with the systems' characteristics since the degree of interpretation (greater or lesser) concerns the nutritional information rather than the perception/degree of interpretation required by the consumer to understand the nutritional composition of the food products.

Figure 2 – Categorization of front-of-pack nutrition labeling models, based on the interpretation of nutritional information

Tipo	Exemplos	
Interpretativos	 Selos de saúde Sistemas de ranqueamento	
Semi-interpretativos	 Alertas Semáforo nutricional	
Não interpretativos	 Guideline Daily Amount (GDA)	 Facts Up Front Etiquetado Frontal Nutricional
Híbridos	 Híbrido/Interpretativo (ranqueamento com estrelas com teor absoluto de nutrientes) Híbrido/Semi-interpretativo (semáforo nutricional com ícones de teor absoluto e/ou %VD)	

Source: SILVA et al. (2019, p.51).

There is yet another way of categorizing FoPNL models, which is closer to interpretation-based classification but refers to the directness characteristic of the health message on the label (HODGKINS *et al.*, 2012). In this categorization, labels are classified into directives, semi-directives, and non-directives, and the lower the directivity of the message, the greater the processing/interpretation of information by the consumer (HODGKINS *et al.*, 2012).

It is also important to mention that although the design of the labels is one of the relevant elements of the FoPNL, its scope, efficacy, and effectiveness also depend on the nutritional profile model adopted (WHO, 2019). Nutritional profiling is the science of classifying or ranking foods based on their nutritional composition for reasons related to disease prevention and health promotion (WHO, 2010). The nutritional profile defines, for example, which foods are eligible to receive the FoPNL and the criteria/parameters of the nutrients targeted by the information (PAHO, 2020). Therefore, the profile must effectively distinguish more and less healthy foods to achieve the FoPNL objective of favoring healthier choices (WHO, 2015; WHO, 2019).

3.4.2 Implementation of front-of-pack nutrition labeling in the World

FoPNL was first introduced in 1987 (BATISTA *et al.*, 2023). In 1989 Sweden, Keyhole was implemented (BATISTA *et al.*, 2023; WHO, 2020). Since then, several other countries have implemented frontal nutritional labeling, with differences in application criteria, label models, and nutritional profiles (JONES *et al.*, 2019). In 2006, Choices logo was introduced in the Netherlands, and 2014, the HSR was implemented in New Zealand and Australia (BATISTA *et al.*, 2023; WHO, 2020).

The Nutri-score has been adopted in several European countries, such as France in 2017, Belgium (2018), Switzerland and Portugal (2019), Germany (2020), and Spain (2021) (BATISTA *et al.*, 2023). The Nutri-Score is currently the quoted model for the harmonization of FoPNL in the European Union and consists of a summary label graduated in letters, from A to E, and coded by colors, from dark green to red, to signal, respectively, foods more and less healthy (MUZZIOLI *et al.*, 2022; WHO, 2020). Scientific research involving Nutri-Score is growing (ANDREEVA *et al.*, 2021; DE TEMMERMAN *et al.*, 2021; DRÉANO-TRÉCANT *et al.*, 2020; FIALON *et al.*, 2022; HAFNER; PRAVST, 2021).

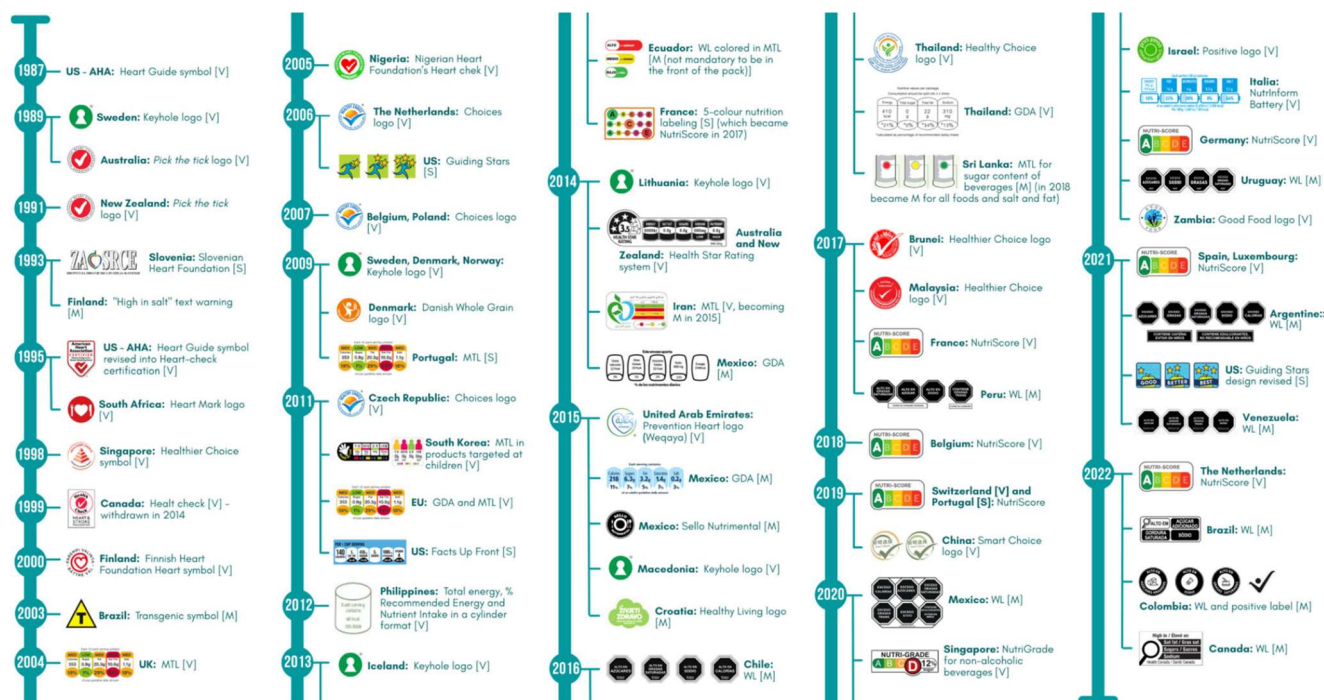
As of 2015, there was an apparent acceleration in developing new FoPNL schemes, emphasizing warning models, mainly in Latin America (CONTRERAS-MANZANO *et al.*, 2022; WHO, 2020). In 2016, Chile was the first country in that region to implement the octagon-shaped warning model, with the caption “*alto en...*”, to warn about excessive calorie, sugar, saturated fat, and/or sodium content (MINISTERIO DE SALUD CHILE, 2015). Then, in 2017, Peru also implemented an octagon-shaped warning model with the caption “*alto en...*”, encompassing the nutrients sugar, saturated fat, trans fat, and sodium (MINISTERIO DE SALUD DE PERÚ, 2018).

Uruguay was the first Mercosur country to implement the FoPNL in 2020. In this country, the octagon-shaped warning label with the caption “*exceso*” indicates foods with excessive sugar, total fat, saturated fat, and sodium (MINISTÉRIO DE SALUD PÚBLICA, 2021). The same year, Mexico adopted the FoPNL with an octagon warning with the caption “*excess...*” for calories, sugar, sodium, saturated fats, and trans fats. Mexican legislation also provides for the inclusion of warning rectangles for products that include added caffeine and non-nutritive sweeteners, along with the respective statements “*contiene cafeína - evitar en niños*” and “*contiene edulcorantes - no recomendable en niños*” (SECRETARIA DE ECONOMIA, 2020).

More recently, in 2021, the healthy eating law was approved in Argentina, including the FoPNL in the octagon format for calories, sugars, sodium, total fats, and saturated fats (MINISTERIO DE SALUD, 2022). As in Mexico, Argentine legislation also provides warnings for foods with caffeine and sweeteners, with the respective captions “*Contiene cafeína. Evitar em niños/as*” e “*Contiene edulcorantes, no recomendable em niños/as*” (MINISTERIO DE SALUD, 2022). Argentine legislation appears to be the most comprehensive and promising in Latin America (ACT; IDEC, 2022). In addition to the FoPNL, this legislation prohibits advertising for children, sales in schools, and public purchases of labeled foods (ACT; IDEC, 2022).

In Latin America, the adoption of the FoPNL had significant participation and contribution from the academy in generating scientific evidence (ACT; IDEC, 2022). In Chile and Uruguay, for example, the choice of FoPNL models was based on evidence on the subject (ARRÚA et al., 2017a; ARRÚA, 2017b; CABRERA et al., 2017) and, after the implementation of the norms, researches have been developed to evaluate their effectiveness (ARES *et al.*, 2020; ARES *et al.*, 2021; CORREA *et al.*, 2019; MINISTERIO DE SALUD, 2017; MINISTERIO DE SALUD, 2019; MINISTERIO DE SALUD, 2021; TAILLIE *et al.*, 2020b). The academy's participation was also consistent in Mexico, Argentina, Colombia, and Venezuela. Figure 3 illustrates the timeline of frontal nutritional labeling models implemented from 1987 to 2022, and Figure 4 illustrates the different models of front labels implemented worldwide.

Figure 3 - Front-of-pack nutrition label implementation timeline from 1987 to 2022.



Abbreviations: AHA, American Heart Association; EU, European Union; GDA, guideline daily amounts; [M], established by the government and mandatory; MTL, multiple traffic lights; [S], supported but not established by the government; US, United States; [V], established by the government but voluntary; WL, warning label.

Source: BATISTA *et al.* (2023).

Figure 4 – Front-of-package labels around the World

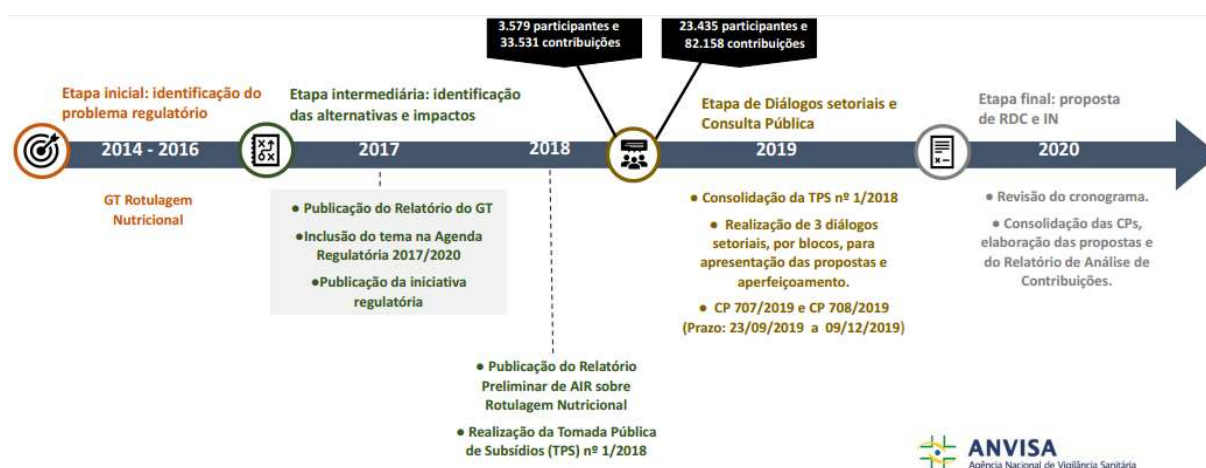


Source: GLOBAL FOOD RESEARCH PROGRAM (2023)

3.4.3 Implementation of front-of-pack nutrition labeling in Brazil

In Brazil, the formalization of the implementation of frontal nutrition labeling was preceded by a long period of discussions on the subject, following the international discussion scenario on adopting a labeling system that could encourage healthy eating (THE INTERCEPT BRASIL, 2021). In 2014, ANVISA established a Working Group to raise the main problems and difficulties and propose improvements to the country's current food labeling rules (ACT; IDEC, 2022). This group was compounded by government sectors, academia, civil society, and the productive sector and acted until 2016 (ACT; IDEC, 2022). Among the various strategies identified as solutions to current regulatory problems, adopting a frontal nutritional labeling model was the main normative innovation (ANVISA, 2019a). The regulatory process officially started in 2017, as shown in Figure 5. This year, proposals to improve nutritional labeling, including models of front labels, were presented to ANVISA by government entities, the productive sector, and academia (ACT; IDEC, 2022).

Figure 5 - Stages of the nutritional labeling regulatory process



Source: ANVISA (2020, p.2).

The food production sector, represented by the Labeling Network, made up of 21 entities from the food and beverage sector, suggested a quantitative nutritional traffic light FoPNL model based on the model used in the UK (United Kingdom) (Chart 1) (ANVISA, 2018), relying on the speech in defense of consumer freedom of choice (ACT; IDEC, 2022).

This model would inform the absolute and relative amount of calories, sugars, saturated fats, and sodium and would classify these contents using red, yellow, and green colors to indicate, respectively, the high, medium, and low content of nutrients, according to the nutritional profile also adapted from the UK (ANVISA, 2018).

The Ezequiel Dias Foundation (*Fundação Ezequiel Dias - FUNED*), as the representative body of the National Health Surveillance System, forwarded to ANVISA, in addition to other suggestions for improving nutritional labeling, a proposal for a FoPNL model based on red circles to highlight the high sugar content, saturated fats, and sodium, with the nutritional profile based on the Pan American Health Organization (PAHO) profile (Chart 1) (ANVISA, 2018). The Interministerial Chamber of Food and Nutritional Security (*Câmara Interministerial de Segurança Alimentar e Nutricional - CAISAN*), representing the Public Administration bodies, proposed a FoPNL model in the format of black octagons, based on the model used in Chile, highlighting the high content of calories, sugars, total fats, saturated fats, and sodium, in addition to the presence of trans fats, sweeteners, and food additives, based on PAHO and Chile nutritional profile parameters (Chart 1) (ANVISA, 2018).

As representatives of Civil Society, several organizations such as the Brazilian Institute of Consumer Protection (*Instituto Brasileiro de Defesa do Consumidor - IDEC*) and the Brazilian Association of Consumer Defence (*Associação Brasileira de Defesa do Consumidor - PROTESTE*), the Federal Council of Nutritionists (*Conselho Federal de Nutricionistas - CFN*) and the Brazilian Association of Collective Health (*Associação Brasileira de Saúde Coletiva - ABRASCO*) participated Actively in the Working Group on Nutrition Labeling (ANVISA, 2018). *IDEC*, in partnership with the *Universidade Federal do Paraná (UFPR)*, proposed a FoPNL model based on black triangles on a white background informing about the high content of sugars, total fats, saturated fats, and sodium, and the presence of fats trans and sweeteners, using the criteria of the PAHO nutritional profile (Chart 1) (ANVISA, 2018).

This process of suggestions for improving nutritional labeling also included contributions from PAHO and the World Health Organization (WHO). PAHO, in addition to other recommendations, guided the use of a warning model in the shape of a black octagon, using the criteria of its nutritional profile (ANVISA, 2018). Accordingly, the WHO Global Ambassador for Non-Communicable Diseases indicated the warning FoPNL models to favor healthier choices and food reformulation by the industry (ANVISA, 2018).

Chart 1 – Front-of-pack nutrition labeling models proposed to ANVISA and the respective nutritional profile models

Food production sector																																																
Front-of-pack model		Nutritional Profile																																														
Uma porção de 30g (3 biscoitos) fornece: Valor Energético 149kcal 7% Açúcares totais 17g 19% Gordura Saturada 3,2g 15% Sódio 21mg 1% Essa embalagem contém aproximadamente 6 porções % valores diários de referência com base em uma dieta de 2000 kcal.		<table><tr><td></td><td colspan="3">Alimentos com porção > 100 g</td><td colspan="3">Alimentos com porção < 100 g e bebidas</td></tr><tr><td></td><td>Baixo</td><td>Médio</td><td>Alto</td><td>Baixo</td><td>Médio</td><td>Alto</td></tr><tr><td>Nutrientes</td><td>Porção</td><td>Porção</td><td>Porção</td><td>Porção</td><td>Porção</td><td>Porção</td></tr><tr><td>Gorduras saturadas</td><td>≤ 1,5 g</td><td>> 1,5 g e ≤ 6,6 g</td><td>> 6,6 g</td><td>≤ 1,5 g</td><td>> 1,5 g e ≤ 3,3 g</td><td>> 3,3 g</td></tr><tr><td>Açúcares totais</td><td>≤ 5 g</td><td>> 5 g e ≤ 27 g</td><td>> 27 g</td><td>≤ 5 g</td><td>> 5 g e ≤ 13,5 g</td><td>> 13,5 g</td></tr><tr><td>Sódio</td><td>≤ 80 mg</td><td>> 80 mg e ≤ 720 mg</td><td>> 720 mg</td><td>≤ 80 mg</td><td>> 80 mg e ≤ 360 mg</td><td>> 360 mg</td></tr></table>						Alimentos com porção > 100 g			Alimentos com porção < 100 g e bebidas				Baixo	Médio	Alto	Baixo	Médio	Alto	Nutrientes	Porção	Porção	Porção	Porção	Porção	Porção	Gorduras saturadas	≤ 1,5 g	> 1,5 g e ≤ 6,6 g	> 6,6 g	≤ 1,5 g	> 1,5 g e ≤ 3,3 g	> 3,3 g	Açúcares totais	≤ 5 g	> 5 g e ≤ 27 g	> 27 g	≤ 5 g	> 5 g e ≤ 13,5 g	> 13,5 g	Sódio	≤ 80 mg	> 80 mg e ≤ 720 mg	> 720 mg	≤ 80 mg	> 80 mg e ≤ 360 mg	> 360 mg
	Alimentos com porção > 100 g			Alimentos com porção < 100 g e bebidas																																												
	Baixo	Médio	Alto	Baixo	Médio	Alto																																										
Nutrientes	Porção	Porção	Porção	Porção	Porção	Porção																																										
Gorduras saturadas	≤ 1,5 g	> 1,5 g e ≤ 6,6 g	> 6,6 g	≤ 1,5 g	> 1,5 g e ≤ 3,3 g	> 3,3 g																																										
Açúcares totais	≤ 5 g	> 5 g e ≤ 27 g	> 27 g	≤ 5 g	> 5 g e ≤ 13,5 g	> 13,5 g																																										
Sódio	≤ 80 mg	> 80 mg e ≤ 720 mg	> 720 mg	≤ 80 mg	> 80 mg e ≤ 360 mg	> 360 mg																																										
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Front-of-pack model		Nutritional Profile																																														
Alto teor de açúcares totais Alto teor de sódio Alto teor de gorduras saturadas		<table><tr><td>Nutrientes</td><td>Sódio</td><td>Gorduras Totais</td><td>Açúcares</td></tr><tr><td>Alto teor</td><td>≥ 1 mg por 1 kcal</td><td>≥ 30% do VET</td><td>≥ 10% do VET</td></tr></table>					Nutrientes	Sódio	Gorduras Totais	Açúcares	Alto teor	≥ 1 mg por 1 kcal	≥ 30% do VET	≥ 10% do VET																																		
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Front-of-pack model	Nutritional Profile																		
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Source: Adapted from ANVISA (2018, p.52, 55-59).

To guide the choice of the most effective FoPNL model for the Brazilian population, an extensive review of international experiences was carried out in addition to research carried out by the General Management Division for Food of ANVISA (*Gerência-Geral de Alimentos - GGALI*) (ANVISA, 2019a). In this context, 2017, notice CNPq/Anvisa nº 17/2017 was published to select projects for financial support in health surveillance (ANVISA, 2019a). This notice included a line of research on frontal nutritional labeling to provide scientific evidence to fill the existing gaps on the subject and identify the most effective models for the Brazilian population (ANVISA, 2019a). Among the projects selected in the line of frontal nutritional labeling, the studies by Deliza *et al.* (2020) and Bandeira *et al.* (2021) evaluated and compared the performance of all FoPNL models that were proposed to ANVISA.

In 2018, ANVISA published the Preliminary Regulatory Impact Analysis Report on Nutrition Labeling, which presented the initial diagnosis of the regulatory problem and the objectives and impacts of the proposed interventions (ACT; IDEC, 2022). In the same year, between May and July, ANVISA opened a Public Taking of Subsidies (*Tomada Pública de Subsídios - TPS*) to collect data, information, and evidence on food labels (ACT; IDEC, 2022). The results of contributions to TPS were published in a document in 2019 (ANVISA, 2019b). As of September 2019, contrary to scientific evidence that front warning labels perform better (ARES *et al.*, 2018; ARRÚA *et al.*, 2017a; ARRÚA, 2017b), including studies conducted with the Brazilian population (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020), and the FoPNL implementation scenario in Latin America, in which several countries had already adopted or were in the process of adopting warning models, ANVISA presented a new FoPNL proposal in public consultation (BRASIL, 2019a; BRASIL, 2019b) with magnifying glass rectangular template.

