

**Health-related cues on the packages of processed and ultra-processed products: prevalence and policy implications**

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## Abstract

The information included on food packages has a crucial role in influencing consumer product associations and purchase decisions. In particular, visual and textual cues on processed and ultra-processed products can convey health-related associations that influence consumer healthiness perception and purchase decisions. In this context, the present work aimed to explore the use of health-related cues on the packages of processed and ultra-processed products sold in Uruguay to provide insights for policy making. A total of 3813 products from 34 different food categories found in four of the most important supermarket chains in Uruguay were surveyed. The textual and visual information included on the packages as well as the nutritional composition of the products were analyzed. Results showed that 67% of the products included at least one health-related cue. Pictures of culinary ingredients, natural and minimally processed foods were the most frequent health-related cue, followed by references to naturalness and claims related to critical nutrients. The prevalence of health-related cues largely differed across product categories, ranging from 100% to 17%. The relationship between the presence of health-related cues on the packages and the excessive content of nutrients associated with non-communicable diseases was assessed using a gradient boosting model, which showed limited predictive ability. This suggests that the inclusion of health-related cues on food packages was not strongly related to the nutritional composition of products and therefore cannot be regarded as a healthiness indicator. These results stress the need of develop stricter labeling regulations to protect consumers from misleading information.

**Keywords:** *packaging; labeling; marketing; nutrition claims; health claims; health-related cues.*

## 1. Introduction

The role of food packaging in the current food system exceeds its original and basic functions related to containment, protection, and convenience<sup>(1)</sup>. According to CODEX Alimentarius, food packages should compulsorily include the following information: name of the food, list of ingredients, net content, name and address of the manufacturer, packer, distributor, importer, exporter or vendor, country of origin, lot identification, instructions for use when applicable, compulsory nutritional information and irradiated foods declaration<sup>(2)</sup>.

Apart from compulsory information, food companies voluntarily include information to advertise products, set them apart from their competitors, attract consumers' attention, shape product associations and influence purchase decisions<sup>(3)</sup>. Particularly, a wide range of textual and visual cues on food packages are included to raise health-related associations and convey the idea that products are healthful<sup>(4,5)</sup>. Health claims are one of the most frequently included health-related cues. They can be defined as '*any representation that states, suggests, or implies that a relationship exists between a food or a constituent of that food and health*'<sup>(6)</sup>. These claims include nutrient function claims, other function claims and reduction of disease risk claims<sup>(6)</sup>. These claims are regulated in most countries to ensure that only substantiated claims are included on food packages<sup>(5,7)</sup>.

In addition, research has shown that food companies also include other type of claims, known as nutrition marketing claims, at their own discretion, regardless of the nutritional composition of products<sup>(4,8)</sup>. Such claims include those related to nutrient content (e.g., 'contains omega 9') or specific ingredients (e.g., 'without preservatives', 'with natural probiotics')<sup>(4,7,8)</sup>. Other studies have shown that package design features (e.g., drawings, typography, colors) can also convey health-related associations<sup>(9-14)</sup>. Images have been reported to be more influential than textual information due to their higher saliency and lower requirement of cognitive resources, as well as their ability to create more vivid associations<sup>(15,16)</sup>.

There is evidence suggesting health-related cues can generate misperceptions about the nutritional quality of products, making them appear healthier than they actually are<sup>(17)</sup>. Several studies have reported that the inclusion of nutrient claims, nutrition marketing claims, images of natural foods (e.g., fruits, vegetables or grains), references to home-made foods on food packages, as well as green color, increase consumer perceived healthfulness as well as consumer purchase intention<sup>(3,18-24)</sup>. The inclusion of health-related cues on the packages of processed and ultra-processed products with excessive content of nutrients associated with

non-communicable diseases (NCDs) has stressed the need to develop stricter packaging regulations<sup>(3,4,18,25)</sup>.

Uruguay is a high-income country with one of the highest rates of overweight and obesity in all age groups in South America: 65% among adults, 39% among school-aged children and 12% among children aged 0-4 years<sup>(26)</sup>. Consumption of processed and ultra-processed products with excessive content of sugar, fat and sodium has been identified as one of the primary causes of malnutrition<sup>(27)</sup>. According to a report published by the Pan American Health Organization, Uruguay showed the largest increase in the sales of ultra-processed products in Latin America between 2000 and 2013 (146%)<sup>(28)</sup>. Local regulations establish that food packages should include the following information in Spanish (the official language): list of ingredients, nutrient declarations, country of origin, expiration date, net weight, the full name and address of the manufacturer and importer, and preparation instructions (if needed)<sup>(29)</sup>. In addition, from February 2021 products with added sugars, fat, and/or sodium that exceed pre-established limits for sugars, fat, saturated fat and sodium should include black octagonal warning labels on the front of the package<sup>(30)</sup>. The inclusion of nutrition and health claims is regulated to assure that substantiated benefits of the products are highlighted by manufacturers<sup>(29)</sup>. However, no regulations have been introduced on other health-related cues or on the type of products that can carry nutrition and health claims.

In this context, the present research aimed to explore: (i) the use of health-related cues on the packages of processed and ultra-processed products sold in the Uruguayan marketplace, and (ii) the relationship between such cues and the nutritional composition of the products. Results are expected to contribute to an in-depth understanding of the strategies used by food companies to communicate the concept of health on packages to inform the development of public policies aimed at protecting consumers' right to information and health.

## **2. Methods**

### **2.1. Sampling**

Four supermarkets corresponding to the four most important chains in terms of market share and number of units in the country were chosen as sites of data collection<sup>(31)</sup>. These supermarkets were located in two cities: Montevideo, the capital city of Uruguay (1.318.755 inhabitants), and Maldonado (62.590 inhabitants).

## 2.2. Data collection

The survey took place between November and December 2020, with the participation of five data collectors. Focus was placed on processed and ultra-processed products, defined according to the NOVA food classification system as products added with sugars, fat and/or sodium<sup>(32)</sup>. The following 34 categories were considered: *alfajor* (traditional Uruguayan product which consist in a sweet cookie sandwich filled with a layer of *dulce de leche* - a traditional type of sweetened condensed milk- usually covered with chocolate or meringue), breakfast cereals and granola, canned food, cereals bars, cheese, chocolate and candies, cookies, dairy desserts, dressings and condiments, frozen foods (this category includes all frozen foods like ready-to-eat dishes, hamburgers, nuggets, pasta, fried potatoes, etc. with the exception of ice cream, desserts, vegetables or fruits), ice cream and popsicles, instant soups and bouillon, jams, juices, nuts and seeds, packaged dry or fresh pasta, plant-based milks, powder mix to prepare desserts and cakes, powdered drinks, salty baked goods, sausages and cold cuts, savory crackers, savory snacks, soft drinks, sweet baked goods, yogurt, doughs, cakes, tomato puree and sauces, coffee and cocoa, beverages, flavored rice and instant puree, butter and margarine and flavored milk.

Within each product category, all the available products were surveyed. Data from each product were collected using a cellphone app specially developed for this survey which scanned the barcode of products and registered 3 photographs: front of package, nutrition declaration and ingredient list (both compulsorily included on food packages according to Uruguayan legislation). A short training of data collectors was performed to ensure the standardization of data collection procedures. The information was available during the survey in an online database. If the same product was available in more than one supermarket, it was included only once in the database.

