



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Effect of five front-of-package nutritional labeling models on time to select food by Brazilians

Efeito de cinco modelos de rotulagem nutricional frontal no tempo para escolhas alimentares entre brasileiros

Abstract

Objective: to compare the time Brazilian adults required to make food choices with different models of front-of-pack nutrition labeling. **Methods:** Interviews were conducted with 150 participants, who were instructed to select the healthiest product between two foods, with eight pairs of images presented. One of the products in each pair had warnings (high in sugars, sodium, or saturated fat), evaluated in different formats according to the group in which the individual was allocated: magnifying glass, octagon, circle, triangle, and traffic light. The number of correct answers for the healthiest product in each pair and the time to correctly select of the healthiest product were measured. **Results:** A lower number of correct answers for the healthier product among the pairs occurred with traffic lights than with any other model ($p < 0.001$), which is also the format in which the longest time was necessary to correctly select the healthiest product ($p \leq 0.001$). There were no significant differences between the other formats. In the individual analysis of the products, the circle performed better, with significantly less time required to make the correct choices in seven of the eight products. **Conclusion:** To support healthy food choices, any of the tested formats for frontal nutrition labeling are indicated, except for the traffic light. The circle appears to be a good option to reduce consumer's time to select healthy choices.

Keywords: Food. Food Legislation. Nutrition Labeling, Time, Choice Behavior.

Resumo

Objetivo: Comparar o tempo necessário para realizar escolhas alimentares com diferentes modelos de rotulagem nutricional frontal entre adultos brasileiros. **Métodos:** Foram realizadas entrevistas com 150 participantes, que foram orientados a escolher o produto mais saudável entre dois alimentos, sendo apresentados oito pares de imagens. Um dos produtos de cada par apresentava advertências (alto em açúcares, sódio ou gordura saturada), testados em formatos diferentes de acordo com o grupo no qual o indivíduo era alocado: lupa, octógono, círculo, triângulo e semáforo. Foram contabilizados o número de acertos do produto mais saudável em cada par e o tempo para escolha correta do produto mais saudável. **Resultados:** Observou-se menor número de acertos do produto mais saudável entre os pares com semáforo, em comparação com qualquer outro modelo ($p < 0,001$), sendo este também o formato no qual se observou maior tempo necessário para escolher corretamente o produto mais saudável ($p \leq 0,001$). Não foram observadas diferenças significativas entre os demais formatos. Na análise individual dos produtos, o círculo teve melhor desempenho, sendo observado tempo significativamente menor para escolhas corretas em sete dos

oito produtos. **Conclusão:** Para apoiar escolhas alimentares saudáveis, indica-se o uso de qualquer um dos formatos testados para a rotulagem nutricional frontal, exceto o do semáforo. O círculo aparenta ser uma boa opção para reduzir o tempo do consumidor frente a escolhas saudáveis.

Palavras-chave: Alimentos. Legislação sobre Alimentos. Rotulagem Nutricional, Tempo, Comportamento de Escolhas..

INTRODUCTION

Front-of-pack nutrition labeling (FOPNL) is a strategy that has already been successfully implemented in some countries and aims to directly and simply inform consumers about high content of specific nutrients, contributing to more qualified food choices.^{1,2}

After conducting an extensive regulatory process, which began in 2014, the Agência Nacional de Vigilância Sanitária (ANVISA – Brazilian National Health Regulatory Agency) approved, in October 2020, the FOPNL model in rectangular format with a magnifying glass to inform the high content of added sugars, saturated fats, and sodium.^{3,4}

The models that were under analysis during the Agency's regulatory process were the black octagon, already approved in some Latin American countries and proposed by the Câmara Interministerial de Segurança Alimentar e Nutricional (Interministerial Commission for Food and Nutritional Security); the red circle, proposed by the Ezequiel Dias Foundation; the black triangle, proposed by the Brasileiro de Defesa do Consumidor (Brazilian Institute of Consumer Defense) and the Universidade Federal do Paraná; and the rectangle with magnifying glass, similar to the FOPNL model that was being considered in Canada.^{4,6} The food and beverage industry sector defended, through the Labeling Network, the nutritional traffic light model that notifies low, medium, and high levels in sugars, saturated fat, and sodium, with green, yellow, and red colors, respectively.⁴