In September 2020, with several postponements, the regulatory process was completed (initially expected to be completed in December 2019) with the publication of resolution RDC 429/2020 and Normative Instruction (*Instrução Normativa - IN*) 75/2020 on nutritional labeling of packaged foods (ACT; IDEC, 2022). In addition to the FoPNL with the magnifying glass model, with changes to the model that was proposed in the Public Consultations (*Consulta Pública - CP*), the legislation brought other changes such as the mandatory nutritional information per 100g or 100mL of product and the inclusion of the amount of total and added sugars (BRASIL, 2020a). In this context, it is worth mentioning the dissatisfaction of the sectors of civil society and academia with the choice of the magnifying glass model by ANVISA, which seems to have had substantial interference from the food production sector due to economic interests, as has also occurred in other countries (ACT;

IDEC, 2022; JULIA; HERCBERG, 2016; MAIS *et al.*, 2022; MIALON *et al.*, 2021a; MIALON, 2021b; THE INTERCEPT BRASIL, 2021)

Studies that evaluated the magnifying glass model, such as the one proposed in the CPs, with the Brazilian population, observed a tendency for the magnifying glass to perform worse compared to warning labels, such as the black octagon and triangle, in terms of facilitating the interpretation of nutritional information (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020). In a contradictory way, ANVISA justified its choice by claiming that the graphic elements of the magnifying glass are more coherent than those of the models that convey the idea of an alert, with the regulatory objective of the Agency, which is to facilitate the understanding of nutrition labeling by Brazilian consumers, allowing autonomous and conscious choices by consumers, with less potential to generate a feeling of fear (ANVISA, 2019a).

It should also be mentioned that the studies that evaluated the rectangular model with black magnifying glass with the Brazilian population (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020) considered the preliminary model, which was presented in the CPs (BRASIL, 2019a, BRASIL, 2019b), and not what was implemented in the country since October 2022 (BRASIL, 2020a; BRASIL, 2020b). In addition to the graphical changes to the loupe model, the approved nutritional profile is less rigorous than previously discussed (ACT; IDEC, 2022). The proposal presented in the CPs (BRASIL, 2019a; BRASIL, 2019b) was that the nutrient profile would be staggered to increase the rigidity of the parameters gradually. However, only the less rigid profile was approved (BRASIL, 2020a; BRASIL, 2020b), allowing several ultra-processed foods and beverages not to receive the FoPNL for nutrients harmful to health according to the nutritional profile of the Brazilian legislation (ACT; IDEC, 2022), as it has already been observed in some studies (CONTRERAS-MANZANO *et al.*, 2022; TOMAZ *et al.*, 2022).

The long term for implementation of the standard in Brazil (between 2 and 5 years from the date of publication, depending on the type of product) is another situation that suggests industry interference in the regulatory process of the new nutritional labeling rules (ACT; IDEC, 2022). The scenario of the COVID-19 pandemic contributed to this extension of deadlines, favoring interference actions by the industry, harming the health of Brazilians and the consumer's proper access to information (ACT; IDEC, 2022).

3.4.4 *Scientific evidence on front-of-pack nutrition labeling*

Scientific evidence demonstrates that the FoPNL favors the understanding of nutritional information, reduces consumers' perceptions of health and purchase intention, favoring healthier food choices (ARRÚA *et al.*, 2017b; BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020; KHANDPUR *et al.*, 2018; KHANDPUR, 2019; NOBREGA; ARES; DELIZA, 2020; SONG *et al.*, 2021). In addition, FoPNL can boost the reformulation of products by the industry, improving the nutritional environment (BABLANI *et al.*, 2020; KANTER; VANDERLEE; VANDEVIJVERE, 2018), and can therefore act to reduce the risk of obesity and obesity and NCDs (JONES *et al.*, 2019).

Evidence from the implementation of the Chilean Food Labeling and Advertising Law shows significant reductions in the amount of sugars and sodium in various groups of packaged foods and beverages after implementation, in addition to a reduction in the purchase of sweetened beverages and calories from your consumption (MINISTERIO DE SALUD, 2019; REYES *et al.*, 2020; TAILLIE *et al.*, 2020b). However, it is worth mentioning possible adverse effects of food reformulation, such as the increased use of food additives, such as sweeteners, as has already been observed in some studies. In this context, countries that are still in the process of implementing FoPNL standards must consider this issue, such as Mexico, Argentina, and Colombia (EL CONGRESO DE COLOMBIA, 2021; MINISTERIO DE SALUD, 2022; SECRETARIA DE ECONOMIA, 2020), where the presence of sweeteners will be highlighted on the front panel of foods containing additives.

Due to the wide variety of FoPNL models, several scientific studies have evaluated and compared the performance of the models in different outcomes, such as the ability to be understood and used by consumers (ANVISA, 2019a). In this scenario, Latin America stands out for many publications and the implementation of evidence-based regulatory strategies (ANVISA, 2018; VARGAS-MEZA *et al.*, 2019). The foundation of labeling standards on current scientific evidence is essential to ensure that the selected alternative is adequate and proportionate to address the local regulatory problem (ANVISA, 2018). This is especially relevant considering that the models must meet the population's needs, considering the educational level, communication barriers, culture, and the need for understanding information by less favored population groups (ANVISA, 2018).

Overall, interpretive FoPNL labels, which make some form of evaluative judgment about the nutritional quality of foods, are more effective and appear to be more helpful to

consumers (WHO, 2019; WHO, 2020), since interpretive aids, such as graphic or textual tips, facilitate the understanding of nutritional information (ANTÚNEZ *et al.*, 2015; ARRÚA *et al.*, 2017b; JONES; RICHARDSON, 2007; VAN HERPEN; TRIJP, 2011). This type of label, based on symbols, colors, words, or quantifiable elements, has already been recommended by WHO (WHO, 2019). More specifically, scientific evidence shows that warning labels, which use text-based seals and inform about excessive content of critical nutrients, seem to better capture consumers' attention, improving understanding of nutritional information and food identification with an excess of harmful nutrients, compared to other models such as the Guideline Daily Amount (GDA) and traffic light, for example (ARRÚA *et al.*, 2017b; ARRÚA, 2017a; BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020; KHANDPUR *et al.*, 2018).

Furthermore, according to Cabrera *et al.* (2017), who evaluated the influence of design features of warning labels on health perception and attention capture, warning symbols in octagonal shape, including the caption “excess of...” can potentially reduce the perception of healthiness of consumers. These same authors also concluded that black octagons are the best choice due to their high attention capture (CABRERA *et al.*, 2017). On the other hand, some studies show that although the traffic light system can improve the understanding of nutritional information by consumers (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020), it has little effect on improving purchase intentions and differentiation of more and less healthy products (DUCROT *et al.*, 2016; FEUNEKES *et al.*, 2008; GORSKI FINDLING *et al.*, 2018; KUNZ *et al.*, 2020; SANDOVAL; CARPIO; SANCHEZ-PLATA, 2019). These results can be justified by the green color, which is used in this model to refer to the low content of harmful nutrients, which can increase the perception of the healthiness of the products (CABRERA *et al.*, 2017; FRANCO-ARELLANO *et al.*, 2020a; MACHÍN *et al.*, 2018; TALATI *et al.*, 2016a), as well as the issue of traffic lights requiring a complex task for consumers, since the assessment of food quality is made considering the level of several nutrients simultaneously (ARRÚA *et al.*, 2017b).

The Nutri-score interpretative model has also gained relevance since it is quoted for harmonizing FoPNL in the European Union. A study that evaluated the ability of 12,015 consumers to understand five different FoPNL models (HSR, traffic light, Nutri-Score, GDA, and warning symbols) in 12 different countries found that although all FoPNL models tested improved consumers' understanding of the nutritional quality of foods, in all evaluated locations and for all three categories of evaluated foods, the Nutri-Score performed better in fulfilling its purpose, which is to rank products, followed by the traffic light, HSR and the symbols of

warning (EGNELL *et al.*, 2018). Following the same line, a study carried out by Pettigrew *et al.* (2022) evaluated the relative ability of different front labels (HSR, traffic light, Nutri-Score, GDA, and octagonal warning) to steer consumers away from unhealthy options (aversion) versus toward healthier options (attraction), in 18 countries (n=18,393). In the total sample, they found the better performance of the Nutri-Score in terms of attraction and aversion results for understanding and simulated choice results, followed by the traffic light (PETTIGREW *et al.*, 2022). GDA exhibited the weakest overall performance, with the warning symbol and HSR showing intermediate performances (PETTIGREW *et al.*, 2022). Ultimately, the authors concluded that the most effective FoPNL labels featured a color-coded spectrum design and that labels that are effective in directing consumers to healthier food products may also steer them away from unhealthy options (PETTIGREW *et al.*, 2022).

Hock *et al.* (2021) examined the impact of HSR front labels, octagon warning, GDA, traffic light, and Nutri-Score, compared to no FoPNL, on perceived health of sugary drinks, with 10,762 children aged 10 to 17 years in six countries (Australia, Canada, Chile, Mexico, United Kingdom, and the United States). They observed that, compared to the control condition (no FoPNL), all FoPNL labels significantly reduced the perceived healthiness of the beverages (HOCK *et al.*, 2021). However, the octagon-shaped warning had the most significant impact on reducing perceived health in five of the six countries. The GDA and Nutri-Score labels demonstrated the most negligible impact in all six countries (HOCK *et al.*, 2021).

A systematic review and meta-analysis performed to assess the impact of color-coded interpretive labels (traffic light and Nutri-Score) and warning labels (nutrient warnings and health warnings) on changing consumers' purchasing behavior found that all evaluated labels were able to direct consumers towards healthier purchasing behavior (SONG *et al.*, 2021). Furthermore, while color-coded labels (Nutri-Score and traffic light) performed better in promoting the purchase of healthier products, warning labels (nutrient warnings and health warnings) had the advantage of discouraging unhealthy purchase behavior (SONG *et al.*, 2021). According to the authors, these differences can be explained by the different psychological mechanisms triggered by each type of label (SONG *et al.*, 2021).

Another systematic review and meta-analysis assessed the impact of FoPNL on the purchase and consumption of sugar, calories, saturated fat, and sodium (CROKER *et al.*, 2020). Two meta-analyses evaluated purchase data: one comparing combined FoPNL systems versus no-FoPNL and another comparing specific FoPNL systems versus no-FoPNL (CROKER *et al.*, 2020). The results of the meta-analyses showed that the sugar and sodium content of the

purchases was lower for the combined FoPNL situation versus without FoPNL, with a trend toward lower purchases of energy and saturated fat (CROKER *et al.*, 2020). For the specific FoPNL systems, the products purchased with the “high in” systems had less sugar, calories, and sodium versus the products without FoPNL, and the products with the traffic light system had less sodium when compared to the products without FoPNL (CROKER *et al.*, 2020). Findings on consumption were limited and inconsistent, and the authors concluded that FoPNL encourages the purchase of healthier foods (CROKER *et al.*, 2020).

According to the WHO, the choice of FoPNL models, the graphic design, and the nutritional profile must be based on the main objective defined for the labeling, for example, promoting the choice of healthier foods, avoiding choosing less healthy foods, and/or compare the nutritional quality of foods (WHO, 2020). For each objective, there are the graphic designs that best fit - while the health labels are more effective in promoting healthier foods, the warning symbols prevent the choice of less healthy foods, and the Nutri-Score and the traffic light make it easier to the comparison of the nutritional quality of food (WHO, 2020). Thus, it becomes difficult to evaluate labels with different objectives using the same evaluation parameters.

Regarding the magnifying glass, there are still few studies with this FoPNL model compared to the number of studies with other models, such as warning symbols and traffic lights, which justifies the questioning about the choice of ANVISA. In general, the studies show a positive effect of the magnifying glass in favoring the understanding of nutritional information, as well as in reducing consumers' perception of healthiness and purchase intention (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020; KHANDPUR; MAIS; MARTINS, 2022; SILVA; NI MHURCHU; ANASTÁCIO, 2022). However, some studies suggest a tendency for the magnifying glass model to perform worse in consumer communication when compared to more familiar symbols, such as the octagon and triangle, for example (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020; GOODMAN *et al.*, 2018).

A recent study by Khandpur *et al.* (2022) compared the effectiveness of the triangular warning label and the magnifying glass label in a Brazilian sample (n = 1384) on the usefulness of the label, understanding of information, and purchase intention of participants. Participants who visualized the triangular system provided statistically higher averages for the outcomes “importance of the information communicated”, “usefulness of the label”, “subjective understanding of nutrient content” – measured on 7-point scale, “understanding of the healthiness of the product” and “concern with consumption infantile” when compared to the averages attributed by the participants who visualized the magnifying glass system.

Although both systems (triangle and magnifying glass) showed similar performance in the “objective understanding of nutrient content” – hit or missed, the magnifying glass performed statistically better in the purchase intention outcome (KHANDPUR; MAIS; MARTINS, 2022).

3.5 Nutritional claims, health halo effect, and impact on effectiveness of front-of-pack nutrition labeling

Nutritional claims, or complementary nutritional information, as ANVISA names them (BRASIL, 2012), are defined as any representation that states, suggests, or implies that a food has particular nutritional properties, including, but not limited to, energy value and protein, fat and carbohydrate content, as well as vitamin and mineral content (CODEX ALIMENTARIUS COMMISSION, 2012). This information, as well as the nutritional information table and front labeling, are components of the nutrition labeling of foods and are intended to inform the consumer of the nutritional properties of the food (BRASIL, 2020a).

As they highlight only the positive nutritional aspects of foods, nutrition claims are often used as a marketing strategy by the food industry (STEINHAUSER; HAMM, 2018). This is because, as some studies indicate, the presence of nutritional claims can positively influence consumer perceptions and behavior (BENSON *et al.*, 2019; FRANCO-ARELLANO *et al.*, 2020b; MCCANN *et al.*, 2022; MEDIANO STOLTZE *et al.*, 2021; NOBREGA; ARES; DELIZA, 2020; TÓRTORA; MACHÍN; ARES, 2019). This positive influence is the health halo effect – a cognitive bias that occurs when positive information is generalized to all other product attributes (ROE; LEVY; DERBY, 1999). The occurrence of the health halo effect is of particular concern when the generalized information, for example, a nutrition claim, does not correspond to the nutritional profile of the product as a whole, which can lead to healthier perceptions than the real one (CHOI *et al.*, 2013; HALL *et al.*, 2020).

Considering that consumers use various information on labels to make judgments about foods (CENTURIÓN; MACHÍN; ARES, 2019), some studies have focused on assessing the relative influence of different information, such as front-end nutrition labeling, nutrition and health claims on consumer perceptions and behavior (CENTURIÓN; MACHÍN; ARES, 2019; FRANCO-ARELLANO *et al.*, 2020b; GOODMAN *et al.*, 2018; NOBREGA; ARES; DELIZA, 2020; TALATI *et al.*, 2016b; TÓRTORA; MACHÍN; ARES, 2019). However, the results of these studies seem to be incongruent. According to Steinhäuser *et al.* (2018), the influence of nutritional and health claims on the consumer may vary according to nutrition knowledge,

health motivation, and the characteristics of the products themselves. Furthermore, these influences seem to be limited to specific food categories (STEINHAUSER; HAMM, 2018), which probably makes it difficult to compare and generalize the results of the studies.

Talati et al. (2017), in a systematic review of this topic, examined whether the cognitive biases generated by health claims persist when other sources of nutritional information, for example, the nutritional information panel and front labels, appear on the package. They noted that the nutrition facts panel could reduce bias, but only when consumers view and interpret it correctly, and front labels have shown more promise in reducing the bias created by health claims (TALATI *et al.*, 2017). However, it is essential to emphasize that the results of this review were published in 2017, and none of the studies included in the review evaluated frontal warning labels, models that have been highlighted worldwide, especially in Latin America (ARES *et al.*, 2021; KHANDPUR; SWINBURN; MONTEIRO, 2018). In addition, since that date, several other relevant studies on the subject have been published (ARRÚA *et al.*, 2017a; CENTURIÓN; MACHÍN; ARES, 2019; EGUREN *et al.*, 2021; FRANCO-ARELLANO *et al.*, 2020b; GEORGINA RUSSELL *et al.*, 2017; GOODMAN *et al.*, 2018; MAUBACH; HOEK; MATHER, 2014; MEDIANO STOLTZE *et al.*, 2021; NOBREGA; ARES; DELIZA, 2020; TALATI *et al.*, 2016b; TALATI, 2018; TALATI, 2016a; TÓRTORA; MACHÍN; ARES, 2019) and may be interesting to add new evidence.

To summarize the most recent evidence, Chart 2 presents the main characteristics and findings of studies that evaluated the effect of the association of claims and FoPNL in foods. The search was performed in June 2022 and updated in May 2023 on PubMed and in related articles. The search strategy was formed by the following descriptors: “consumers”, “food labeling”, “frontal nutritional labeling” and “claims”. Descriptors were combined with the Boolean operator “AND”, while their synonyms were combined with “OR”. Notably, only studies that considered claims and FoPNL schemes were included disregarding other relevant studies on the subject that considered, for example, the impact of claims with written health warnings (HALL *et al.*, 2020), only the effect of claims on the consumer (HUANG *et al.*, 2022), and the effect of health images (DELIVETT *et al.*, 2022).

Chart 2 – Compiled from studies that evaluated the effect of the presence of nutrition claims and front-of-pack nutrition labeling on consumers

Author <i>et al.</i>, Year	Population/n	Objective	Evaluated outcomes	Food product evaluated	FoPNL models	Claims	Results	Conclusion
McClean; Hoek; Hedderley, (2012).	500 hypertensive and 191 non-hypertensive (18-79 years old).	To examine how sodium FoPNL and nutrition claims influence consumer choice behavior.	Choice behavior.	Baked beans.	GDA, traffic light vs. nutritional information table.	“low salt” or “reduced salt”.	FoPNL increased the ability of both groups to discriminate between high and low-sodium products. Both FoPNL formats improved discrimination in the presence of a reduced salt claim.	FoPNL labels, and specific visual cues, enhance consumers' ability to discriminate between high and low-sodium products, even with nutrition claims.
Maubach; Hoek; Mather, (2014).	768 New Zealanders (18-83 years).	Estimate main and interaction effects of FoPNL label formats and claims on consumer preferences.	Consumers' choice behaviors and product perceptions.	Fruit muesli.	Nutritional Information Panel, GDA, Traffic Light, and HSR (Health star rating).	Nutrient content claim - “Made with whole grains for fiber” and health claim - “Made with whole grain oats and barley to reduce cholesterol”.	Health claims increased ratings for less nutritious options, although this effect was less pronounced when products carried a traffic light label.	The HSR will affect changing food choice patterns less than the traffic light label. Health claims can lead consumers to judge products more favorably, so their impact on less healthy food purchases should also be monitored.
Talati et al. (2016b).	50 adults and 35 children (10-46+ years).	Investigate the relationship between FoPNL and health claims.	Reactions of adults and children when presented with FoPNL and a health claim – focus groups.	Breakfast cereal, cheese, chicken nuggets, muesli bar, potato chips, and yogurt.	GDA, Multiple Traffic Lights or HSR (Health star rating).	Nutrient content claims, general-level health claims, and superior-level health claims.	Health claims were considered more reliable, relevant, and informative when perceived. Reliability and ease of interpretation were more critical to FoPNL than health claims.	Consumers generally find FoPNL more useful than health claims.

Talati et al., (2016a).	1,984 Australian adults and children (10-65+ years).	Investigate whether positivity bias occurs in products with different health claims and FoPNL conditions.	Positivity bias - perceived healthiness, global evaluations (taste, quality, convenience, etc.), and willingness to buy.	Cookies, cornflakes, pizzas, and yogurts (unhealthy).	GDA, Multiple Traffic Lights, and HSR (Health star rating).	Nutrient claim, general level health claim, and superior level health claim.	Health claims did not produce positivity bias, while RNF did, with GDA being the most likely to cause this effect. HSR led to lower food ratings than GDA and traffic light.	Reductive FoPNL labels could lead to more positive reviews of unhealthy products than no front label.
Arrúa et al. (2017a).	442 children from Montevideo (8-13 years old).	To assess the relative influence of two FoPNL schedules and label design on children's choice.	Food choice.	Wafer cookies and orange juice.	Traffic light system and the Chilean warning system (black octagon).	Cartoon character, drawing of fruits, the claim of vitamin C (orange juice only).	The children's choices were significantly influenced by the label design (character, fruit design, and nutrition claim on the orange juice) and the FoPNL nutrition labels. The relative impact of FoPNL was more significant for the warning system than the traffic light system.	Need to regulate packaging design and the inclusion of nutrient claims. Potential for warnings to discourage children from choosing unhealthy products.
Georgina Russell et al. (2017).	520 parents (+18) of children aged between five and eleven.	Understand the trade-offs that parents make when faced with products that exhibit a range of front-of-pack characteristics	Food choice.	Breakfast cereal	HSR (Health Star Rating) and nutritional information panel.	“Good source of folate and iron, source of B vitamins”; “Low in fat, low in sugar”, “With the taste and crunch children love”, and “Made with organic and biodynamic ingredients”.	Product images, followed by HSR, were the most significant attributes in choosing, while claims and other features (such as characters) were the least significant.	FoPNL systems can affect choice when parents exchange this information for marketing attributes. Still, some marketing attributes can be more influential; not all parents use this information similarly.
Acton; Hammond, (2018b).	1000 Canadians	Examine the ability of consumers to	Understanding nutritional	Multigrain	“high in sodium”, “high in sugar”.	“reduced sodium”, “reduced fat”.	Statistically, fewer hits when the product had a claim referring to the	A voluntary nutrient claim can undermine the effectiveness of

	(16-32 years old).	correctly interpret FoPNL “high content” warnings in the presence of a voluntary claim for the same or a different nutrient.	information (correct answers).	crackers and multigrain granola bars.			same nutrient as the FoPNL, with a more substantial effect when the claim was positioned far from the FoPNL. No statistical difference when the claim referred to a nutrient other than the FoPNL.	FoPNL for the same nutrient.
Talati et al. (2018).	2069 adults and children (10-65+ years).	Examine how food choice of varying levels of healthfulness is affected by the appearance of various FoPNLs when combined with different claim conditions.	Food choice.	Cookies, cornflakes, pizza, and yogurt of different health levels (least healthy, moderately healthy, and most healthy).	GDA, Semáforo, HSR (<i>Health star rating</i>).	Nutrient claim, general level health claim, and superior level health claim.	The probability of choosing a healthy product and avoiding an unhealthy product was higher when only FoPNL appeared on the package. Adding a claim did not affect the likelihood of eating healthier foods, but it did increase the likelihood of selecting less healthy foods across all FoPNL conditions.	FoPNL is most effective in helping consumers make better food choices when nutrition and health claims are absent.
(Centurión ; Machín; Ares, (2019).	100 Uruguayans (18-56 years old).	To investigate the relative influence of nutrition warnings and two marketing strategies (nutrient claims and fruit images) on consumers' health judgments.	Healthfulness perception and eye tracking variables.	Cereal bars.	Black octagon (“Excess of sugar, saturated fat”) Note: GDA with calorie content was also displayed due to frequent inclusion in commercial cereal bars.	“Source of fiber”.	Nutrition warnings significantly reduced health perception, but nutrient claims and fruit images did not. All interactions between variables were not significant. Eye Tracking: Nutritional warnings caught participants' attention and reduced the amount of visual attention needed to assess healthiness.	The results confirm the potential of nutritional warnings to influence consumers' perception of health, overcoming the effect of other label tips used by the food industry to convey the concept of health.