For all products included in the sample, the product name, company name, brand name, net weight, ingredients, nutrition information as well as portion size, were exported manually from the photographs in the web-base to a spreadsheet by three of the researchers. The consistency of the database was checked by checking the recorded information of 5% of the labels.

## 2.3. Data analysis

In order to organize the information, data analysis started by classifying the products scanned into the 34 categories considered. Products were considered unique if they differed in at least one of the following product characteristics: bar code, product name, company

name, brand name, and net weight. From the nutrition information of each product, the content of energy, protein, total fat, saturated fat, carbohydrates, sugar, fiber and sodium were calculated per 100 grams or milliliters of product. Considering that the sugar content of products should not be compulsorily informed on the labels of food products in Uruguay, it was estimated using the algorithm developed by Scapin et al.<sup>(33)</sup>. This algorithm establishes a series of criteria to estimate the added sugar content based on the information provided on the label of the product or similar products.

All the information included on the front-of-packages was manually coded using content analysis based on deductive-inductive coding<sup>(34)</sup>. Three coders with previous experience in content analysis independently coded the data. First, the following nine dimensions of health-related cues were deductively selected based on previous studies identifying visual and textual packaging cues associated with food healthiness: green color, food pictures, references to naturalness, critical nutrient claims, other nutrition claims, nutrition marketing claims, ingredient claims, endorsement from non-governmental organizations (NGOs) and references to tradition/homemade<sup>(9,12,35,36)</sup>. A description of each dimension and examples are shown in Table 1. an inductive approach was used to identify categories within each of the dimensions. The coders identified the categories as they emerged when examining the food labels. Binary variables were created for each of the categories denoting whether each of the labels contain elements related to the category or not (0/1). After the three coders independently coded the data, a meeting was held to define the final categories were established by consensus. Examples of the visual and textual images included in each category are shown in Table 3. The analysis was performed in Spanish and dimensions, categories, as well as examples were translated into English for publication.

The number of products that included elements in the front of package label within each category was determined. The chi-square test was used to compare the frequency of inclusion of elements within the categories of each of the dimensions across product categories. Additionally, correspondence analysis was used to obtain a simplified graphical representation of the association between product categories and health-related cues dimensions. This analysis provided a bi-dimensional representation of the similarities and differences between categories and dimensions.

In order to explore the relationship between the use of health-related cues on food packages and the nutritional composition of products, the content of sugar, fat, saturated fat and sodium of each product was classified into excessive or not according to the nutrient profile model underlying the Uruguayan front-of-package nutrition labeling regulation, which

was not in force at the time of the study<sup>(30)</sup>. With that aim, the following thresholds were considered for excessive content of nutrients for products with added sugar, fat and/or sodium: Excess of sugar ( $>3\text{g}/100\text{g}$  and calories from sugar  $> 20\%$ ), Excess of fat (calories from fat  $> 35\%$ ), Excess of saturated fat (calories from saturated fat  $> 12\%$ ), Excess of sodium ( $>500\text{ mg}/100\text{ g}$  or sodium/calories  $> 8\text{ mg/Kcal}$ )<sup>(30)</sup>.

Then, a new variable ( $y$ ) indicating whether each product from the database was excessive in at least one of the critical nutrients associated with NCDs ( $y = 0$ ) or not ( $y = 1$ ) was created. A gradient boosting model (GBM) was built to explore the association of the dimensions of health-related cues identified in the packages on the new variable  $y$ <sup>(37)</sup>. GBMs are supervised machine learning models based on the combination of several decision trees, which enable to predict a response variable from several categorical and/or continuous explanatory variables. They are able to model both linear and non-linear responses, which make them suitable to explore complex processes, and are not affected by the inclusion of irrelevant predictor variables<sup>(37)</sup>.

The analysis involved two main steps: optimization and fitting. For this purpose, the dataset was randomly split into a training (75%,  $n=2861$ ) and a test set (25%,  $n=952$ ). A stratified partition was used to guarantee that both the training and the test sets had the same proportion of positive ( $y = 1$ ) and negative ( $y = 0$ ) cases as in the complete database. Using the training set a set of hyper-parameters was optimized to improve the GBM model's predictive performance while avoiding overfitting to the training data, as in most machine learning methods<sup>(37, 38)</sup>. For this purpose, the following hyper-parameters were systematically varied for model optimization: number of trees (total number of trees to fit in the model ;  $nt = \{30, 60, 90, 120, \dots, 6000\}$ ), learning rate (accounts for the contribution of each tree to the model;  $lr = \{0.001, 0.005, 0.01, 0.05\}$ ), tree complexity (accounts for the model complexity in terms of the maximum interaction between predictive variables allowed;  $tc = \{1, 2, 3, 5, 9\}$ ) and the minimum number of observations in the terminal nodes the trees ( $nmon = \{5, 10\}$ ). Several GBM models were fitted using the training set through a cross-validation approach considering the area under the receiver operating characteristic curve (AUC) as the metric indicating the predictive performance of the models. AUC ranges from 0.5 to 1, being 1 a perfect prediction while 0.5 means random performance<sup>(39)</sup>. The best combination of hyper-parameters was the one that provided the largest cross-validation AUC value. After setting the hyper-parameters, the training set was used to fit the final model and its quality of the model was assessed using the AUC value. In order to interpret the final GBM model, variable importance (i.e. the contribution of each explanatory variable to the prediction of the



response variable) and partial dependence plots (i.e. dependence of the response on a set of explanatory variables after accounting for the average effect of the rest of the predictor variables included in the model) were used<sup>(37, 38)</sup>. A model-agnostic permutation method was used to compute variable importance of each explanatory variable<sup>(40)</sup> and the relative contribution of each variable to the model was obtained by scaling the variable importances to sum up to 100.

All data analyses were carried out using R statistical software version 4.1.0<sup>(41)</sup>. FactoMineR was used to run the correspondence analysis<sup>(42)</sup>. Packages gbm<sup>(43)</sup> and caret<sup>(44)</sup> were used to build the models and select the hyper-parameters. Package vivid<sup>(45)</sup> was used to compute and visualize variable importance and partial dependence plots for the final GBM model.

### 3. Results

A total of 3813 unique products were surveyed across the 34 product categories (Table 2). Chocolate and candies was the category with the largest number of products (n=438; 11.5 %), followed by cookies (n=330; 8.7%), frozen foods (n=237; 6.2%), canned foods (n=216; 5.7%) and savory crackers (n=195; 5.11%).

#### 3.1. Health related cues on food packages

Results showed that 2547 products presented at least one health-related cue on the package (67% of all the surveyed products). Table 3 shows the percentage of products featuring elements within the categories and dimensions identified in the deductive-inductive coding.

Food pictures, involving culinary ingredients, natural and minimally processed foods, were the most frequent health-related cues, being identified in 39% of the packages. Within this dimension, pictures of fruits and vegetables were the most prevalent, accounting for 17.1% and 14.9% of the packages, respectively. References to naturalness were found in 23% of the products. In particular, botany elements (e.g., grass, flowers or leaves) were the most frequent within this dimension (12.5%). Another common reference to nature and healthfulness was the use of green color on the packages. This strategy was found on 13% of the packages.