Previous studies have assessed consumer's ability to select the healthiest food between pairs and trios, without measuring the time needed for their selection.^{5,7} The findings of these studies diverge. Arrúa et al.⁷ and Deliza et al.⁵ did not observe significantly superior performance of the traffic light in relation to the octagon, triangle, circle, and magnifying glass; however, two other studies found the travel light was superior.^{1,8} Another study found that the octagon was better than the magnifying glass.⁹

Studies have evaluated the time required for consumers to identify high content of critical nutrients in foods. Ares et al.¹⁰ observed that when compared to packaging without a FOPNL, the nutritional traffic light reduced this time by approximately four seconds. In another study, carried out with Brazilian consumers, the time was significantly shorter with the triangle and the octagon compared to the red circle, black magnifying glass, red magnifying glass, nutritional traffic light, and Guideline Daily Amounts (GDA).⁵ Arrúa et al.⁷ observed that the octagon significantly reduced the time for the consumer to identify the food with high content of critical nutrients in relation to the GDA and the nutritional traffic light.

No studies could be found that evaluated the effect of different FOPNL models in reducing the time needed to select the healthiest food, which has less high content of critical nutrients. This study compared the effect of five models of FOPNL, which were under analysis in the regulatory process of ANVISA – the octagon, triangle, traffic light, circle, and magnifying glass – regarding the time needed to make healthy food choices.

METHODS

A cross-sectional study was conducted in which participants had to make choices between pairs of products. A convenience sample was adopted, with 150 adults participated in the study. The participants either attend or were employed at a specific Brazilian public university between April and June 2019, and they could be either gender. Each experimental group, with 30 individuals, was assigned to analyze a specific FOPNL model: octagon, triangle, traffic light, circle, and magnifying glass (Figure 1). The research was approved by the Research Ethics Committee of the Faculdade de Ciências da Saúde da Universidade de Brasília (Protocol CAE 36352314.9.0000.0030). Respondents participated only after signing the Informed Consent Form.

Figure 1. Different alerts that were presented on the front labeling of the products in the survey



Legenda:

ALTO EM AÇÚCARES = high in sugars; ALTO EM GORDURAS SATURADAS = high in saturated fats; ALTO EM SÓDIO = high in sodium.

Traffic light FOPNL – Per 25g portion (1 1/2 cup); Low sugars, High saturated fats, Medium sodium; % of daily values based on a 2000 Kcal diet.

Source: compiled by the authors

A questionnaire was used during the interview and was completed by the researcher at the place the participants were recruited. Participants provided data on education, age, and gender. Then they were

presented with eight pairs of industrialized products, namely: cookies, rolls, breakfast cereal, strawberry yogurt, canned corn, tomato sauce, orange juice, and wholewheat bread (Figure 2).

Figure 2. Presentation of the five models of front-of-pack nutrition labeling presented as examples of products



Saltine Crackers



Rolls



Loaf of Whole Wheat Bread



Breakfast cereal



Strawberry Yogurt



Canned Corn



Tomato Sauce



Orange juice

Source: compiled by the authors

The foods were chosen from industrialized products commonly consumed in Brazil¹¹ or considered healthy but had a high content of at least one critical nutrient (sodium, sugars, or saturated fat). Each pair included a healthier product, which had fewer critical nutrients.

Participants were instructed to respond as quickly as possible, within a 60 second limit per pair of products: "Which of the two products is healthier in your opinion? Choose only one food." The time it took the participant to select the healthiest food in each pair was measured. Food images were developed for this study without trademarks and health claims.

The five FOPNL models were applied to the images of the products in each group, which could have one, two, or three warnings, according to the more restrictive nutritional profile proposed by ANVISA.⁵

For data analysis, the foods in which the participant correctly chose the healthiest option and the time needed to make that choice were recorded. The FOPNL models were compared, to identify which model provided more correct answers faster.

ANOVA analysis of variance with multiple comparisons (HSD-Tukey) was performed to assess the existence of at least one significant difference according to the different models.

RESULTS

The mean age of participants was 22.2±6.0 years, 52.7% were women and the majority (81.3%) had not completed higher education. Participants obtained an average of 5.83±2.18 correct responses for the healthiest product in the eight pairs presented. The number of correct answers was lower for those who viewed the traffic light compared to any other FOPNL format ($p<0.001$) (Table 1). No significant differences were found in the number of correct answers between the other models evaluated.

For all the models adopted, the participants took an average of 8.09±4.37 seconds to make a correct choice between foods pairs. The average time taken to make correct choices with the traffic light was greater than to the time taken with any other model ($p<0.001$). No other differences were found between the other FOPNL models evaluated (Table 1).