Tórtora; Machín; Ares, (2019).	124 (18-55 years old).	Study the influence of nutritional warnings and other information commonly displayed on food labels to convey health associations (image, nutrient claim, nutritional information).	Health associations on consumers' choice and visual attention.	Cookies and crackers.	Nutritional information (<i>facts up front</i>) and black octagon (<i>alto en</i>).	"0% cholesterol, 0% trans fat".	Nutritional warnings attracted consumers' attention and required less time and fixation than nutritional information. The presence of warnings significantly discouraged the choice of products, but the product type was the most crucial variable.	Nutritional warnings are superior to non-directive schemes in discouraging the choice of products with excess critical nutrients, but they were not the most crucial variable for influencing choices.
Nobrega; Ares; Deliza, (2020).	820 Brazilian adults (+18 years old).	Evaluate the effect of nutrition warnings and claims on perceived healthfulness.	Healthfulness perception.	Yogurt, juice, bread, and crackers.	Black octagon ("High in saturated fat, sodium, sugar").	"Source of fiber", "Source of fiber", "Rich in Zinc, with vitamins A & D", "With fruit pieces", "Rich in Zinc, with vitamins C & B", "Here you have one bunch of grapes".	There are significant and positive effects of nutrition claims and significant and adverse effects of nutrition warnings. Non-significant interactions, with the greater relative importance of warnings over claims.	Warnings can facilitate the identification of products with an unfavorable nutritional profile and overcome healthy associations generated by the claims.
Franco-Arellano et al. (2020b).	1997 Canadians (+18 years old).	To examine the influence of different FoPNL symbols and nutrition claims on consumers' healthfulness perceptions and purchase intentions.	Perception of healthfulness and purchase intention.	Fruit juices (more and less healthy).	Warning (black octagon with an exclamation mark – "high in sugar"), Health star rating (HSR), nutritional traffic light.	The claim of nutrient content and disease risk reduction.	In healthier drinks, HSR and semaphore created a 'halo' effect, which was not seen with warning labels. Beverages with disease risk reduction claims were perceived as healthier than those without.	FoPNL had a significantly more decisive influence than nutrition claims on consumer perceptions; however, the effect of each RNF label varied between healthier and less healthy beverages.

							The effect of a nutrient content claim was similar. The effect of FoPNL and claims was mitigated for those who used the Nutrition Facts Table.	
Eguren et al. (2021).	510 (18-82 years old).	(i) Evaluate the effect of nutrition warnings and health-related packaging tips (nutrition claims and natural food images); (ii) evaluate the influence of two types of messages (gain-framed and loss-framed) intended to encourage the use of such warnings and packing tips.	Food choices.	Crackers.	Black octagon preto (“ <i>excess</i> ”).	“Source of Fiber. With omega 9”.	The warnings were the most relevant element in the choices. Loss-framed messages influenced the relative importance attributed to the characteristics of the packet, but gain-framed messages did not. Messages encouraging the use of nutrition warnings increased the relative importance assigned to warnings and decreased the relative importance to those related to health.	While warnings were the most relevant health-related information, nutrient claims, and images also increased the likelihood of choice. This suggests the need to develop stricter labeling regulations for products with excessive content of nutrients associated with chronic NCDs.
Mediano Stoltze et al. (2021).	602 Chilean adults (22-47 years).	Test the co-occurrence of warning labels and nutrient content claims on product perceptions and behavioral intentions.	Product perceptions and behavioral intentions.	Breakfast cereals.	Black octagon (“ <i>alto en</i> ”).	“High in fiber”, “Wholegrain”, “Low in fat”, and “Cholesterol free”.	Fiber claims had a main effect, leading to more favorable product ratings. The positive evaluations extended to other perceptions. No significant interaction between warnings and claims.	Warning labels can mitigate, but not eliminate, influences of nutrient content claims on consumer perceptions of product healthiness.

							Warnings had the main effect on perceptions, regardless of the claims.	
Jürkenbeck ; Nehlhose; Zühlsdorf, (2022).	Germans (n = 1.103; 16-50+).	To assess how the NutriScore, in combination with nutrition claims about the sugar content and taste claims about the level of sweetness, influences consumers' evaluation of the perceived healthiness of these products.	Perceived healthiness.	Instant cappuccino, Oat drink and chocolate crunchy muesli.	Nutri-score.	“Less sweet”, “Without added sugar” and “30% less sugar”.	Depending on the initial perceived healthiness of a product, the Nutri-Score is able to prevent health-halo effects caused by claims on sugar.	Making the Nutri-Score mandatory when using nutrition claims would be one possible way to reduce misperceptions about unhealthy food and reduce health-halo effects caused by claims on sugar.
Prates et al. (2022).	720 Brazilian consumers (Age median - 30)	To evaluate the influence of nutrition claims on the efficacy of FoPNL models in the understanding of nutritional information, healthfulness perception, and purchase intention.	Understanding of nutritional information, healthfulness perception, and purchase intention.	Cereal bars, whole grain cookies, and snacks.	Black octagon, black triangle, and magnifying glass (ANVISA).	Nutrient claim related to health, and nutrient content Claim.	FoPNL increased the understanding of the information and reduced healthfulness perception and purchase intention. The presence of nutrition claims acted oppositely. The interaction “FoPNL*claims” was insignificant, indicating that claims act independently.	The results prove the efficacy of FoPNL in consumer understanding and judgment. Despite the positive effects of FoPNL, it did not cancel the positivity bias generated by the claims.

Musicus et al. (2022).	Primary caregivers of children ages 0 to 5 years throughout the United State (n = 5005; age mean (SD) = 31.58.3).	To assess the effects of a front-of-package 100% vitamin C claim, fruit imagery, percentage juice and teaspoons of added sugar disclosures, and high-added sugar warnings on parents' choices, knowledge, and perceptions.	Choices, knowledge, and perceptions of beverages.	Six high-added sugar beverages: 4 fruit drinks, 1 cola, and 1 fruit-flavored soda) and 6 low- or no-added sugar beverages: 1 low-added sugar fruit drink, 1 no-added sugar fruit drink, two 100% juices, 1 milk, and 1 water).	Warning labels (rectangular with an exclamation point) with or without added sugar disclosures in teaspoons.	"100% vitamin C" and "contains 11% juice".	Compared with the control, only participants who saw warnings with teaspoons of added sugar disclosures had significantly reduced added sugar in selected beverages. In warning conditions, the proportion of participants choosing high-added sugar beverages was significantly reduced. The no claim or imagery condition significantly reduced the proportion of parents choosing high-added sugar beverages. Percentage juice disclosures did not affect beverage choice.	These findings suggest that added sugar warnings and prohibitions of front-of-package claims and imagery may reduce parents' purchases of high-added sugar beverages for their young children, but that percentage of juice disclosures may not change behavior.
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4 CHAPTER II - INFLUENCE OF NUTRITION CLAIMS ON DIFFERENT MODELS OF FRONT-OF-PACKAGE NUTRITIONAL LABELING IN SUPPOSEDLY HEALTHY FOODS: IMPACT ON THE UNDERSTANDING OF NUTRITIONAL INFORMATION, HEALTHFULNESS PERCEPTION AND PURCHASE INTENTION OF BRAZILIAN CONSUMERS



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Influence of nutrition claims on different models of front-of-package nutritional labeling in supposedly healthy foods: Impact on the understanding of nutritional information, healthfulness perception, and purchase intention of Brazilian consumers

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Nutrition claims are positive information about foods, which are widely used as a marketing strategy on labels. On the contrary, front-of-package nutritional labeling (FoPNL) aims to make it easier for consumers to understand the nutritional composition of foods and favor healthy food choices. However, the concomitant presence of nutrition claims and FoPNL may hinder the understanding, judgment, and choices of consumers at the moment of purchase. Therefore, the objective of this study was to evaluate the influence of nutrition claims on the efficacy of FoPNL models in the understanding of nutritional information, healthfulness perception, and purchase intention of Brazilian consumers. It was an experimental cross-sectional study carried out using an online questionnaire, with a total of 720 participants randomly divided into four FoPNL conditions: control, octagon, triangle, and magnifying glass. Each participant looked at 12 food packages, which were produced following the factorial design: (i) food category (cereal bar, whole grain cookies, and snacks); (ii) product type (containing one critical nutrient × containing two critical nutrients); and (iii) nutrition claims (present × absent). The comprehension of nutritional information was evaluated through the identification of excessive nutrients, and the healthfulness perception and purchase intention were evaluated using a seven-point scale. The results

indicated that the presence of FoPNL increased the understanding of the information and reduced healthfulness perception and purchase intention. The presence of nutrition claims influenced the three outcomes, decreasing the probability of understanding information about food composition by 32% (OR 0.68, 95% confidence interval 0.58–0.78, $p < 0.01$) and significantly increasing ($p < 0.05$) average health scores (1.95–2.02) and purchase intention (2.00–2.05). Nonetheless, the interaction “FoPNL $\times$ claims” was not significant, which indicated that claims act independently. All FoPNL models were more effective than the control. For the least healthful type of product (two nutrients in excess), the octagon and triangle models were superior to the magnifying glass, regarding the outcome of healthfulness perception. The results prove the efficacy of FoPNL in consumer understanding and judgment. Despite the positive effects of FoPNL, it did not cancel the positivity bias generated by the claims.

KEYWORDS

food labeling, nutrition policy, FOP, warning labels, consumer research, consumer perception, health halo, positivity bias

Introduction

In general, nutrient declarations, especially those related to excessive nutrients considered critical (such as added sugars, saturated fat, and sodium), are hard to find and interpret and are therefore rarely used by consumers at the moment of purchase (1–3). For this reason, the front-of-package nutritional labeling (FoPNL) was proposed to make it easier for consumers to understand the nutritional information of foods (4, 5). Besides improving the comprehension of nutritional information, FoPNL encourages healthier food choices as well as product reformulations by the industry toward less nutritionally unbalanced options (6). Thus, it may aid in the reduction of obesity risk and non-communicable diseases (7).

As recommended by international health bodies (8–10), FoPNL has been implemented in different countries with differences in design, type of information provided, and the degree/level of guidance provided for consumers to communicate the nutritional content and relative healthfulness of the foods (11, 12). Among the different models of FoPNL, nutritional warning models, which provide direct information about the excessive content of harmful nutrients, using text-based seals (13), have performed better than other FoPNL models (11, 13–16). This happens because nutritional warning models better serve the purpose of FoPNL: to allow consumers to correctly, quickly, and easily identify products that contain excessive amounts of critical nutrients, promoting more informed choices (13).

Several Latin American countries already have mandatory frontal nutritional labeling with warning models (17). In Chile (18), Mexico (19), Peru (20), and Uruguay (21), for example,

the black octagon is applied to the front panel of packages to inform consumers when a product contains excessive amounts of critical nutrients (13). In Brazil, the triangle model was proposed to the regulatory body as an option for FoPNL, by design and nutrition experts (22). However, the magnifying glass was the chosen model, which will be implemented on a mandatory basis in October 2022 (23, 24). Although the magnifying glass models can promote the identification of “high in” food products as other warning models, its graphic symbol does not refer to the idea of alert or risks like other symbols, such as the octagon and the triangle, but the idea of “magnifying information, making its visualization easier, and suggesting the search for and evaluation of other information” (25).

A series of factors influence the performance and efficacy of FoPNL models, both regarding design characteristics such as color, size, and position in the package (26), and personal characteristics of consumers, such as gender, age, socioeconomic status, and interest in health (12). For instance, studies have shown that individuals with greater interest in health and healthy eating tend to check the nutritional information available on labels more frequently to make their food choices (27–30). Nutrient declarations are not the only source of information that compete for the attention of consumers who read labels to choose foods (31–33). Nutrition claims, though regulated, are used by the food industry to attract attention, promote health associations/perceptions among consumers, and increase sales (31, 32, 34, 35). According to the taxonomy developed by the International Network for Food and Obesity/Non-communicable Diseases Research, Monitoring, and Action Support (INFORMAS), food claims are classified into three categories: nutritional, health, and other claims that

include, for example, claims related to the environment, such as “organic” (36).

Some studies have shown that the presence of claims on foods positively influences consumer perceptions of products (32, 37–43). However, in the literature, results concerning the effects of claims on consumer perceptions and behavior are inconsistent (44, 45). A review on the topic, which evaluated different types of claims (nutrition, health, and risk reduction), concluded that specific consumer characteristics, such as nutrition knowledge and health motivation, as well as product characteristics such as perceived healthiness, are the factors responsible for this incongruity of results (45). Furthermore, the influences of these characteristics may be limited to the food categories tested in the studies, which makes it difficult to generalize the results (45).

This positive influence generated by the presence of the claims is defined as a positivity bias or a health halo effect (44). The positivity bias occurs when the presence of information leads to better evaluations of the products by the consumer (46). The halo effect occurs when the consumer uses more specific information, for example, claims, to evaluate the product instead of other available information (46). These positive effects can generate misjudgments about the healthiness of foods (47), especially nutritionally unbalanced foods (45).

For this reason, some studies have evaluated the effects of the concomitant presence of FoPNL with other resources from the label, such as nutrition claims (32, 39, 40, 48, 49). The results of the studies are contradictory; while some have observed that FoPNL can nullify the positivity bias generated by claims (32, 41, 50), others have observed that the positive effect of claims on consumer perceptions occurs even in the presence of FoPNL (39, 40), and claims concerning the nutrients targeted by FoPNL may hinder the effectiveness of the FoPNL itself (49).

In this type of experimental design, there is still a lack of research performed on the Brazilian population (32) and, so far, there have been no studies in the literature that evaluate the influence of nutrition claims on the magnifying glass model, which will be implemented in the country (23). Therefore, the objective of this study was to evaluate the influence of nutrition claims on the efficacy of octagon and triangle FoPNL models, as determined by the Chilean legislation, and of the magnifying glass model, according to Brazilian legislation, in the understanding of nutritional information, healthfulness perception, and purchase intention of Brazilian consumers.

Given the positivity bias generated by nutritional claims on consumer perceptions (15, 32, 39, 41), and the trend toward the better performance of warning labels compared to the magnifying glass model (12, 51, 52), reported in the literature, the following hypotheses were created: (i) The presence of claims will lead to a positivity bias (greater perceptions of healthiness and purchase intent), regardless of FoPNL; (ii) the positivity bias generated by the claims will be weaker in the presence of warning labels (octagon and triangle),

intermediate in the presence of the magnifying glass, and higher in the control.

Materials and methods

Participants

The study was performed with 720 participants who were over 18 years of age, representing the Brazilian population regarding gender, geographical region, socioeconomic status, and education characteristics, using quotas defined according to the Brazilian Institute of Geography and Statistics (53). The inclusion criteria of the study were being over 18 years of age and answering the questionnaire with the use of a computer. This last criterion excluded the participation using cellphones and tablets to ensure label visualization was as close as possible to real-sized products. The exclusion criteria were working in the food and/or nutrition field. The participants were recruited from a panel of respondents obtained from a market research company. All participants consented to participate in the research through a free and informed consent form. The study was carried out between December 2021 and February 2022, as approved by the Research Ethics Committee of the Universidade Federal de Minas Gerais (Brazil Platform—CAAE 2395020.1.0000.5149).

Experimental design

This was an experimental, cross-sectional study, carried out through an online questionnaire, to evaluate the influence of nutrition claims on different FoPNL models. It was based on the studies by Deliza et al. (12) and Bandeira et al. (51), who evaluated the performance of different FoPNL models according to observations from Brazilian consumers, among which was a preliminary model of the magnifying glass model. The study was also based on the research by Nobrega et al. (32), who evaluated the effect of the presence of nutrition claims and warnings on the healthfulness perception of Brazilian consumers. In this study, the FoPNL models tested were black octagon, black magnifying glass, and black triangle (Figure 1). Data on three outcomes were collected: the understanding of nutritional information (correct or incorrect), healthfulness perception, and purchase intention (both measured using a seven-point scale).

The participants were randomized in one of the four experimental conditions: control (without FoPNL), octagon, magnifying glass, and triangle (Figure 2). For each condition, the combinations between the following three factors tested in the food labels were assessed: (i) product category (cereal bar, whole grain cookies, and snacks); (ii) product type (containing one critical nutrient $\times$ containing two critical nutrients); and (iii) nutrition claims (present $\times$ absent). The combination of

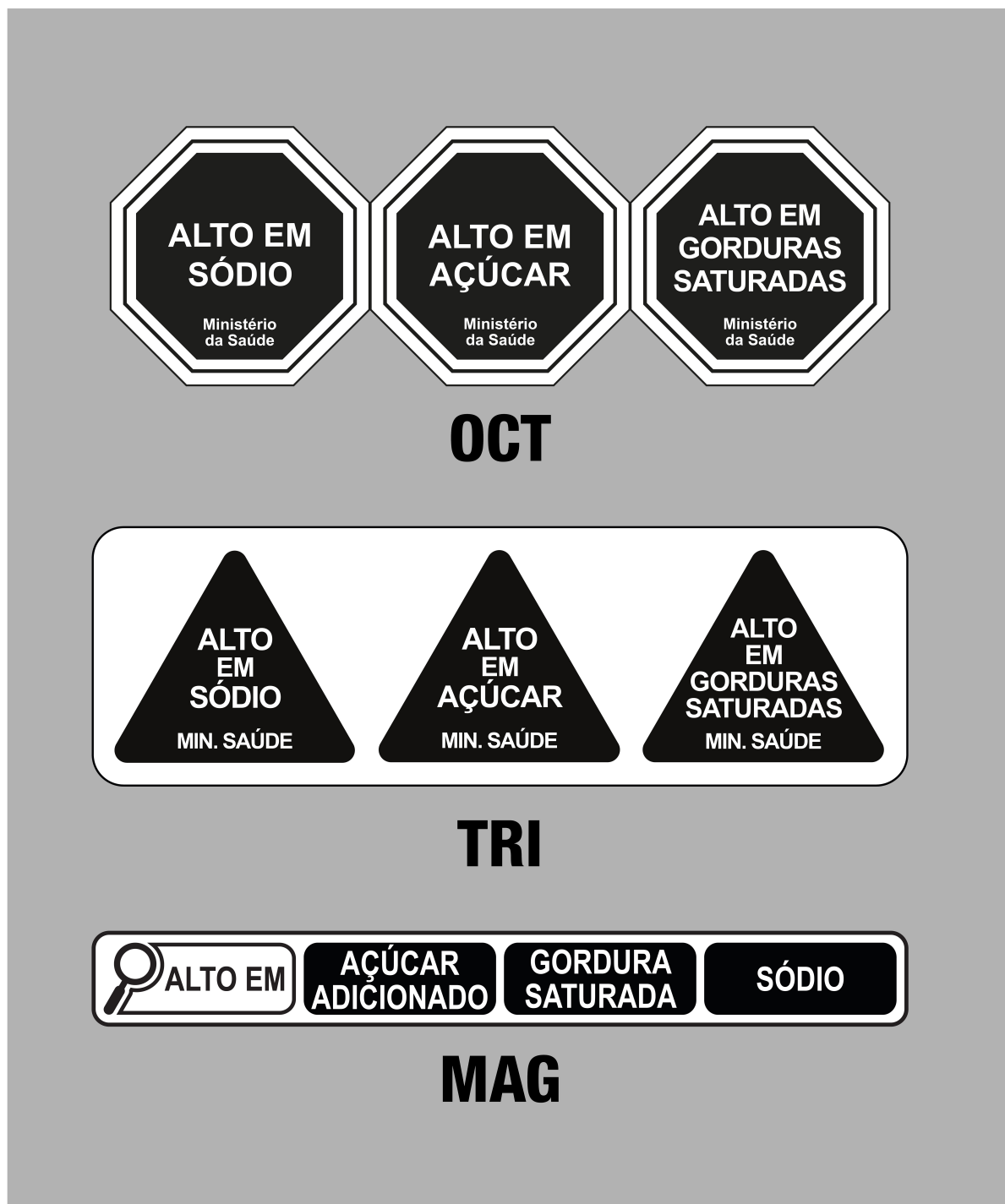
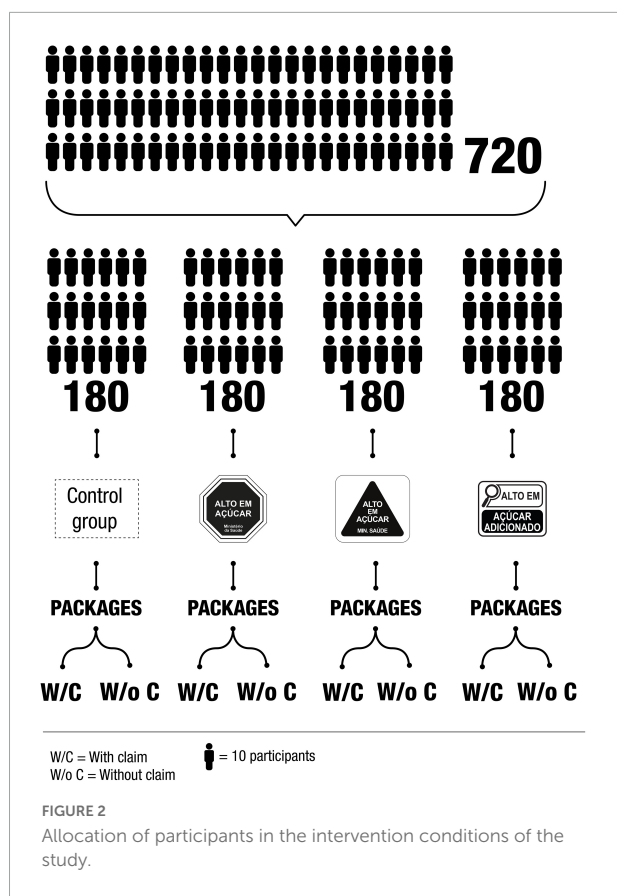