Nutrient claims were also frequently found on food packages (Table 3). Claims related to critical nutrients were identified in 16% of the products. Within this dimension, claims referring to the absence of sugar (e.g. '0% sugar') and the absence of trans-fat (e.g.



‘0% trans-fat’) were the most prevalent, followed by claims related to reduced calorie and fat content (Table 3). In addition, claims related to other non-critical nutrients were found in 9% of the products and were mainly related to the content of vitamins or fiber presence as well as the absence of cholesterol.

Nutrition marketing claims were found in 12% of the products. Most of the claims were related to the absence of gluten in products (e.g., ‘gluten free’), followed by references to calorie content (e.g., ‘only 30 Kcal per toast’), explicit references to health (e.g., ‘healthy eating’), probiotics (e.g., ‘probiotics added’) and health-related brand names or slogans (e.g., ‘simply good’) (Table 3). Ingredient claims were found in 11% of the packages. This dimension was mainly composed of claims related to the absence of food preservatives (6.3% of products) followed by references to specific ingredients (e.g. ‘100% fruit juice’) or the absence of colorings (e.g., ‘No artificial color’).

The last two types of health-related cues were endorsement from non-governmental organizations (e.g., ‘ACELU logo’- the Spanish acronym for the Uruguayan Celiac Association-), found on 8% of products, and references to tradition/homemade (e.g., ‘traditional’, ‘homemade’), which appeared on 7% of the products (Table 3).

### 3.2. Prevalence of health-related cues per product category

As shown in Figure 1, the prevalence of health-related cues largely differed across product categories, ranging from 100% to 17%. In particular, all products within the categories beverages, flavored rice and instant puree, powdered drinks, and plant-based milks included at least one health-related cue on front of package. Additionally, there were other product categories where the great majority of products featured health-related cues: juices (98.7%), yogurt (96.3%), tomato puree and sauces (96.3%), instant soups and bouillon (95.7%), salty baked goods (93.4%), breakfast cereals and granola (91.7%), and jams (91.7%). On the other hand, the food categories cakes (16.7%), *alfajor* (23.5%), sweet baked goods (37.4%), and ice cream and popsicles (38.0%) showed the lowest percentage of products featuring health-related claims. The percentage of products featuring health-related cues within each of the dimensions identified in the deductive-inductive coding is shown in Table S1 in the Supplementary material.

Results from the chi-square test showed a significant association between product categories and the inclusion of the different types of health-related cues ( $\chi^2 = 1889.2$ ,  $p < 0.001$ ). Correspondence analysis (CA) was used to visualize the relationship between

product categories and the 9 dimensions of health-related cues identified in the content analysis (Figure 2). The first and second dimension of the CA explained 53.6% of the inertia of the experimental data and showed an association between the inclusion of endorsements from non-governmental organizations and several product categories: sausages and cold cuts, dairy desserts, flavored milk, powder mix to prepare desserts and cakes, and butter and margarine. Additionally, these two dimensions also showed an association between categories such as savory crackers, salty baked goods and powdered drinks and the health-related cues critical nutrient claims and other nutrient claims.

The third and fourth dimensions of the correspondence analysis also showed associations between some types of health-related cues and specific product categories (Figure 2). The use of green color was more prevalent for products within the instant soups and bouillon cubes category. In addition, references to tradition and homemade were associated with the categories *alfajor*, sausages and cold cuts, salty baked goods and doughs.

### 3.3. Association of health-related cues with product nutrition composition

Seventy-six percent of the products in the database had excessive content of at least one critical nutrient according to the nutrient profile model underlying the Uruguayan front-of-package regulation. Results showed that 45% of products had excessive content of sugar, 32% excessive content of fat, 31% excessive content of saturated fat, while 23% showed excess of sodium.

The association of health-related cues on product packages with product nutrition composition was explored using a GBM model. A variable indicating whether each product was excessive in at least one of the critical nutrients associated with NCDs ( $y = 0$ ) or not ( $y = 1$ ) was used as the response for the model. The set of hyper-parameters that yielded the best cross-validation predictive performance was  $nt = 5040$ ,  $lr = 0.001$ ,  $tc = 9$  and  $nmon = 10$ . The final model presented an AUC computed on the independent test dataset of 0.702, meaning that its ability to predict if the products did not have excess of any of the critical nutrients associated with NCDs or not was limited. In fact, from the observations in the test set that were predicted as not excessive in any of the critical nutrients ( $\hat{y} = 1$ ) only 20.6% were correct.

The relative variable importance of all the explanatory variables in the final model was computed. Critical nutrient claims were the health-related cues with the greatest importance for predicting if products did not have excessive content of any of the critical nutrients, followed by references to naturalness. The relative variable importance of these

variables were 28.3% and 20.1%, respectively. The partial dependence plots showed that the presence of both health-related cues increased the likelihood of not having excessive content of any of the critical nutrients associated with NCDs (not shown). The relative importance of the dimensions green color, food pictures, ingredient claims and nutrition marketing claims ranged between 13.1% and 7.6%, while the remaining three dimensions (endorsement from non-governmental organizations, other nutrition claims and references to tradition/homemade) presented relative variable importance of less than 5%.

#### 4. Discussion

The information included on food packages has a crucial role in influencing consumer associations and purchase decisions<sup>(3)</sup>. In this context, the present work aimed at providing insights for policy making by exploring the use of health-related cues on the packages of processed and ultra-processed products sold in the Uruguayan marketplace. Results showed that these cues were frequently included on the food packages, in agreement with results reported by Christoforou et al.<sup>(4)</sup> when analyzing the packages of products commercialized in Canada.

The highest prevalence of health-related cues was found on beverages, flavored rice and instant puree, powdered drinks, and plant-based milks, followed by juices, yogurts, tomato puree and sauces, instant soups and bouillon, salty baked goods, breakfast cereals and granola and jams. Within these categories, most products were ultra-processed products with excessive content of nutrients related to NCDs. Considering that these products are not recommended as part of a healthy diet by the Uruguayan dietary guidelines<sup>(27)</sup>, stricter labeling regulations for processed and ultra-processed products with excessive content of nutrients associated with NCDs are needed.

Food pictures, mostly depicting fruits and vegetables, was the most prevalent health-related cue. This kind of visual cue has been reported to increase healthfulness perception and purchase intention<sup>(46-49)</sup>. Results from the present work showed that pictures of fruit and vegetables were frequently included on food packages even if they only included flavorings. The analysis of the list of ingredients of products featuring pictures of fruits revealed that 25% of these products did not include any fruit as ingredient but fruit flavorings, 38% of the products featuring a picture of vegetables did not include any vegetable as ingredient. This result is particularly relevant considering that most labeling regulations worldwide, including Uruguayan food packaging regulations, do not include specific requirements on the quantity of natural ingredients a product should contain to include pictures on the label<sup>(50)</sup>. In recent

years some labeling regulations have changed in order to protect consumers from deceptive information<sup>(51,52)</sup>. For example, according to the European Quantitative Ingredient Declarations, when labels include a text or picture of an ingredient, the quantity of that ingredient should be declared in the list of ingredients<sup>(53)</sup>. Although this regulation can provide consumers information about the quantity of the ingredients, it does not take into account the fact that consumers do not make an in-depth processing of the information included on the labels and rarely read the back-of-package at the point-of-purchase<sup>(54)</sup>. In this sense, in 2019 the Academy of Nutrition and Dietetics recommended to the Food and Drug Administration to introduce regulations on the inclusion of images of healthy ingredients on the labels of products that contain insignificant amount of such ingredients as part of its Nutrition Innovation Strategy<sup>(55)</sup>.