In the individual analysis of the products, the circle performed better than the other models evaluated, and the average time for correct choices with this model was significantly lower than for the traffic light for seven of the eight products tested. The magnifying glass and triangle achieved similar performance, with five products with averages lower than those of the traffic light. The octagon obtained lower averages than the traffic light for four products (Table 1).

Table 1. Distribution of the mean and standard deviation (SD) of the number of correct answers for the healthiest product and the time in seconds that it took the study participants to select the healthiest products according to different formats of front-of-pack nutrition labeling. Brasilia, DF, Brazil, 2019.

	<i>magnifying glass</i>	<i>octagon</i>	<i>circle</i>	<i>triangle</i>	<i>traffic light</i>
<i>Number of correct responses for the healthiest product – mean (SD)*</i>	6.27(1.91) ^a	6.10(1.71) ^a	6.80(2.02) ^a	6.27(2.10) ^a	3.70(1.80) ^b
<i>Time – mean in seconds (SD) – to select the healthier choice:</i>					
<i>Saltine Crackers</i>	9.10(5.24)	9.25(4.25)	7.76(4.60)	7.75(3.11)	11.28(7.78)
<i>Rolls*</i>	8.54(5.28)	8.96(6.14)	7.63(4.06) ^a	8.29(4.29)	12.53(6.58) ^b
<i>Breakfast cereal*</i>	8.17(4.47) ^a	8.25(3.99) ^a	7.21(4.85) ^a	7.70(4.92) ^a	13.05(7.62) ^b
<i>Yogurt*</i>	7.54(4.65)	7.14(4.86)	5.69(2.98) ^a	7.42(4.91)	10.30(3.83) ^b

Table 1. Distribution of the mean and standard deviation (SD) of the number of correct answers for the healthiest product and the time in seconds that it took the study participants to select the healthiest products according to different formats of front-of-pack nutrition labeling. Brasilia, DF, Brazil, 2019. (Continues)

	<i>magnifying glass</i>	<i>octagon</i>	<i>circle</i>	<i>triangle</i>	<i>traffic light</i>
<i>Number of correct responses for the healthiest product – mean (SD)*</i>	6.27(1.91) ^a	6.10(1.71) ^a	6.80(2.02) ^a	6.27(2.10) ^a	3.70(1.80) ^b
<i>Time – mean in seconds (SD) – to select the healthier choice:</i>					
<i>Corn*</i>	6.33(3.66) ^a	6.82(3.54) ^a	5.54(3.59) ^a	6.91(4.37) ^a	17.67(3.50) ^b
<i>Tomato Sauce*</i>	4.96(2.82) ^a	7.18(5.76)	4.96(3.19) ^a	4.96(2.41) ^a	10.78(5.33) ^b
<i>Orange juice*</i>	5.82(4.16) ^a	6.40(2.97) ^a	5.22(3.43) ^a	5.18(2.52) ^a	10.50(4.06) ^b
<i>Loaf of bread*</i>	7.05(5.33) ^a	8.19(5.04) ^a	5.91(3.92) ^a	5.37(2.79) ^a	15.20(6.49) ^b
Mean	7.04(3.77)^a	8.07(3.77)^a	6.39(3.45)^a	6.75(3.06)^a	12.20(4.97)^b

Legenda: * p-value one-way ANOVA < 0.05. Note: Different superscript letters on the same line

DISCUSSION

In general, of the eight pairs presented, consumers made about six correct choices and correctly identified the image of the product considered to be healthier. This can be attributed to the fact that the less healthy products in each pair always had warnings, which agrees with the finding by Ares et al.¹² that the presence of FOPNL models on the products facilitates identification of the healthier product.

Among the FOPNL models evaluated, the traffic light had the worst performance, with a lower number of correct answers between pairs, as well as a longer time to make healthy food choices. Helfer & Shultz¹³ argue that the presence of nutrients marked with a green in the traffic lights confuses consumers and limits the effectiveness of this FOPNL. The times of the other FOPNL models did not differ significantly.