FIGURE 1

Models of front-of-package nutritional labeling tested in the study. OCT, octagon; TRI, triangle; MAG, magnifying glass.

these three factors ($3 \times 2 \times 2$) resulted in 12 front panels of food labels, by experimental condition, and the presentation of the images varied among the participants, following a Latin square experimental design (54). Considering operational

issues regarding data collection that would make it impossible to obtain preliminary data to calculate the sample size, the calculations were done assuming a continuous response to be analyzed by an ANOVA applied to the data of an experiment



designed with blocks (participants) that evaluated 12 treatments (repeated measures). The number of participants in each one of the four experiments was limited to 180, resulting in a total of 720 participants (Figure 2). Since each Latin square required a minimum of 12 participants, it was replicated $180/12 = 15$ times. Considering a probability of 5% of Type I Error and a test power of 90%, the number of 180 participants would be able to detect a size effect equal to or higher than 0.345 (a moderate one). All participants looked at the same food labels, with changes only in the presence/model of FoPNL.

Stimuli

The three food categories (cereal bars, whole grain cookies, and snacks) with a “healthy snack” visual appeal (Figure 3) were selected due to the potential of FoPNL to modify consumer healthfulness perception and purchase intention, especially for foods that are mistakenly regarded as healthy (55), such as cereal bars, breakfast cereals, among others, which traditionally use the healthfulness “appeal” as a marketing strategy (33, 56–58). For each category, two types of products with different nutritional compositions were selected, one with only one excessive critical nutrient and another with two excessive critical nutrients (Figure 4). The presence and absence of positive

nutrition claims on food labels were controlled. Two nutrition claims were included in products that were supposed to carry such information: nutrient content claim and another nutrient claim related to health, according to the INFORMAS taxonomy (36) (Figure 4). The combination of the three mentioned factors, (i) product category, (ii) product type, and (iii) nutrition claims, resulted in 12 ($3 \times 2 \times 2$) package front panels with different food labels, for each experimental condition. Table 1 shows the nutritional composition of the products used as a reference to elaborate the labels, with the respective information on FoPNL inclusion and nutrition claims.

The front panels of packages with labels were developed by an information designer, using Photoshop and Illustrator software (Adobe®), to combine graphic elements (colors, typography, photography, and illustrations) from different products that exist in the Brazilian market, fictitious brands, and at least one excessive critical nutrient (added sugars, saturated fat, and sodium). Although the Chilean legislation (18) encompasses a greater number of critical nutrients in FoPNL, only the three nutrients mentioned were considered, once that is how the Brazilian legislation (23) defines it. The added sugar, saturated fat, and sodium limits considered for the inclusion/declaration in the FoPNL were also defined according to the parameters of the Brazilian legislation (23), considering the nutritional composition of the used products as a reference. Once the total and added sugars were not available in the nutritional information of the products, an estimate of the added sugars was performed based on the method proposed by the Pan American Health Organization Nutrient Profile Model, considering the quantity of total sugars declared (59). Even though this method estimates the quantity of free sugars in the product, all the free sugar corresponding to the added sugars in the products are used as a reference (cereal bars and sweet whole grain cookies). The FoPNL models were applied to the top-right corner of the labels, as suggested by the Chilean legislation that regulates FoPNL (18), and the percentage of the main panel area of the packages they occupied followed the model guidelines. The octagon and triangle models followed the proportions established in the Chilean legislation and application manual (18), and the labels with magnifying glasses followed the proportions in the Brazilian legislation (23).

Experimental procedure

The research questionnaire consisted of four steps. In the first one, participants provided some personal information such as weight (kg), height (cm), whether they were responsible for the household grocery shopping, and the frequency of consumption of the evaluated products. Sociodemographic information such as gender, age, geographical region, socioeconomic status, and education was not requested, once the research company already had such data.



FIGURE 3
Food categories considered in the study with an example of the octagon symbol.

In the second step, the participants were introduced to the 12 food labels, one by one, following the Latin square design, and answered three questions:

- (i) does this product contain any nutrient in a higher quantity than recommended for a healthy diet? With the following answer options: “No,” “Yes, sugar,” “Yes, saturated fat,” and “Yes, sodium.” The participant could choose more than one answer;
- (ii) show how healthy you consider this product by choosing one of the options on a seven-point scale, ranging from 1—“not healthy” to 7—“very healthy”;
- (iii) show your intention to purchase this product by choosing one of the options on a seven-point scale, ranging from 1—“I would definitely not buy it” to 7—“I would definitely buy it.”

The third step of the questionnaire was applied only to the groups that looked at FoPNL labels (octagon, magnifying glass, and triangle). The participants observed the respective FoPNL model and answered eight questions that assessed consumer opinions and perceptions regarding visibility, ease of understanding, and credibility of the information, among other aspects related to front-of-package labeling. Such questions were adapted from the study by Khandpur et al. (60) and answered according to a seven-point Likert scale, ranging from 1—“I strongly disagree” to 7—“I strongly agree.”

In the fourth and last step of the questionnaire, the participants were asked to answer the General Health Interest questionnaire, a subscale of the Health and Taste Attitude Scales (61), translated to Portuguese (62) and validated. This questionnaire consists of eight questions designed to assess consumer interest in healthy eating, which were answered according to a seven-point Likert scale, ranging from 1—“I strongly disagree” to 7—“I strongly agree” (62).

Data analysis

All statistical analyses were performed using the *Statistical Package for the Social Sciences* (SPSS) software, versions 20.0 and 28.0, at a significance level of 5%. Differences in the frequency

of participant sociodemographic characteristics were assessed using the chi-square test.

To evaluate the understanding of nutritional information, a binary variable was created for each label/product to identify the correct answers, using the answers to the question “Does this product contain any nutrient in a higher quantity than recommended for a healthy diet?” (“No;” “Yes, sugar;” “Yes, saturated fat;” “Yes, sodium”). Since the participant could choose more than one option, an answer to this question was considered correct only if the participant mentioned those nutrients that were excessive. Answers that considered the nutrients in excess, as well as others whose values were not above the ones recommended by the nutritional profile adopted (23), were not considered correct. The percentage of correct answers was calculated for each FoPNL condition. A generalized linear mixed model (GLM), through binary logistic regression, with random effects on the individuals was used to evaluate the influence of FoPNL conditions (control, octagon, magnifying glass, and triangle), nutrition claim condition (presence and absence), food category (cereal bar, cookie, and snack), and type of product (containing one or two excessive nutrients) and their two-way interactions in the probability of a correct understanding of the nutritional information. The model was adjusted for questions about interest in health in which significant differences between experimental groups were detected.

Healthfulness perception and purchase intention scores were evaluated using a mixed model analysis of variance (ANOVA). FoPNL, nutrition claims, food category, type of product, and their interactions were considered fixed effects, and participants were considered random effects. When interactions were significant, ANOVA was performed for each type of product separately. Sidak’s test was used for a *post hoc* comparison of the average values. The models included, as adjustment variables, those questions about interest in health in which significant differences between experimental groups were detected.

The average and standard deviation of agreement regarding the Likert scale were calculated separately for each question of the opinion and perception questionnaire and the interest in health one. ANOVA was used to assess the existence of

CEREAL BARS		
1 Nutrient		
2 Nutrients		
	With claims	Without claims

SNACKS		
1 Nutrient		
2 Nutrients		
	With claims	Without claims

CRACKERS/COOKIES		
1 Nutrient		
2 Nutrients		
	With claims	Without claims

FIGURE 4

Combination of factors considered for label development: food category (cereal bars, snacks, and crackers/cookies); type of product (containing 1 or 2 nutrients in excess); nutrition claim (present vs. absent).

TABLE 1 Nutritional composition of the products used as a reference for the study and their respective FoPNL and nutrition claim information.

Category	Type of product	Serving (g)	Nutrient content per serving				FoPNL		Nutrition claims	
			Calories (kcal)	Total sugars (g)	Added sugars (g)*	Saturated fat (g)	Sodium (mg)	Added sugars	Saturated fat	Nutrient claim related to health/Nutrient content claim
Cereal bar	1 nutrient	22	87	4.8	3.6	1.3	17	✓		With whole grains/Low in sodium
	2 nutrients	20	86	5.7	5.7	2.5	28	✓	✓	With whole grains/Low in sodium
Whole grain cookie	1 nutrient	21	88	2.4	2.4	0.4	130		✓	Whole grains/Low in saturated fat
	2 nutrients	20	92	6.4	4.8	1.7	40	✓	✓	Whole grains/Source of vitamins and minerals
Snack	1 nutrient	45	184	2.8	2.8	0.7	182		✓	Whole grains/Low in saturated fat
	2 nutrients	40	188	–	–	4.0	500	✓	✓	Whole grains/High in fiber

*Estimated according to the PAHO Nutrient Profile Model.

significant differences between the conditions of FoPNL, and Tukey's test was used for *post hoc* comparisons.

Results

Participants

The samples consisted of 51.7% women and 48.3% men, and the median age was 30 years, ranging from 18 to 73 years (Table 2). Significant differences were found between groups solely regarding the consumption frequency of cereal bars and snacks (Table 2).

Understanding of nutritional information

The understanding of nutritional information was significantly affected by FoPNL, food category, type of product, nutrition claims, and by “FoPNL × food category” and “Food category × type of product” interactions (Table 3).

The presence of nutritional claims reduced by 32% the chance of answering correctly in relation to the content of critical nutrients (Table 4). The inclusion of FoPNL increased the chance of correct answers in the three food categories (Table 4). For the cereal bar category, for instance, the chance of answering correctly was 63 times greater for the octagon group and 54 and 44 times greater for the triangle and magnifying glass, respectively, when compared to the control (Table 4).

Comparing the products with one and two critical nutrients in excess, it was possible to observe that the greater amount of critical nutrients (i.e., two nutrients) reduced the understanding of nutritional information by 49, 21, and 49% for the cereal bars, cookies, and snacks, respectively (Table 4).

Healthfulness perception

Healthfulness perception of products was significantly affected by all the main effects included in the model (FoPNL, food category, type of product, and nutrition claims) and by the interaction “FoPNL × type of product.” The significance of this interaction suggested that the impact of FoPNL on healthfulness perception depends on the number of critical nutrients in the product (1 or 2 nutrients in excess) (Table 3).

Table 5 shows the average health scores for the evaluated products, considering the effects included in the model, and their interactions. It is possible to observe that cereal bars were perceived as least healthy than cookies and snacks and the presence of nutrition claims statistically increased health perceptions (Table 5).

TABLE 2 Sociodemographic characteristics of the study participants.

Characteristic	Participant percentage (%)				
	General (n = 720)	Control (n = 180)	Octagon (n = 180)	Triangle (n = 180)	Magnifying glass (n = 180)
Age (median/P25–p75)	30 (23–41)	30 (24–39)	31 (23–42)	30 (23–42)	31 (23–41)
18–24 years old	33.3	33.3 ^a	33.3 ^a	33.3 ^a	33.3 ^a
25–34 years old	30.0	30.0 ^a	30.0 ^a	30.0 ^a	30.0 ^a
35–44 years old	17.2	17.2 ^a	17.2 ^a	17.2 ^a	17.2 ^a
45–54 years old	12.2	12.2 ^a	12.2 ^a	12.0 ^a	12.2 ^a
55 years old or older	7.2	7.2 ^a	7.2 ^a	7.2 ^a	7.2 ^a
Gender					
Female	51.7	51.7 ^a	51.7 ^a	51.7 ^a	51.7 ^a
Male	48.3	48.3 ^a	48.3 ^a	48.3 ^a	48.3 ^a
BMI (median/P25–P75)	24.7 (21.9–27.8)	24.5 (21.5–28.0)	25.4 (21.8–28.2)	24.5 (22.0–27.2)	24.4 (21.9–27.7)
Underweight	4.2	3.9 ^a	5.0 ^a	4.4 ^a	3.3 ^a
Normal weight	48.2	49.4 ^a	40.0 ^a	51.1 ^a	52.2 ^a
Overweight	32.8	29.4 ^a	40.6 ^a	31.1 ^a	30.0 ^a
Class I obesity	10.0	10.6 ^a	9.4 ^a	8.9 ^a	11.1 ^a
Class II obesity	4.0	5.6 ^a	3.9 ^a	3.3 ^a	3.3 ^a
Class III obesity	0.8	1.1 ^a	1.1 ^a	1.1 ^a	0.0 ^a
Region					
Midwest	7.8	7.8 ^a	7.8 ^a	7.8 ^a	7.8 ^a
North	8.9	8.9 ^a	8.9 ^a	8.9 ^a	8.9 ^a
Northeast	27.2	27.2 ^a	27.2 ^a	27.2 ^a	27.2 ^a
South	13.9	13.9 ^a	13.9 ^a	13.9 ^a	13.9 ^a
Southeast	42.2	42.2 ^a	42.2 ^a	42.2 ^a	42.2 ^a
Education					
Incomplete middle school education	38.9	38.9 ^a	38.9 ^a	38.9 ^a	38.9 ^a
Complete middle school/Incomplete high school education	12.8	12.8 ^a	12.8 ^a	12.8 ^a	12.8 ^a
Complete high school/Incomplete higher education	31.1	31.1 ^a	31.1 ^a	31.1 ^a	31.1 ^a
Complete higher education	12.5	12.8 ^a	14.4 ^a	10.6 ^a	12.2 ^a
Post-graduation education	4.7	4.4 ^a	2.8 ^a	6.7 ^a	5.0 ^a
Socioeconomic status					
Up to 2 minimum wages	16.7	17.8 ^a	14.4 ^a	15.6 ^a	18.9 ^a
2–4 minimum wages	13.3	12.2 ^a	15.6 ^a	14.4 ^a	11.1 ^a
4–10 minimum wages	55.6	55.6 ^a	55.6 ^a	55.6 ^a	55.6 ^a
10–20 minimum wages	13.2	13.9 ^a	12.2 ^a	12.8 ^a	13.9 ^a
Over 20 minimum wages	1.2	0.6 ^a	2.2 ^a	1.7 ^a	0.6 ^a
Are you responsible for the grocery shopping?					
Yes	93.2	95.6 ^a	97.8 ^a	87.8 ^b	91.7 ^{a,b}
No	6.8	4.4 ^a	2.2 ^a	12.2 ^b	8.3 ^{a,b}
Frequency of cereal bar consumption					
Every day	10.4	9.4 ^a	10.6 ^a	8.9 ^a	12.8 ^a
2–3 times a week	30.3	41.1 ^a	31.1 ^{a,b}	23.3 ^b	25.6 ^b
Once a week	17.4	18.3 ^a	17.2 ^a	18.9 ^a	15.0 ^a
2–3 times a month	27.9	22.8 ^a	25.6 ^a	30.6 ^a	32.8 ^a
Never	14.0	8.3 ^a	15.6 ^{a,b}	18.3 ^b	13.9 ^{a,b}
Frequency of whole grain cookies consumption					
Every day	10.1	11.7 ^a	13.3 ^a	7.2 ^a	8.3 ^a
2–3 times a week	37.1	37.8 ^a	34.4 ^a	37.2 ^a	38.9 ^a

(Continued)

TABLE 2 (Continued)

Characteristic	Participant percentage (%)				
	General (n = 720)	Control (n = 180)	Octagon (n = 180)	Triangle (n = 180)	Magnifying glass (n = 180)
Once a week	20.8	22.2 ^a	20.0 ^a	20.6 ^a	20.6 ^a
2–3 times a month	19.2	17.8 ^a	22.2 ^a	18.3 ^a	18.3 ^a
Never	12.8	10.6 ^a	10.0 ^a	16.7 ^a	13.9 ^a
Frequency of snack consumption					
Every day	3.5	5.6 ^a	4.4 ^a	1.7 ^a	2.2 ^a
2–3 times a week	26.5	36.7 ^a	23.3 ^b	20.0 ^b	26.1 ^{a,b}
Once a week	30.0	26.1 ^a	31.7 ^a	30.0 ^a	32.2 ^a
2–3 times a month	28.3	21.7 ^a	27.8 ^{a,b}	35.6 ^b	28.3 ^{a,b}
Never	11.7	10.0 ^a	12.8 ^a	12.8 ^a	11.1 ^a

Different letters on the same line indicate a significant difference using the chi-square test ($p < 0.050$).

TABLE 3 *F* values and *p*-values of fixed effects and interactions of the GLM performed to the understanding of nutritional information and the ANOVA models used for healthfulness perception and purchase intention.

Effect	df	Understanding of nutritional information	Healthfulness perception	Purchase intention
		<i>F</i> (<i>p</i> -value)	<i>F</i> (<i>p</i> -value)	<i>F</i> (<i>p</i> -value)
FoPNL	3	205.66 (<0.001)	88.46 (<0.001)	70.00 (<0.001)
Food category	2	4.50 (0.011)	7.48 (0.001)	116.00 (<0.001)
Type of product	1	73.31 (<0.001)	327.85 (<0.001)	99.25 (<0.001)
Nutrition claims	1	24.90 (<0.001)	57.82 (<0.001)	31.21 (<0.001)
FoPNL*food category	6	3.61 (0.001)	1.62 (0.138)	3.79 (0.001)
FoPNL*type of product	3	1.30 (0.271)	15.92 (<0.001)	10.04 (<0.001)
FoPNL*nutrition claims	3	0.50 (0.681)	0.40 (0.753)	0.71 (0.545)
Food category*type of product	2	4.54 (0.011)	2.93 (0.053)	39.70 (<0.001)
Food category*nutrition claim	2	0.07 (0.936)	0.99 (0.371)	3.57 (0.028)
Type of product*nutrition claims	1	0.70 (0.403)	2.02 (0.155)	0.08 (0.780)
FoPNL*food category*type of product	6	0.50 (0.806)	0.84 (0.536)	2.66 (0.014)
FoPNL*food category*nutrition claims	6	0.90 (0.495)	1.53 (0.165)	0.70 (0.648)
FoPNL*type of product*nutrition claims	3	0.14 (0.934)	2.05 (0.105)	0.41 (0.742)
Food category*Type of product*nutrition claims	2	0.45 (0.635)	0.45 (0.638)	0.24 (0.782)
FoPNL*food category*type of product*nutrition claims	6	0.70 (0.651)	0.48 (0.823)	0.16 (0.988)

ID Variance**Estimate (standard error); *p*-value**

3.393 (0.254); $p < 0.001$ 0.320612 (0.17628); $p < 0.001$ 0.342764 (0.19059); $p < 0.001$

df, degree of freedom. Bold indicates statistically significant findings at $p < 0.05$ level. Models adjusted for the questions about interest in health with $p < 0.05$ and random effects on individuals.