Results also showed the frequent inclusion of health-related cues related to production methods, such as references to naturalness, home-made and traditional foods on the packages of processed and ultra-processed products. In particular, the highest prevalence of references to naturalness was found on product categories containing ingredients derived from fruits, vegetables and grains (e.g., jams, juices, plant-based beverages, powdered drinks and yogurt). Meanwhile, salty baked goods, savory crackers, juices and dressings and condiments were the categories with the highest prevalence of references to traditional and homemade foods. Similarly, Machado et al.<sup>(56)</sup> reported the frequent inclusion of terms such as "homemade" and "traditional" on the packages of processed products commercialized in the Brazilian marketplace. The inclusion of images and words related to small-scale or domestic production has also been reported in the European marketplace<sup>(50)</sup>. The inclusion of these cues can be related to new public health recommendations related to the consumption of natural and minimally processed foods and homemade culinary preparations<sup>(27,57)</sup>. A recent research by Devia et al.<sup>(18)</sup> showed that the inclusion of references to home-made and images of natural foods on the labels of ultra-processed products can increase perceived healthfulness and purchase intention. This stresses the need to introduce changes in local and international labeling regulations to ensure that visual and textual information on food labels do not mislead consumers about the nature, composition, or production method of processed food products. In this sense, although the European Food Information to Consumers refers to the inclusion of misleading information, only a few countries have introduced specific regulations about the inclusion of references to nature and homemade production<sup>(50,58)</sup>.

Food packages frequently included regulated nutrient claims: 16% included nutrient claims related to critical nutrients, whereas 9% included nutrient claims related to other

nutrients (e.g., vitamins, fiber, minerals). Similar results have been reported by Hieke et al.<sup>(7)</sup> and Schermel et al.<sup>(8)</sup> for products commercialized in five European countries and Canada, respectively. In the present work, nutrient claims related to fat content (trans fat, total fat, and saturated fat) were the most frequent, followed by nutrient claims related to sugar. The relevance of claims related to fat is consistent with the emphasis given for decades to fat as dietary cause of coronary heart disease<sup>(59)</sup>. Despite the emphasis on reducing sugar and sodium intake in the Uruguayan dietary guidelines<sup>(27)</sup>, claims related to these nutrients were only found in a small proportion of products. In addition, disease risk reduction claims were not found despite the great attention given by the food industry to these claims<sup>(60)</sup>. Similar results have been reported in Europe and Canada<sup>(7, 8)</sup>. Regarding Uruguay, some years before, Giménez et al.<sup>(61)</sup>, showed similar results when focused on products targeted at children. The low prevalence of disease risk reduction claims can be related to the strong scientific evidence needed to substantiate them<sup>(62, 63)</sup>.

Apart from regulated claims, 12% of the packages included nutrition marketing claims, including references to calorie content, explicit references to health, energy, or hydration, as well as endorsements from NGOs. These claims have also been shown to influence consumer healthiness perception<sup>(19)</sup>, which can increase purchase and consumption intention.

The exploration of the relationship between the inclusion of health-related cues on food packages and nutritional composition using GBM provided a model with limited predictive ability. This suggests that health-related cues are not a good predictor of the nutritional quality of processed and ultra-processed products across categories, stressing the need for stricter labeling regulations. Similarly, Maschkowski et al.<sup>(64)</sup> showed that the presence of health and/or nutrition claims did not have a significant effect on the nutrient profile of highly processed ready-to-eat cereals.

Among the different cues included in the model, critical nutrient claims had the greatest importance for predicting if products did not have excessive content of any of the critical nutrients according to the Uruguayan front-of-package regulation. This matches expectations as nutrient content claims are regulated in Uruguay<sup>(65)</sup>. However, it is worth noting that these claims were also available on products with excessive content of nutrients related to NCDs. In a previous study, Duran et al.<sup>(36)</sup> reported that products with high content of critical nutrients showed nutrition claims more frequently than products with low content of critical nutrients. Taken together, results from the present work and previous studies suggest the need to introduce restrictions on the use of nutrient claims according to the

nutritional composition of products, as currently done in several countries across the globe, including Argentina, Mexico, Australia and New Zealand<sup>(50,66-69)</sup>.

In summary, results from present work stress the need for stricter labelling regulations for processed and ultra-processed foods with excessive content of nutrients associated with non-communicable diseases. Regulations should consider limiting the use visual and textual elements that convey positive health-related associations, such as references to natural foods like fruits or green color, not regulated nutrition claims, nutrition marketing claims, references to homemade production or tradition, as well as any other element than can increase perceived healthfulness.

## **5. Strengths and limitations of the study**

The present research provided a comprehensive overview of the prevalence of a wide range of health-related cues on the packages of processed and ultra-processed products. Results extend the existing literature on the prevalence of health and nutrition claims (e.g., Hieke et al.; Schermel et al.)<sup>(7,8)</sup> and references to homemade and traditional on food packages<sup>(56)</sup>. Although this research evaluated a large number of products commercialized in the Uruguayan marketplace, some limitations must be considered. First of all, results only refer to the products commercialized in the Uruguayan marketplace. Secondly, although all processed and ultra-processed products sold in 4 of the largest supermarket chains in the country were surveyed, data collection was limited to Montevideo and Maldonado, and thus may not be completely representative of all products commercialized in the country. However, it should be noted that food products are relatively standardized across the Uruguayan marketplace. Finally, the influence of health-related cues on consumer perceived healthiness and purchase intention was not assessed. Albeit extensive research on the influence of claims on consumer perception has been conducted<sup>(70)</sup>, experimental evidence on the influence of other cues, such as images and references to homemade, is still scarce. Future studies should address this research gap to identify priorities for policy making.

## **6. Conclusion**

Health-related cues are widely used as a marketing strategy on processed and ultra-processed products commercialized in the Uruguayan marketplace, regardless of their nutritional composition. Although the inclusion of some cues is regulated worldwide, these results stress the need for stricter labeling regulations to protect consumers from misleading

information and encourage healthy eating habits. The experience of anti-tobacco policies should serve as example for policy making.

## 7. CRediT authorship contribution statement

**Florencia Alcaire:** Conceptualization, Methodology, Data curation, Formal analysis, Writing - original draft, Writing - review & editing; **Leticia Vidal:** Conceptualization, Methodology, Data curation, Formal analysis, Writing - original draft, Writing - review & editing. **Leandro Machín:** Methodology, Formal analysis, Writing - review & editing; **Lucía Antúnez:** Conceptualization, Methodology, Writing - review & editing; **Ana Giménez:** Conceptualization, Methodology, Writing - review & editing; **María Rosa Curutchet:** Conceptualization, Writing - review & editing; **Gastón Ares:** Conceptualization, Methodology, Data curation, Formal analysis, Writing - original draft, Writing - review & editing.