Our findings corroborate two previous studies in which the consumer's ability to select the healthiest food in triangle¹¹ and octagon¹³ was significantly better than the nutritional traffic light. However, unlike that identified by another study, we did not observe the superiority of the octagon over the magnifying glass for this outcome.¹⁴

For consumers to identify the healthiest food, the FOPNL must draw their attention and allow correct, easy, and quick identification of the high content of critical nutrients present in a given product.¹⁵ Although we did not measure the same result, our findings reinforce those of a previous study, in which the time the consumer took to identify the product with a high content of critical nutrients was significantly longer with the nutritional traffic light than the octagon.⁷ On the other hand, we did not observe any significant differences between the high-content models, unlike the findings of another previous study which found that the time to identify the product with a high content of critical nutrients was significantly shorter with the presence of the triangle and the octagon than the circle, black magnifying glass, red magnifying glass, and nutritional traffic lights.⁵

After drawing attention, allowing the correct identification of the high content of critical nutrients in a product and facilitating the choice of the healthiest food, the presence of FOPNL can generate responses such as discouraging the purchase of ultra-processed foods.¹⁵ A study conducted in Chile, a year after of implementation of a FOPNL and other measures, including restricting food advertising aimed at children and banning the sale of foods with FOPNL in schools, indicated a 23.7% reduction in the volume of purchases of beverages with high calorie and sugar content.¹⁶

Previous studies indicate the need to implement measures to reduce the consumption of ultra-processed foods, as carried out in Chile. Among these, the following measures stand out: the adoption of

taxes to increase the price of ultra-processed foods and beverages; subsidies to reduce the price of fresh and minimally processed foods; restriction on food advertising; and ban the sale of ultra-processed foods in schools.^{15,17,18}

Our findings reinforce that the FOPNL is an important measure to facilitate the choice of healthy foods, especially considering the cheaper price¹⁹ and increased consumption of ultra-processed foods,²⁰ with a high content of critical nutrients, as well as the increased price of fresh and minimally processed foods,²¹ such as rice, beans, fruits, and vegetables, and the worsening of social inequalities and hunger in Brazil.²²

A limitation of the study is that the participants only saw the image on the front of the products. There was no list of ingredients or nutritional information to compare the products of each pair. Therefore, small differences between the images may have influenced the choices, as these were the only resource available to facilitate participants choosing between the products. Furthermore, time is related to the participant's mental processing and attention; thus, independently measuring attention and information processing would be ideal.

Another limitation is the sample size and composition. This restricted sample included individuals with higher levels of education, which limits the extrapolation of the findings to other audiences. However, the findings related to traffic lights could be even worse in a population with less education.²³ Future studies should explore why the participants made their choices, as well as the interpretation of different models, as these aspects were not evaluated in this study.

In conclusion, the performance for both correct answers and choice time was similar between the magnifying glass, octagon, circle, and triangle FOPNL models; however, the traffic light resulted in fewer hits and longer decision time. Thus, the use of the FOPNL, regardless of the model, seems to be a valid strategy to support the consumer to make healthier food choices, with the traffic light being the FOPNL model with the worst performance.

Finally, considering that some studies suggest the superiority of the octagon and triangle over the magnifying glass, which was approved by ANVISA, future studies should evaluate the effect of these FOPNL models in discouraging the purchase of foods with a high content of critical nutrients, to support the implementation and improvement of the FOPNL in Brazil.^{5,14}

REFERENCES

1. Machín L, Aschemann-Witzel J, Curutchet MR, Giménez A, Ares G. Does front-of-pack nutrition information improve consumer ability to make healthful choices? Performance of warnings and the traffic light system in a simulated shopping experiment. *Appetite*. 2018; 121(1):55-62.
2. Becker MW, Bello NM, Sundar RP, Peltier C, Bix L. Front of pack labels enhance attention to nutrition information in novel and commercial brands. *Food policy*. 2015; 56: 76-86.
3. Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. Diretoria Colegiada. Resolução de Diretoria Colegiada RDC nº 429, de 8 de outubro de 2020. Dispõe sobre a rotulagem nutricional dos alimentos embalados. *Diário Oficial da União*, 09/10/2020, Edição: 195, Seção: 1, Página: 106.
4. Brasil. Agência Nacional de Vigilância Sanitária. Gerência-Geral de Alimentos. Relatório de Análise de Impacto Regulatório sobre Rotulagem Nutricional. Brasília: ANVISA, 2018.
5. Deliza R, de Alcántara M, Pereira R, Ares G. How do different warning signs compare with the guideline daily amount and traffic-light system? *Food Quality and Preference*. 2020; 80.
6. Health Canada. Consumer research on front of package nutrition labeling. Montréal: Léger; 2018.