FoPNL reduced the healthfulness perception in the two types of the evaluated products (1 or 2 nutrients in excess). However, it is important to note that for products with only one nutrient in excess, the FoPNL models did not differ from each other, all being more effective than the control. In products with two critical nutrients, the octagon and triangle significantly reduced the perception of healthfulness in relation to the magnifying glass and all models were superior to the control. The least healthy products (two

excessive nutrients) received lower health scores than the products with one critical nutrient in excess, across all experimental arms.

Purchase intention

Purchase intention was significantly affected by all the main effects of the model and by the interactions “FoPNL*food

TABLE 4 Odds ratios (IC95%) of the significant effects and interactions of the model in the understanding of nutritional information.

Effect		Understanding of nutritional information correct answers
Nutrition claims		
Absence		1
Presence		0.68 (0.58–0.78)**
Food category × FoPNL		
Cereal bar	Control	1
	Octagon	63.28 (39.79–100.63)**
	Triangle	54.19 (34.13–86.03)**
	Magnifying glass	44.15 (28.12–69.31)**
Cookie	Control	1
	Octagon	91.25 (55.52–149.97)**
	Triangle	88.16 (53.44–145.44)**
	Magnifying glass	93.21 (56.70–153.24)**
Snack	Control	1
	Octagon	89.53 (54.01–148.40)**
	Triangle	85.91 (51.60–143.02)**
	Magnifying glass	108.85 (65.25–181.57)**
Food category × type of product		
Cereal bar	1 Excessive nutrient	1
	2 excessive Nutrients	0.51 (0.41–0.64)**
Cookie	1 Excessive nutrient	1
	2 Excessive nutrients	0.79 (0.63–0.99)*
Snack	1 Excessive nutrient	1
	2 Excessive nutrients	0.51 (0.41–0.65)**
Akaike information criteria		46,342.696

Model adjusted for the questions about interest in health with $P < 0.05$ and random effects on individuals. Significance was evaluated in relation to the reference category (1.00) at * $p < 0.05$ and ** $p < 0.01$.

TABLE 5 Average healthfulness perception scores by FoPNL (control, octagon, triangle, and magnifying glass), food category (cereal bar, cookie, and snack), type of product (containing 1 and 2 excessive nutrients), nutrition claims (absence and presence), and their interactions.

Effect	Healthfulness perception Mean (95% Confidence interval)	
Food category		
Cereal bar	1.96 (1.92–2.01) ^b	
Cookie	2.00 (1.96–2.05) ^a	
Snack	1.99 (1.95–2.03) ^a	
Nutrition claims		
Absence	1.95 (1.91–2.00) ^a	
Presence	2.02 (1.98–2.06) ^b	
FoPNL × type of product	1 excessive nutrient	2 excessive nutrients
Control	2.61 (2.52–2.07) ^{b A}	2.55 (2.47–2.64) ^{c B}
Octagon	1.82 (1.73–1.91) ^{a A}	1.64 (1.56–1.73) ^{a B}
Triangle	1.84 (1.75–1.93) ^{a A}	1.63 (1.54–1.71) ^{a B}
Magnifying glass	1.98 (1.89–2.07) ^{a A}	1.82 (1.73–1.90) ^{b B}

Different lowercase letters on the same column and uppercase letters on the same line indicate a significant difference using Sidak's test ($p < 0.050$). Model adjusted for the questions about interest in health with $p < 0.05$ and random effects on individuals.

category,” “FoPNL*type of product,” “Food category*type of product,” “Food category*nutrition claim,” and “FoPNL*food category*type of product” (Table 3).

In the presence of claims, purchase intention was higher in the cookies and snacks categories, but for cereal bars, the inclusion of this information did not change consumers' intentions (Table 6). The effect of FoPNL varied according to food category and type of product, reducing consumers' purchase intention. In the snacks category, no statistical difference was observed between the evaluated FoPNL models in either of the two types of products. This also happened in the most healthy version of the cookie. However, considering the least healthy version of the cookie, the purchase intentions of consumers who saw the octagon and the triangle were lower than the ones who saw the magnifying glass (Table 6).

In the cereal bar category, while in the most healthy version of the product, the octagon symbol reduced the purchase intention in relation to the magnifying glass and control, and in the least healthy version, only the triangle symbol had this effect. It is worth noting that in all experimental arms, participants had different purchase intentions among the most and least healthy versions of the evaluated products, except for the cereal bars without FoPNL (Table 6).

Consumer perceptions of front-of-package nutritional labeling models

The opinions and perceptions of participants regarding the evaluated FoPNL models are shown in Table 7. No significant difference between models was observed in any of the questions presented and, for all of them, the median answer was 7.0. Participant interest in health only varied between the experimental groups for three of the eight questions in the questionnaire (Table 8).

Discussion

Front-of-package nutritional labeling will be implemented in Brazil in October 2022 and will become mandatory for the vast majority of food and beverage producers in October 2023. However, so far, there has been little research on how Brazilian consumers understand and perceive different FoPNL models, especially the magnifying glass model, as it will be implemented in the country, as it will be implemented in the country. In this context, the present work compared the magnifying glass model with two FoPNL models in the warning format, in terms of understanding nutritional information, healthfulness perception, and purchase intention of Brazilian consumers.

TABLE 6 Average purchase intention scores by FoPNL (control, octagon, triangle, and magnifying glass), food category (cereal bar, cookie, and snack), type of product (containing 1 and 2 excessive nutrients), nutrition claims (absence and presence), and their interactions.

Effect	Purchase intention Mean (95% confidence interval)					
	Absence		Presence			
	Food category × nutrition claims		Food category × nutrition claims			
Cereal bar	2.09 (2.01–2.14) ^a A		2.12 (2.07–2.17) ^a A			
Cookie	2.03 (1.98–2.07) ^b A		2.08 (2.03–2.12) ^b B			
Snack	1.88 (1.83–1.93) ^c A		1.97 (1.92–2.02) ^c B			
FoPNL × food category × type of product	Cereal Bar		Cookie		Snack	
	1 excessive nutrient		1 excessive nutrient		1 excessive nutrient	
	2 excessive nutrient		2 excessive nutrient		2 excessive nutrient	
Control	2.64 (2.55–2.74) ^c A		2.64 (2.54–2.74) ^c A		2.57 (2.47–2.67) ^b A	
Octagon	1.94 (1.84–2.04) ^a A		1.81 (1.71–1.90) ^{a,b} B		1.84 (1.74–1.94) ^a A	
Triangle	1.95 (1.85–2.05) ^{a,b} A		1.72 (1.63–1.82) ^a B		1.83 (1.73–1.93) ^a A	
Magnifying glass	2.15 (2.05–2.24) ^b A		1.99 (1.90–2.09) ^b B		1.92 (1.82–2.02) ^a A	
					2.65 (2.55–2.75) ^c B	
					1.77 (1.67–1.87) ^a B	
					1.81 (1.72–1.91) ^a A	
					2.01 (1.91–2.11) ^b B	
					2.54 (2.44–2.63) ^b A	
					1.82 (1.72–1.92) ^a A	
					1.80 (1.70–1.90) ^a A	
					1.92 (1.82–2.02) ^a A	
					2.42 (2.33–2.52) ^b B	
					1.65 (1.55–1.75) ^a B	
					1.56 (1.47–1.66) ^a B	
					1.68 (1.58–1.78) ^a B	

Different lowercase letters on the same column and uppercase letters on the same line indicate a significant difference using Sidak's test ($p < 0.050$). Model adjusted for the questions about interest in health with $p < 0.05$ and random effects on individuals.

TABLE 7 Participant perception of the FoPNL models evaluated.

Questions	FoPNL		
	Octagon	Triangle	Magnifying glass
	Average (SD)	Average (SD)	Average (SD)
(1) This front-of-package labeling model called my attention.	6.54 (1.02) ^a	6.55 (1.04) ^a	6.45 (1.06) ^a
(2) This front-of-package labeling model is visible.	6.57 (1.03) ^a	6.54 (0.97) ^a	6.52 (0.95) ^a
(3) This front-of-package labeling model is easy to understand.	6.68 (0.75) ^a	6.73 (0.74) ^a	6.73 (0.61) ^a
(4) This front-of-package labeling model will help me quickly decide which products to buy.	6.58 (0.86) ^a	6.49 (1.07) ^a	6.51 (0.86) ^a
(5) This front-of-package labeling model will help me identify healthier products.	6.52 (1.04) ^a	6.56 (1.09) ^a	6.55 (0.80) ^a
(6) This front-of-package labeling model will help me decide whether I should buy a product.	6.41 (1.13) ^a	6.36 (1.12) ^a	6.44 (0.74) ^a
(7) I consider the information of this front-of-package labeling model credible and truthful.	6.58 (0.89) ^a	6.45 (1.06) ^a	6.49 (0.81) ^a
(8) This front-of-package labeling model will change my decision of which products to buy.	6.34 (1.17) ^a	6.20 (1.32) ^a	6.29 (0.99) ^a

Different letters on the same line indicate a significant difference using Tukey's test ($p < 0.050$).

Effect on the understanding of nutritional information

The results found in the present study are aligned with the literature, which shows that FoPNL indeed favors the understanding of nutritional information (12, 14, 51, 60, 63). The presence of FoPNL, in the three evaluated models, increased the correct answers regarding the presence of critical nutrients in excess in the three evaluated food categories. Bandeira et al. (51) indicated a similar result, in which the octagon, the triangle, the circle, and magnifying glass symbols increased the understanding of the nutritional content, compared to the control, in an equal way.

On the contrary, the presence of claims and the greater quantity of excessive critical nutrients (i.e., the presence of two excessive nutrients) reduced the percentage of correct answers, in the three evaluated food categories, indicating that such information hinders consumer understanding. Some studies have reported that the overload of information in food labels may discourage consumers from seeking more nutritional information on packages as a way to minimize cognitive effort (33, 64), jeopardizing choices and, consequently, the change in consumer behavior (65).

Effect on healthfulness perception and purchase intention

As hypothesized, the presence of nutrition claims on the evaluated labels generated a positivity bias, as it increased the participants' healthfulness perceptions of food and purchase intentions. The results from the literature, concerning the influence of claims in foods with FoPNL on healthfulness perception and purchase intention, are mixed (32, 33, 39, 40, 50, 66), and some studies have observed a positivity bias of claims, as reported in the present study (39, 40). Such influence seems

to be related to the type of claim presented on labels (39, 40, 67). For example, Mediano Stoltze et al. (39) observed, using breakfast cereal packages, that fiber-related claims led to more positive product ratings compared to having no claims or having fat-related claims. Furthermore, according to Talati et al. (44), claims may be less persuasive for foods considered "unhealthy," which justifies the observed effect in the present study, especially in relation to cereal bars, which received the lowest health scores and their purchase intentions were not affected by the inclusion of nutrition claims.

Although such claims refer to positive nutritional properties, they are frequently presented in products with unbalanced nutritional profiles (68–71). This is particularly worrisome, once, as in the present study, other studies have already shown that the presence of claims on food labels tends to increase their healthfulness perception (15, 39, 72–74). Thus, some countries, such as Australia, New Zealand (75), and Mexico (19), forbid claims on foods that contain excessive content of critical nutrients.

The inclusion of FoPNL statistically reduced healthfulness perceptions and purchase intentions of the evaluated foods. In products with two critical nutrients, the octagon and the triangle had a greater effect than the magnifying glass in reducing the perception of healthfulness. As for the outcome of purchase intention, although all FoPNL models were greater than the control, for the cereal bars category and for the least healthy version of cookies, there was a better performance of the octagon and the triangle symbols in relation to the magnifying glass. These findings can be explained by the number of seals applied to the labels in the different FoPNL conditions. In the condition of the warning symbols (octagon and triangle), for each nutrient in excess, one seal was applied to the label. While in the magnifying glass condition, regardless of the number of critical nutrients, only one magnifying glass symbol was present on food labels.

TABLE 8 Participant interest in health, evaluated through the General Health Interest Questionnaire, by experimental condition.

Questions	FoPNL			
	Control	Octagon	Triangle	Magnifying glass
	Average (SD)	Average (SD)	Average (SD)	Average (SD)
(1) I am very worried about how healthy foods are.	6.03 (1.06) ^a	6.06 (1.13) ^a	5.90 (1.28) ^{a,b}	5.68 (1.24) ^b
(2) I always follow a healthy and balanced diet.	5.21 (1.36) ^b	4.90 (1.52) ^{a,b}	4.67 (1.62) ^a	4.84 (1.45) ^{a,b}
(3) It is important for me that my diet is low in fat.	5.47 (1.55) ^a	5.17 (1.65) ^{a,b}	4.81 (1.76) ^b	4.87 (1.65) ^b
(4) It is important for me that my daily diet contain many vitamins and minerals.	6.28 (0.98) ^a	6.10 (1.24) ^{a,b}	5.97 (1.22) ^b	6.02 (1.03) ^{a,b}
(5) I eat what I like and I DO NOT worry about how healthy the food is.	3.13 (2.04) ^a	3.39 (1.96) ^a	3.26 (2.01) ^a	3.23 (1.72) ^a
(6) How healthy the food is has little impact on my choices.	3.26 (2.07) ^a	3.30 (2.04) ^a	3.51 (2.00) ^a	3.38 (1.87) ^a
(7) How healthy snacks are does not make any difference for me.	3.19 (1.99) ^a	3.09 (1.91) ^a	3.23 (1.97) ^a	3.18 (1.88) ^a
(8) I DO NOT avoid any food, even those that may elevate my cholesterol.	2.81 (1.98) ^a	3.25 (2.05) ^a	2.91 (1.84) ^a	2.89 (1.77) ^a

Different letters on the same line indicate a significant difference using the Tukey's test ($p < 0.050$).

This result can be discussed under the aspect of processing fluency, which concerns the ease or difficulty of processing new information (76). This fluency can be influenced by a large number of variables, such as the “figure-ground contrast, the clarity with which a stimulus is presented, the duration of its presentation, or the amount of previous exposure to the stimulus,” and can be objectively measured, through processing speed and accuracy (76). According to Delivett et al. (77), easily processed images and texts provide feelings of processing fluency that can shape people's judgment of information. Some studies have already demonstrated this effect, where an increase in processing fluency has led to more positive product reviews (77–79).

In the present study, probably, the presence of two warning seals vs. a single magnifying glass, contemplating the same nutritional information, improving the processing fluency, and reducing the healthfulness perceptions and purchase intention (in the cereal bars category and for the less healthy version of cookies) of the consumers. Deliza et al. (12) observed that participants needed less time to identify the high nutrient content in the presence of the black octagon and triangle, compared to the magnifying glass, which may also reflect greater processing fluency in the presence of the warning symbols, since this fluency can be measured by processing speed and accuracy (76). Those authors (12) attribute this finding to the fact that warning symbols are more familiar and this has also been discussed by other authors (51, 52). However, the results of the present study demonstrate that not only the FoPNL design but also the number of seals applied to the labels influence consumers' perceptions. Furthermore, in the present study, FoPNL was applied according to the requirements of the legislation, so that the smallest labeling area for the magnifying glass could also contribute to the worst results of this symbol.

Hodgkins et al. (80) suggest that labels with a data approach (nutrient-specific) require greater cognitive effort from the consumer for understanding, while the criteria-based approach

(synthesis) requires less cognitive effort from the consumer. In this way, the use of two warning symbols—as a visual synthesis of two nutrition warnings, could help the consumer to understand the message more than just one symbol with two warning texts. However, a specific study would need to be designed for this.

Combined effect of front-of-package nutritional labeling and claims

In the present study, no interaction between nutrition claims and FoPNL was observed in the evaluated outcomes, contradicting hypothesis 2. Despite the positive effects of FoPNL, as the increase in understanding of nutritional information and the reduction of healthfulness perception and purchase intention, this information could not cancel the positivity bias generated by the claims, which seems to happen independently. Other studies have evaluated the relative impact of FoPNL information and claims on consumers, obtaining diverse results, mainly in relation to the effect of the claims. However, while some studies observe the occurrence of the positivity bias (32, 39, 67), others do not find it (33, 34). In general, the results indicate a stronger effect of FoPNL information on consumers, compared to the claims (32, 39–41, 50, 67, 81). It was also observed in the present study since the F values for FoPNL were greater than the ones for claims in all the evaluated outcomes. Mediano Stoltze et al. (39) tested the co-occurrence of warning labels and nutrient content claims on consumers' perception of products and behavioral intentions using breakfast cereal labels. They found similar results to those obtained in the present study—although the claims generated a positivity bias, the FoPNL presented a stronger effect, with no interaction with the claims (39). On the contrary, in the study by Talati et al. (82), the authors concluded that FoPNLs are more effective in improving food choices by consumers when

nutrition and health claims are not present. These differences seem to be justified both by factors that influence the effect of claims on consumers and by differences in experimental design, such as the evaluated categories and types of food. The similarity between the results of this study and those found by Mediano Stoltze et al. (39), for example, may be due to the similarities between foods (foods with a “healthy connotation”) and the nutrition claims tested in both studies.

Such findings help support regulations on FoPNL, providing evidence concerning the influence of claims on FoPNL. According to McLean et al. (41), nutrition claims are only useful when they are consistent with the nutritional profile of foods, which is hardly ever a reality (68–71). For instance, Duran et al. (69) evaluated a sample of 3,491 products available in the Brazilian market and observed that foods with nutrition claims were more likely to be high in critical nutrients when compared to those with low content of critical nutrients. The presence of claims in “unhealthy” foods has also been reported by other authors (71, 83).

Consumer perceptions of the front-of-package nutritional labeling models

With regards to participants’ opinions and perceptions about the respective evaluated FoPNL models, the “high grades” found and the lack of significant difference in the results support the efficacy of FoPNL concerning visibility, ease of understanding, and credibility of the information assessed through the questionnaire. Nonetheless, it is noteworthy that the octagon and the triangle models, as applied in this study, indicated better results than the magnifying glass, and all showed better results compared to the control in relation to healthfulness perception and purchase intention. According to Khandpur et al. (60), who evaluated consumers’ opinions about the triangle and the traffic light FoPNL models, although those opinions are important, label appeal may not mean that consumers will use labels in a better way. Likewise, their opinion about a piece of information may have a different impact on their behavior or behavior intention, which corroborates with the findings of the present study.

Strengths and limitations

It is worth mentioning that this research is the first to evaluate the influence of nutrition claims on FoPNL, including the magnifying glass model, in the Brazilian population. This study was also carefully designed by applying the FoPNL dimensions as defined in the Brazilian legislation for the magnifying glass model (23) and in the Chilean legislation for the octagon and triangle models (18), collecting results

closer to reality. Besides, the sample was meticulously composed of age-diverse participants and represented the Brazilian population regarding gender, socioeconomic status, education, and country region.

However, the present research has some limitations. The experimental design performed online may not represent the reality of purchases in physical stores and actual product labels. Nonetheless, it is believed that this limitation was minimized by excluding mobile devices (cell phones and tablets) from the study, allowing the visualization of food labels and their constituents in dimensions close to real ones on computer/laptop screens. In addition, online shopping has increased considerably, which requires understanding how consumers behave in this environment. Another aspect to be highlighted refers to the nutrition claims on the labels. For the three models, they were applied near the center of the front panel of the packages to promote similarity with the way claims appear on actual products. Thus, their application did not follow the parameter established by the new Brazilian legislation, which states that nutrition claims should be placed on the lower half of the frontal panel, with smaller characters than those used in the magnifying glass FoPNL (24). Moreover, the effect of the different types of nutrition claims that were included on labels was not evaluated, to assess possible differences in participants’ associations.

The question about participants’ weight before the application of the questionnaire and the order in which the outcomes were evaluated in the questionnaire may have triggered a response bias. The question about nutrient content, presented first, may have influenced the perception of healthfulness and this, in turn, influenced the purchase intention. Another issue that should be mentioned as a limitation is that changing both the design and the size of the FoPNL, based on the application criteria of Brazilian and Chilean legislation, makes it difficult to conclude which factor was responsible for the differences found in results. It is also worth noting that the results may not be generalizable to a larger variety of foods, once only three food categories were evaluated.

Conclusion

In general, the presence of FoPNL favored the understanding of nutritional information and reduced healthfulness perception and purchase intention. On the contrary, nutrition claims reduced the percentage of correct answers regarding excessive nutrients and increased healthfulness perception and purchase intention. Despite the positive effects of FoPNL, it did not cancel the positivity bias generated by the claims, which occurred independently. However, the effect of FoPNL varied according to the food category and the amount of critical nutrients in the product,

with those with two nutrients in excess receiving the lowest health and purchase intentions scores.

Regarding the FoPNL models, all were more effective than the control. However, for the least healthy type of product (2 nutrients in excess), the octagon and the triangle models were superior to the magnifying glass, regarding the outcome of healthfulness perception. Finally, we consider that the results of this study constitute evidence that proves and reinforces the efficacy and benefits of including FoPNL for consumer understanding and judgment of the healthfulness perception and purchase intention of products. Future research that evaluates FoPNL effectiveness on consumer behavior changes, as well as research that evaluates the effect of different types of claims on consumers' associations and specific research on the understanding of the symbols and attention to them, may be interesting to complement the body of evidence regarding FoPNL inclusion on food labels.