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## 9. Declaration of competing interest

The authors declare no conflict of interest.



## 10. References

1. Pal, M., Devrani, M., & Hadush, A. (2019). Recent developments in food packaging technologies. *Bev Food World*, 46, 21-25.
2. Codex Alimentarius. (2018). General standard for the labeling of prepackaged foods - CXS 1-1985. Rome: FAO. Available at: <https://www.fao.org/fao-who-codexalimentarius/codex-texts/list-standards/es/> (Last accessed 29<sup>th</sup> December, 2021).
3. Ares, G., Velázquez, A.L., Vidal, L. et al. (2022). The role of food packaging on children's diet: Insights for the design of comprehensive regulations to encourage healthier eating habits in childhood and beyond. *Food Qual Prefer*, 95, 104366.
4. Christoforou, A., Dachner, N., Mendelson, R. et al. (2018). Front-of-package nutrition references are positively associated with food processing. *Public Health Nutr*, 21, 58–67.
5. van Buul, J.V., & Brouns, F. J. (2015). Nutrition and health claims as marketing tools. *Crit Rev Food Sci Nutr*, 55(11), 1552-1560.
6. Codex Alimentarius. (2004). Codex guideline for use of nutrition and health claims - CAC/GL 23-1997. Rome: FAO. Available at: <http://www.fao.org/ag/humannutrition/32443-04352e8311b857c57caf5ffc4c5c4a4cd.pdf> (Last accessed 27<sup>th</sup> December, 2021).
7. Hieke, S., Kuljanic, N., Pravst, I. et al. (2016). Prevalence of nutrition and health-related claims on pre-packaged foods: A five country study in Europe. *Nutrients*, 8(3), 137.
8. Schermel, A., Emrich, T. E., Arcand, J. et al. (2013). Nutrition marketing on processed food packages in Canada: 2010 food label information program. *Appl Physiol Nutr Metab*, 38(6), 666–672
9. Ares, G., Piqueras-Fiszman, B., Varela, P. et al. (2011). Food labels: Do consumers perceive what semiotics want to convey?. *Food Qual Prefer*, 22, 689-698.
10. Carrillo, E., Fiszman, S., Lähteenmäki, L. et al. (2014). Consumers' perception of symbols and health claims as health-related label messages. A cross-cultural study. *Food Res Int*, 62, 653-661.
11. Hieke, S., Kuljanic, N., Wills, J. M., et al. (2015). The role of health-related claims and health-related symbols in consumer behaviour: Design and conceptual framework of the CLYMBOL project and initial results. *Nutr Bull*, 40(1), 66-72.
12. Karnal, N., Machiels, C. J., Orth, U. R. et al. (2016). Healthy by design, but only when in focus: Communicating non-verbal health cues through symbolic meaning in packaging. *Food Qual Prefer*, 52, 106-119.

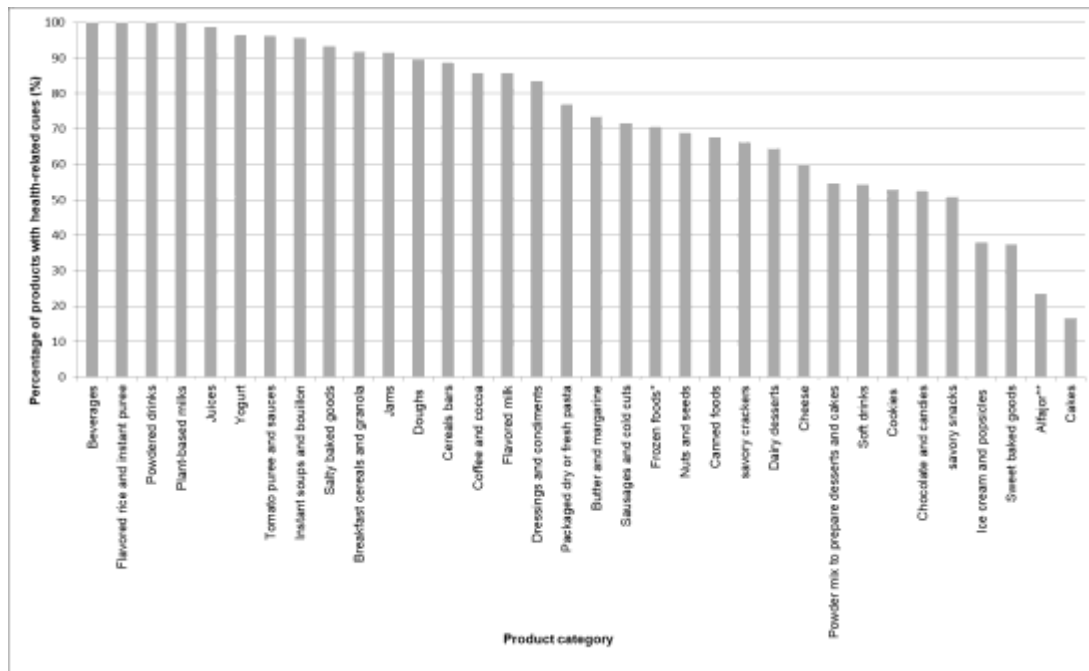
13. Letona, P., Chacon, V., Roberto, C. et al. (2014). Effects of licensed characters on children's taste and snack preferences in Guatemala, a low/middle income country. *Int J Obes*, 38, 1466–1469.
14. Tijssen, I., Zandstra, E.H., De Graaf, C. et al. (2017). Why a 'light 'product package should not be light blue: Effects of package colour on perceived healthiness and attractiveness of sugar-and fat-reduced products. *Food Qual Prefer*, 59, 46-58.
15. Gil-Pérez, I., Rebollar, R., & Lidón, I. (2020). Without words: The effects of packaging imagery on consumer perception and response. *Curr Opin Food Sci*, 33, 69-77. <https://doi.org/10.1016/j.cofs.2019.12.006>
16. Varela, P., Antúnez, L., Cadena, R. S. et al. (2014). Attentional capture and importance of package attributes for consumers' perceived similarities and differences among products: A case study with breakfast cereal packages. *Food Res Int*, 64, 701-710.
17. Kaur, A., Scarborough, P., & Rayner, M. (2017). A systematic review, and meta-analyses, of the impact of health-related claims on dietary choices. *Int J Behav Nutr Phys Act*, 14(1), 1-17. <https://doi.org/10.1186/s12966-017-0548-1>
18. Devia, G., Forli, S., Vidal, L. et al. (2021). References to home-made and natural foods on the labels of ultra-processed products increase healthfulness perception and purchase intention: Insights for policy making. *Food Qual Prefer*, 88, 104110.
19. Nobrega, L., Ares, G., & Deliza, R. (2020). Are nutritional warnings more efficient than claims in shaping consumers' healthfulness perception? *Food Qual Prefer*, 79, 103749.
20. Arrúa, A., Curutchet, M. R., Rey, N. et al. (2017). Impact of front-of-pack nutrition information and label design on children's choice of two snack foods: Comparison of warnings and the traffic-light system. *Appetite*, 116, 139–146.
21. Schuldt, J.P. (2013). Does Green Mean Healthy? Nutrition Label Color Affects Perceptions of Healthfulness. *Health Commun*, DOI: 10.1080/10410236.2012.725270
22. Sütterlin, B., & Siegrist, M. (2015). Simply adding the word “fruit” makes sugar healthier: The misleading effect of symbolic information on the perceived healthiness of food. *Appetite*, 95, 252–261.
23. Saba, A., Vassallo, M., Shepherd, R. et al. (2010). Country-wise differences in perception of health-related messages in cereal- based food products. *Food Qual Prefer*, 21, 385–393.
24. van Trijp, H. C. M., & van der Lans, I. A. (2007). Consumer perceptions of nutrition and health claims. *Appetite*, 48, 305–324.
25. Al-Ani, H., Devi, A., Eyles, H. et al. (2016) Nutrition and health claims on healthy and less-healthy packaged food products in New Zealand. *Br J Nutr*, 116, 1087–1094