7. Arrúa, A., Machín, L., Curutchet, M. R., Martínez, J., Antúnez, L., Alcaire, F., Giménez, A., & Ares, G. "Warnings as a directive front-of-pack nutrition labelling scheme: comparison with the Guideline Daily Amount and traffic-light systems." *Public health nutrition* vol. 20,13 (2017): 2308-2317.
8. Khandpur N, et al; Nutrient-Based Warning Labels May Help in the Pursuit of Healthy Diets. *Obesity Society*. 2018 nov; 26(11):1670-1671.
9. Pan American Health Organization. Superior Efficacy of Front-of-Package Warning Labels in Jamaica. 2011.
10. Ares G, et al. Attentional capture and understanding of nutrition labelling: a study based on response times. *J Food Sciences and Nutrition*. 2012 set; 63(6): 679-688.
11. IBGE - Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009: Avaliação nutricional da disponibilidade domiciliar de alimentos no Brasil. Rio de Janeiro; 2011.
12. Ares G, Aschemann-Witzel J, Curutchet MR, Antúnez L, Machín L, Vidal L, et al. Product reformulation in the context of nutritional warning labels: Exploration of consumer preferences towards food concepts in three food categories. *Food Res Int*. 2018; 107: 669-674.
13. Helfer P, Shultz TR. The effects of nutrition labeling on consumer food choice: a psychological experiment and computational model. *Ann NY Acad Sci*. 2014; 1331: 174-85.
14. Khandpur N, Mais LA, Sato PM, Martins APB, Spinillo CG, Rojas CFU, et al. Choosing a front-of-package warning label for Brazil: A randomized, controlled comparison of three different label designs. *Food Res Int*. 2019; 121(1): 854-861.
15. Taillie, LS.; Hall, MG.; Popkin, BM.; Ng, SW.; Murukutla, N. Experimental Studies of Front-of-Package Nutrient Warning Labels on Sugar-Sweetened Beverages and Ultra-Processed Foods: A Scoping Review. *Nutrients*. 2020; 12(2):569
16. Taillie, LS., Hall, MG., Popkin, BM., Ng, SW., Murukutla, N. (2020). Experimental Studies of Front-of-Package Nutrient Warning Labels on Sugar-Sweetened Beverages and Ultra-Processed Foods: A Scoping Review. *Nutrients*, 12(2), 569.
17. Mahesh, R., Vandevijvere, S., Dominick, C., Swinburn, B. Relative contributions of recommended food environment policies to improve population nutrition: results from a Delphi study with international food policy experts. *Public health nutrition*, 21(11), (2018): 2142–2148.
18. Roberts, S., Pilard, L., Chen, J., Hirst, J., Rutter, H., Greenhalgh, T. Efficacy of population-wide diabetes and obesity prevention programs: An overview of systematic reviews on proximal, intermediate, and distal outcomes and a meta-analysis of impact on BMI. *Obesity reviews: an official journal of the International Association for the Study of Obesity* vol. 20,7 (2019): 947-963.
19. Maia EG., dos Passos CM., Levy RB., Bortoletto Martins AP., Mais LA., Claro RM. What to expect from the price of healthy and unhealthy foods over time? The case from Brazil. *Public Health Nutrition*. Cambridge University Press; 2020;23 (4):579–88.
20. IBGE - Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2017-2018: Avaliação nutricional da disponibilidade domiciliar de alimentos no Brasil. Rio de Janeiro; 2020.
21. Baccarin, JG. e Oliveira, JA. Inflação de alimentos no Brasil em período da pandemia da Covid 19, continuidade e mudanças. *Segur. Aliment. Nutr.* 28(00) (mar. 2021), e021002.
22. Rede PENSSAN. Insegurança alimentar e Covid-19 no Brasil – VIGISAN – Inquérito Nacional sobre Insegurança Alimentar no Contexto da Pandemia da Covid-19 no Brasil. 2021.
23. Grunert KG, Wills JM, Fernández-Celemín L. Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK. *Appetite*. 2010; 55(2):177-89.

Contributors

Polari AS analyzed and interpreted the data and wrote the article; Bandeira L and Pedroso J critically reviewed the intellectual content; Gubert MB participated in the conception and project, the writing of the article, and the relevant critical review of the intellectual content; Toral N participated in the conception and design, data analysis and

interpretation, article writing, and the relevant critical review of the intellectual content. The authors declare that they have approved the final version and that they are responsible for all aspects of the work guaranteeing the accuracy and integrity of throughout the work.

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