Data availability statement

The original contributions presented in this study are included in the article, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving human participants were reviewed and approved by Research Ethics Committee of the Universidade Federal de Minas Gerais (Brazil Platform–CAAE 2395020.1.0000.5149). The participants provided their written informed consent to participate in this study.

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Author contributions

SP and LA: study conception and manuscript. CR and CS: label creation. SP, LA, and IR: statistical analysis. SP, IR, LA, and CR: data analysis and discussion. All authors reviewed and approved the final version submitted.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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5 CHAPTER III - ARTICLE "IT LOOKS HEALTHY, BUT IT'S NOT": EFFECT OF NUTRITION CLAIMS AND THE FRONT-OF-PACKAGE NUTRITIONAL LABELING ON THE HEALTH PERCEPTIONS OF PRODUCTS

Abstract

This study aimed to explore the effect of different models of front-of-pack nutrition labeling (FoPNL) and nutrition claims on perceptions of the healthiness of food products. Brazilian adults ($n = 720$) viewed 12 food labels, one by one, which were developed according to a factorial design ($3 \times 2 \times 2$) that considered food categories (cereal bars, wholegrain cookies, and snacks), amounts of harmful nutrients in excess (one critical nutrient and two nutrients in excess) and nutrition claim condition (absence and presence) and completed a word association task. Participants were randomized into one of four FoPNL conditions (control, magnifying glass, octagon, and triangle). Including FoPNL increased the associations with harmful nutrients and negative associations with health. It increased the probability of participants giving answers about the unhealthiness of the products by 12%, 26%, and 27% for the magnifying glass, octagon, and triangle, respectively, relative to the control. The claims had the opposite effect, increasing associations with beneficial nutrients and positive associations with health. Still, they had no significant effect on the likelihood that participants gave answers about the healthiness or unhealthiness of the products. The results suggest that the FoPNL information and the nutritional claims influenced consumers' perceptions of the evaluated foods differently. However, FoPNL seems to have a more significant impact than nutrition claims.

Keywords: food labeling, public policy, FOP, warning labels, consumer perception, health halo.

5.1 Introduction

Nutrition labeling is considered an important tool to help consumers make decisions at the time of purchase since it informs about the nutritional content of foods (COWBURN; STOCKLEY, 2005; MUZZIOLI *et al.*, 2022). The front-of-package nutrition labeling (FoPNL) was proposed to make this information more straightforward and accessible for consumers and favor healthier choices (WHO, 2020).

FoPNL consists of labeling systems presented on the front panel of labels to communicate the nutritional quality of foods (WHO, 2020). Interpretive systems evaluate food quality and are considered more helpful to consumers (WHO, 2020). This is because this type of FoPNL usually helps to quickly identify products that contain excessive amounts of nutrients harmful to health, such as sugars, saturated fats, and sodium (PAHO,

2020), improving judgment purchase intentions and decisions (TAILLIE *et al.*, 2020; TAILLIE *et al.*, 2020).

On the other hand, nutrition claims are information that highlights the specific valuable nutritional content in the product, such as “source of calcium”, “high in fiber”, and “low in fat” (CODEX ALIMENTARIUS COMMISSION, 2012). Despite the positive appeal, this information is often conveyed in foods with an overall unfavorable nutritional profile (DURAN *et al.*, 2019; GIMÉNEZ *et al.*, 2017) and represents a marketing strategy for the food industry (LÄHTEENMÄKI, 2013; STEINHAUSER; HAMM, 2018).

Since both FoPNL and nutrition claims are information that communicates the healthiness of foods, the joint presence of this information can confuse the consumer (LEEK; SZMIGIN; BAKER, 2015; MEDIANO STOLTZE *et al.*, 2021). Past studies have shown that although nutrition and health claims positively influence consumer perceptions and behavior (BENSON *et al.*, 2019; FRANCO-ARELLANO *et al.*, 2020b; MAUBACH; HOEK; MATHER, 2014; MCCANN *et al.*, 2022; MEDIANO STOLTZE *et al.*, 2021; NOBREGA; ARES; DELIZA, 2020; TÓRTORA; MACHÍN; ARES, 2019) overall, FoPNL has a more significant relative impact than claims and may mitigate the effect of the claims (EGUREN *et al.*, 2021; FRANCO-ARELLANO *et al.*, 2020a; MAUBACH; HOEK; MATHER, 2014; MCLEAN; HOEK; HEDDERLEY, 2012; MEDIANO STOLTZE *et al.*, 2021; NOBREGA; ARES; DELIZA, 2020; PRATES *et al.*, 2022; TALATI *et al.*, 2016).

In Brazil, FoPNL has been implemented since October 2022, with the “high in” system, in the shape of a magnifying glass, present in food products with excessive added sugars, saturated fat, and sodium (BRASIL, 2020a; BRASIL, 2020b). In the country, the legislation (BRASIL, 2020a) does not prohibit the placement of nutrition claims as long as they do not refer to the same nutrients warned in FoPNL. For example, foods receiving FoPNL for saturated fat cannot carry claims regarding fat (such as total fat and cholesterol). Still, they may carry claims about sugars and sodium (BRASIL, 2020b).

So far, few studies have evaluated the magnifying glass model implemented in the country (PRATES *et al.*, 2022; SILVA; NI MHURCHU; ANASTÁCIO, 2022) and its effect on nutrition claims (PRATES *et al.*, 2022). Thus, studies that assess how Brazilian consumers associate the information of FoPNL and nutrition claims with the healthiness of the food products are necessary to fill this gap. In addition, this study

provides evidence that can help monitor the implementation of legislation in the country. Therefore, the objective was to explore the effect of different FoPNL models and the nutrition claims on perceptions of the healthiness of food products by Brazilian consumers' and compare the effects of FoPNL models on these perceptions.

Some hypotheses were raised to answer the research questions of the study.

Question 1: How do FoPNL and nutrition claims influence perceptions of the healthiness of evaluated food products?

Hypothesis 1: Products with FoPNL will have fewer positive reviews, while products with claims will be evaluated more positively.

Question 2: The evaluated FoPNL models differ from each other based on their influence on the perception of healthiness of the evaluated food products?

Hypothesis 2: The warning models (octagon and triangle) will be more likely to reduce the perception of the healthiness of products compared to the magnifying glass.

Question 3: Does the joint presence of FoPNL with the claims (interaction) influence the evaluated outcomes?

Hypothesis 3: FoPNL and claims influence the evaluated outcomes (hypothesis 1) but have independent effects - without interaction.

5.2 Material and methods

This was an experimental randomized controlled study carried out online through the application of a questionnaire.

5.2.1 Participants

A total of 720 Brazilians were recruited from a market research company's (Offerwise) panel of respondents to answer the questionnaire. A total of 180 participants per experimental arm would be able to detect an effect size equal to or greater than 0.345 (moderate), considering a 5% probability of type I error and a test power of 90%. Quotas were established for gender, socioeconomic level, education, and region of the country, according to the Brazilian Institute of Geography and Statistics (IBGE, 2022), to represent the characteristics of the Brazilian population for these items. According to these quotas, the participants' sociodemographic characteristics are presented in a previous study (PRATES *et al.*, 2022). The sample had a median age of 30 and was 51.7% of women.

There was no statistical difference in the distribution of participants in the experimental arms for body mass index, region of the country, education, and socioeconomic status.

The inclusion criteria were:

1. to be 18 years old or older;
2. to answer the questionnaire through a computer.

Responses via cell phones or tablets were not accepted to ensure that the visualization of the evaluated labels was as close as possible to the full-size products. After the research presentation and the TCLE signing, the participant responded by where they were accessing the questionnaire. If they responded by cell phone or tablet, the questionnaire ended.

The exclusion criteria were:

1. not studying/working in the food or nutrition field.

The study took place from December/2021 to February/2022 and was approved by the Research Ethics Committee of the Federal University of Minas Gerais (Brazil Platform – CAAE 2395020.1.0000.5149). All participants consented to the research through an informed consent form.

5.2.2 Stimuli

Four factors were considered for the development of the labels:

(i) FoPNL models (control vs. black magnifying glass vs. black octagon vs. black triangle).

Octagon and triangle were models proposed for consideration by the National Health Surveillance Agency (*Agência Nacional de Vigilância Sanitária – Anvisa*) (ANVISA, 2018). Still, the Agency chose the magnifying glass model for implementation in the country (BRASIL, 2020b). The octagon has robust evidence of its performance and is implemented in several countries in Latin America (EL CONGRESO DE COLOMBIA, 2021; MINISTERIO DE SALUD, 2022; MINISTERIO DE SALUD CHILE, 2015; MINISTERIO DE SALUD DE PERÚ, 2018; MINISTÉRIO DE SALUD PÚBLICA, 2021; MINISTERIO DEL PODER POPULAR PARA LA SALUD, 2021; SECRETARIA DE ECONOMIA, 2020). The triangular model has also been studied with the Brazilian population, and some studies show good performance with this population (BANDEIRA et al., 2021; DELIZA et al., 2020; KHANDPUR et al., 2018; KHANDPUR, 2019; KHANDPUR; MAIS; MARTINS, 2022; PRATES et al., 2022).

The application of the octagon and triangle models was based on the criteria of the Chilean legislation (MINISTERIO DE SALUD CHILE, 2015), while the application of the magnifying glass was based on the Brazilian legislation (BRASIL, 2020b) to evaluate the models and their application in a more approximate of how it happens in implementation practice. Critical nutrient limits (added sugars, saturated fat, and sodium) were also defined according to the nutritional profile of Brazilian legislation (BRASIL, 2020b). The nutritional composition of commercial products on the Brazilian market was considered to determine which nutrients were in excess.

(ii) food categories (cereal bar vs. whole grain cookies vs. snack).

The choice of these food categories was due to the potential of FoPNL to influence consumer behavior, especially for supposedly healthy foods (ARES *et al.*, 2018).

(iii) amount of nutrients in excess (one nutrient in excess vs. two nutrients in excess) to verify the difference between the warning systems (for each nutrient in excess, one symbol - octagon or triangle - is included on the label) and the magnifying glass (independent of the number of nutrients in excess, only one magnifying glass is included).

(iv) nutrition claims (present vs. absent).

Two nutrition claims were included in all evaluated labels, which were classified as the nutrient content claim (examples, “low in sodium”, “low in saturated fat” and “high in fiber” and the health-related nutrient claim (example, “with whole grains”), according to the INFORMAS taxonomy (RAYNER; VANDEVIJVERE, 2017). Nutrition claims were defined based on claims present in Brazilian commercial products used as a reference for the study.

The combination of these four factors resulted in 48 ($4 \times 3 \times 2 \times 2$) front panels of food labels, 12 of each FoPNL condition. The food labels developed for this study consisted of fictitious brands and contained at least one critical nutrient in excess (added sugars, saturated fat, and sodium). The food labels were created by an information designer using Photoshop and Illustrator (Adobe©) to combine graphic elements (colors, typography, photography, and illustrations) from products existing in the Brazilian market to confer visual adequacy to the research stimuli. The labels consisted Figure 1 illustrates examples of some labels used in the study.

Figure 1 - Examples of labels used in the study



5.2.3 Experimental procedure, outcomes, and measures

Participants were randomized into one of four experimental arms (control – no FoPNL, magnifying glass, octagon, and triangle). First, participants were asked to provide personal information such as weight (kg), height (cm), frequency of consumption of the evaluated foods, and whether they were responsible for food purchases at home. Then, the 12 food labels, according to the experimental arm, were presented, one by one, to the participants, following a Latin square design. Order was maintained in the presentation of the labels. Still, considering the Latin square, the presentation position varied among the participants to ensure that all evaluated labels were viewed in all possible positions. These 12 food labels consisted of six different products (three food categories – cereal bar, whole grain cookies, and snack * two excess nutrients - one and two excessive nutrients), half with the presence of nutrition claims and the other half without the nutrition claims.

For each label viewed, participants were asked to imagine they were in a supermarket and answered four questions:

(i) Word association task (“Write the first words that come to your mind when looking at this label”. Participants responded in open text, with no limit on the number of words.

(ii) Understanding nutritional information (does this product contain any nutrient in a higher quantity than recommended for a healthy diet? With the following answer options: “No,” “Yes, sugar,” “Yes, saturated fat,” and “Yes, sodium.” The participant could choose more than one answer;

(iii) Healthiness perception (show how healthy you consider this product by choosing one of the options on a seven-point scale, ranging from 1 - “not healthy” to 7 - “very healthy”;

(iv) Purchase intention (show your intention to purchase this product by choosing one of the options on a seven-point scale, ranging from 1 - “I would definitely not buy it” to 7 - “I would definitely buy it.”

Concluded the evaluation of the label, the next label was presented, and the same questions were answered. The results of the last three outcomes (understanding of nutritional information, health perception, and purchase intention) were presented in a previous study (PRATES *et al.*, 2022). Data from the word association task are presented in this study. Participants did not have the option to go back to previous steps in the questionnaire and change their answers.

5.2.4 Data analysis

The participant’s responses to the 12 food product labels evaluated were analyzed using content analysis, following inductive coding. For this, a pre-analysis of the participant's responses to the word association task was carried out to identify the main subjects that emerged from the text. From this, subject categories were created and organized/grouped into subject dimensions, encompassing categories that involved the same type of theme. Table 1 presents the dimensions and subject categories identified by the data and respective examples of answers given by the study participants. Consensus by two researchers defined such dimensions and categories, and a third researcher helped in cases of doubt. Saturation in the categories was reached when data analysis did not require the creation of new subject categories.

For this analysis, the frequency of responses in each category was calculated by FoPNL condition (control, magnifying glass, octagon, and triangle) in each nutrition

claims condition (present vs. absent). The ambiguous responses, which emerged from different subjects, for example, “healthy, but you need to be careful with salt” and “low in saturated fat, high in sodium”, were classified more than once in the respective subject categories. The chi-square test was used to assess statistical differences between the FoPNL conditions. The sign test detected intragroup differences between the nutrition claims’ conditions (presence x absence).

A second analysis of participants' responses was undertaken to explore perceptions based on healthiness. For this, only the responses to the first displayed label were analyzed. This was done to avoid the participants' knowledge bias since, in the following labels, the participants were already familiar with the proposed task. The analysis was performed by two researchers, following deductive coding, considering three thematic categories:

- (i) Healthiness. In the first category, responses refer to healthiness, adequate nutritional composition, and claims.
- (ii) Unhealthiness. Responses about unhealthy conditions and inadequate/harmful nutritional composition were included. Responses in this category did not refer to claims.
- (iii) Undefined. All answers that did not fit into the other two categories and did not emit any conception/judgment that referred to the healthiness of the evaluated products were included in the third category.

Examples of responses in each of these three categories are shown in Table 1. Similar to the first analysis, which considered all participants' responses to the twelve evaluated labels, this analysis classified the ambiguous responses more than once in the respective subject categories.

Generalized linear models (GLMs) were used to assess the influence of experimental conditions (control vs. FoPNL) and nutrition claims (presence vs. absence) on the likelihood of participants responding within categories 1 (“healthiness”) and 2 (“unhealthiness”). For this, a binary variable was created, indicating whether each participant responded positively to healthiness or unhealthiness. For category 1, the GLM also evaluated the interaction effect (FoPNL x claims). However, for category 2, the evaluation of this interaction was impossible since, in the absence of nutrition claims, the frequency of individuals responding within this category was equal to zero, making it impossible to estimate the models' coefficients.

Word clouds were created to illustrate the most frequent words in the participant's responses to the first evaluated label. Clouds were created using TagCrowd software (STEINBOCK, 2006), and the 40 most frequent words were counted. First, errors in the participants' writing were corrected. Then, some words were modified to correctly represent the participant's response (for example, "not healthy" so that "not" and "healthy" are not counted separately, as well as the expression "harmful to health" were changed to "unhealthy").

All data were analyzed in Portuguese, and the results (participant responses, subject dimensions, categories, word clouds) were translated into English for publication purposes. Statistical analyzes were performed in Statistical Package for the Social Sciences (SPSS) software, version 20.0, at a significance level of 5%.

5.3 Results

The sample consisted of 51.7% women and 48.3% men; the median age was 30, ranging from 18 to 73 years. The results of categorizing the participants' responses to the twelve evaluated labels are shown in Table 1. The four most frequent subject categories among the responses were the following: "Description of the product/ingredients" (category 1), "Other characteristics" (category 3), on the subject dimension of sensory/hedonic aspects, "Positive aspects" (category 6), related to perceptions of health and food composition and "High content of nutrients of public health concern" (category 10). The presence of FoPNL increased participants' associations with negative aspects of food health/composition (category 5), harmful nutrients to health (category 7), high content of critical nutrients (category 10), and positive conceptual aspects (category 12). Conversely, associations with positive health aspects (category 6) were reduced in the presence of FoPNL. Health-related negative aspects (category 5) and high content of critical nutrients (category 10) were statistically higher among participants who viewed the octagon and triangle than those who viewed the magnifying glass.

In general, the absence of nutrition claims on food labels increased associations related to the product description (category 1), sensory aspects (category 3), references to nutrients harmful to health - category 7 (only in the experimental arm of the octagon), and positive conceptual aspects - category 12 (only in the experimental arms of the octagon and triangle) (Table 2). On the other hand, in the presence of nutrition claims,

there were more responses related to low content of critical nutrients (category 9), positive aspects of health perception/food composition - category 6 (only in the experimental arm of the octagon) and references to beneficial nutrients (category 8) (Table 2). For the FoPNL in the octagon format, there was a statistical difference in more categories between the conditions “with” and “without” nutrition claims when compared to the control (without FoPNL), magnifying glass, and triangle (Table 2). For example, responses about positive aspects of health perception (category 6) were higher in the presence of claims, and references about harmful nutrients (category 7) were higher in the absence of claims only among participants who viewed the octagon as FoPNL.

The analysis based on healthiness, which considered only the first label evaluated by the participants, showed that the magnifying glass and octagon models reduced the probability of participants responding positively in category 1 (“healthiness”) by 60% and 58%, respectively, when compared to the control. The triangle model did not differ statistically from the control (Table 3) and the “FoPNL x claims” interaction had no significant effect. For category 2 (“unhealthiness”), the three FoPNL models statistically increased the probability of participants mentioning answers in this category by 12, 26, and 27 times for magnifying glass, octagon, and triangle, respectively, compared to the control (Table 3). Nutrition claims had no significant effect on the responses of participants in the assessed categories, but for category 1 (“healthiness”), the result suggests a trend toward an increase in responses in the presence of claims (Table 3).

Word clouds showed that, in the presence of FoPNL, more associations were observed with critical nutrients such as saturated fatty acids, sugar, and sodium, more mentions of the words “health” and “healthy”, and fewer mentions of the words “unhealthy” compared to the control condition (without FoPNL) (Figure 2). In this context, it is noteworthy that the word “unhealthy” did not appear in the word cloud of the control group, unlike the groups that viewed FoPNL models. On the other hand, the presence of nutrition claims favored more mentions of words related to healthiness and fewer mentions of the word “unhealthy”, compared to the absence of this information (Figure 2).

It is important to note that some participants’ responses addressed both FoPNL information and nutrition claims. Some examples of this type of response are: “a lot of sodium and little fat”; “despite being a source of vitamins and minerals, it is still bad for health”; “analysis of how much the fibers would be more beneficial than the sugar

and saturated fat” and “mixing of healthy and unhealthy items”. In addition, some responses seemed to show the participants' surprise/disappointment about the composition of the evaluated foods, such as: “this label changed my purchase opinion”; “deceiving”; “it looks healthy, but it's not”; “disappointment, as I would have been fooled by the healthy-looking packaging if it weren't for the warnings”; “fake wholemeal candy” and “false feeling of being healthy”.

Table 1 - Subject dimensions/categories and respective examples of participant responses to the word association task.