26. Parlamento del Uruguay. (2021). Diálogo Nacional “Uruguay: Hacia sistemas alimentarios más saludables, sostenibles e inclusivos.”
27. Ministerio de Salud Pública. (2016). *Guía Alimentaria Para la Población Uruguaya. Para una Alimentación Saludable, Compartida y Placentera*. Montevideo: Ministerio de Salud Pública.
28. Pan American Health Organization. (2015). Ultra-processed food and drink products in Latin America: Trends, impact on obesity, policy implications. Pan American Health Organization.
29. Ministerio de Salud Pública. (2006). Decreto N° 117/006. Montevideo, Uruguay: Ministerio de Salud Pública.
30. Ministerio de Salud Pública. (2018). Decreto N°272/18. Montevideo: Ministerio de Salud Pública.
31. Ministerio de Economía y Finanzas. (2022). Informe N°23/22 Asunto N° 31/2020. Mercado de distribución Minorista. Medida preparatoria. Montevideo, Uruguay: Ministerio de Economía y Finanzas.
32. Monteiro, C. A., Cannon, G., Moubarac, J. C. et al. (2017). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutr*, 21, 5–17.
33. Scapin, T, Yu Luoie, C.Y, Pettigrew, S. et al. (2021). The adaptation, validation and application of a methodology for estimating the added sugar content of packaged food products when total and added sugar are not mandatory. *Food Res Int*, 144, 100329.
34. Krippendorff, K. (2004). *Content analysis: An introduction to its methodology*. Thousand Oaks, CA: Sage Publications.
35. Machín, L., Antúnez, L., Curutchet, M.R. et al. (2020). The heuristics that guide healthiness perception of ultra-processed foods: a qualitative exploration. *Public Health Nutr*, 23(16), 2932–2940.
36. Duran, A.C., Zancheta, C., Mais, L. et al. (2019). Conflicting Messages on Food and Beverage Packages: Front-of-Package Nutritional Labeling, Health and Nutrition Claims in Brazil. *Nutrients*, 11, 2967.
37. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The elements of statistical learning. Data mining, inference and prediction* (2nd ed.). New York: Springer.
38. Elith, J., Leathwick, J. R., & Hastie, T. (2008). A working guide to boosted regression trees. *J Anim Ecol*, 77, 802–813.

39. Hanley, J. A., & McNeil, B. J. (1982). The meaning and use of the area under the receiver operating characteristic (ROC) curve. *Radiology*, 143, 29–36.
40. Fisher, A. J., Rudin, C., & Dominici, F. (2019). All Models are Wrong, but Many are Useful: Learning a Variable's Importance by Studying an Entire Class of Prediction Models Simultaneously. *J Mach Learn Res*, 20, 1–81.
41. R Development Core Team (2017). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.
42. Lê, S., Josse, J., & Husson, F. (2008). FactoMineR: An R package for multivariate analysis. *Journal of Statistical Software*, 25(1), 1–18.
43. Greenwell, B., Boehmke, B., Cunningham, J. et al. (2020). *gbm: Generalized Boosted Regression Models. R package version 2.1.8*. Available at: <https://CRAN.R-project.org/package=gbm>
44. Kuhn, M. (2021). *caret: Classification and Regression Training. R package version 6.0-90*. Available at: <https://CRAN.R-project.org/package=caret>
45. Inglis, A., Parnell, A., & Hurley, C.B. (2022). Visualizing Variable Importance and Variable Interaction Effects in Machine Learning Models. *J Comput and Graph Stat*, DOI: 10.1080/10618600.2021.2007935.
46. Ares, G., Aschemann-Witzel, J., Curutchet, M. R. et al. (2018). Nutritional warnings and product substitution or abandonment: Policy implications derived from a repeated purchase simulation. *Food Qual Prefer*, 65, 40–48.
47. Ares, G., Aschemann-Witzel, J., Vidal, L. et al. (2018). Consumer accounts of favourable dietary behaviour change and comparison with official dietary guidelines. *Public Health Nutr*, 21, 1952–1960.
48. Rekhy, R., & McConchie, R. (2014). Promoting consumption fruit and vegetables for better health. Have campaigns delivered on the goals? *Appetite*, 79, 113–123.
49. Simmonds, G., & Spence, C. (2017). Thinking inside the box: How seeing products on, or through, the packaging influences consumer perceptions and purchase behaviour. *Food Qual Prefer*, 62, 340–351.
50. BEUC. (2018). *Food labels: Tricks of the trade*. Brussels: BEUC.
51. Bergallo, P., Castagnari, V., Fernández, A. et al. (2018). Regulatory initiatives to reduce sugar-sweetened beverages (SSBs) in Latin America. *PLOS One*, 13, Article e0205694.
52. Zhang, Q., Liu, S., Liu, R. et al. (2014). Food policy approaches to obesity prevention: An international perspective. *Curr Obes Rep*, 3, 171–182.

53. European Commission. (2017). Commission Notice on the application of the principle of quantitative ingredients declaration (QUID) (2017/C 393/05). Available at: <https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX%3A52017XC1121%2801%29> (Last accessed February 11<sup>th</sup>, 2022).
54. Machín, L., Curutchet, M.R., Gugliucci, V. et al. (2020). The habitual nature of food purchases at the supermarket: Implications for policy making. *Appetite*, 155, 104844.
55. Academy of Nutrition and Dietetics. (2019). Academy comments to FDA re Nutrition Innovation Strategy. Available at: <https://www.eatrightpro.org/news-center/on-the-pulse-of-public-policy/regulatory-comments/academy-comments-to-fda-re-nutrition-innovation-strategy> (Last accessed October, 2020).
56. Machado, P. C. I., dos Antos, A. M., Uggioni, P. L. et al. (2018). Labelling of packaged foods in Brazil: Use of terms such as home-made, traditional, and the like. *Rev Nutr*, 31, 83–96.
57. Monteiro, C. A., Cannon, G., Moubarac, J.C. et al. (2015). Dietary guidelines to nourish humanity and the planet in the twentyfirst century. A blueprint from Brazil. *Public Health Nutr*, 18(13), 2311–2322.
58. European Commission. (2014). *Food information to consumers- legislation*. Available at: [https://ec.europa.eu/food/safety/\\_legislation\\_en](https://ec.europa.eu/food/safety/_legislation_en) (Last accessed October 17<sup>th</sup>, 2020).
59. Kearns, C.E., Schmidt, L.A., & Glantz, S.A. (2017). Sugar Industry and Coronary Heart Disease Research. A Historical Analysis of Internal Industry Documents. *JAMA Intern Med*, 176, 1680-1685.
60. Tollin, K., Erz, A., & Vej, J. (2016). The strategic viewpoints of innovation and marketing teams on the development of novel functional food. In D. Bagchi, & S. Nair (Eds.). *Developing new functional food and nutraceutical products* (pp. 63–83). Cambridge: Academic Press.
61. Giménez, A., de Saldamando, L., Curutchet, M. R., & Ares, G. (2016). Package design and nutritional profile of foods targeted at children available in supermarkets in Montevideo, Uruguay. *Cadernos de Saúde Pública*, 33, e00032116.
62. Domínguez Díaz, L., Fernández-Ruiz, V., & Cámara, M. (2020). An international regulatory review of food health-related claims in functional food products labeling, *J Funct Foods*, 68, 103896,
63. Kusar, A., Žmitek, K., Lähteenmäki, L. et al. (2021). Comparison of requirements for using health claims on foods in the European Union, the USA, Canada, and Australia/New Zealand. *Compr Rev Food Sci Food Saf*, 20, 1307-1332.

64. Maschkowski, G., Hartmann, M., & Hoffmann, J. (2014). Health-related on-pack communication and nutritional value of ready-to-eat breakfast cereals evaluated against five nutrient profiling schemes. *BMC Public Health*, 14, 1178 doi: 10.1186/1471-2458-14-1178.
65. Mercosur. (2003). Resolución GMC N° 26/03. *Reglamento técnico Mercosur sobre el rotulado nutricional de alimentos envasados*. Montevideo, Uruguay. [https://normas.mercosur.int/simfiles/normativas/13541\\_RES\\_026-2003\\_ES\\_FERR\\_RTM%20Rotulaci%C3%B3n%20Alimentos.pdf](https://normas.mercosur.int/simfiles/normativas/13541_RES_026-2003_ES_FERR_RTM%20Rotulaci%C3%B3n%20Alimentos.pdf). (Last accessed February 14<sup>th</sup>, 2022).
66. Congreso de la Nación Argentina (2021). Ley de promoción de la alimentación saludable Buenos Aires: Congreso de la Nación.
67. Food Standards Australia and New Zealand. (2016). Short guide for industry to the nutrient profiling scoring criterion in standard 1.2.7 – nutrition, health and related claims. Available at: <https://www.foodstandards.gov.au/industry/labelling/Documents/Short-guide-for-industry-to-the-NPSC.pdf> (Last accessed December 18<sup>th</sup>, 2020)
68. Secretaría de Economía. (2020). Modificación a la Norma Oficial Mexicana NOM-051-SCFI/SSA1-2010. Available at: [https://www.dof.gob.mx/2020/SEECO/NOM\\_051.pdf](https://www.dof.gob.mx/2020/SEECO/NOM_051.pdf) (Last accessed April 2020)
69. Ministerio de Salud. (2017). *Directriz para la vigilancia y fiscalización de la composición nutricional de los alimentos y su publicidad, de acuerdo al reglamento sanitario de los alimentos*. Santiago: Ministerio de Salud.
70. Lähteenmäki, L. (2013). Claiming health in food products. *Food Qual Prefer*, 27(2), 196–201.

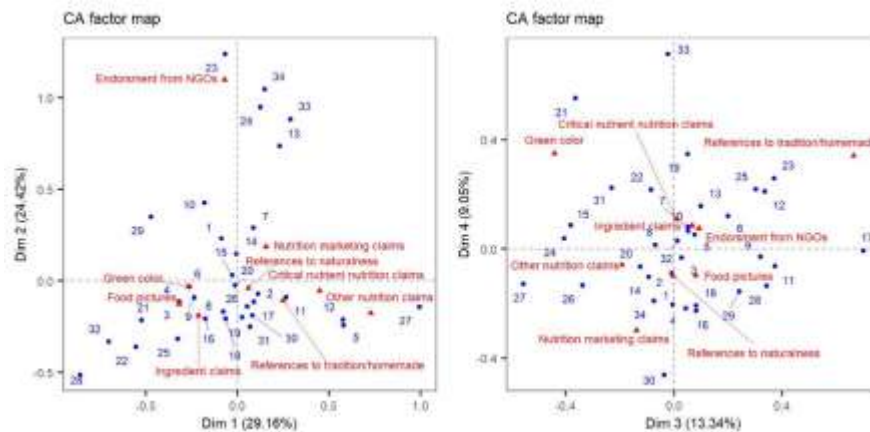


**Figure 1.** Percentage of products with health-related cues per product category.

#### Footnotes Figure 1

\*Frozen foods: this category includes all frozen foods like ready-to-eat dishes, hamburgers, nuggets, pasta, fried potatoes, etc., with the exception of ice cream, desserts, vegetables or fruits. \*\**Alfajor* is a traditional product in Uruguay. It is a sweet cookie sandwich filled with a layer of *dulce de leche* (a traditional type of sweetened condensed milk), usually covered with chocolate or meringue.





**Figure 2.** Representation of the food categories and health-related cues included in the first four dimensions of the correspondence analysis.

### Footnotes Figure 2

1. Chocolate and candies; 2. Cookies; 3. Frozen foods\*; 4. Canned foods; 5. Savory crackers; 6. Savory snacks; 7. Cheese; 8. Juices; 9. Dressings and condiments; 10. Ice cream and popsicles ; 11. Sweet baked goods; 12. Salty baked goods; 13. Powder mix to prepare desserts and cakes; 14. Jams; 15. Yogurt; 16. Nuts and seeds; 17. *Alfajor*\*\*; 18. Breakfast cereals and granola; 19. Soft drinks; 20. Cereals bars; 21. Instant soups and bouillon; 22. Packaged dry or fresh pasta; 23. Sausages and cold cuts; 24. Dairy desserts; 25. Doughs; 26. Plant-based milks; 27. Powdered drinks; 28. Cakes; 29. Tomato puree and sauces; 30. Coffee and cocoa; 31. Beverages; 32. Flavored rice and instant puree; 33. Butter and margarine; 34. Flavored milk.

\*Frozen foods: this category includes all frozen foods like ready-to-eat dishes, hamburgers, nuggets, pasta, fried potatoes, etc., with the exception of ice cream, desserts, vegetables or fruits. \*\**Alfajor* is a traditional product in Uruguay. It is a sweet cookie sandwich filled with a layer of dulce de leche (a traditional type of sweetened condensed milk), usually covered with chocolate or meringue.

**Table 1.** Description of the type of elements included in each dimension considered in the content analysis of the front-of-packages.

<b>Dimension</b>	<b>Description</b>
Green color	Green color on the packages.
Food pictures	Inclusion of pictures of natural foods, culinary ingredients or minimally processed foods, recommended by the Uruguayan dietary guidelines (e.g. fruits, vegetables, meat, wheat flour).
References to naturalness	Visual or textual references to nature (botany, plants, grass, sun, animals, meadows, countryside), as well as explicit references to nature or 'natural'.
Critical nutrient nutrition claims	Nutrient claims related to the content of sugar, salt, fat, saturated fat, trans fat or calories considered in the Uruguayan legislation.
Other nutrition claims	Nutrient claims related to other non-critical nutrients (e.g., minerals, vitamins, fiber) considered by the Uruguayan legislation.
Nutrition marketing claims	Claims included at the discretion of food manufacturers, including references to elements like prebiotics or gluten, references to health, energy or brand's slogans related to exercise or portion sizes.
Ingredient claims	Expressions about specific ingredients, including both absence and presence.
Endorsement from non-governmental organizations	Logos or explicit references to endorsements from non-governmental organizations.
References to tradition/homemade	References or expressions that evoke the concept of homemade or traditional.