Full analysis	
Subject dimensions/categories	Examples of responses
Product description	
(1) Description of the product/ingredients	“Cereal bar” / “Bar” / “Strawberry cereal bar” / “Artificial Strawberry Flavored Cereal Bar” “Strawberry” / “Peanut” / “Cocoa” / “Chocolate” / “Banana” “Wholegrain biscuit” / “Cookie” / “Wholegrain snack” / “Soy snack” “Sesame” / “Fine Herbs” / “Soy Mix” / “Soy” / “Oat”
Sensory/hedonic aspects	
(2) Taste	“Sour” / “Sweet” / “Bitter” / “Salty” / “Taste” “Taste that stays in the mouth for a long time” “Hard” / “Soft” / “Dry and crunchy biscuit” / “Crispy” / “Crocance”
(3) Other features	“Yummy” / “Tasty” / “Juicy” / “Delicious” / “Delicious bar” / “Very tasty” “Perfectly delicious” / “Hmm” / “Tasty food for my family”
(4) Visuals	“Attractive” / “Beautiful” / “Beauty” “Beautiful picture” / “Very eye-catching photo” “Beautiful packaging” / “The packaging attracted me a lot” / “I liked the tones of the packaging”
Health perceptions/nutritional composition/components	
(5) Negative aspects	“It is not good for your health” / “Dangerous food for your health” / “It is not healthy” / “Harmful to your health” “Diabetes” / “I am diabetic; I will not consume this” / “Increased blood glucose” “Caloric” / “Not recommended for those looking to lose weight” “Hypertension” / “High blood pressure” “Unhealthy components” / “There was this story that cereal bars are “healthy”; there is nothing healthy about them”
(6) Positive aspects	“Healthy food” / “Rich in fiber and nutrients that are good for health” / “Health” / “Healthy life”

	“Nutrition” / “Satiety” “Diet” / “Fit” / “Fitness” / “Natural” / “Light”
(7) Reference to harmful nutrients	“Sugar” / “Added Sugar” “Fat” / “Bad fat” / “Saturated fat” / “Saturated fat, enjoy in moderation” “Trans fat and sodium” “Salt” / “Sodium”
(8) Reference to beneficial nutrients	“Whole grains” / “Cereal” / “Grains” / “Wholegrain” “Fiber” / “Source of fiber” / “Rich in fiber” / “Fiber for a healthy gut” “Vitamins”
(9) Low content of nutrients of public health concern	“Low sodium” / “Less salt” / “Sodium free” / “Low sodium cookies” “Low in fat” / “Low in saturated fat” / “No sugar”
(10) High content of nutrients of public health concern	“High in sugar” / “Too much sugar” / “Cookies with much sugar” “Too much fat” / “High fat” / “Too much-saturated fat” “Too much salt” / “High in sodium” / “Too much sodium”
Conceptual, personal aspects	
(11) Negatives	“I don't like it” / “It doesn't attract me” / “Bad” / “Terrible” / “I wasn't interested” / “I don't recommend it” “I'd walk right by” / “It doesn't catch my attention” / “It's not worth it” “Deception” / “Confused” / “Inconsistent” / “Indifferent”
(12) Positive	“I liked it” / “Very good” / “Great” / “Good” “Pleasant” / “Adequate” / “Quality” / “Good quality” / “Satisfaction” “Interesting” / “Modern” / “Practical” / “Practicality” / “Seriousness” / “Sophisticated”
Possibility of buying/consuming	
(13) Favorable	“Eat” / “I would eat” / “Will” / “Want to eat” / “Hungry” “I want” / “I will experiment” / “Will to consume” “I would buy” / “I will buy”
(14) Unfavorable	“I don't want to” / “I wouldn't consume” / “I won't consume” / “I don't feel like eating” / “I reject” “Wouldn't buy” / “Would never buy”

(15) Occasion/form of consumption	"Snack" / "Food for breaks between meals" / "Morning Snack" / "Afternoon Snack" / "Sunday Snack"
	"Quick snack" / "Fast food" / "Quick meal, emergency" / "Hurry"
	"Afternoon coffee" / "Weekend" / "Christmas" / "Travel"
	"Delicacy" / "Dessert" / "Pre-workout" / "Appetizer" / "Snack" / "Vegan" / "Vegetarian"
(16) Unclassifiable	"Different" / "Again?" / "Nothing" / "Normal" / "Name" / "Neutral"
Healthiness analysis	
Categories	
(1) Healthiness	"Healthy" / "Health" / "The benefits that this product brings to health" / "Natural product, does not harm health" / "Natural, healthy and nutritious" / "Health, good nutrition and prevents fats" / "Healthier food because it contains low sodium" / "Low in salt" / "High fiber content" / "Reduction of sugars" / "Hole grains" / "Light" / "Nutritive" / "For a balanced diet" / "Fitness" / "Diet"
(2) Unhealthiness	"Death on the spot" / "Unhealthy" / "Bad product for health" / "Not at all healthy" / "Hypertension" / "Product that may cause health problems if used in the long term" / "Avoid; bad health; caloric" / "High-calorie and low-nutrition product" / "High in sodium, should not be consumed" / "It has saturated fat which is very bad for the heart" / "High sodium and fat" / "Too much sodium" / "Very caloric and very sugar content" / "Caloric, not satiety"
(3) Undefined	"Cereal bar" / "Tasty" / "Sweet" / "Delicious" / "Beautiful" / "Banana" / "Snacks" / "Small" / "Beautiful packaging" / "Attractive, quality"

The complete analysis considered all participants' responses to the twelve evaluated labels. Healthiness analysis considered only the responses to the first evaluated label.

Table 2 - Relative frequency of participants' responses to the twelve evaluated labels, by subject category, in each FoPNL condition (control, black magnifying glass, black octagon, and black triangle) in the presence and absence of nutrition claims

Subject dimensions/categories	With claims				Without claims			
	Control (%)	Magnifying glass (%)	Octagon (%)	Triangle (%)	Control (%)	Magnifying glass (%)	Octagon (%)	Triangle (%)
Product description	-	-	-	-	-	-	-	-
(1) Description of the product/ingredients	10.8 ^{a,bA}	16.3 ^{cA}	9.4 ^{bA}	13.2 ^{a,cA}	15.2 ^{a,bB}	24.4 ^{cB}	12.9 ^{bB}	16.7 ^{aB}
Sensory/hedonic aspects	-	-	-	-	-	-	-	-
(2) Taste	4.1 ^a	6.0 ^{aA}	4.1 ^{aA}	4.9 ^a	5.3 ^{a,b}	6.4 ^{bB}	3.8 ^{aB}	5.3 ^{a,b}
(3) Other features	19.6 ^{aA}	9.0 ^b	8.9 ^{bA}	9.5 ^b	20.1 ^{aB}	11.0 ^b	10.2 ^{bB}	10.4 ^b
(4) Visuals	4.4 ^{a,bA}	3.4 ^b	5.5 ^a	3.8 ^{a,b}	3.5 ^{a,bB}	2.4 ^b	4.5 ^a	4.2 ^a
Health perceptions/nutritional composition/components	-	-	-	-	-	-	-	-
(5) Negative aspects	0.5 ^a	3.9 ^b	7.7 ^c	7.5 ^c	0.8 ^a	4.4 ^b	9.6 ^c	7.0 ^c
(6) Positive aspects	28.9 ^a	14.8 ^b	13.0 ^{bA}	12.3 ^b	24.2 ^a	10.2 ^b	9.3 ^{bB}	8.8 ^b
(7) Reference to harmful nutrients	1.4 ^a	6.8 ^b	6.8 ^{bA}	6.7 ^b	1.0 ^a	8.8 ^b	9.1 ^{bB}	8.7 ^b
(8) Reference to beneficial nutrients	6.9 ^a	10.6 ^b	6.4 ^a	7.1 ^{aA}	3.9 ^a	4.4 ^a	3.1 ^a	3.7 ^{aB}
(9) Low content of nutrients of public health concern	2.6 ^{aA}	2.5 ^{aA}	3.6 ^a	3.1 ^a	0.3 ^{aB}	0.0 ^{aB}	0.0 ^a	0.1 ^a
(10) High content of nutrients of public health concern	0.4 ^a	10.0 ^b	19.9 ^c	18.0 ^c	0.6 ^a	9.0 ^b	19.6 ^c	17.2 ^c
Conceptual. personal aspects	-	-	-	-	-	-	-	-
(11) Negatives	3.5 ^a	4.1 ^a	3.2 ^a	3.9 ^a	4.6 ^a	4.7 ^a	3.9 ^a	4.9 ^a
(12) Positive	10.1 ^a	5.1 ^b	5.4 ^{bA}	4.7 ^{bA}	13.9 ^a	5.9 ^b	6.9 ^{bB}	6.7 ^{bB}
Possibility of buying/consuming	-	-	-	-	-	-	-	-
(13) Favorable	1.2 ^a	1.2 ^a	0.8 ^a	1.5 ^a	1.5 ^a	1.5 ^a	1.3 ^a	1.6 ^a
(14) Unfavorable	0.3 ^a	1.2 ^b	0.8 ^{a,b}	0.7 ^{a,b}	0.6 ^a	1.0 ^a	0.5 ^a	1.4 ^a
(15) Occasion/form of consumption	2.6 ^{a,b}	4.2 ^b	3.5 ^{a,b}	2.3 ^a	3.1 ^a	5.1 ^b	4.6 ^{a,b}	2.8 ^a
(16) Unclassifiable	2.4 ^a	0.9 ^b	1.0 ^b	0.9 ^b	1.4 ^a	0.8 ^a	0.7 ^a	0.6 ^a

Different lowercase letters on the same line, in each claim condition (presence and absence), indicate a significant difference using the chi-square test ($p < 0.05$). Different uppercase letters on the same line indicate a significant difference ($p < 0.05$) intragroup (FoPNL), between the conditions "with" and "without" nutrition claims, by the Sign test.

Table 3 - Results of the GLMs performed to evaluate the effect of FoPNL and nutrition claims on the probability of responding within the categories created to assess consumers' perceptions of the healthiness of the evaluated food products. For each category, examples of answers, odds ratio (95%CI), and p-value of the factors of the GLMs are presented.

Categories	Factors of GLMs			Claim
	FoPNL			
(1) Healthiness*	Magnifying glass	Octagon	Triangle	Presence
	0.40 (0.20-0.79)	0.42 (0.21-0.82)	0.64 (0.33-1.22)	1.80 (0.96-3.36)
	p = 0.008	p = 0.011	p = 0.172	p = 0.066
	FoPNL			Claim
(2) Unhealthiness	Magnifying glass	Octagon	Triangle	Presence
	11.94 (3.52 – 40.52)	25.63 (7.68-85.48)	26.9 (8.10 – 89.35)	1.06 (0.70 – 1.60)
	p < 0.001	p < 0.001	p < 0.001	p = 0.776
	FoPNL			Claim

Healthiness = included responses that refer to Health-beneficial associations, adequate/healthy nutritional composition, and claims. Unhealthiness = included responses that refer to harmful health associations and inadequate/harmful nutritional composition.

Bold indicates statistically significant findings at $p < 0.05$ level. Significance was evaluated in relation to the reference category (1.00). To FoPNL, the reference category was the experimental arm control, and to the claims, the reference category was the absence condition.

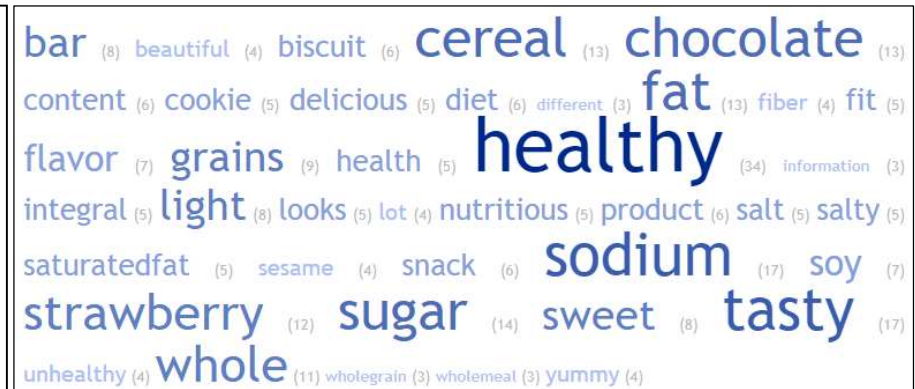
Models adjusted by food category (cereal bar, whole grain cookies, and snack), amount of nutrients in excess (one nutrient in excess and two nutrients in excess), and questions from the General Health Interest questionnaire in which significant differences between experimental groups were detected ($p < 0.05$) - presented in a previous study (PRATES *et al.*, 2022).

*FoPNL x Claims interaction had no significant effect.

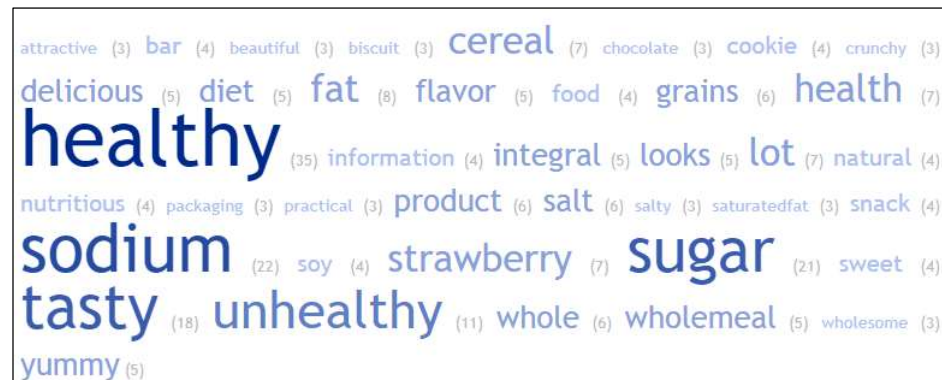
Figure 2 - Word clouds with the 40 most frequent words among participants' responses to the word association task to the first evaluated label, by FoPNL condition (control, magnifying glass, octagon, and triangle) and nutrition claims (present and absent).



(A) Control



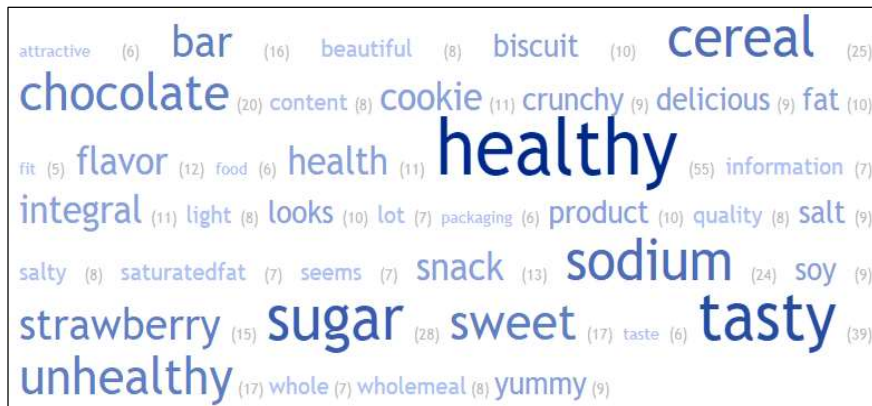
(B) Magnifying glass



(C) Octagon



(D) Triangle



(E) Without nutrition claims



(F) With nutrition claims

5.4 Discussion

The results of this study suggest that labeling information on foods with health connotations influences consumer associations/perceptions of products. The variation in the frequency of participants' responses between the subject categories defined in Table 1 suggests that the labeling information has a different relative impact on these associations. This phenomenon is salience or availability bias and refers to the perceptual and cognitive factors mediating attention (KAHNEMAN; SLOVIC; TVERSKY, 1982). When an element becomes more salient or “available” to the observer, it receives greater weight or relevance and can shape the associations and consumers' decisions (KAHNEMAN; SLOVIC; TVERSKY, 1982).

Confirming hypothesis 1, the inclusion of FoPNL favored the identification of harmful nutrients, increased negative associations with health, and reduced the perception of the healthiness of the evaluated products, as already observed in other studies (ARES *et al.*, 2021; BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020; PRATES *et al.*, 2022). Ares *et al.* (2020) explored the effect of including nutrition warnings, in an octagon format, in consumer associations about ultra-processed products and found a similar result - salience bias caused by the warnings, increasing associations about the excessive content of critical nutrients, and negative consequences to the health.

It is noteworthy that the different FoPNL models evaluated had different effects on consumers' health perceptions, as observed in other studies (BANDEIRA *et al.*, 2021; DELIZA *et al.*, 2020). Although the magnifying glass model was superior to the control (without FoPNL), the results in Table 1 and the word clouds suggest a better performance of the warning symbols (octagon and triangle) in favoring the perception of excess harmful nutrients and increasing negative associations to health, confirming hypothesis 2. According to Cabrera *et al.* (2017), the warning signs octagonal-shaped in black color, compared to the triangular shape in black and red, can maximize the consumer's unhealthfulness perception and capture great attention. Future research that evaluates the influence of front-of-pack label design features and nutrition claims on model performance is essential to deepen the discussion and better understand these results.

On the other hand, the results of the GLM (Table 2) show that the triangle model could not overcome the control (without FoPNL) in reducing the probability of participants mentioning responses associated with healthiness, unlike the magnifying glass and octagon. According to (Song *et al.*, 2021), the differences in the performance of FoPNL models can be explained by the different psychological mechanisms triggered by each type of label. In

addition, according to the WHO, the choice of FoPNL models, the graphic design, and the nutritional profile must be based on the main objective defined for the labeling, for example, promoting the choice of healthier foods, avoiding choosing less healthy foods, and/or compare the nutritional quality of foods (WHO, 2020). For each objective, there are graphic designs that are best suited (WHO, 2020).

Regarding nutrition claims, although the GLMs did not show a significant effect of this factor, their presence on the tested labels influenced participants' perceptions, increasing the associations to beneficial nutrients. In a meta-analysis, Ikonen et al. (2020) observed a similar result on product perceptions - both health claims and nutrient content claims reduced perceived healthfulness. However, the nutrient content claims' effects were insignificant (IKONEN *et al.*, 2020). In the present study, the nutrition claims also produced participants' positive associations with health and the low content of harmful nutrients – information characteristics of nutrition claims. These results confirm hypothesis 1, which was also reinforced by word clouds. Other authors have also reported this bias in the misperception of healthiness generated by claims (HALL *et al.*, 2020; MEDIANO STOLTZE *et al.*, 2021; NOBREGA; ARES; DELIZA, 2020).

Regarding hypothesis 3, it was also confirmed since both the FoPNL and the nutritional claims information impacted consumers' health perceptions of the evaluated products. In addition, the results of this study confirm the results of previous studies (MEDIANO STOLTZE *et al.*, 2021; PRATES *et al.*, 2022), which do not find an interaction effect between FoPNL and claims.

It is still worth discussing that the answers that referred to both information evaluated (FoPNL and claims) may reflect consumers needing clarification in interpreting the nutritional composition of foods since this is contradictory information. This has been confirmed in previous studies (LEEK; SZMIGIN; BAKER, 2015; MEDIANO STOLTZE *et al.*, 2021), in which the results showed that claims and nutrient warnings could confuse consumers about the overall healthiness of products. The feeling of surprise/disappointment was also observed in the study by Ares et al. (2020). According to these authors, nutritional warnings are expected to have a more significant impact on products that are perceived as healthy, even when they have an excessive content of nutrients that are harmful to health (ARES *et al.*, 2020).

5.4.1 *Strengths And Limitations*

The present study is the first to qualitatively assess Brazilian consumers' perceptions of foods with FoPNL and nutrition claims. In addition, the magnifying glass model was evaluated, according to the design and size implemented in the country, with a representative sample of the Brazilian population. However, this study has limitations. The experimental design carried out online may not represent reality in physical stores. However, the visualization only through computer/laptop screens allowed the visualization of the labels in approximate size to the real ones. Furthermore, the results may not be generalizable to a greater variety of foods since only three food categories were evaluated in the study.

5.5 Conclusions

In conclusion, the results suggest that the FoPNL information and the nutrition claims influenced consumers' perceptions of the evaluated foods. FoPNL mainly increased associations with harmful nutrients and negative associations with health and increased the probability of participants giving answers regarding the unhealthiness of the products. On the other hand, the presence of nutrition claims increased the associations with beneficial nutrients and positive associations with health. These findings reinforce the potential of FoPNL as a strategy to facilitate consumers' understanding of the nutritional composition of foods and reduce their perception of healthiness. However, more studies are needed to explain the different psychological mechanisms triggered by different FoPNL models. In addition, the results also highlight the need to regulate the use of claims on foods to ensure that the eligibility for disclosure of this information is congruent with the nutritional profile of the products.

6 FUTURE PERSPECTIVES

6.1 Visual attention experiment and understanding the nutritional quality of supposedly healthy food products

Visual attention and understanding of nutritional quality will be assessed using an eye-tracking methodology at the Experimental Translation Laboratory - Faculty of Letters, Universidade Federal de Minas Gerais (UFMG) – an already established partnership.

6.1.1 *Participants*

Participants will be invited by email and publicity posters at the UFMG. A total of 36 participants will be recruited. Participants must be between 18 and 35 years old, reside in Belo Horizonte (BH) or the metropolitan area of BH, and be able to experiment without using glasses or prescription lenses. Students and/or professionals in the field of food will be excluded. Everyone must sign the Free and Informed Consent Form (TCLE) (ANNEX A). The present study was approved by the UFMG Research Ethics Committee (Plataforma Brasil – CAAE 2395020.1.0000.5149) (ANNEX B).

6.1.2 *Experimental design*

Participants will be randomized into one of three experimental arms: control (without FoPNL), octagon, and magnifying glass. Attention capture will be assessed using eye-tracking measures, and understanding of nutritional quality will be assessed using the question, “Select from these two products, which one do you consider LESS harmful, by clicking on it”.

For each experimental arm, a total of 6 front panels of food labels were developed by a graphic designer, considering the factorial design (3*2), which considered food category (cereal bar x whole grain cookie x snack) and nutritional claim (present x absent).

6.1.3 *Experimental procedure*

The six food label front panels will be combined into three pairs, always one product with one nutrient in excess and the other with two nutrients in excess. Each pair will be presented following an experimental Latin square design. The pairs of products presented

will be identical for all participants, with the differential of the FoPNL model, but the position (right x left) will be balanced between them. After viewing the labels, participants will be asked to answer the question about product composition/excess nutrients (understanding nutritional quality). The responses will be categorized into a binary variable (right or wrong), and the response time will be computed.

All labels will be displayed on the LCD (Liquid Crystal Display) monitor of the Tobii T60 eye tracker. Before starting the task, participants will perform a calibration procedure. Before each viewing, a fixation cross will be shown on the computer screen for 200 milliseconds to minimize transition effects and fix the participant's gaze. Eye movements will then be recorded via the eye tracker integrated into the monitor. At the end of the experiment, participants will be invited to answer the sociodemographic information questionnaires (ANNEX C) and general health interests (ANNEX D). The latter consists of a subscale of the Health and Taste Attitude Scales, developed by Roininen; Lähteenmäki; Tuorila (1999) and translated and validated into Portuguese by Soares; Deliza; Goncalves (2006).

6.1.4 Data analysis

The validity of eye tracking data will be assessed by considering the percentage of time the participant's gaze is recorded. Only data from participants whose gaze is recorded at least 50% of the time will be analyzed. Raw eye-tracking data will be used to calculate fixations. The following variables will be defined as areas of interest for the labels: nutritional claims and FoPNL. For each area of interest (AI), the following eye tracking measures will then be calculated: (i) a percentage of participants who fixed their gaze on the area of interest; (ii) time to first fixation (time elapsed from the moment the image was displayed until the participant fixed gaze on the AI for the first time; (iii) total fixation duration (duration of all fixations within an AI); (iv) Average duration of fixation (within each AI) and (v) fixation count (number of times a participant fixed their gaze on an AI) (HOLMQVIST et al., 2011).

Logistic regression will be used to assess differences in the likelihood of consumer attachment between AIs. For the other eye tracking measures (time to first fixation, fixation count, and total fixation duration), variance analysis (ANOVA) will be performed.

Data from evaluating the understanding of nutritional quality will be analyzed by binary logistic regression; the allegations and frontal labeling will be considered independent variables, and the correct answers will be considered dependent variables. Participants will be included as a random effect. The response time to the nutritional quality question will only be

analyzed for the correct answers. ANOVA will compare response times, considering FoPNL and nutritional claims as fixed factors and participants as a random effect.

In all analyses, a significance level of 5% will be considered. When the differences are significant, post-hoc tests will be performed. All statistical analyzes will be performed using the Statistical Package for the Social Sciences (SPSS) software, version 20.0.

7 INTEGRATED CONCLUSIONS AND FINAL CONSIDERATIONS

The results of the present study demonstrate that the FoPNL favored the understanding of nutritional information and reduced the perception of healthiness and purchase intention of Brazilian consumers about the evaluated products. Although all models showed better results than the control (without FoPNL), the octagonal and triangular symbols were superior to the magnifying glass in reducing the perception of healthiness in products with two harmful nutrients in excess. This result can be attributed to the greater familiarity of the warning symbols, compared to the magnifying glass, and to the differences in the criteria for applying them (more prominent size and several seals, in the case of warnings).

Regarding the nutritional claims, they acted contrary to the FoPNL, reducing the understanding of the nutritional information and increasing the perception of healthiness and purchase intention, corroborating with evidence from the literature demonstrating that this information can generate positivity bias about the products and confusion in consumers. This result is especially relevant in the context of the new food nutrition labeling legislation that was implemented in October 2022 in Brazil since it does not prohibit the publication of nutritional claims on foods with FoPNL as long as they do not refer to the nutrients warned on the front label (as evaluated in the present study).

The results of the word association task reinforced the effect of claims and FoPNL on consumers' perceptions of products; claims generated more associations related to health, while FoPNL generated more associations about harmful nutrients and unhealthy. These analyses also showed differences in the performance of the evaluated FoPNL models, depending on the outcome, the evaluated food category, and the number of excessive nutrients in the products.

This difference in the FoPNL model's performance is already highlighted in the scientific literature and is explained by the psychological mechanisms each type of label triggers. For this reason, the choice of graphic design and other factors that influence the FoPNL, such as the nutritional profile, must be defined coherently with the policy's objective.

Since FoPNL aims to inform consumers about the actual composition of food products to favor healthier food choices and, consequently, face the current pandemic of obesity and NCDs, nutritional information must be the clearest, most direct, and truthful for the consumer. The results found in the present study demonstrate that the presence of nutritional claims on labels containing FoPNL made it difficult for consumers to understand and judge, going against the policy's objective.

The interaction between information from the FoPNL and the claims was insignificant in the evaluated outcomes, demonstrating that both acted independently on the consumer. Finally, the results confirm the potential of the FoPNL as a public policy strategy to facilitate the understanding of nutritional information and favor more conscious choices. Above all, considering the regulatory scenario in Brazil, this study provides relevant evidence on the effect of different FoPNL models and their joint placement with nutritional claims on Brazilian consumers, which can help monitor the implementation of legislation in the country.

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ANNEX A – FREE AND INFORMED CONSENT FORM (EYE TRACKING EXPERIMENT)

1

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Você está sendo convidado(a) como voluntário(a) a participar da pesquisa “EFEITO DA PRESENÇA E AUSÊNCIA DE ALEGAÇÕES NUTRICIONAIS EM RÓTULOS DE ALIMENTOS CONTENDO ROTULAGEM NUTRICIONAL FRONTAL: CAPTURA DA ATENÇÃO, COMPREENSÃO DAS INFORMAÇÕES NUTRICIONAIS, PERCEPÇÃO DE SAUDABILIDADE E INTENÇÃO DE COMPRA”, a ser desenvolvida na Universidade Federal de Minas Gerais, sob a responsabilidade da Profa. Lucilene Rezende Anastácio e da doutoranda Sarah Morais Senna Prates.

A rotulagem nutricional em alimentos industrializados é obrigatória em vários países e considerada medida que permite que as pessoas façam escolhas informadas sobre os alimentos que consomem. Apesar disto, na prática, tais informações são de difícil entendimento e os consumidores lutam para interpretar dados quantitativos sobre os nutrientes. Como objetivo de facilitar a interpretação das informações nutricionais e promover escolhas mais autônomas e conscientes, a rotulagem nutricional frontal tem sido incluída de forma complementar à tabela nutricional em diversos países. No Brasil, alguns modelos de rotulagem frontal foram propostos à ANVISA e, em setembro de 2019, o órgão apresentou o design de lupa como o modelo a ser implementado no país. Apesar da escolha, alguns questionamentos têm sido feitos acerca da eficiência de tal modelo em informar a população brasileira. Neste sentido, este projeto tem como objetivo avaliar o efeito de alegações nutricionais em rótulos de alimentos contendo diferentes modelos de rotulagem nutricional frontal, com consumidores brasileiros.

Você está sendo convidado a participar da etapa em que serão avaliadas a captura da atenção e a compreensão das informações nutricionais. A captura da atenção será avaliada por meio de rastreador ocular – equipamento que detecta pra onde é direcionado o olhar do indivíduo, e, a compreensão das informações nutricionais será avaliada por meio de perguntas relacionadas ao conteúdo nutricional dos rótulos analisados. Os testes serão realizados no Laboratório Experimental de Tradução, na Faculdade de Letras da UFMG e terão duração média de 1h30min. Apesar de não envolver grandes riscos, você pode achar cansativa e difícil a participação. No entanto, você tem a liberdade de se recusar a participar e retirar o seu consentimento em qualquer fase da pesquisa sem nenhum tipo de prejuízo. Também tem a garantia de que sua identidade será mantida em sigilo e nenhuma informação prestada será dada a outras pessoas que não façam parte da equipe de pesquisadores. Após a coleta de dados, os resultados serão codificados e na divulgação dos resultados desse estudo, seu

nome não será citado. Os dados de sua participação ficarão armazenados pelo pesquisador responsável pelo período de cinco anos, em drive da pesquisa, e serão descartados após este tempo.

Não haverá custos por participar desta pesquisa, nem benefício direto ou compensação financeira. Contudo, a sua participação ajudará aos pesquisadores a melhor entender os efeitos do uso da rotulagem nutricional frontal na população brasileira.

Em caso de dúvidas sobre o estudo, você poderá entrar em contato com a pesquisadora responsável: Lucilene Rezende Anastácio (UFMG, Av. Antônio Carlos, 6627- Faculdade de Farmácia, Departamento de Alimentos, sala 2074 - (31) 3409-6917; e-mail: lucilene.rezende@gmail.com). A pesquisadora se compromete a obedecer os termos da Resolução CNS 466-12. Em caso de dúvidas sobre questões éticas do estudo, você pode entrar em contato com o Comitê de Ética em Pesquisa (COEP/UFMG- Av. Antônio Carlos, 6627 – Unidade Adm. II, 2º andar, sala 2005- (31) 3409-4592, coep@prpq.ufmg.br).

Se estiver esclarecido quanto aos seus direitos como participante da pesquisa, solicitamos que assine o consentimento abaixo, em duas vias, sendo que uma ficará em sua posse e a outro, conosco.

AUTORIZAÇÃO

Eu, _____, portador(a) do documento de identidade nº _____, fui informado(a) dos objetivos do estudo e aceito participar da pesquisa intitulada “Efeito da presença e ausência de alegações nutricionais em rótulos de alimentos contendo rotulagem nutricional frontal: captura da atenção, compreensão das informações nutricionais, percepção de saudabilidade e intenção de compra”, realizada na Universidade Federal de Minas Gerais sob responsabilidade da Profa. Dra. Lucilene Rezende Anastácio. Declaro ter conhecimento das informações contidas neste documento e sei que minha participação é voluntária, que meus dados pessoais serão confidenciais, que não terei custos nem compensações e que tenho direito a recusa em participar sem consequências por essa decisão. Recebi uma via deste Termo de Consentimento Livre e Esclarecido e me foi dada a oportunidade de ler e esclarecer as minhas dúvidas. Portanto, dou meu consentimento para a realização do estudo.

Local e data: Belo Horizonte, _____ de _____ de 20____.

Assinatura do(a) participante

Assinatura da pesquisadora responsável

ANNEX B – APPROVAL OF THE PROJECT BY THE RESEARCH ETHICS COMMITTEE

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PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: EFEITO DA PRESENÇA E AUSÊNCIA DE ALEGAÇÕES NUTRICIONAIS EM RÓTULOS DE ALIMENTOS CONTENDO ROTULAGEM NUTRICIONAL FRONTAL: CAPTURA DA ATENÇÃO, COMPREENSÃO DAS INFORMAÇÕES NUTRICIONAIS, PERCEPÇÃO DE SAUDABILIDADE E INTENÇÃO DE COMPRA

Pesquisador: Lucilene Rezende Anastácio

Área Temática:

Versão: 2

CAAE: 42395020.1.0000.5149

Instituição Proponente: UNIVERSIDADE FEDERAL DE MINAS GERAIS

Patrocinador Principal: CONS NAC DE DESENVOLVIMENTO CIENTIFICO E TECNOLÓGICO

DADOS DO PARECER

Número do Parecer: 4.862.583

Apresentação do Projeto:

Nesta nova apresentação, o projeto em andamento "EFEITO DA PRESENÇA E AUSÊNCIA DE ALEGAÇÕES NUTRICIONAIS EM RÓTULOS DE ALIMENTOS CONTENDO ROTULAGEM NUTRICIONAL FRONTAL: CAPTURA DA ATENÇÃO, COMPREENSÃO DAS INFORMAÇÕES NUTRICIONAIS, PERCEPÇÃO DE SAUDABILIDADE E INTENÇÃO DE COMPRA" trata de Emenda para inclusão, em todas as etapas de avaliação do projeto, a participação de adolescentes (15 a 17 anos de idade). Tal inclusão se justifica pelo elevado consumo de alimentos ultraprocessados, os quais serão avaliados no estudo, nesta faixa etária (Louzada et al., 2015; Costa et al., 2018; Viola et al., 2020; Mendes et al., 2021). Para isto, foram incluídos novos Termos de Consentimento Livre e Esclarecido (TCLE), os quais serão destinados aos responsáveis pelos menores de idade, além dos Termos de Assentimento Livre e Esclarecido (TALE) para os jovens, para as etapas de avaliação já aprovados no projeto.

Também queremos solicitar a aprovação para alteração dos modos de aplicação dos grupos focais, de presenciais para online, em virtude das atuais medidas de distanciamento social da pandemia de COVID-19. A realização de grupos focais online pode também minimizar dificuldades características de grupos focais presenciais, como o não comparecimento dos participantes, custos com o não comparecimento, alimentação, aluguel de local para a realização das reuniões e dificuldade em atingir públicos geograficamente diversos (Stewar & Shamdasani, 2017; Halliday et

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E-mail: coep@prpq.ufmg.br

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Continuação do Parecer: 4.862.583

al., 2021). Se aprovada tal solicitação, as reuniões serão realizadas por meio da plataforma de videoconferência Zoom, a qual tem se mostrado escolha vantajosa, uma vez que é segura, pois não necessita e-mail dos participantes para fazer login, conforme exigido em outras plataformas, além de fornecer recursos de gravação que auxiliam na transcrição dos dados (Archibald et al., 2019). Para isto, modificamos o TCLE referente à realização dos grupos focais, alterando a informação sobre a forma de aplicação de presencial para online, e incluímos o TCLE destinado aos responsáveis pelos menores de idade e o respectivo TALE.

Objetivo da Pesquisa:

Objetivo Primário:

Avaliar o efeito da presença e ausência de alegações nutricionais em rótulos de alimentos contendo rotulagem nutricional frontal na captura da atenção, compreensão das informações nutricionais, percepção de saudabilidade e intenção de compra de consumidores brasileiros.

Avaliação dos Riscos e Benefícios:

Riscos:

Este estudo não envolve grandes riscos, mas os participantes podem achar cansativa e difícil a participação, assim como se sentirem intimidados em participar dos grupos focais. Todavia, eles terão liberdade de se recusar a participar do estudo e retirar o consentimento em qualquer fase da pesquisa sem nenhum tipo de prejuízo. Os participantes também terão a garantia de que sua identidade será mantida em sigilo e nenhuma informação prestada será dada a outras pessoas que não façam parte da equipe de pesquisadores. Após a coleta de dados, os resultados serão codificados e na divulgação dos resultados os nomes dos participante não serão citados. Os dados ficarão armazenados pelo pesquisador responsável pelo período de cinco anos, em drive da pesquisa, e serão descartados após este tempo.

Benefícios:

Não haverá custos por participar desta pesquisa, nem benefício direto ou compensação financeira. Contudo, a participação ajudará aos pesquisadores a melhor entender os efeitos do uso da rotulagem nutricional frontal na população brasileira.

Comentários e Considerações sobre a Pesquisa:

Pesquisa relevante para o esclarecimento nutricional.

Considerações sobre os Termos de apresentação obrigatória:

Todos os termos de apresentação obrigatória foram devidamente apresentados, de acordo com a

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norma aplicável.

Recomendações:

Não se aplica.

Conclusões ou Pendências e Lista de Inadequações:

Diante do texto e documentos apresentados, somos, s.m.j., pela aprovação do projeto.

Considerações Finais a critério do CEP:

Tendo em vista a legislação vigente (Resolução CNS 466/12), o CEP-UFMG recomenda aos Pesquisadores: comunicar toda e qualquer alteração do projeto e do termo de consentimento via emenda na Plataforma Brasil, informar imediatamente qualquer evento adverso ocorrido durante o desenvolvimento da pesquisa (via documental encaminhada em papel), apresentar na forma de notificação relatórios parciais do andamento do mesmo a cada 06 (seis) meses e ao término da pesquisa encaminhar a este Comitê um sumário dos resultados do projeto (relatório final).

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_1758352_E1.pdf	24/05/2021 21:09:55		Aceito
Outros	Carta_emenda.docx	24/05/2021 21:07:51	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TALE_gruposfocais.docx	19/05/2021 23:35:48	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_responsavel_legal_gruposfocais.docx	19/05/2021 23:35:37	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TALE_eyetracker.docx	19/05/2021 23:35:30	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_responsavel_legal_eyetracker.docx	19/05/2021 23:35:23	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de	TALE_experimentoonline.docx	19/05/2021 23:34:47	SARAH MORAIS SENN PRATES	Aceito

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Continuação do Parecer: 4.862.583

Ausência	TALE_experimentoonline.docx	19/05/2021 23:34:47	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_responsavel_legal_experimentoonline.docx	19/05/2021 23:34:39	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_grupos_focais_online.docx	19/05/2021 23:30:06	SARAH MORAIS SENN PRATES	Aceito
Outros	Parecer_Alegacoes_nutricionais_COEP_270820.pdf	25/01/2021 13:53:26	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_saudabilidade_e_intencao_de_compra.pdf	25/01/2021 13:51:00	SARAH MORAIS SENN PRATES	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_captura_da_atencao_e_compreensao_das_informacoes.pdf	25/01/2021 13:50:15	SARAH MORAIS SENN PRATES	Aceito
Outros	aprovacao_AD_referendum_do_Chefe_de_Departamento.pdf	07/01/2021 11:41:04	SARAH MORAIS SENN PRATES	Aceito
Folha de Rosto	Folha_de_rosto.pdf	27/10/2020 10:30:27	SARAH MORAIS SENN PRATES	Aceito
Projeto Detalhado / Brochura Investigador	projeto_doutorado_SarahPrates.pdf	09/10/2020 23:00:59	SARAH MORAIS SENN PRATES	Aceito
Outros	Questionario_sociodemografico.pdf	09/10/2020 22:57:26	SARAH MORAIS SENN PRATES	Aceito
Outros	Questionario_interesse_por_saude_geral.pdf	09/10/2020 22:50:22	SARAH MORAIS SENN PRATES	Aceito
Declaração de Instituição e Infraestrutura	Termo_de_Consentimento_de_Uso_de_Laboratorio.pdf	09/10/2020 22:47:29	SARAH MORAIS SENN PRATES	Aceito
Declaração de Pesquisadores	Termo_de_Compromisso_do_Pesquisador.pdf	09/10/2020 21:43:27	SARAH MORAIS SENN PRATES	Aceito

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

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Continuação do Parecer: 4.862.583

BELO HORIZONTE, 24 de Julho de 2021

Assinado por:
Críssia Carem Paiva Fontainha
(Coordenador(a))

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ANNEX C – SOCIODEMOGRAPHIC QUESTIONNAIRE

Você está participando como voluntário da pesquisa “EFEITO DA PRESENÇA E AUSÊNCIA DE ALEGAÇÕES NUTRICIONAIS EM RÓTULOS DE ALIMENTOS CONTENDO ROTULAGEM NUTRICIONAL FRONTAL: CAPTURA DA ATENÇÃO, COMPREENSÃO DAS INFORMAÇÕES NUTRICIONAIS, PERCEPÇÃO DE SAUDABILIDADE E INTENÇÃO DE COMPRA”. Agora que já concluiu o teste de avaliação, gostaríamos que nos informasse alguns dados para que possamos caracterizar os participantes deste estudo.

SEXO:

- ☐ Masculino
- ☐ Feminino

IDADE:

- ☐ 18 a 25
- ☐ 26 a 35
- ☐ 36 a 45
- ☐ 46 a 60

ESCOLARIDADE:

- ☐ Não alfabetizado
- ☐ Fundamental Incompleto
- ☐ Fundamental Completo/Ensino Médio Incompleto
- ☐ Ensino Médio Completo/Superior Incompleto
- ☐ Superior Completo
- ☐ Pós graduação

RENDA:

- ☐ Até 2 salários mínimos
- ☐ 2 a 4 salários mínimos
- ☐ 4 a 10 salários mínimos
- ☐ 10 a 20 salários mínimos
- ☐ acima de 20 salários mínimos

FREQUÊNCIA DE CONSUMO DO ALIMENTO AVALIADO:

- ☐ Todo dia
- ☐ 2 ou 3 vezes/semana
- ☐ Uma vez/semana
- ☐ 2 ou 3 vezes/mês
- ☐ Nunca

VOCÊ É O RESPONSÁVEL PELA COMPRA DE ALIMENTOS EM CASA?

- ☐ Sim
- ☐ Não

ANNEX D – GENERAL HEALTH INTEREST QUESTIONNAIRE

Instruções: Estamos interessados em saber sua opinião sobre alimentação e como você decide sobre os alimentos que vai comer.

1) Interesse por Saúde Geral

		Discordo Fortemente	Discordo	Discordo ligeiramente	Não Concordo nem discordo	Concordo ligeiramente	Concordo	Concordo fortemente
1.	Eu sou muito preocupado sobre o quão saudável os alimentos são.	()	()	()	()	()	()	()
2.	Eu sempre sigo uma dieta saudável e balanceada.	()	()	()	()	()	()	()
3.	É importante para mim que minha dieta seja pobre em gordura.	()	()	()	()	()	()	()
4.	É importante para mim que minha alimentação diária contenha muitas vitaminas e minerais.	()	()	()	()	()	()	()
5.	Eu como o que eu gosto e eu não me preocupo com o quão saudável o alimento é.	()	()	()	()	()	()	()
6.	O quão saudável é o alimento tem pouco impacto nas minhas escolhas.	()	()	()	()	()	()	()