**Table 2.** Number of products identified in each product category.

Product category	Number of products
Chocolate and candies	438
Cookies	330
Frozen foods*	237
Canned foods	216
Savory crackers	195
Savory snacks	179
Cheese	176
Juices	157
Dressings and condiments	145
Ice cream and popsicles	142
Sweet baked goods	139
Salty baked goods	136
Powder mix to prepare desserts and cakes	132
Jams	131
Yogurt	109
Nuts and seeds	106
<i>Alfajor</i> **	98
Breakfast cereals and granola	96
Soft drinks	72
Cereals bars	70
Instant soups and bouillon	69
Packaged dry or fresh pasta	69
Sausages and cold cuts	60
Dairy desserts	56
Doughs	38
Plant-based milks	38
Powdered drinks	38
Cakes	30
Tomato puree and sauces	27
Coffee and cocoa	21
Beverages	19
Flavored rice and instant puree	15
Butter and margarine	15
Flavored milk	14

\*Frozen Foods: this category includes all frozen foods like ready-to-eat dishes, hamburgers, nuggets, pasta, fried potatoes, etc., with the exception of ice cream, desserts, vegetables or fruits.

\*\**Alfajor* is a traditional product in Uruguay. It is a sweet cookie sandwich filled with a layer of *dulce de leche* (a traditional type of sweetened condensed milk), usually covered with chocolate or meringue.

**Table 3.** Number and percentage of products featuring elements within the categories identified in the content analysis of products' front-of-packages for the nine health-related cues dimensions.

Dimension	Category	Examples	Number of products	Percentage of products (%)
Food pictures			1491	39.1
	Fruits	Apple, banana	653	17.1
	Vegetables	Tomatoes, letucce	569	14.9
	Nuts	Nuts, almonds	129	3.4
	Milk	Glass of milk	94	2.5
	Seeds and cereals	Cereal bowl, quinoa seeds in a bowl	93	2.4
	Red meat	Cooked ground beef, cooked beef chunks	44	1.2
	Chicken	Chicken bites, whole roasted chicken	23	0.6
	Eggs	Bowl with fresh eggs, drawn eggs over grass	18	0.5
	Fish	Fish on blue background	15	0.4
	Wheat flour	Drawn open bags of wheat flour	4	0.1
References to naturalness			865	22.7
	Botany elements	Grass, flowers, leaves	476	12.5
	Explicit reference to nature/natural	'Natural', 'Naturally fresh'	233	6.1
	Natural place	Moutains, dairy farms	154	4.0
	Animals	Cows, birds	73	1.9
	Natural production process	'Free range chicken eggs', 'Natural fermentation'	50	1.3
	Fresh	'With fresh tomatoes', 'Fresh vegetables'	18	0.5
	Organic	'Organic'	7	0.2
	Natural flavor	'With natural mint flavor ', 'Natural flavor'	5	0.1
Green color	-	-	503	13.2
Critical nutrient nutrition claims			609	16.0
	Sugar free	'0% sugar added', 'Without sugar'	191	5.0

0% trans fat	'0% trans fat'	176	4.6
Reduced in calories	'58% reduced in calories', 'Reduced caloric value'	171	4.5
Reduced in fat	'60% less fat', '0% fats'	121	3.2
Salt free	'No salt added', '0% mg Sodium'	48	1.3
Reduced in sodium	'Low sodium', 'Reduced 63% in sodium'	38	1.0
Reduced in sugar	'Low Sugar', '100% sugar reduced'	26	0.7
Reduced in saturated fat	'Low saturated fat', '0% saturated fat'	13	0.3
Nutrition marketing claims		473	12.4
Gluten free	'Gluten free'	371	9.7
References to calorie content	'Only 30Kcal per toast', 'Unique with 98Kcal per portion'	56	1.5
Explicit reference to health	'Healthy heart', 'Healthy feeding'	48	1.3
Probiotics	'Probiotics added', 'With natural probiotics'	16	0.4
Health-related brand name or slogan	'Movimiento ser' ('Ser movement'), 'Simplemente bueno' ('Simply good'), 'Pura vida' ('Pure life')	12	0.3
References to energy or hydration	'Start the day with energy', 'Hydrates you'	7	0.2
Other nutrient claims		355	9.3
Vitamins	'5 vitamins', 'Vitamins A, D, E'	136	3.6
Cholesterol free	'0% cholesterol', 'Cholesterol free'	133	3.5
Fiber	'Containing fiber', 'High fiber'	92	2.4
Omega	'Contains omega 9', 'With omega 3'	49	1.3
Minerals	'Contains minerals', '2 minerals added'	30	0.8
Added calcium	'Contains calcium', '50% more calcium'	23	0.6
Source of protein	'Protein source', '79 g of protein'	19	0.5
Ingredient claims		415	10.9
Absence of preservatives	'No preservatives', 'Preservatives free'	240	6.3
References to specific ingredients	'100% fruit juice', '100% vegetable'	93	2.4

	Absence of colorings	‘No artificial color’, ‘No coloring’	69	1.8
	Absence of lactose	‘Lactose free’, ‘No lactose added’	34	0.9
	No flavorings	‘No artificial flavors’, ‘No flavors added’	31	0.8
	Whole-grain foods and seeds	‘Whole wheat, ‘7 seeds’	28	0.7
	Vegan	‘Vegan’, ‘plant-based’	28	0.7
	Sweeteners	‘Contains stevia’, ‘Contains splenda’	25	0.7
	Chemicals free	‘No chemicals added’	21	0.6
	With salt	‘Salt added’	5	0.1
	Absence of soy	‘No soy’	4	0.1
	With sugar	‘Sugar added’	3	0.1
	Non-transgenic	‘Non-transgenic’, ‘No GMO’	3	0.1
Endorsement from			322	8.4
non-governmental organizations	Uruguayan Celiac Association	‘ ACELU logo’ (by its Spanish acronym)	190	5.0
	Uruguayan Diabetic Association	‘ADU logo’ (by its Spanish acronym)	146	3.8
	Other organizations	Red Cross, Argentine Society of Nutrition	15	0.4
	References to			266
tradition/homemade	Traditional	‘Traditional recipe’, ‘Tradition’	81	2.1
	Homemade	‘Hand cooked’, ‘Homemade’	54	1.4
	Since X date	‘Since 1914’, ‘Since 1986’	47	1.2
		‘Self-elaboration’, ‘Grain ground in our	21	0.6
	Self-elaboration	own mill’		
	Artisan	‘Artisan’	21	0.6
		‘With known ingredients’, ‘100% real	19	0.5
	Known ingredients	coconut chunks’		
	Original recipe	‘Originals’, ‘Original flavor’	19	0.5
	Classic	‘Classic’, ‘Classic recipe’	18	0.5